State of Florida
Department of Transportation

FDOT Civil 3D Drainage

Course Guide

Chapters 1-16

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PRODUCTION SUPPORT CADD OFFICE
TALLAHASSEE, FLORIDA
http://www.fdot.gov/cadd/

FDOT Civil 3D Drainage

Description

This manual serves two primary functions. It is a training manual for instructor-led training, and a user's manual for drainage engineers, designers, and technicians. Lab exercises are provided in the chapters, although the instructor-based classes may not use all the exercises or cover all the chapters.

This manual is a comprehensive guide demonstrating FDOT Civil 3D workflows for defining drainage basins, pipe and structure placement, editing and labeling Civil 3D's intelligent objects, and visualization techniques to promote ease of understanding and facilitating communication of design intent

This manual demonstrates the workflows for base map compilation, rules-based layout of pipes and structures, displaying and editing network parts in plan and profile views, and creating finished ground terrain models. Roadway alignments, profile views, and digital terrain models are utilized to display and edit the network parts during the design process. Terrain models are used to communicate flow direction, delineate watershed boundaries, set rim elevations, and represent existing and design grades.

This manual contains an example of a closed drainage system for paved areas utilizing inlet, junction and outfall structures with connecting pipes. 3D visualization tools enable the user to quickly recognize errors and effectively communicate design intent.

Hydrologic analysis, hydraulic analysis, and plan production are not topics covered by this manual.

Objectives

The student will have a basic understanding of ….

- FDOT Civil 3D State Kit Tools
- Pipe Network Creation, Layout, and Editing
- Alignments and Profiles
- Surfaces
- Grading
- Annotation
- Data Management Techniques Annotating Drainage Plans

Audience

This course is intended for roadway designers and drainage engineers.

Prerequisites

Participants need to have an understanding of AutoCAD and Civil 3D Essentials.

Duration: 24 Hours

Professional Credit Hours: 24 PDHs

Note PDH Credit will only be available with Instructor lead or Computer Based Training (CBT) thru Learning Curve.

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1 GETTING STARTED

DESCRIPTION

This chapter provides the background information and context to help the user prepare to use this manual.

OBJECTIVES

This chapter is divided into two sections:

- Introduction
    - Purpose
    - Terminology
    - Civil 3D Objects
    - About Civil 3D
    - About this Manual
    - Resources
- Project Components
    - Civil 3D Drawings
    - Pipe Network Part Catalogs
    - Entity Manager Database
    - Survey Database
    - Drainage Design Workflow Using Civil 3D

CHAPTER SETUP

Basic understanding of AutoCAD and Civil 3D.

INTRODUCTION

PURPOSE

This manual serves two primary functions. It is a training manual for instructor-led training, and a user's manual for drainage engineers, designers, and technicians. Lab exercises are provided at the end of the chapters, although the instructor-based classes may not use all the exercises or cover all the chapters.

TERMINOLOGY

Throughout this document the term “Department” refers to the Florida Department of Transportation. The Department’s standards for drainage design are provided in the Drainage Manual. Guidelines for drainage design are provided in the various drainage handbooks (Storm Drain, Hydrology, etc.). The Department’s Plans Preparation Manual and CADD Manual provide the standards for preparing the construction plan sets. Discussions about how to best use Civil 3D to comply with the Department’s CADD standards and guidelines are included in this document where appropriate.

CIVIL 3D OBJECTS USED IN THE DATASETS FOR THIS MANUAL

- Surface
- Feature Line
- Grading
- Alignment
- Profile
- Profile View
- Catchment

Note Descriptions for each object can be found in the Civil 3D Online Help system:

https://knowledge.autodesk.com/support/autocad-civil-3d

ABOUT CIVIL 3D

Civil 3D is a comprehensive application for designing and analyzing storm drain systems. Civil 3D includes a comprehensive set of tools for designing storm water conveyance systems in a dimensionally accurate 3D model. The FDOT Civil 3D State Kit contains over 1500 3D structures in the Custom FDOT Part Catalog.

The pipe and structure objects can be edited graphically or numerically using a variety of convenient user interface features including interactive dialog boxes, cursor menus, tool tips, toolbars, ribbons, palettes, with most of these having context sensitive behaviors. Predefined styles compliant with FDOT standards are included with the FDOT Civil 3D State Kit. These styles control the graphical appearance of pipes, structures, surfaces, their labels and much more.

Preset command behaviors simplify the use of commands so pipes and structures are created and labeled simultaneously using the desired styles. Designs are produced with less effort and eliminate labeling errors.

ABOUT THIS MANUAL

This manual is a comprehensive guide demonstrating FDOT Civil 3D workflows for defining drainage basins, pipe and structure placement, editing and labeling Civil 3D's intelligent objects, and visualization techniques to promote ease of understanding and facilitating communication of design intent.

This manual demonstrates the workflows for rules-based layout of pipes and structures that can be displayed in plan and profile views. Roadway alignments, profile views, and digital terrain models are utilized by the network parts during the design process. Terrain models are used to communicate flow direction, delineate watershed boundaries, and represent existing and design grades.

This manual contains an example of a closed drainage system for paved areas utilizing inlet, junction and outfall structures with connecting pipes. 3D visualization tools enable the user to quickly recognize errors and confirm satisfaction of design intent.

RESOURCES

- Roadway Drainage

  http://www.fdot.gov/roadway/Drainage/Manualsandhandbooks.shtm
- CADD Manual

  http://www.fdot.gov/cadd/downloads/publications/CADDManual/default.shtm
- FDOT Civil 3D State Kit

  http://www.fdot.gov/cadd/downloads/software/software.shtm

PROJECT COMPONENTS

Civil 3D has four major Components within each project:

- Civil 3D Design File (*.dwg)
- Pipe Network Catalogs (*.xml) for both Structures and Pipes
- Entity Manager Database (*.xml)
- Survey Database (*.sdbx) storage for all Survey Information of the project

CIVIL 3D DRAWINGS

Civil 3D Drawing Files are in a binary format with a .dwg file extension. They contain object tables and databases. When opened in an AutoCAD environment the drawing displays graphical and textual content. Civil 3D objects are created and stored in this .dwg file format along with native AutoCAD objects.

PIPE NETWORK PART CATALOGS

Civil 3D comes with a pipe network part catalog that contains a variety of pipe and structure shapes organized into part families and part sizes. Since the part catalog contains many items, you can create a parts list containing only the parts (pipes and structures) that you will use for a particular pipe network. Using a parts list saves you from having to navigate through the entire part catalog to find a desired part.

Pipe Network Part Catalogs are defined external to the .dwg file. The FDOT Civil 3D State Kit contains a customized Part Catalog named FDOT Drainage containing over 1500 structures and pipes conforming to the Department's standards.

Refer to Civil 3D Help for more details on Pipe Network Part Catalogs and Parts Lists.

ENTITY MANAGER DATABASE (EMX)

Entity Manager uses a Pay Item Database in an .xml format. Entity Manager is used to assign, modify, and append pay items to AutoCAD objects for the purpose of querying drawings to create quantity reports.

When you open Entity Manager there is a Help button in the upper right corner of the dialog box. This link opens the Entity Manager Reference Guide.

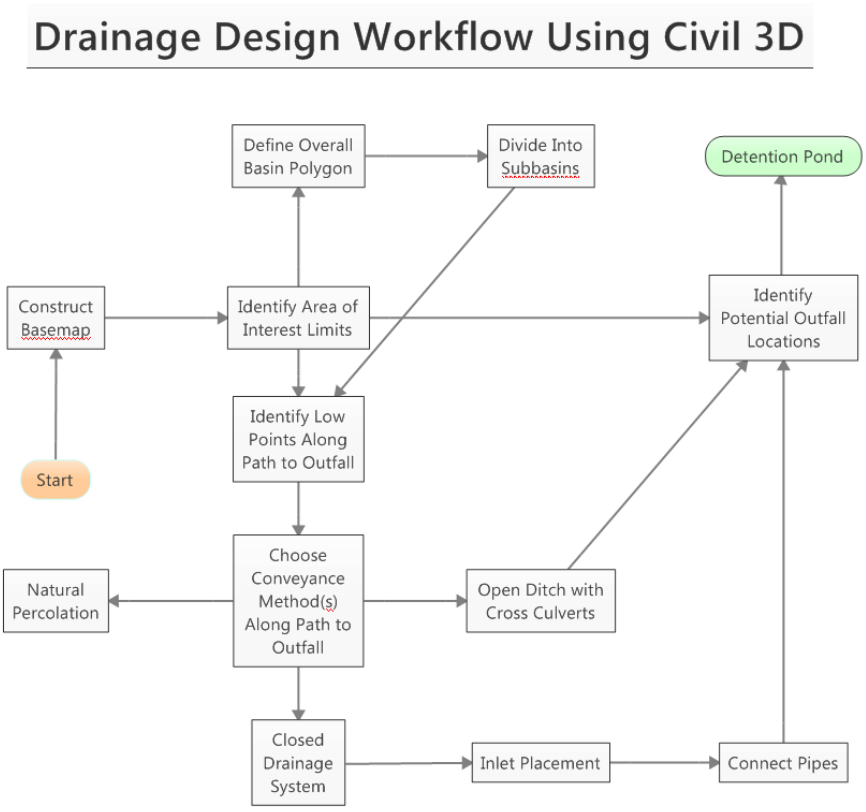
SURVEY DATABASE

In Civil 3D, survey data is not drawing dependent and is stored in an external database. For display and visualization, survey data can be manually and automatically inserted into a drawing when the survey database is updated or when data is imported into the survey database.

The Survey database consists of two files, the sdbx file is the main survey database and it contains all the data in the survey database collections except for the Extended Properties definitions and values. The Survey sdxx file contains the Extended Properties definitions and values. The.sdbx file is a Microsoft® SQL Server® Compact 3.5 file format.

DRAINAGE DESIGN WORKFLOW USING CIVIL 3D

GENERAL PROCESS OVERVIEW



The Basemap is the background data assembled in a Drainage Map drawing file. Background data can be in the form of external references to other drawings from Survey, Roadway Design, Geotech, and Right of Way Mapping. The Survey Database can provide point and breakline data for surfaces representing existing conditions. Data references to surfaces from design tasks can be used to automatically place structures at corresponding design rim elevations.

- Surface Analysis and styles are used to define the boundaries of Watershed areas.
- Watershed areas and basins and subbasins are terms used interchangeably.
- Inlets and Junctions are types of Civil 3D Pipe Network Structures. Pipes are Civil 3D Pipe Network objects that connect structures and determine flow direction.
- Grading tasks use Civil 3D Grading objects and Feature Line objects. Objects created during grading tasks are added as source data to a Civil 3D Surface object. Changes in source data will cause Civil 3D objects to react dynamically Data Shortcuts are a mechanism for sharing original Civil 3D object data with other .dwg files.
- Data Shortcuts enable you to maintain one drawing containing the defining editable content and use a non-editable instance of the object in other .dwg files. The display of the shared objects can be altered using the same object styles as if it were the original object. Linking to the original source is known as creating a data reference.

2 PIPE NETWORK SETUP

DESCRIPTION

This chapter introduces the Parts Catalog from which a Civil 3D Pipe Network adds content to drawings and derives parameters such as identity, description, and dimension. It also contains a brief overview of the custom configuration provided by the FDOT Civil 3D State Kit.

OBJECTIVES

In this chapter, you will learn about:

- Pipe Network Catalogs
- Parts Lists

PIPE-NETWORK CATALOGS

DRAINAGE COMPONENTS

Pipe Network catalogs *(*.xml)* - The Pipe Network catalogs is utilized for numerous projects, as it contains the standards for an entire organization. The Pipe Network catalogs contains the Rainfall Parameters, standard inlet types, standard pipes configurations, spread sections, and land use symbology tables. All of these items are merely referenced by each project to accommodate standardization and information sharing among projects. The Department provides Pipe Network catalogs as part of the FDOT Civil 3D State Kit. If the designer needs to modify any of the standard provided files, he needs to include these updated files as part of his project deliverable.

Civil 3D organizes the components of a drainage system according to their spatial characteristics. Spatial information is stored as *Structures, Pipes* and *Pipe Networks*.

- **Structures:** Structure (inlets, manholes, etc.) is a point with a user-defined location. The location may be in Cartesian coordinates (x,y), State Plane (northing, easting) or in curvilinear coordinates (station, offset).
- **Pipes:** Pipes represents a linear feature depicting a path connecting two nodes, traversing upstream to downstream. The path may be straight line or curvilinear (along a graphic element).
- **Pipe Networks**: A network is a system of interconnected structures and pipes that form a system through which water can flow to a single outlet. A drainage project can accommodate any number of Pipe Networks.

HOW THE PARTS CATALOG WORKS

When pipe networks are created or edited, Civil 3D references the parts catalog for information about each part (pipe or structure).

The FDOT Civil 3D State Kit installs the default pipe network parts catalog at:

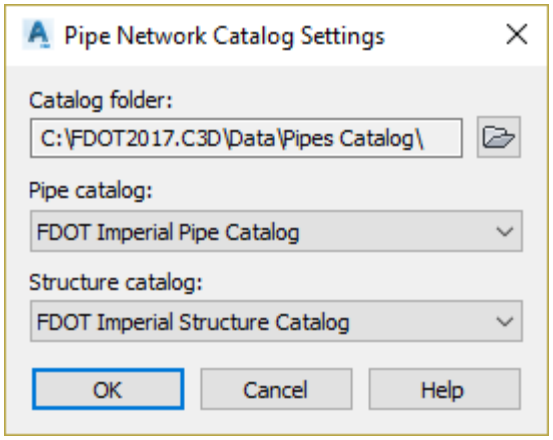
C:\FDOT20xx.C3D\Data\Pipes Catalog.

PIPE NETWORK CATALOG SETTINGS DIALOG BOX

Use this dialog box to configure Civil 3D to access the FDOT pipe network parts catalog, or to access specific FDOT pipe and structure catalogs within the imperial catalog folders.

The FDOT part catalog settings defined here enable pipe network parts lists to access the content for FDOT pipe and FDOT structure shapes.

Part catalogs are set for each drawing. When in a drawing, and you switch between drawings, the catalogs (both pipe and structure) will automatically be set to the unit it was last in that particular drawing. You can alternate between drawings that use imperial or metric units without changing any settings.



Note The default catalog unit is determined by the Drawing Units setting in the Drawing Settings dialog box Units and Zone tab. For new and previously existing drawings, use this setting on initialization to set the unit of measure.

CATALOG FOLDER

Specifies the folder that contains the current Civil 3D Pipe Network Parts Catalogs.

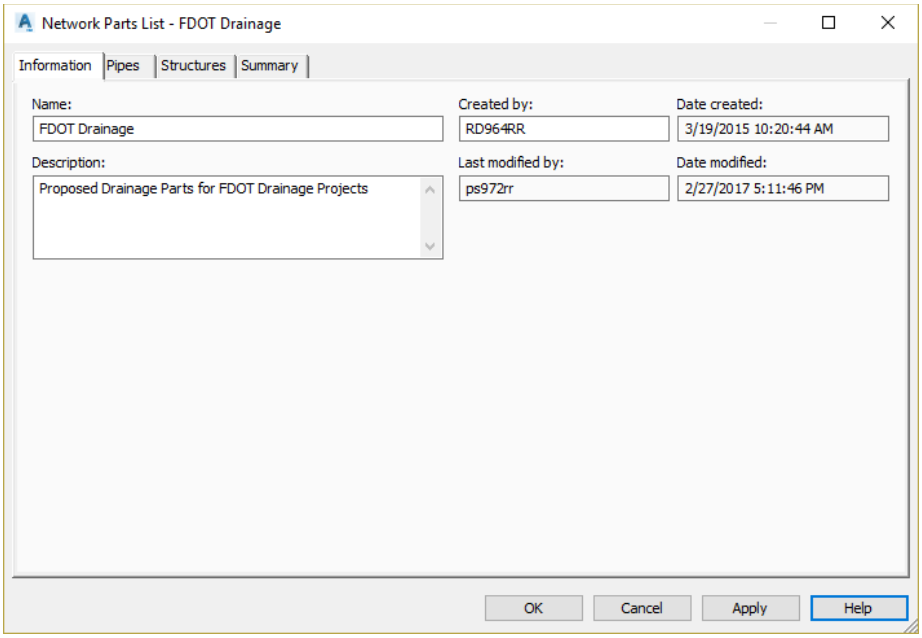
- Pipe Catalog:
- Specifies the current Civil 3D pipe catalog.
- Structure Catalog:
- Specifies the current Civil 3D structure catalog.

DRAINAGE PART LIST INFORMATION

The FDOT Drainage parts list resides in the fdotmaster.dwt template that is used every time a design file is created using the Create File application. The path to the parts list is already set when you open Civil 3d using the FDOT State Kit icon.

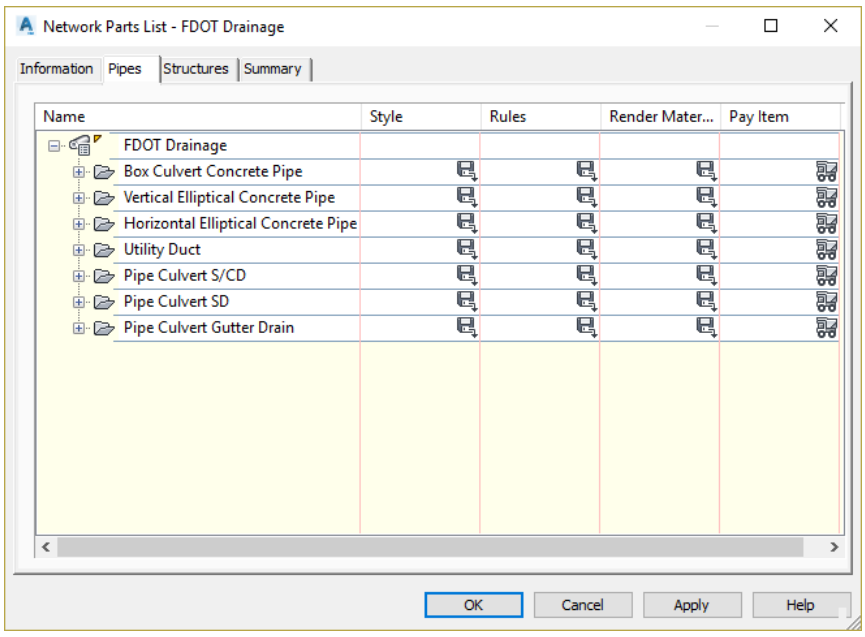
INFORMATION TAB:

Use this tab to view or change general information for the pipe network parts list. The Name specifies the name of the current parts list. The Description specifies the description for the current parts list. .



PIPES TAB:

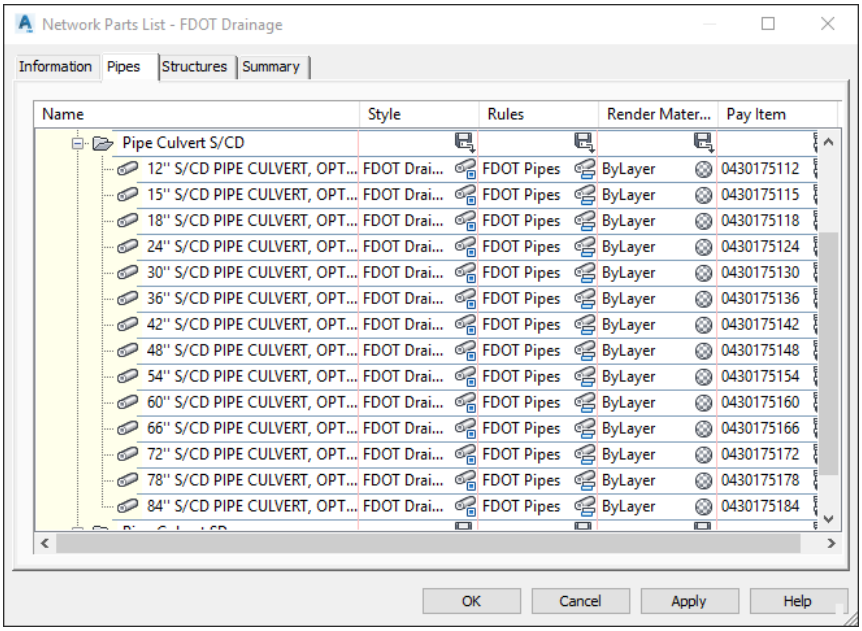
Inside the Parts list there are several styles that reside controlling the appearance of the parts to match FDOT standards. The image below shows what is contained within the Pipes tab of the parts list.



You can add new pipe sizes to the parts list or remove pipe sizes from the parts list. Each size selection matches a part size from an FDOT part family in the part catalog. Optional properties may also be set on the part size. The combined set of selected and optional properties is assigned to the pipe when it is inserted into the drawing.

- **Name:** This tree view displays the name of the FDOT parts list at the top level, and then the names of the FDOT part families included in the parts list, and then the names of the part sizes included in each part family. Note when a new size is added to the parts list, it is assigned a default unique name. The size name can be edited (renamed) to any unique name within the part family size list.
- **Style:** Specifies the default FDOT style assigned to the pipe when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected FDOT style to all part sizes within that family.
- **Rules:** Specifies the default rules assigned to the pipe when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected style to all part sizes within that family.
- **Render Material:** Specifies the default render material assigned to the pipe when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected style to all part sizes within that family.
- **Pay Item:** Specifies the FDOT pay item ID assigned. Select a part family, or a part size within a FDOT part family, and then click to assign a pay item to all part sizes within that family, or to an individual part size within that family.

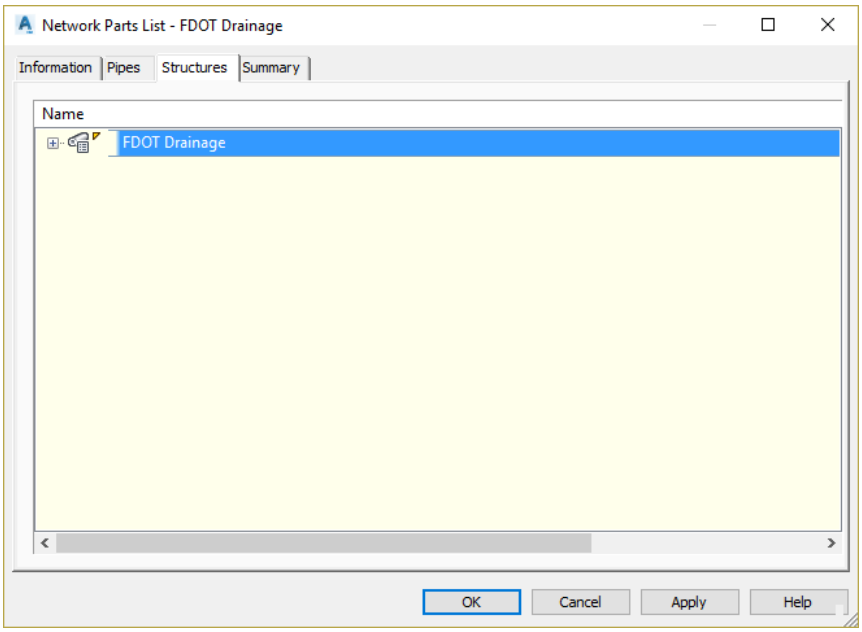
Click on the + sign to the left of FDOT Drainage style to expand the list Pipe families.



Click on the + sign to the left of Pipe Culvert S/CD family to expand the list and display Round Pipe sizes.

Note Adding additional FDOT Pipe families and sizes will be discussed in a later chapter.

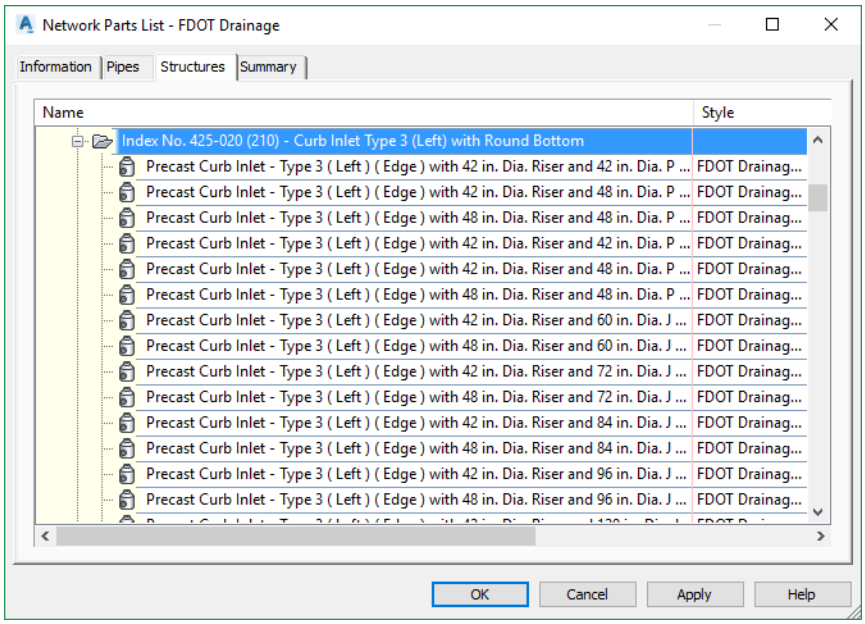
STRUCTURES TAB:



The Structure tab contains all the Structure families added from the Structure catalog: FDOT Imperial Structure Catalog. Use this tab to view or change the FDOT structure sizes included in the parts list.

You can add new FDOT structure sizes to the parts list or remove structure sizes from the parts list. Each size selection matches a part size from a part family in the part catalog. Optional properties may also be set on the part size. The combined set of selected and optional properties is assigned to the structure when it is inserted into the drawing.

- **Name:** This tree view displays the name of the FDOT parts list at the top level, and then the names of the FDOT part families included in the parts list, and then the names of the part sizes included in each part family. Note when a new size is added to the parts list, it is assigned a default unique name. The size name can be edited (renamed) to any unique name within the part family size list.
- **Style:** Specifies the default FDOT style assigned to the structure when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected style to all part sizes within that family.
- **Rules:** Specifies the default FDOT rules assigned to the structure when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected style to all part sizes within that family.
- **Render Material:** Specifies the default render material assigned to the FDOT structure when it is inserted into the drawing. Select an FDOT part family and click the Select All Edit icon to assign the selected style to all part sizes within that family.
- **Pay Item:** Specifies the FDOT pay item ID assigned. Select an FDOT part family, or a part size within an FDOT part family, and then click to assign a pay item to all part sizes within that family, or to an individual part size within that family.



Click on the + sign to the left of FDOT Drainage style to expand the list of Structure families

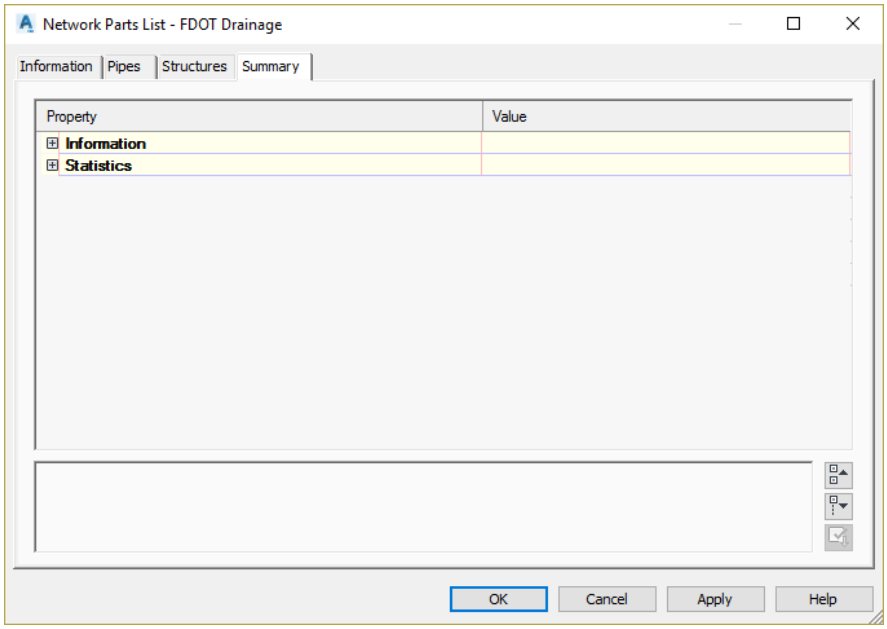
Using the vertical slider button on the right side of the dialog box, scroll down to the structure family: Index No. 425-020 (210) - Curb Inlet Type 3 (left) with Round Bottom.

Click on the + sign to the left of Index No. 425-020 - Curb Inlet Type 3 (left) with Round Bottom family to expand the list and display the part sizes within the part family.

Note Adding additional FDOT Structure families and sizes will be discussed in a later chapter.

SUMMARY TAB:

The Summary tab is used for information and statistics related to the part list, such as number of structures or pipes used.



3 DEFINING A DRAINAGE MAP

DESCRIPTION

In this chapter, you will create a Drainage Map by compiling background data from files in a variety of file formats. You will make connections to the data sources and change the display settings. These display settings will help you depict the project limits, display planimetric geometry, and elevation data within the project limits. As part of this exercise you will learn to overlay an aerial photo to align with the site's coordinate system. This compiled data serves as a basemap revealing existing site conditions which a designer can use to understand site constraints, natural drainage patterns and physical site limitations.

OBJECTIVES

The objectives of this chapter are to

- Define a Drainage Map
- Create Design File
- Associate the Drawing to the Project
- Attach External References to .dwg Files
- Attach a Georeferenced Image File
- Control Display of Civil 3D Objects
- Use Layer Controls & Clip Boundaries to Display Data
- Create Data Shortcuts
- Final Data Surface Shortcuts
- Create Data References for Surfaces

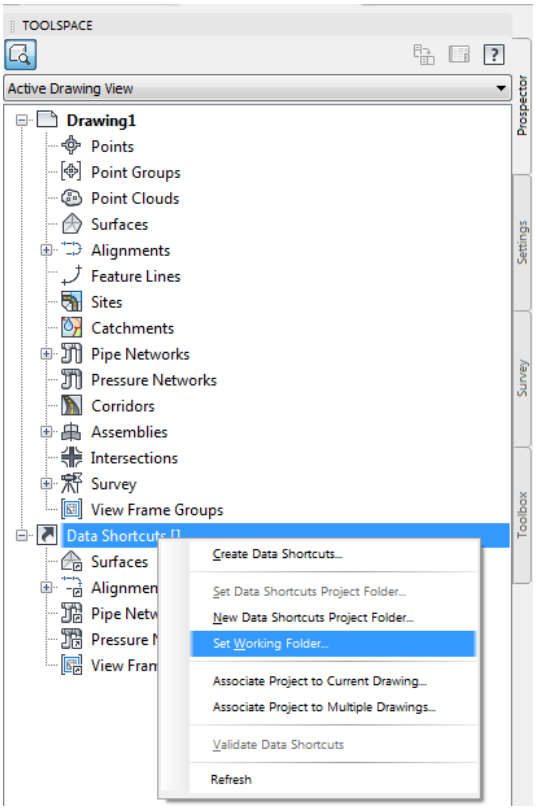
CHAPTER SETUP

Run the Chapter 3 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

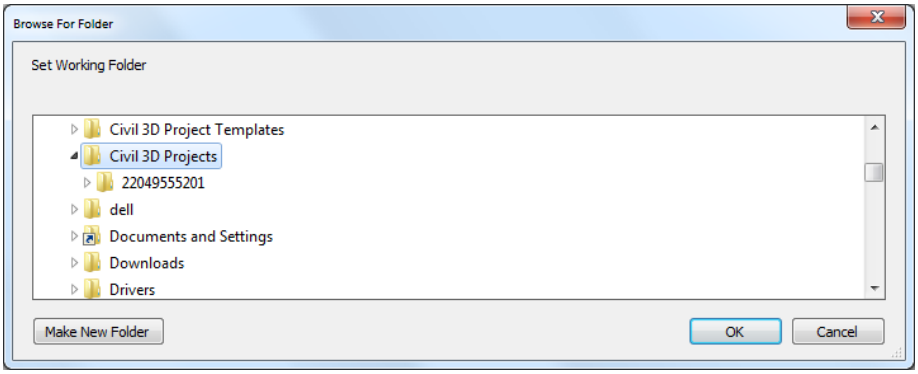
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 3.1 Define a Drainage Map for 22049555201 Drainage Project

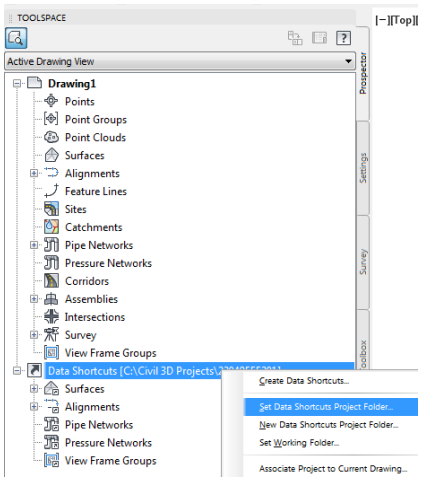
1. Start the FDOT Civil 3D State Kit by double clicking the **_FDOT20##.C3D** icon as shown below:



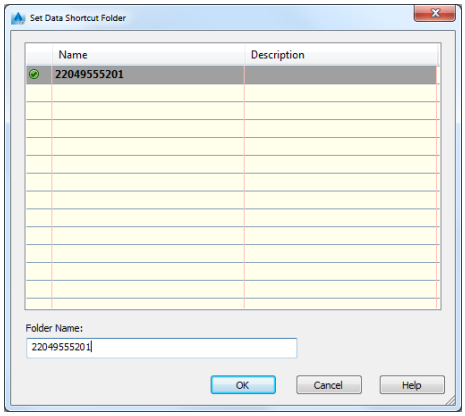
2. From *TOOLSPACE > Prospector tab > Data Shortcuts*, right click to display popup menu and select **Set Working Folder.**



3. From the Browse For Folder dialog box, use the scroll bar to navigate and click on the **C:\Civil 3D Projects** folder. Click **OK** to close the Browse For Folder dialog box.

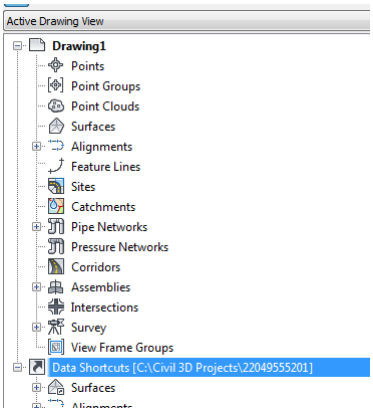


4. From *TOOLSPACE* > *Prospector tab* > *Data Shortcuts*, right click and select **Set Data Shortcuts Project Folder**.

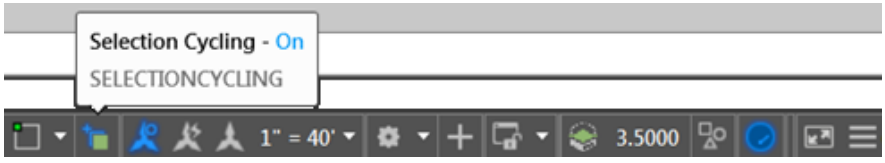


5. From the Set Data Shortcut Folder dialog box, select **22049555201** from the list.

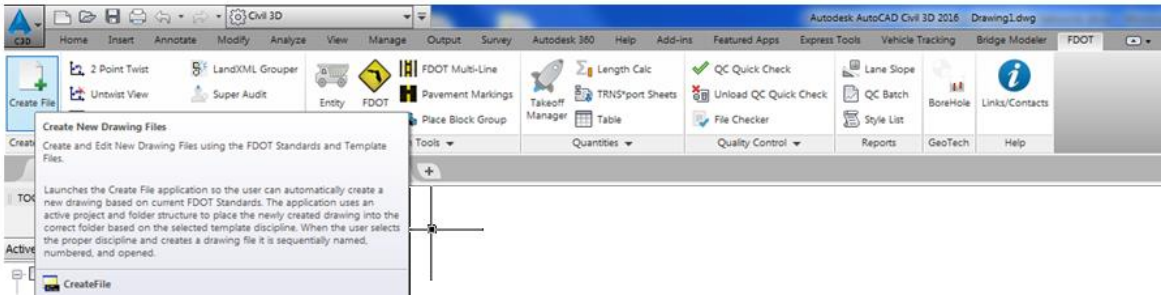
6. Click **OK** to close the Set Data Shortcut Folder dialog box. The *Data Shortcuts* are now set to reference the *C:\Civil 3D Projects\22049555201* folder.



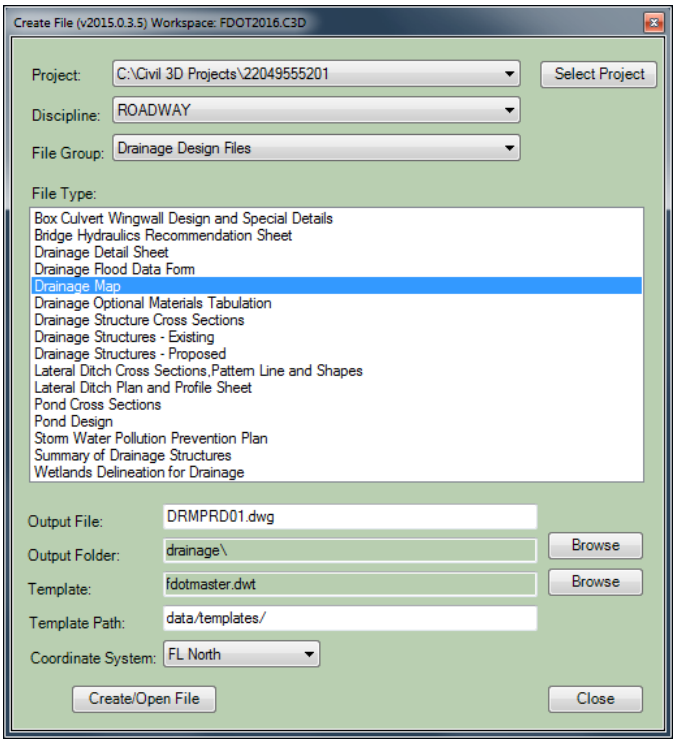
7. From the Status Bar at the bottom of the window toggle **On** *Selection Cycling if* not on by clicking on the icon as shown below. Selection Cycling is not drawing specific but an option that you can toggle on or off at any time. If a new drawing is created or opened the Selection Cycling option will retain the previous toggle setting



Exercise 3.2 Create DRMPRD01.dwg Design File

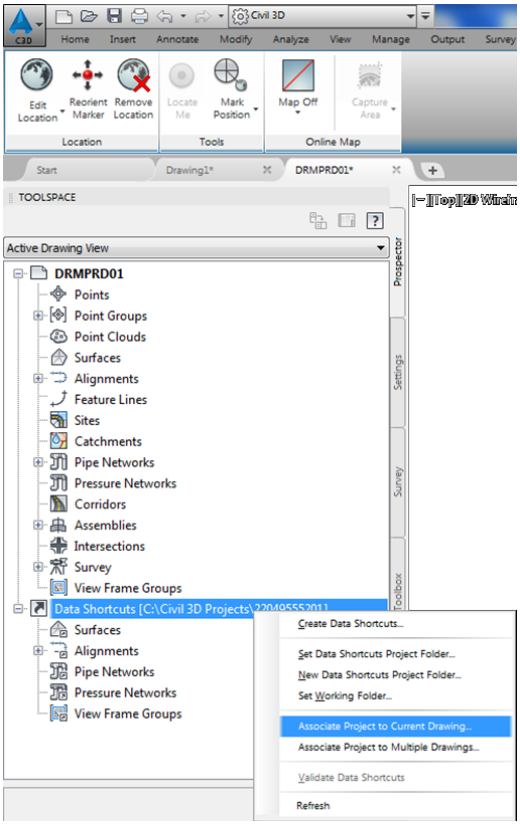


1. From the *FDOT tab > Create File* panel, click the **Create File** tool.

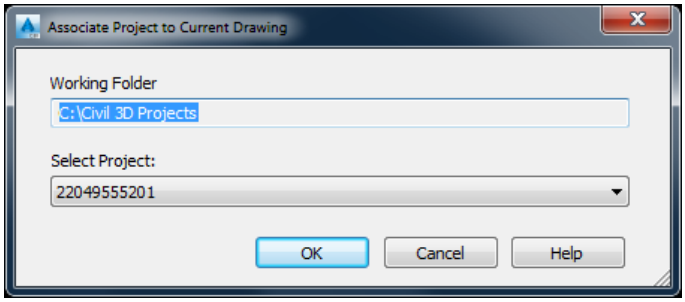


2. From the Create File dialog box, set the following values:
   a. *Project:* **C:\Civil 3D Projects\22049555201**
   b. *Discipline:* **ROADWAY**
   c. *File Group:* **Drainage Design Files**
   d. *File Type:* **Drainage Map**
   e. *Output File:* **DRMPRD01.dwg**
   f. *Output Folder:* **drainage**
   g. *Template:* **fdotmaster.dwt**
   h. *Template Path:* **data/templates**
   i. *Coordinate System:* **FL North**
3. Click **Create/Open File**
4. Click **Close** to close the Create File dialog box.

Exercise 3.3 Associate DRMPRD01.dwg File to the Project



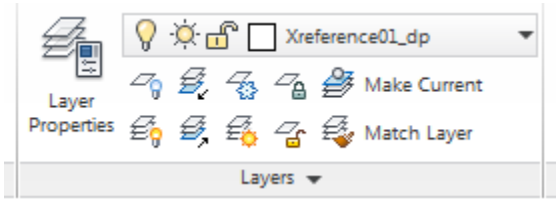
1. From the *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201], right-click and select **Associate Project to Current Drawing**.



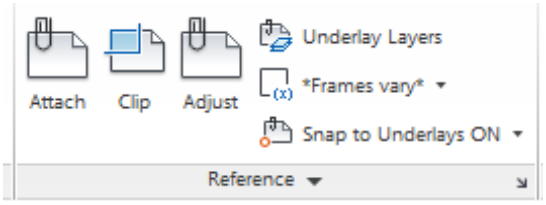
2. From Associate Project to Current Drawing dialog box, set the following values:
   a. *Working Folder:* set to **C:\Civil 3D Projects**
   b. *Select Project:* click **22049555201** from drop down list
3. Click **OK** to close Associate Project to Current Drawing dialog box. *DRMPRD01.dwg* is now associated to the C:\Civil 3D Projects\22049555201 Project.

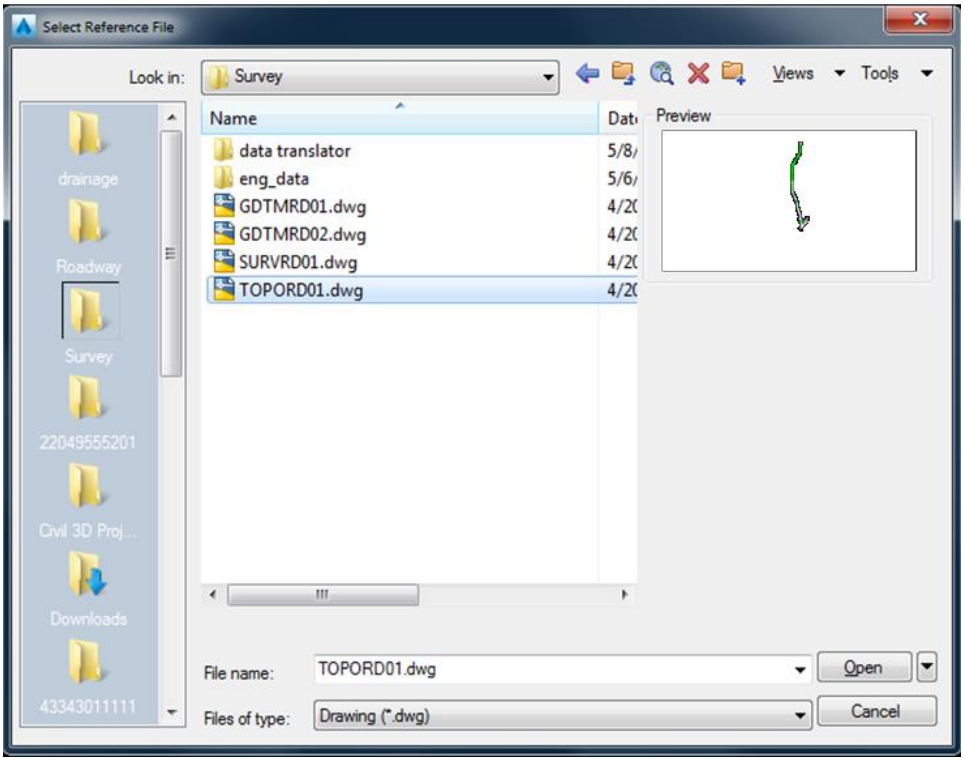
Exercise 3.4 Attach External Reference Files (Xref) TOPORD01.dwg to Open File

1. From the *Home tab* > *Layers panel*, set current *layer* to **Xreference01_dp.**

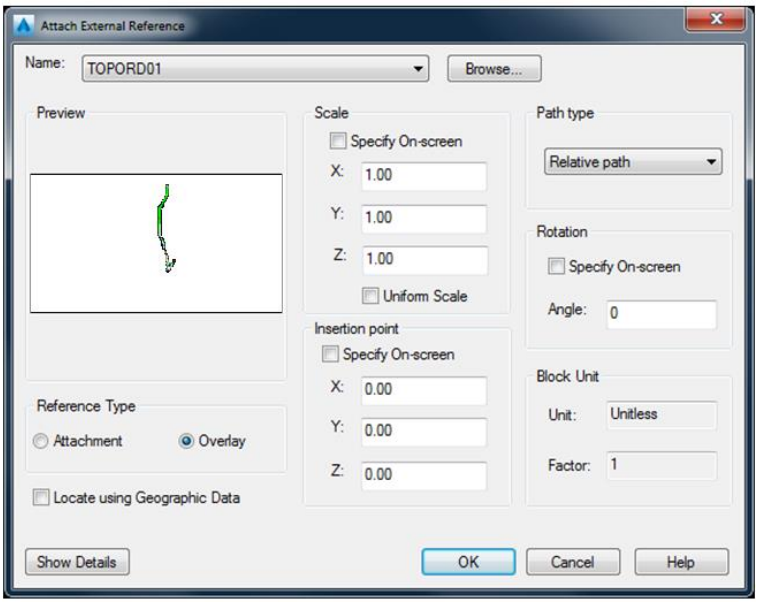


2. From the *Insert tab* > *Reference panel*, click **Attach**.

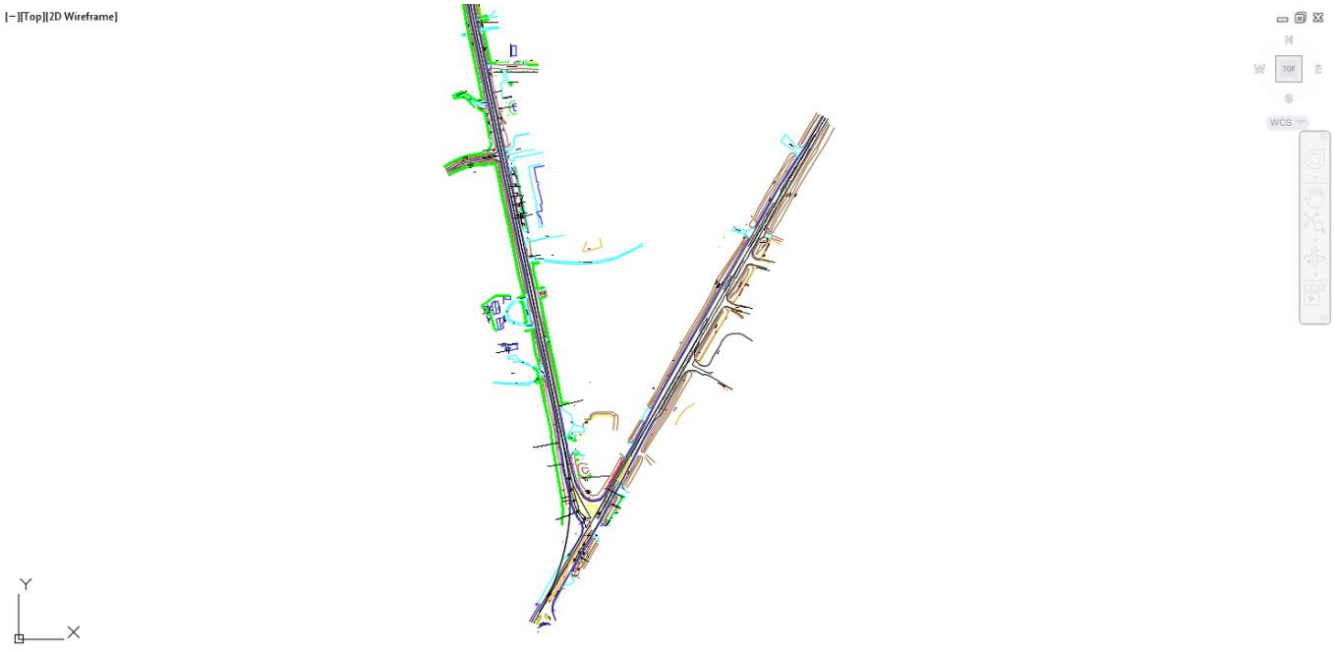




3. From the Select Reference File dialog box, navigate to: **C:\Civil 3D Projects\22049555201\Survey** folder. Select **TOPORD01.dwg** and then click **Open** to close the Select Reference File dialog box.



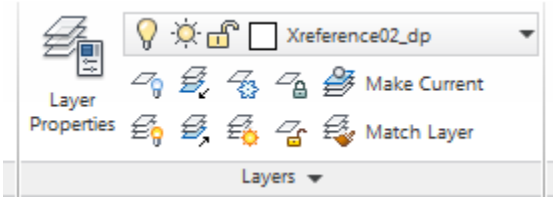
4. From the Attach External Reference dialog box, set the following values:
   a. *Reference Type:* **Overlay**
   b. *Scale:* Un-Check **Specify On-screen**
   c. *Uniform Scale:* Un-check
   d. *Insertion point:* Un-Check **Specify On-screen**
   e. *Path Type:* **Relative path**
   f. *Rotation:* Un-Check **Specify On-screen**
   g. *Angle:* **0**
5. Click **OK** to close Attach External Reference dialog box.

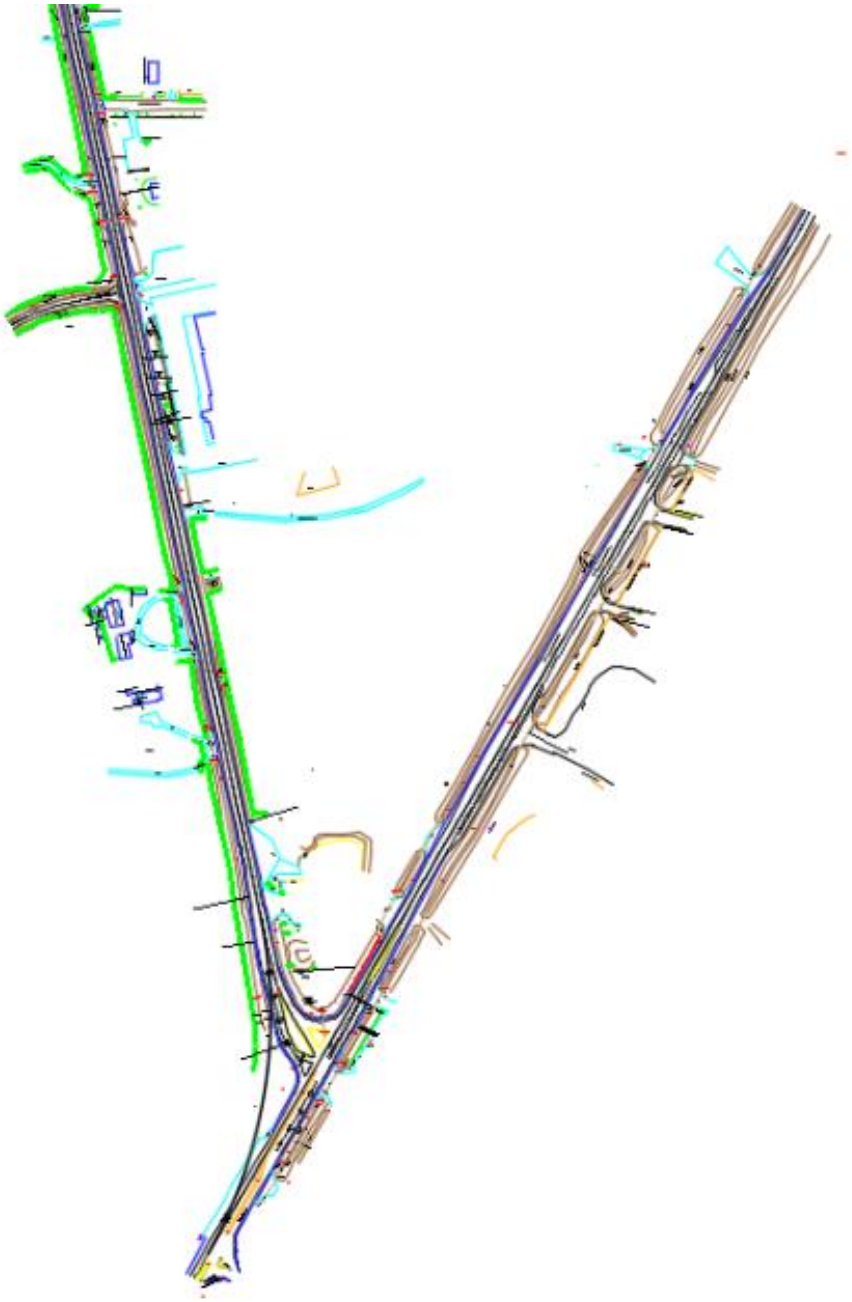


6. **Zoom** and **Pan** to display the Project location.

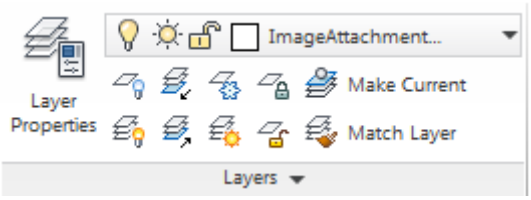
➢ *Attach External Reference Files (Xref) DREXRD01*

Using steps in Exercise 3.4 above, attach another Xreference file. Change the *layer* to **Xreference02_dp** first. You are going to reference in the DREXRD01.dwg which stands for (Drainage Structure - Existing) to the DRMPRD01.dwg. Zoom and Pan to display the project location when complete. Your drawing should look like image below.

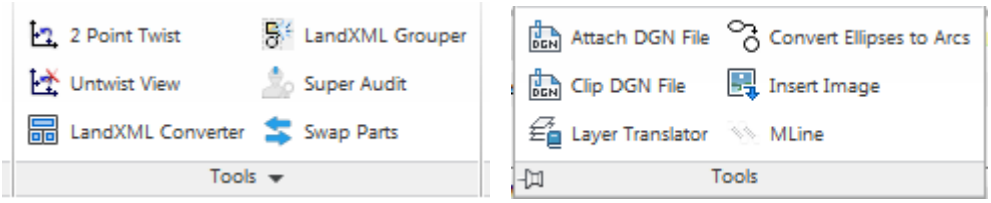




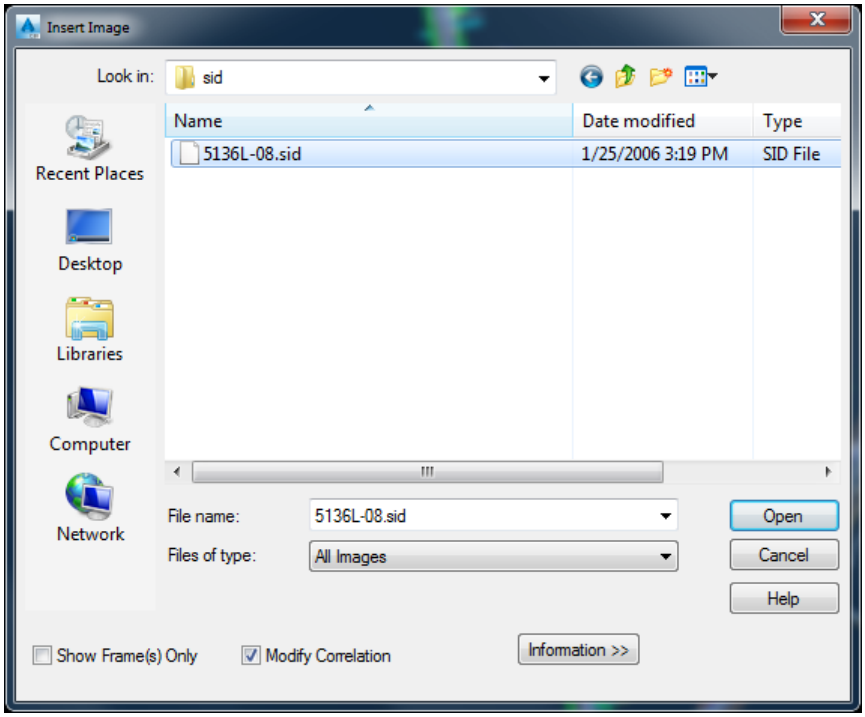
Exercise 3.5 *Attach Georeferenced Raster Image - 5136L-08 File to* **DRMPRD01.dwg**



1. From the *Home tab* > *Layers panel*, set current *layer* to **ImageAttachment_dp.**

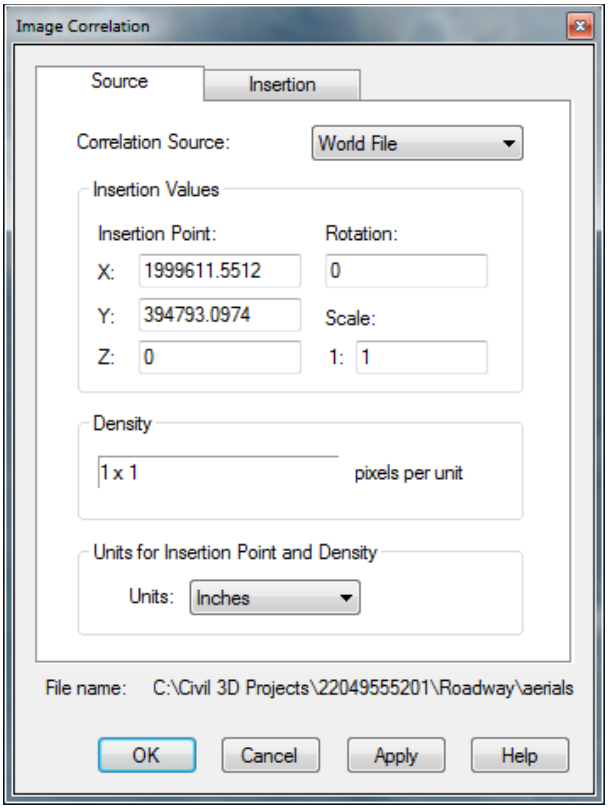


2. From the *FDOT tab* > *Tools panel*, click **Tools** and then click **Insert Image**.



3. From the Insert Image dialog box, navigate to the

   C:\Civil 3D Projects\22049555201\Roadway\aerials\sid folder, select **5136L-08.sid**, then click **Open** to close the Insert Image dialog box.

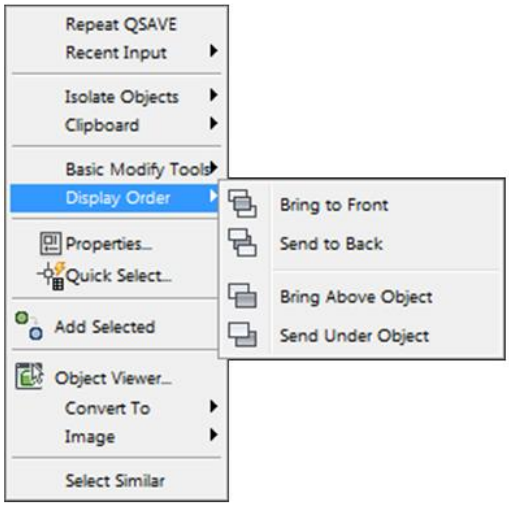


4. From the Image Correlations dialog box, review settings, then click **OK** to close the Image Correlations dialog box.

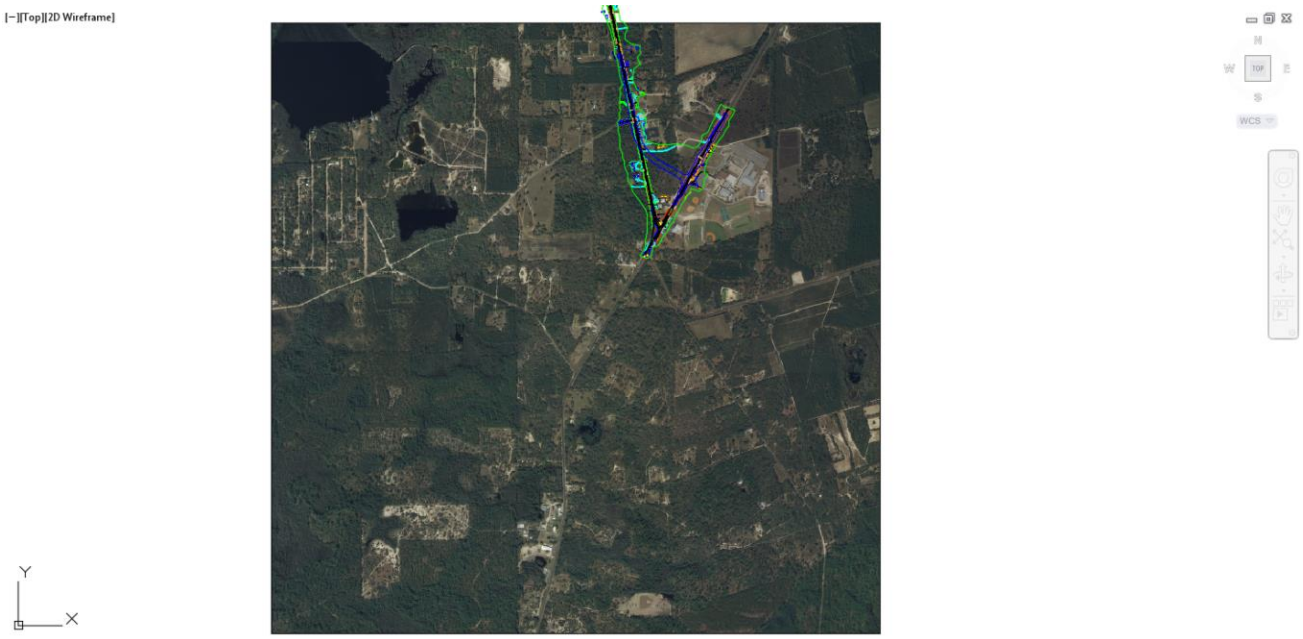
Exercise 3.6 Control Display Order of Civil 3D Objects

1. **Zoom** and **Pan** to display the **5136L-08.sid** *image*.
2. Hold the **Shift** key down and click on the **5136L-08.sid** *image* to select.

   <OR> Select any **edge** on the *5136L-08.sid image* frame.



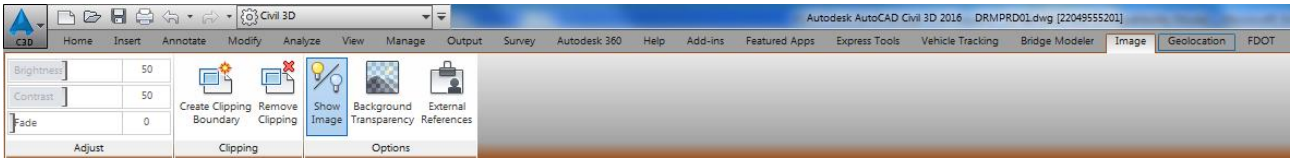
3. Right-click to open popup menu, hover over *Display Order* and select **Send to Back**.
4. Results of sending *5136L-08.sid image* to back:

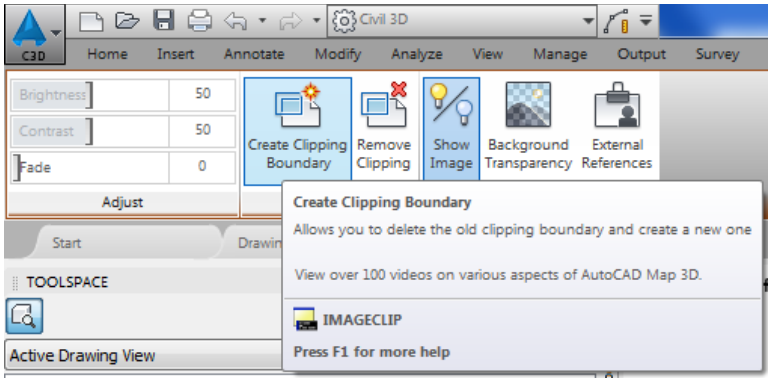


Exercise 3.7 Use Layer Controls & Create Clip Boundary to Display Data

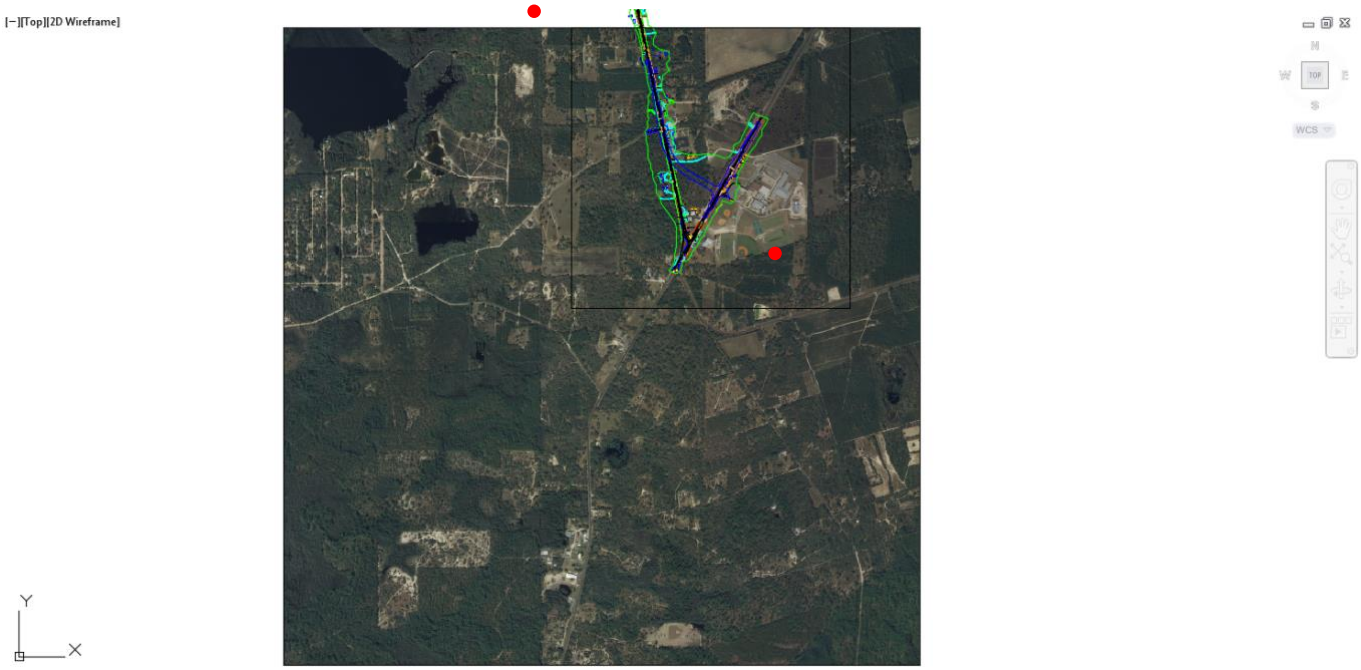
1. Hold the **Shift** key down and click on the **5136L-08.sid** *image* to select.

   <OR> select any **edge** of the *5136L-08.sid image* frame to select.



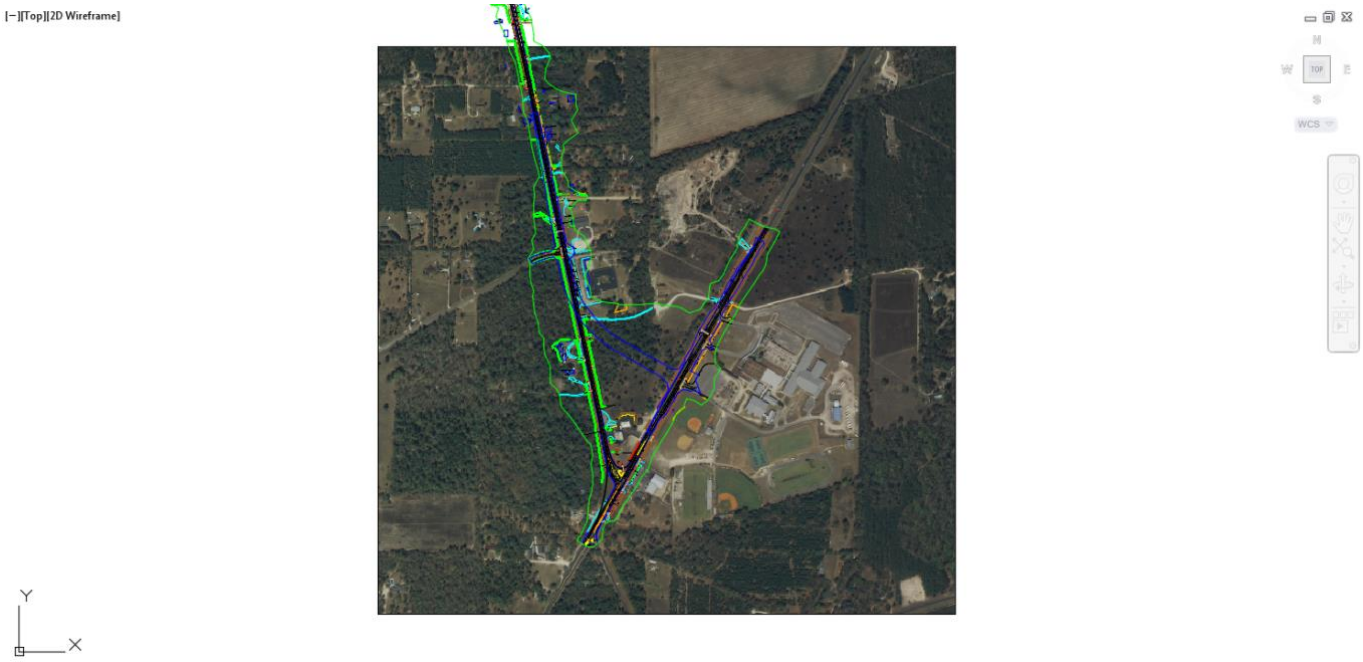


2. From the *Image tab > Clipping panel*, select **Create Clipping Boundary.**




```
Enter image clipping option [ON/OFF/Delete/New boundary] <New>: _N
Outside mode - Objects outside boundary will be hidden.
Specify clipping boundary or select invert option:
IMAGECLIP [Select polyline Polygonal Rectangular Invert clip] <Rectangular>:
```

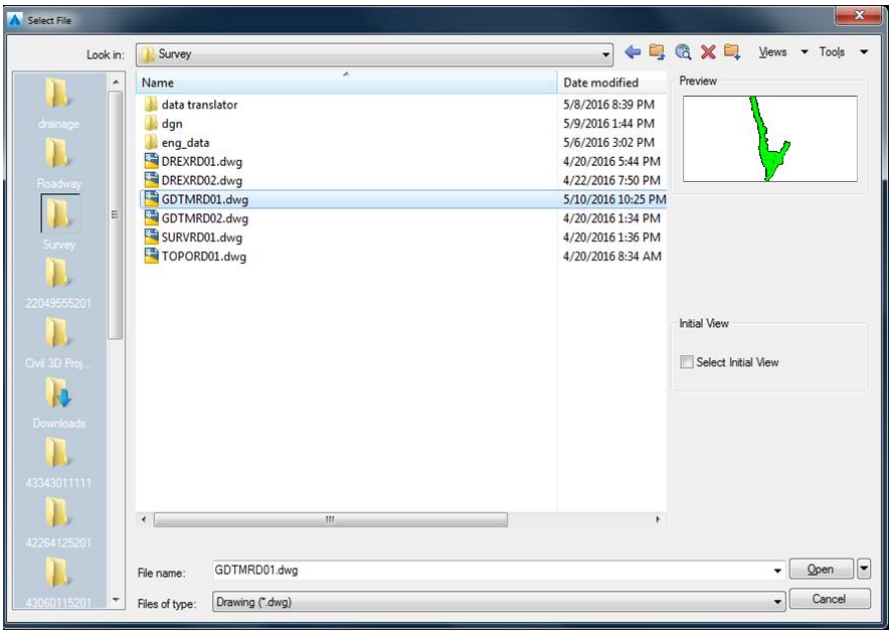
3. On the *command line* select the **Rectangular** option, by typing **R** then enter.
4. Click **two points** to define *project boundary* as shown by the red circles displayed above.



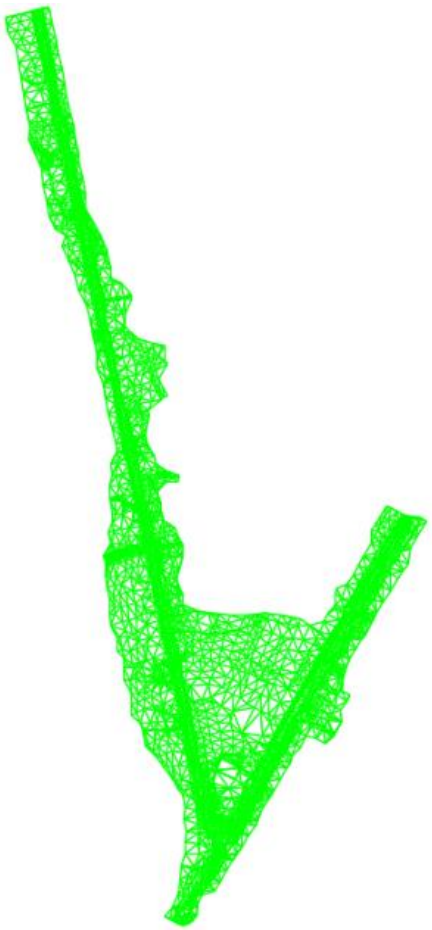
5. **Zoom** and **Pan** to display the SR61 Project location.
6. **Save** *DRMPRD01.dwg* file.

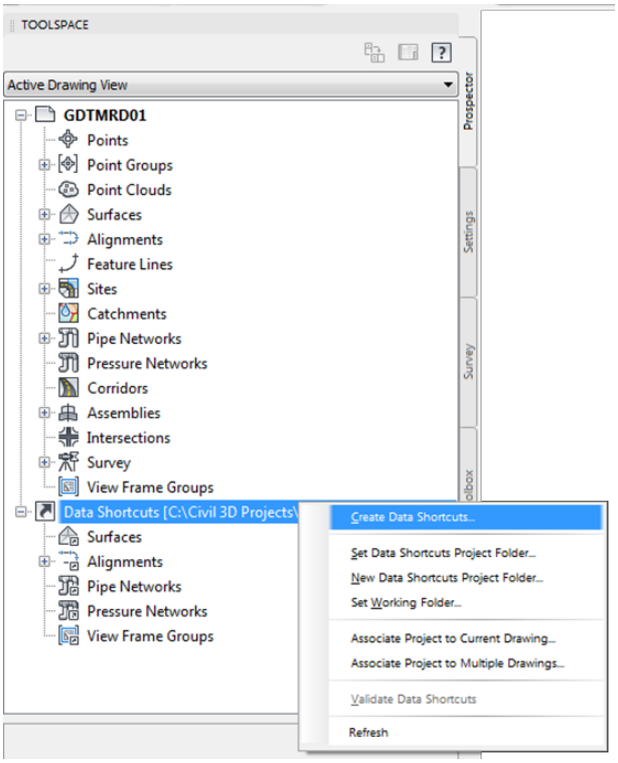
Exercise 3.8 Create Data Shortcuts for the SR61 - Existing Surface

1. Open the *GDTMRD01.dwg* located in the **Survey** folder.

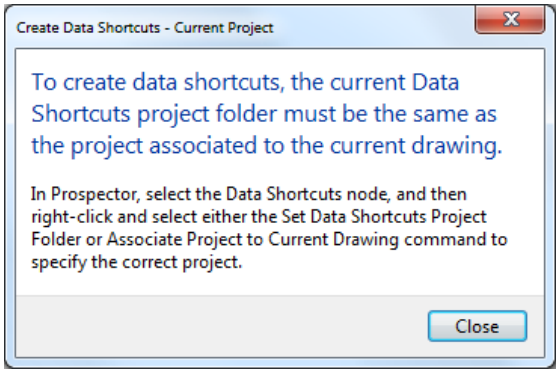


2. From the Select File dialog box, navigate to the *C:\Civil 3D Projects\22049555201\Survey* folder and select **GDTMRD01.dwg**. Click **Open** to close the Select File dialog box.





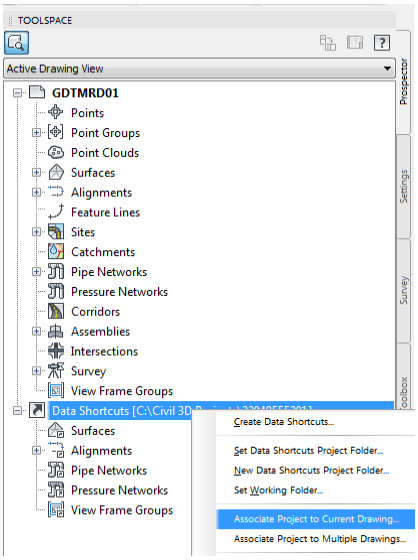
3. From *TOOLSPACE* > *Prospector tab*, right-click, then select **Create Data Shortcuts**.



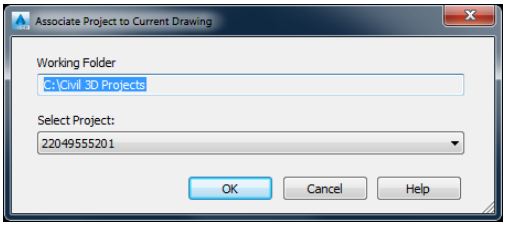
4. If the Create Data Shortcuts - Current Project dialog box **opens** and you receive this message, click **Close** to close the Create Data Shortcuts - Current Project dialog box. You must **associate** the *GDTMRD01.dwg* to the Project. Continue on to the *Associate GDTMRD01 Drawing to Project* section.

5. If the Create Data Shortcuts - Current Project dialog box **does NOT open**, then continue on to the *Create Data Shortcuts - Surface* section following the *Associate GDTMRD01 Drawing to 22049555201 Project* section.

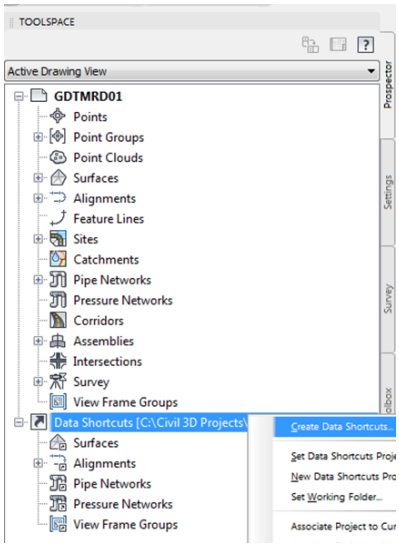
Exercise 3.9 Associate GDTMRD01.dwg File to Project



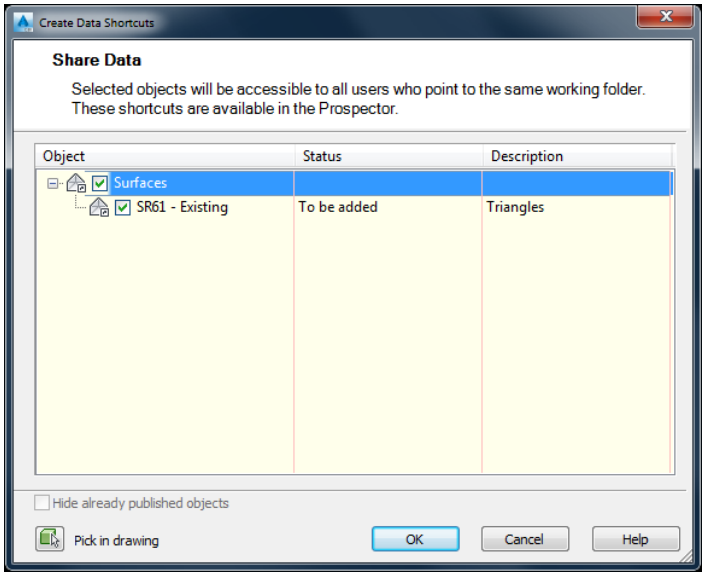
1. From the *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201] right-click and select **Associate Project to Current Drawing**.



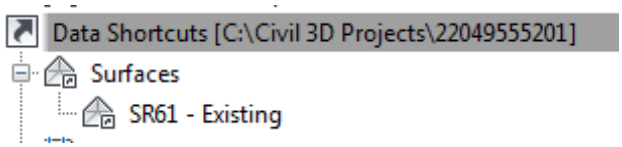
2. From Associate Project to Current Drawing dialog box, set the following values:
   a. *Working Folder:* set to **C:\Civil 3D Projects**
   b. *Select Project:* click **22049555201** from drop down
3. Click on **OK** to close Associate Project to Current Drawing dialog box. *GDTMRD01.dwg* is now associated to the C:\Civil 3D Projects\22049555201 project.



4. From *TOOLSPACE > Prospector tab*, right-click to open popup menu and select **Create Data Shortcuts**.

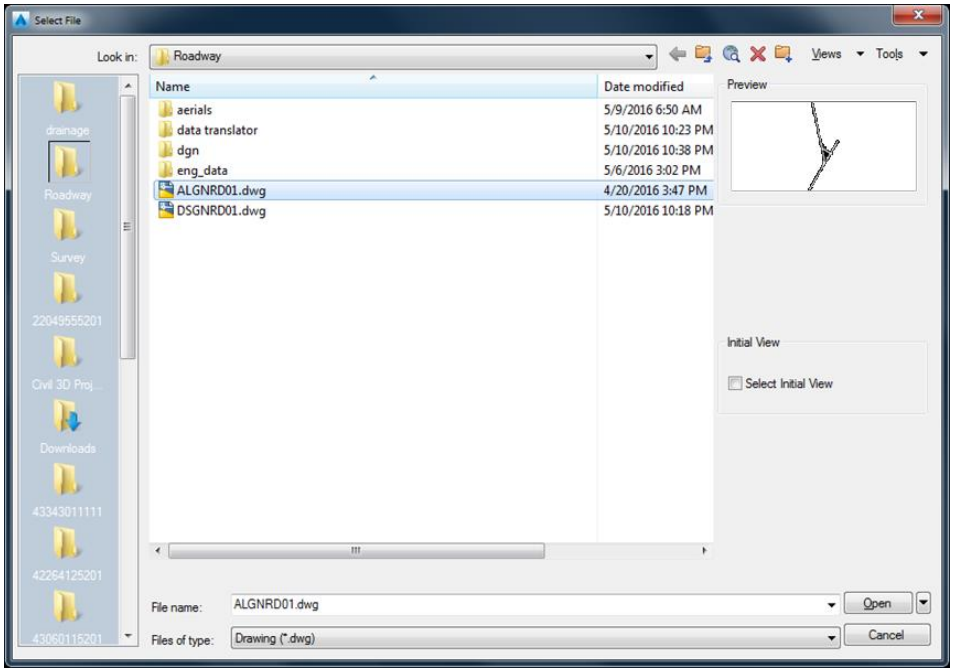


5. From the Create Data Shortcuts dialog box, select the **Surfaces** box.
6. Click **OK** to close the Create Data Shortcuts dialog box.

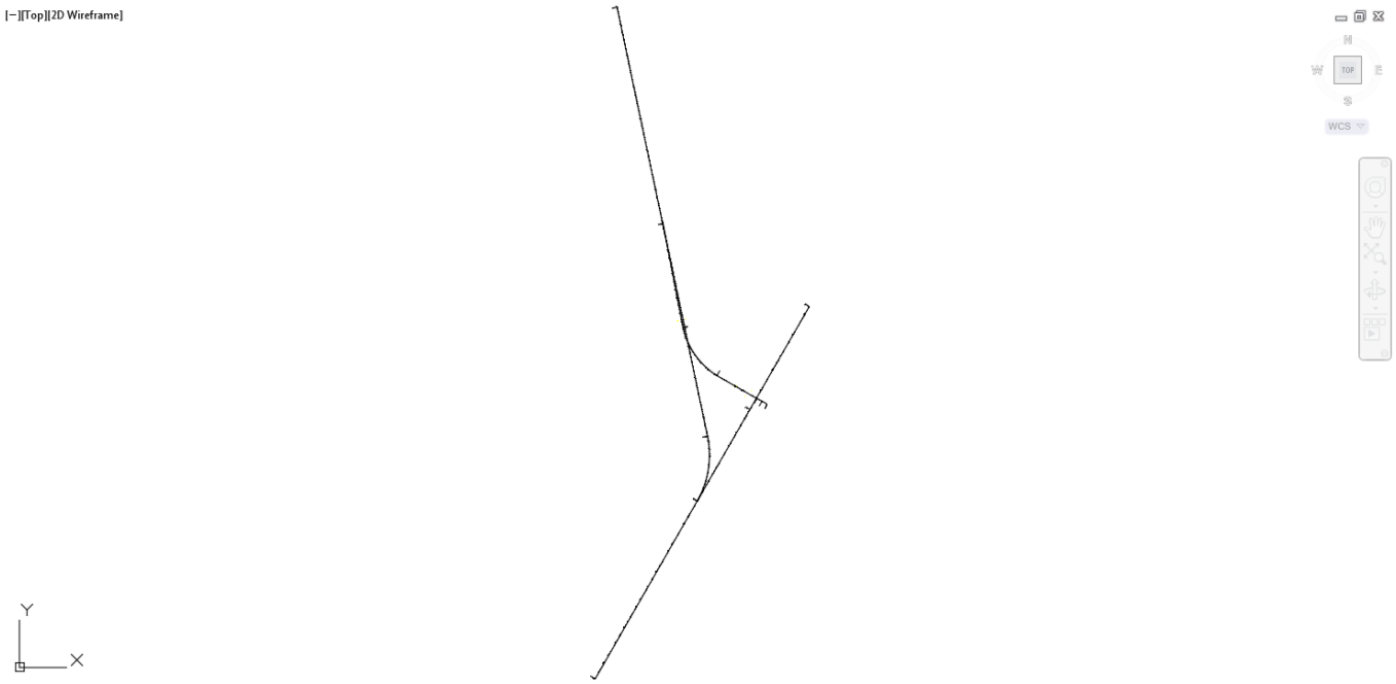


7. Review **Data Shortcuts for Surfaces**, from *TOOLSPACE > Prospector tab*, expand **Data Shortcuts** [C:\Civil 3D Projects\22049555201], expand **Surfaces.**
8. **Close** and **Save** *GDTMRD01.dwg*.

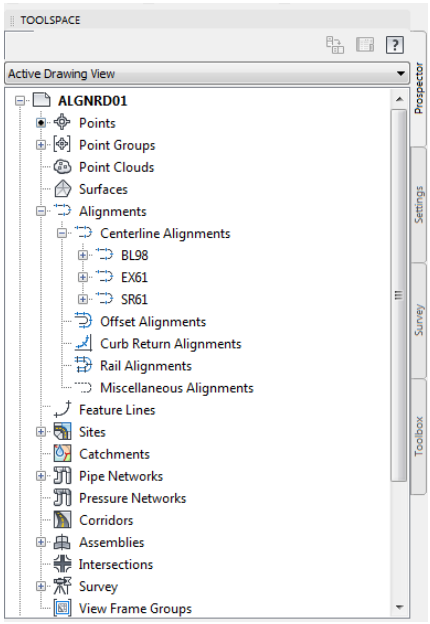
Exercise 3.10 Create Data Shortcuts for Alignments



1. From the Select File dialog box, navigate to the *C:\Civil 3D Projects\22049555201\Roadway* folder.
2. Select **ALGNRD01.dwg**, then click **Open** to close the Select File dialog box.

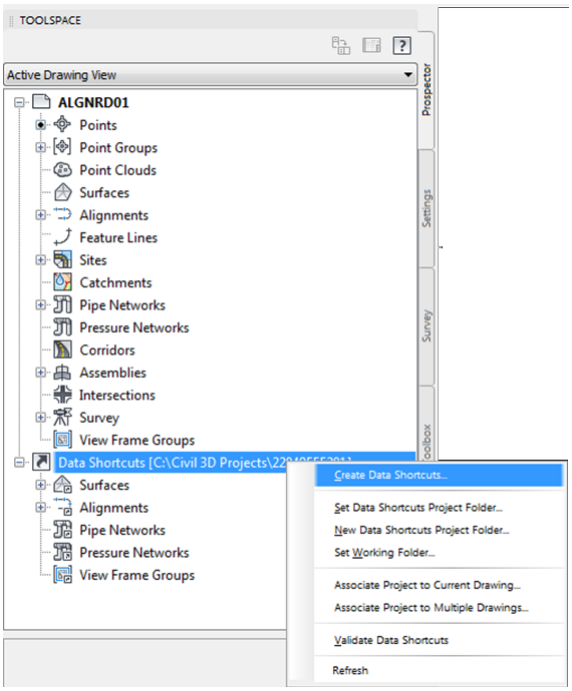


3. Double-click the *scroll wheel* on the mouse to **Zoom to** the Project location.



4. Review *Alignments* in ALGNRD01 from *TOOLSPACE* > *Prospector tab*, expand **Alignments** > **Centerline Alignments**.

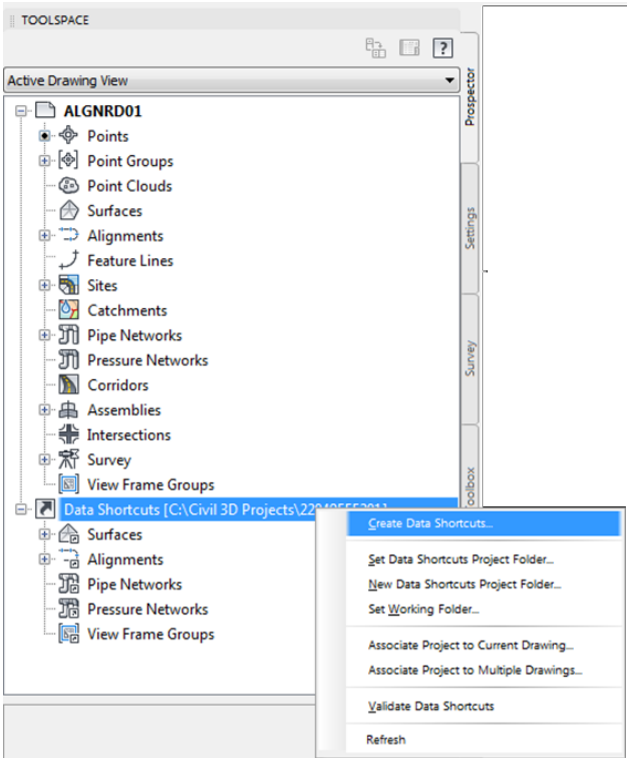
➢ *Create Data Shortcuts for the EX61, BL98, and SR61 Alignments*

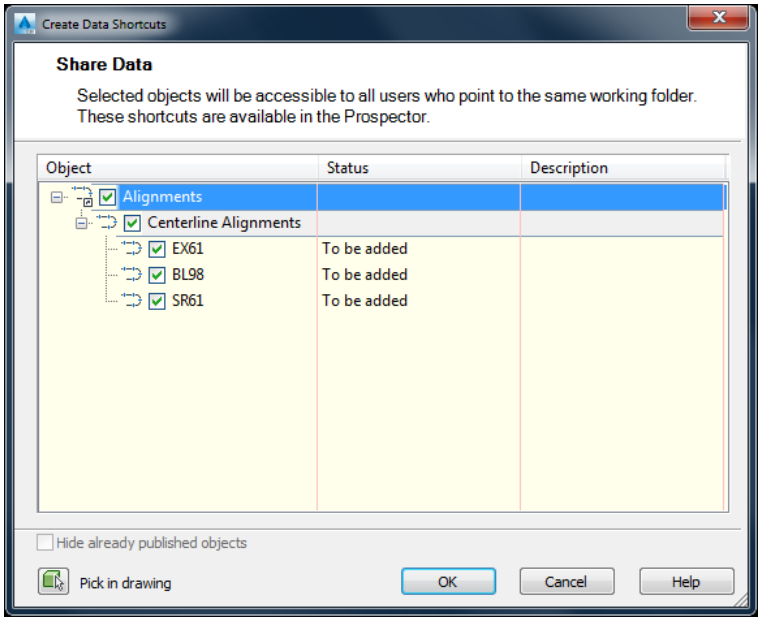


1. From *TOOLSPACE* > *Prospector tab*, right-click to open popup menu, select **Create Data Shortcuts**.
2. If the Create Data Shortcuts - Current Project dialog box **does NOT open**, then continue on to the *Create Data Shortcuts - Alignments* section following the *Associate ALGNRD01 Drawing to 22049555201 Project* section.

➢ *Associate ALGNRD01 Drawing to the 22049555201 Project*

1. From the *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201] right-click to open the popup menu, select **Associate Project to Current Drawing** and make selections based off of earlier steps.
2. From *TOOLSPACE* > *Prospector tab*, right click to open popup menu, select **Create Data Shortcuts**.

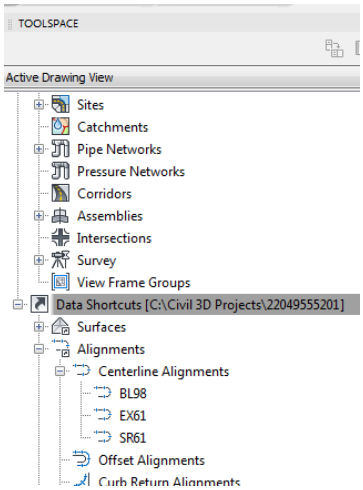




3. From the Create Data Shortcuts dialog box, check **Alignments**, then click **OK** to close Create Data Shortcuts dialog box.

➢ *Review Data Shortcuts - Alignments*

The next steps will show you how to review Data Shortcuts for the EX61, BL98, and SR61 Alignments.

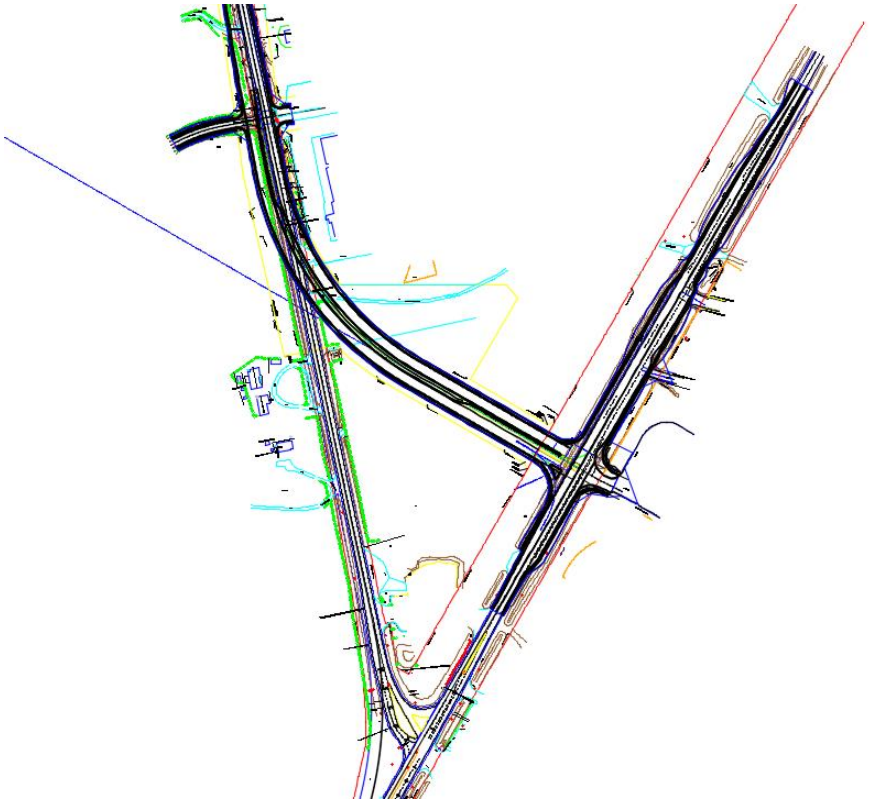


1. From the *TOOLSPACE* > *Prospector tab*, expand **Data Shortcuts** [C:\Civil 3D Projects\22049555201], expand **Alignments**, expand **Centerline Alignments**.
2. **Close** and **Save** *ALGNRD01.dwg*.

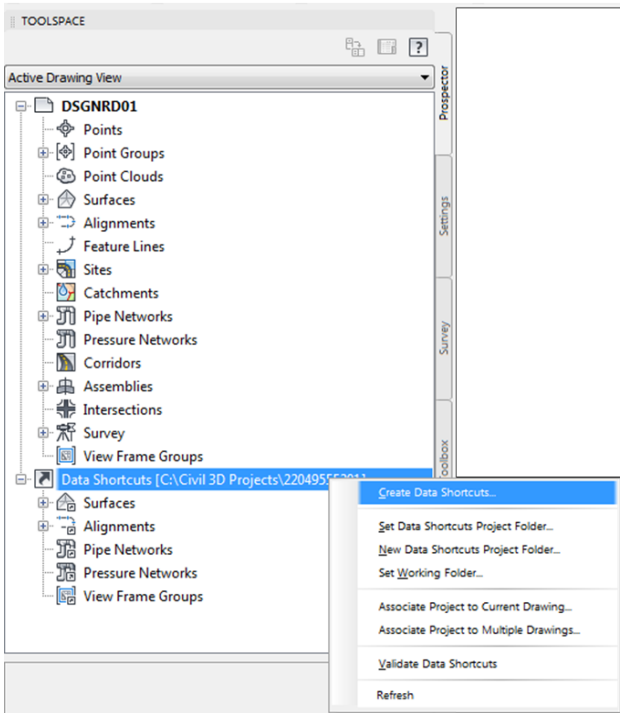
Exercise 3.11 Creating a Data Shortcut of the Final Surface

The next steps will show you how to create a data shortcut of the SR61_Final Surface from the DSGNRD01.dwg

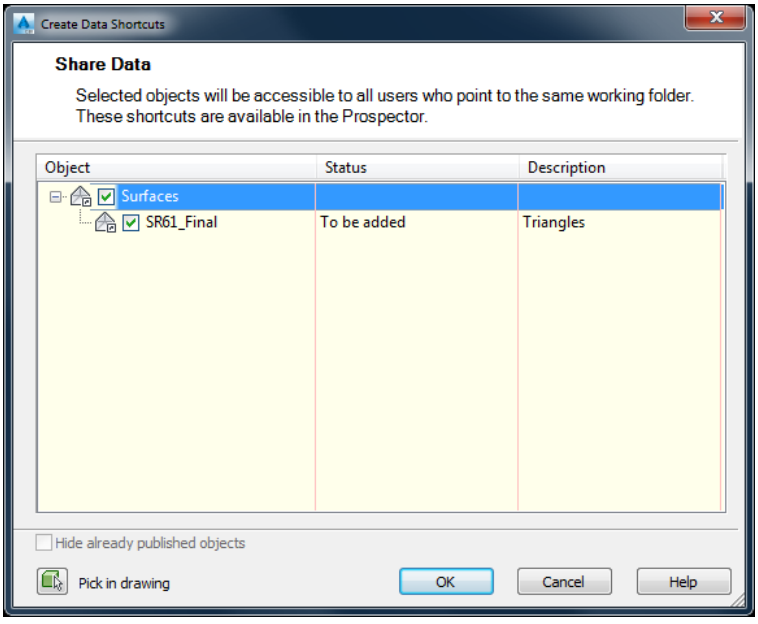
1. From the *Roadway* folder open the **DSGNRD01.dwg** file.



2. From the *TOOLSPACE* > *Prospector tab*, right-click to open popup menu, select **Create Data Shortcuts...**



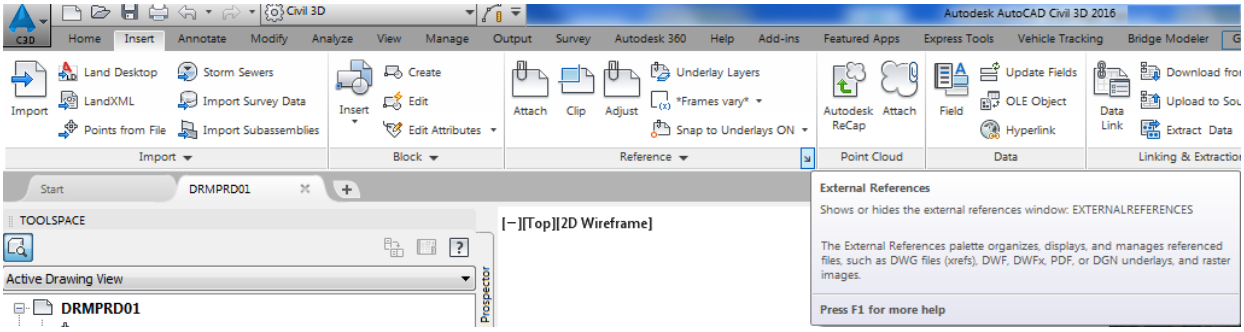
3. From the *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201] right-click to open popup menu, select **Create Data Shortcuts.**

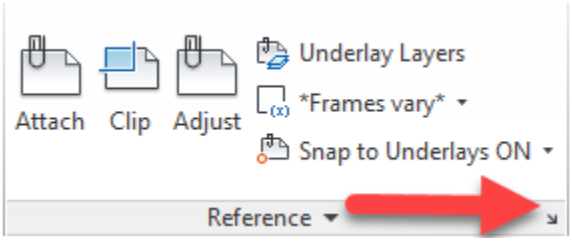


4. From the Create Data Shortcuts dialog box, check **Surfaces.**
5. Click **OK** to close the Create Data Shortcuts dialog box.

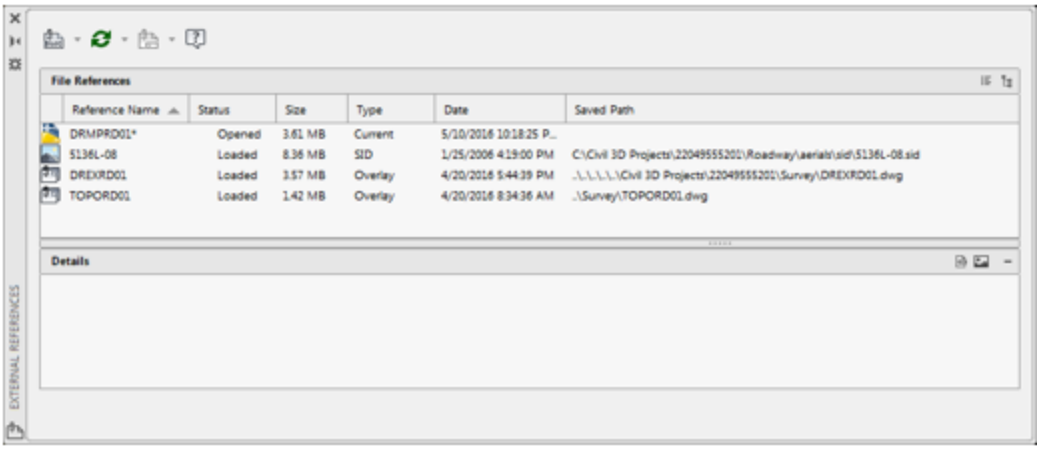
Exercise 3.12 Review Attached External Reference Files (Xrefs)

The next steps will show you how to review the attached External Reference files (Xrefs) in the DRMPRD01.dwg





1. From the *Insert Tab* > *Reference panel*, click the **arrow** located in the lower right hand corner to open the *External Reference* tool palette.



2. The External References tool palette is displayed.
   - 5136L-08.sid is listed and loaded as an SID (Image) attachment.
   - DREXRD01.dwg is listed and loaded as an Overlay attachment.
   - TOPORD01.dwg is listed and loaded as an Overlay attachment.
3. **Close** *External References* tool palette.

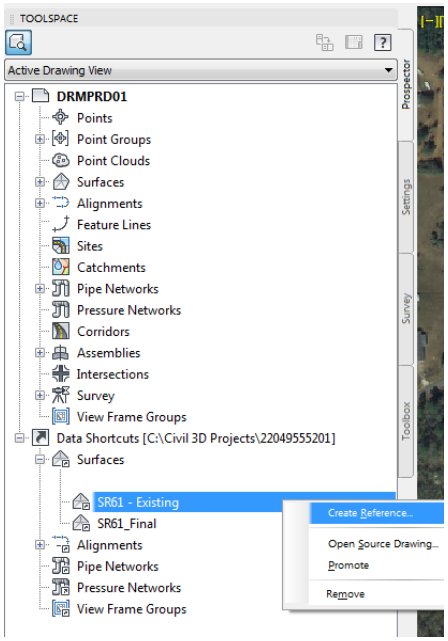
Exercise 3.13 Create Data References for Surfaces SR61 - Existing and SR61_Final

The next steps will show you how to create Data References for the Surfaces SR61 - Existing and SR61_Final to the DRMPRD01.dwg.

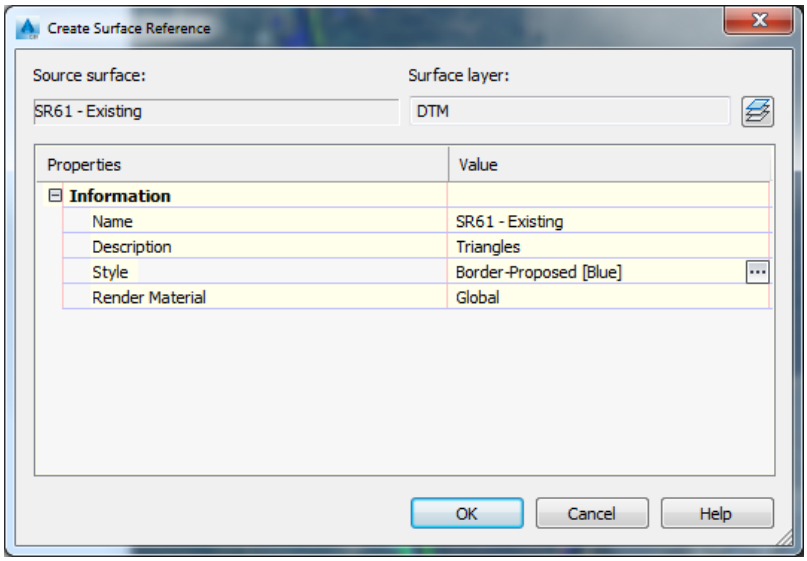
1. From the *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201], expand **Surfaces**.

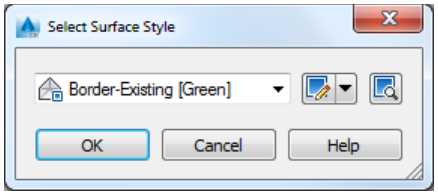
➢ *Add SR61 - Existing Surface*

The next steps will show you how to create a Data Reference for SR61 - Existing Surface to the DRMPRD01.dwg. You created Data Shortcuts in the previous steps, Data Reference is when you bring in the Shortcut.

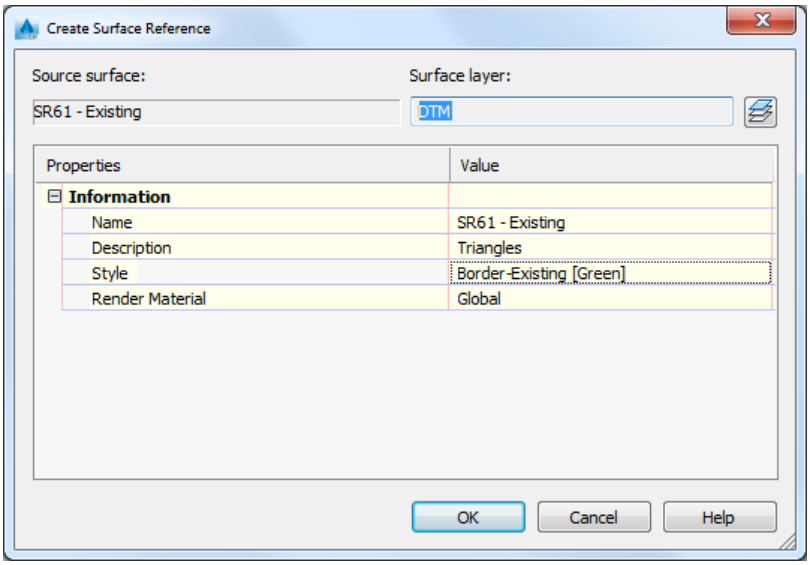


1. From *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201], expand **Surfaces**, right-click on **SR61_Existing**, and select **Create Reference**.
2. From Create Surface Reference dialog box, under *Properties* > *Information*, select the **Style Value** box.





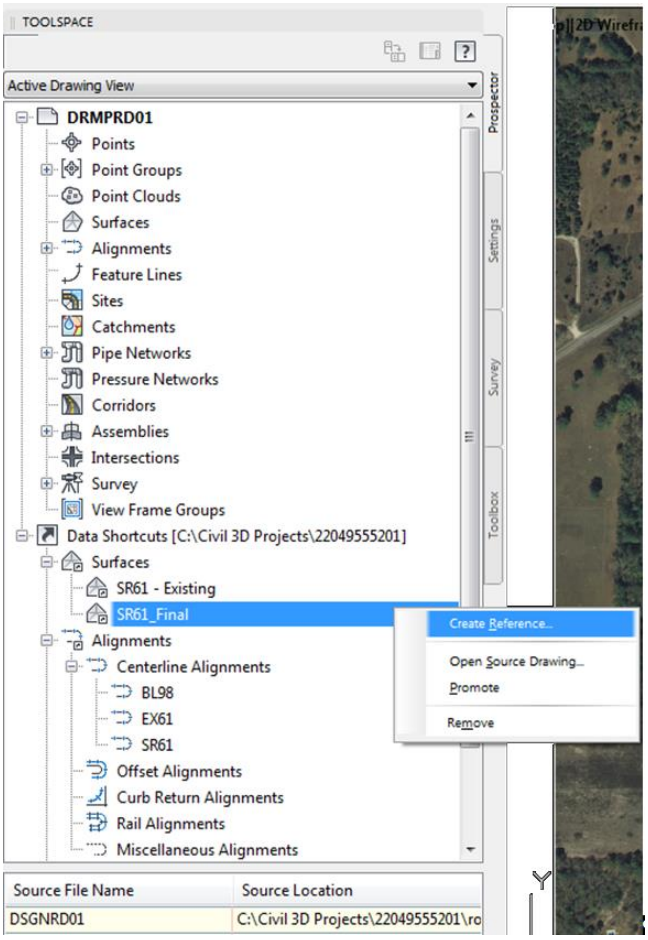
3. From the Select Surface Style dialog box, set the *Style* to **Border-Existing [Green]** from the drop down list.
4. Click **OK** to close the Select Surface Style dialog box



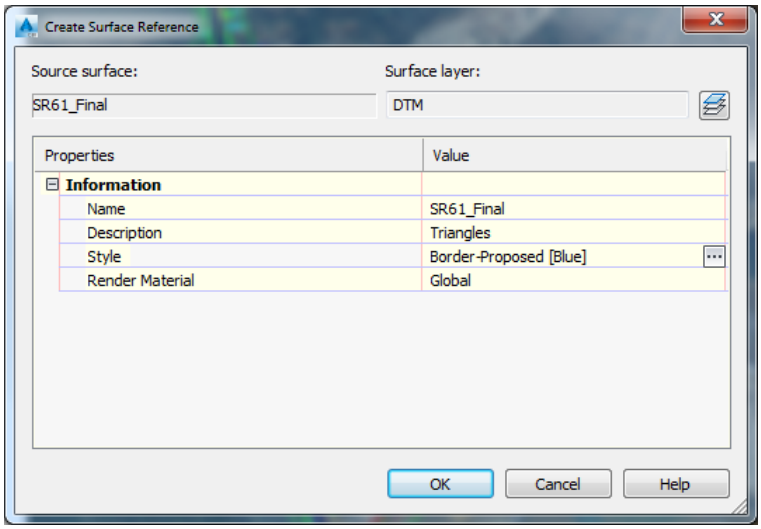
5. Click **OK** to close Create Surface Reference dialog box. SR61 - Existing Surface data reference displays in the SR61 Project location.

➢ *Add SR61_Final Surface*

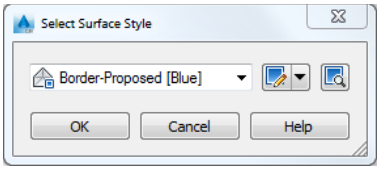
The next steps will show you how to Create Reference for SR61_Final Surface to the *DRMPRD01.dwg*.



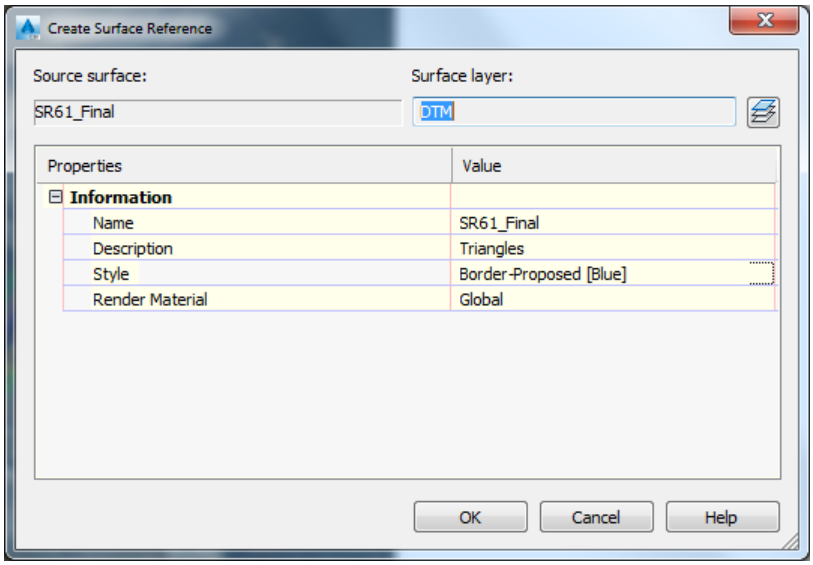
1. From *TOOLSPACE* > *Prospector tab* > *Data Shortcuts* [C:\Civil 3D Projects\22049555201], expand **Surfaces**, right-click on **SR61_Final**, and select **Create Reference**.



2. From Create Surface Reference dialog box, under *Properties* > *Information*, select the **Style Value** box.



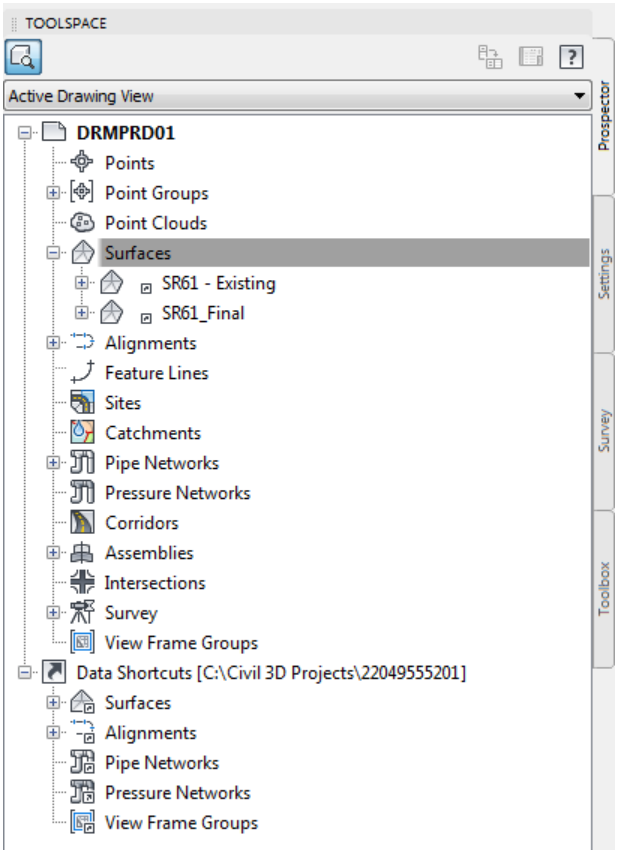
3. From Select Surface Style dialog box, set the *Style* to **Border-Proposed [Blue]** from the drop down list.
4. Click **OK** to close the Select Surface Style dialog box.



5. Click **OK** to close Create Surface Reference dialog box. SR61_Final Surface data reference displays in the SR61 Project location.

➢ *Review Data References Surfaces In DRMPRD01*

The next steps will show you how to review the Data Referenced Surfaces in the *DRMPRD01.dwg*.



1. From *TOOLSPACE > Prospector tab*, expand **Surfaces**.
2. **Save** and **Close** *DRMPRD01 file.*

4 WATER FLOW DIRECTIONS

DESCRIPTION

This chapter contains examples of FDOT surface styles to display watershed areas, contours, flow direction arrows as well as usage of the water drop command.

OBJECTIVES

In this chapter, you will learn about:

- Displaying Water Flow Directions
- XREF'S Files
- XLIST Command
- Define Catchments Using Surface & Water Drop

CHAPTER SETUP

Run the Chapter 4 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

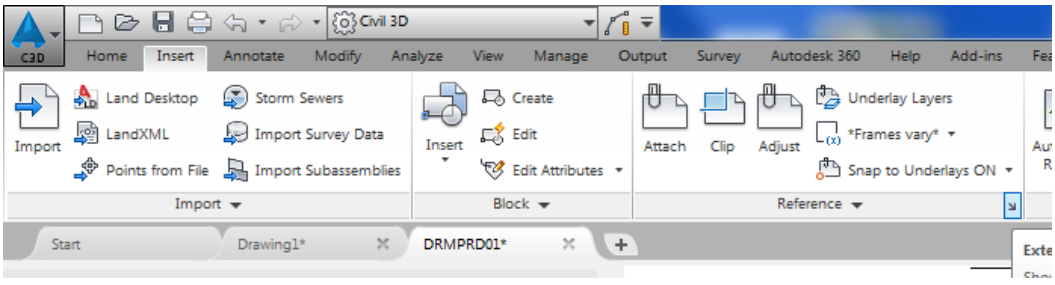
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

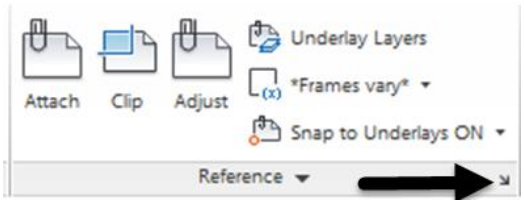
Exercise 4.1 Displaying Water Flow Directions

➢ *Unload Attached Xrefs in DRMPRD01 File*

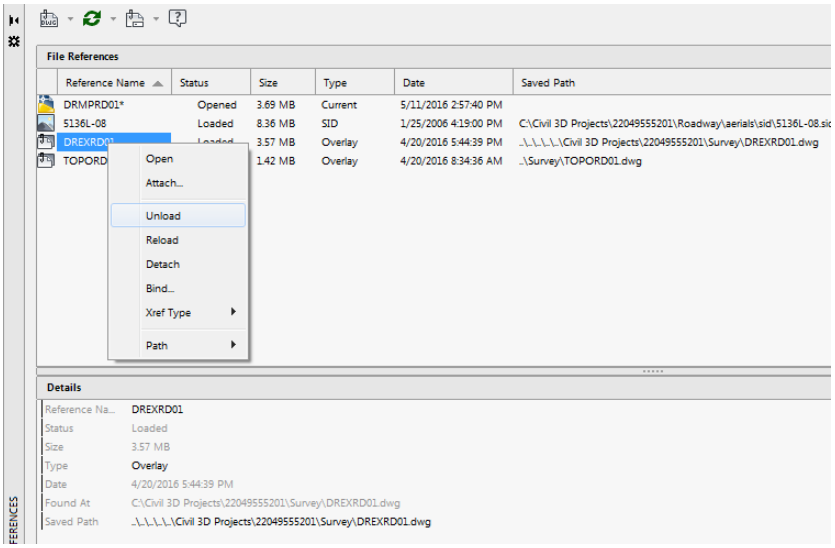
The next steps will show you how to unload an attached Xrefs in DRMPRD01.dwg. When you unload a drawing, it does not remove it from the Xref list, it removes it from memory and visibility.

1. Start the FDOT Civil 3D State Kit and open the DRMPRD01.dwg located in the Chapter 4 dataset drainage folder.





2. From the *Insert Tab > Reference panel*, click the **arrow** located in the lower right hand corner to open the *External Reference* tool palette.

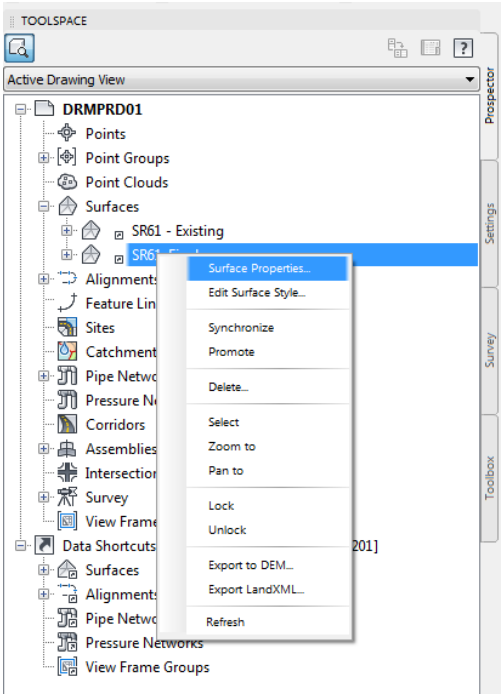


3. The *External References* tool palette displays. Right-click on **DREXRD01** in the *Reference Name* column and select **Unload**.
4. Right-click on **TOPORD01** and select **Unload**.
5. In the Status column notice the two files are now listed as *Unloaded*. **Close** *External References* tool palette.

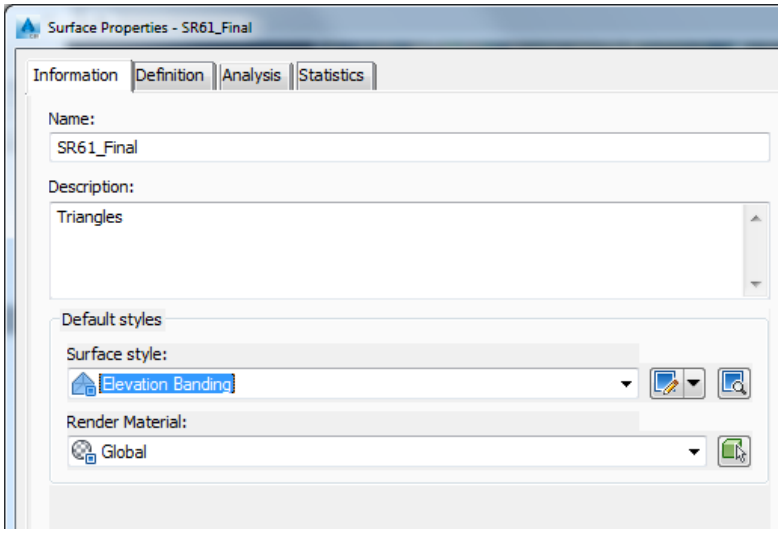
6. Review the results of unloading the DREXRD01 and TOPORD01Xref's.

➢ *Elevation Analysis of SR61_Final surface*

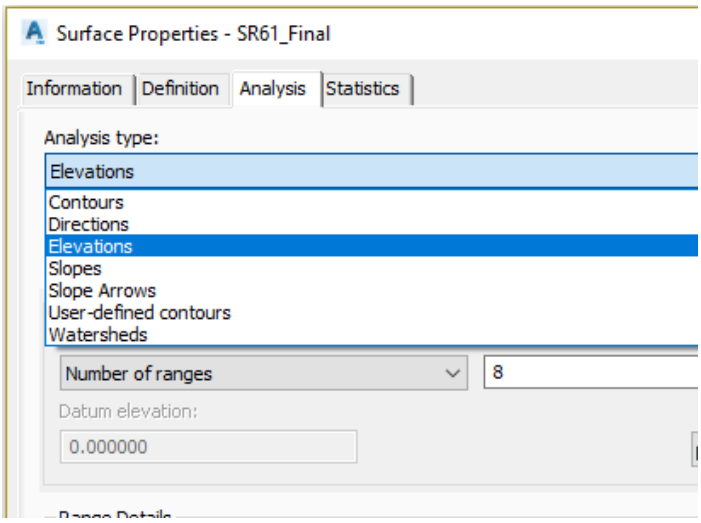
The next steps will show you how to perform an Elevation Analysis of the SR61_Final surface



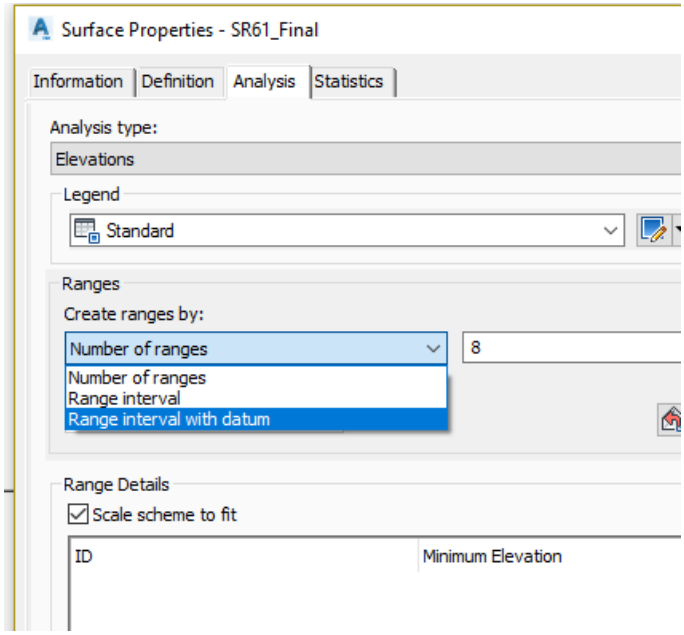
1. From the *TOOLSPACE > Prospector tab*, expand **Surfaces,** then right-click on **SR61_Final** and select **Surface Properties**.



2. From the Surface Properties – SR61_Final dialog box, select the *Information* tab. From the *Surface style*: *drop-down list*, select **Elevation Banding**.

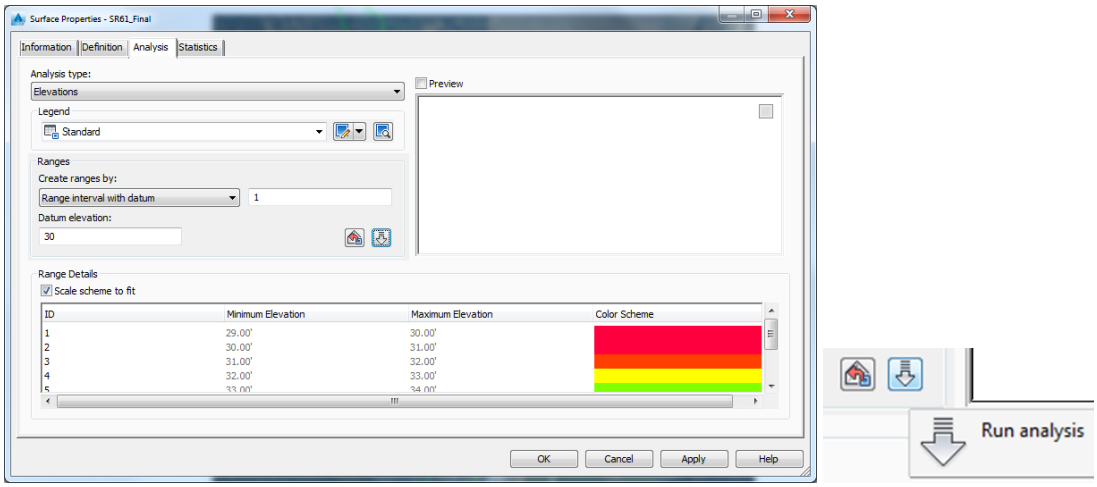


3. Select the *Analysis* tab. Under the *Analysis type*: *drop down list*, select **Elevations**.



Note Under *Ranges* > *Create ranges by: drop down list*, select **Range interval with datum**.

4. Set the *Range interval with datum* field to **1** and *Datum elevation:* field to **30**.



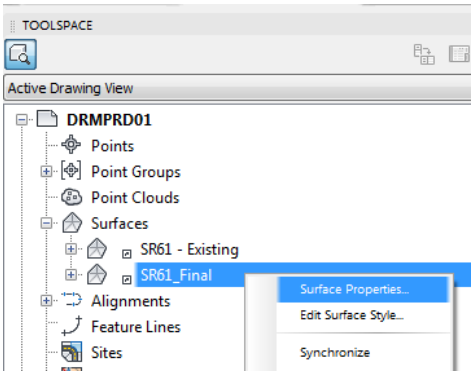
5. Click the down **arrow** to *Run analysis*. The *Range Details* at the bottom will populate with *Minimum Elevation, Maximum Elevation values,* and *various colors* under the Color Scheme column.

6. Click **Apply**, then **OK** to close the Surface Properties dialog box.

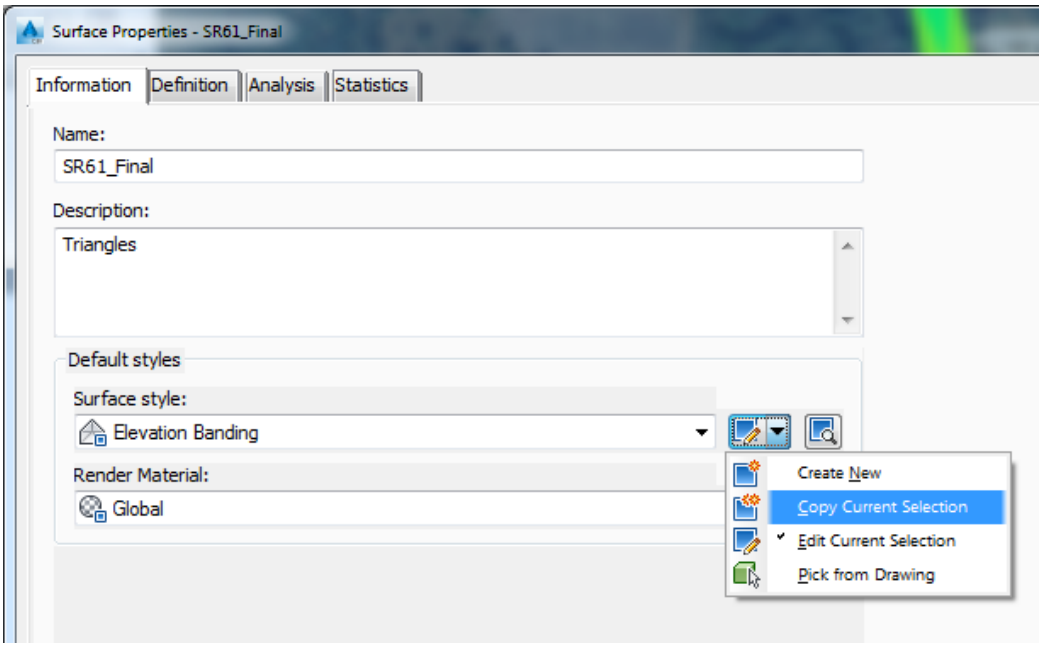
7. Notice the *Elevation Banding* surface style displays the color range in model space as shown above. Setting a Datum Elevation sets the starting point for the sequence of colors in the Color Scheme. When all the colors have been used the pattern repeats at the next range interval. In this color scheme red is at the beginning and blue is at the end.

Exercise 4.2 Slope Arrows / Watershed Analysis of SR61_Final Surface

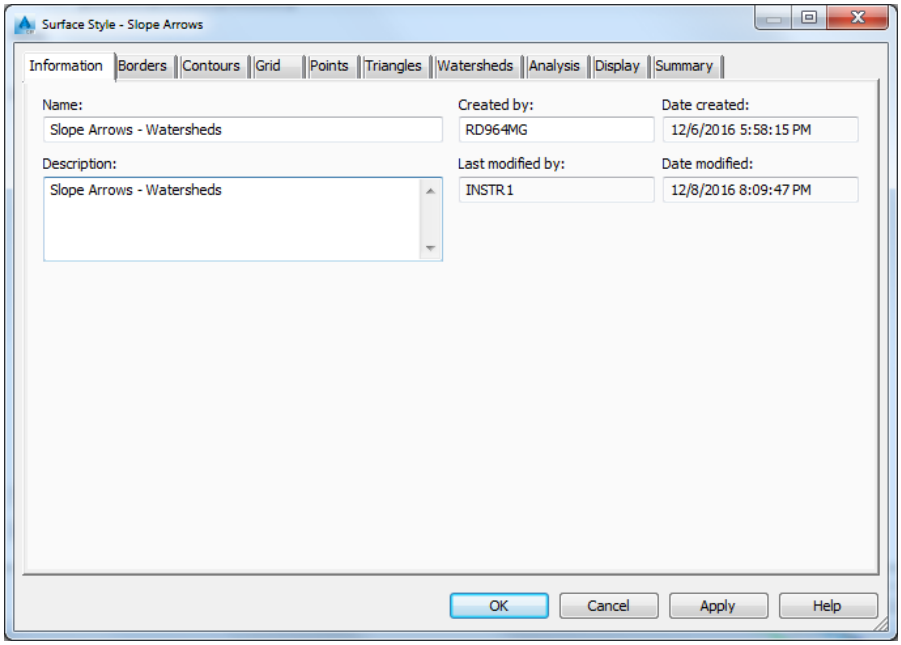
The next steps will show you how to repeat the Analysis process to create and display a Slope Arrows / Watershed surface style.



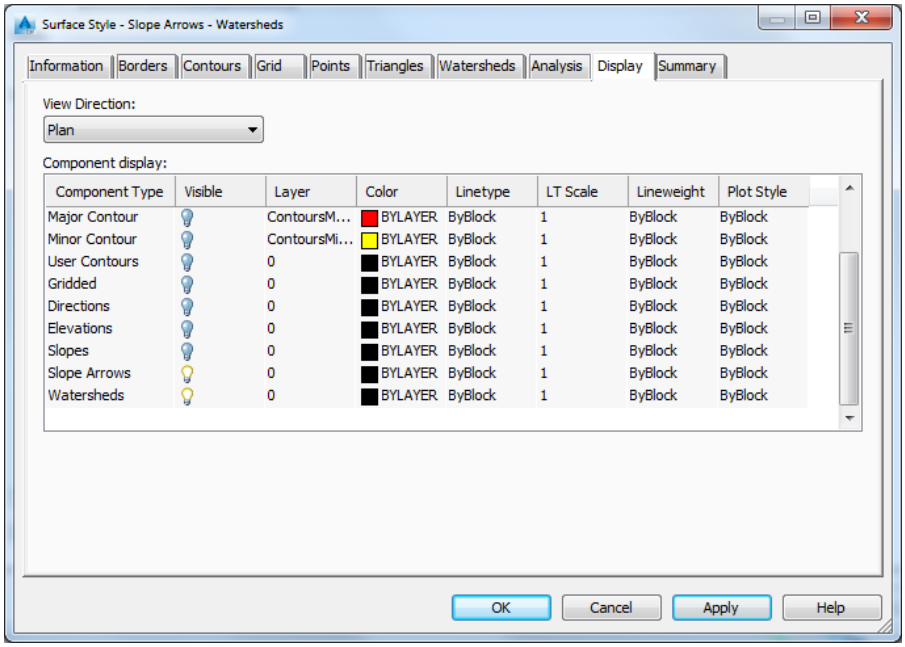
1. From the *TOOLSPACE > Prospector tab*, expand **Surfaces**, then right-click on **SR61_Final** and select **Surface Properties**.



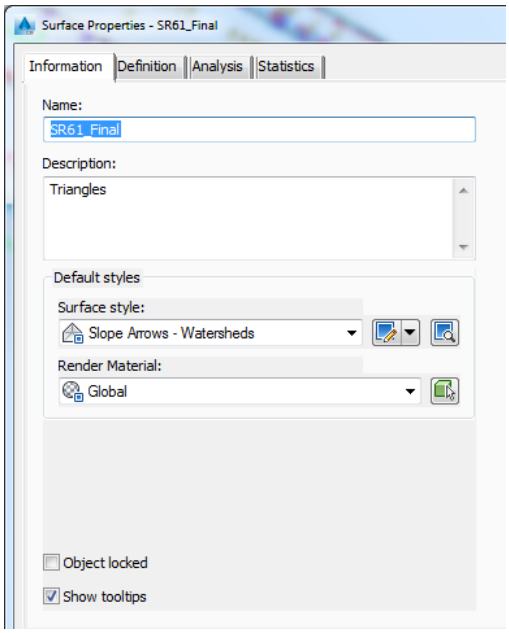
2. From the Surface Properties - SR61_Final dialog box, select the *Information tab*. Click the down **arrow** next to the *Edit* button and select **Copy Current Selection.**



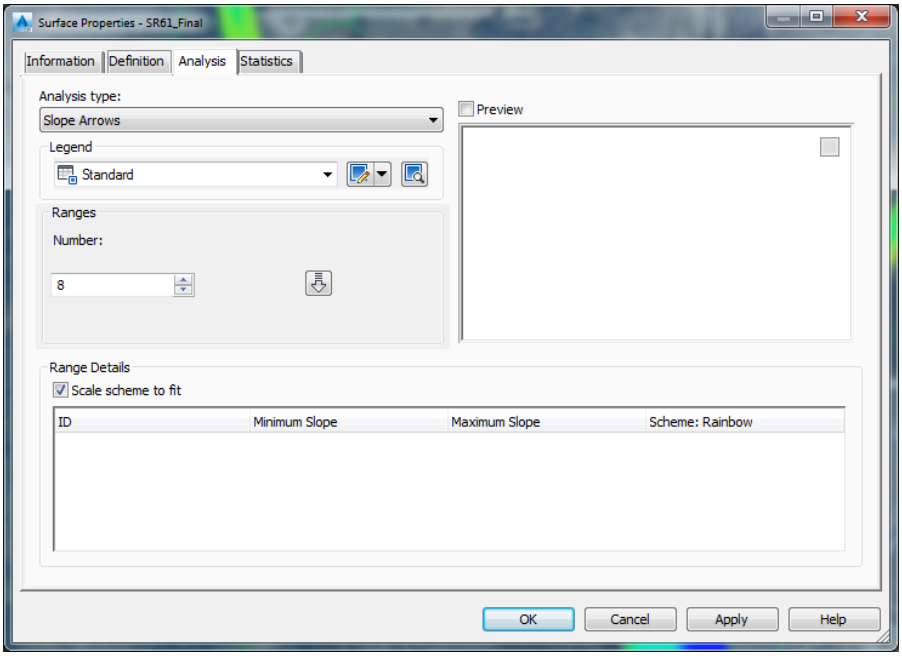
3. From the Surface Style – Slope Arrows dialog box, select the *Information tab*. Enter **Slope Arrows - Watershed** into the *Name:* and *Description:* fields, then click **Apply**.



4. From the Surface Style Slope Arrows - Watersheds dialog box, select the **Display** *tab*.
5. Under *Component display:* highlight **elevations** in the *Component* column.
6. The *Visible* column contains Light Bulb icons. “Yellow” Light Bulb, status is *On*. "Blue" Light Bulb, status is *Off*.
    a. Click the *Elevations Light Bulb* to turn **Off** the Elevations component.
    b. Click the *Slope Arrows* and *Watersheds Light Bulbs* to turn Turn **On** the Slope Arrows and Watersheds components.
7. Click **Apply**, and then **OK** to close the Surface Style Slope Arrows - Watersheds dialog box.

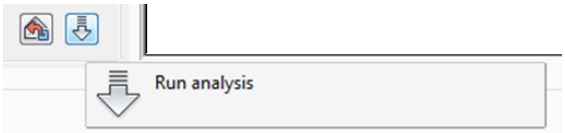


8. From the Surface Properties - SR61_Final dialog box, select the *Information tab*, make sure the *Surface style*: is set to **Slope Arrows - Watersheds**.

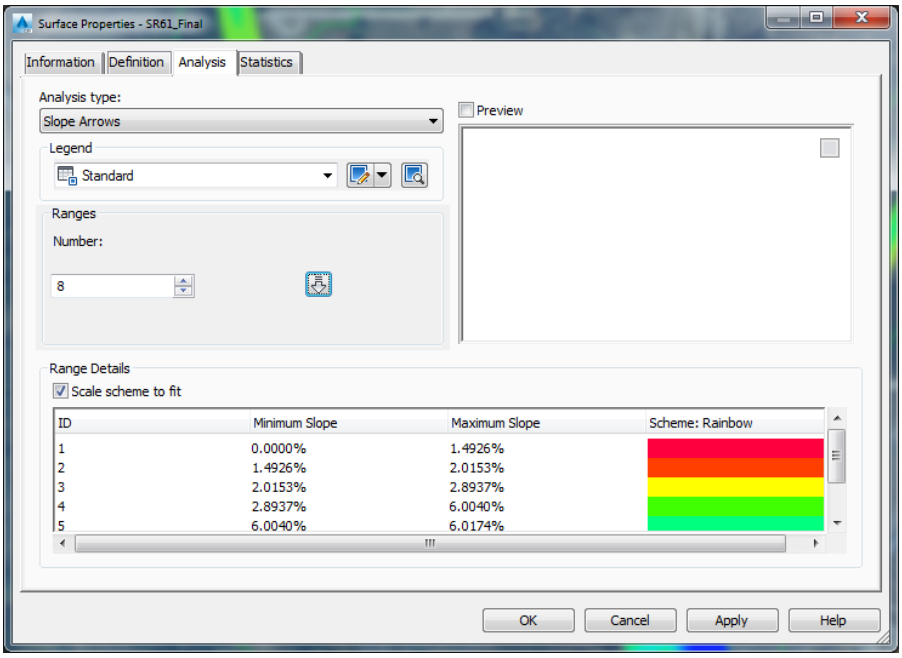


9. Select the *Analysis tab*, set the *Analysis type:* to **Slope Arrows** from the drop down list.

10. In the Ranges area, set the *Number:* field to **8** and click the down **arrow** to *Run the Slope Arrow analysis*.



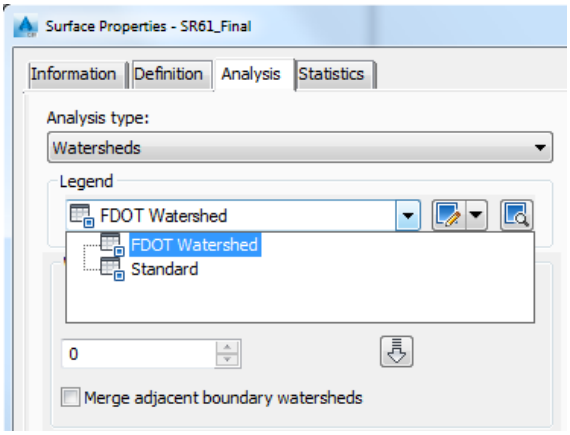
11. Review the *Range Details* at the bottom that display values for *Minimum Slope*, *Maximum Slope*, and various colors for *Scheme: Rainbow* values.



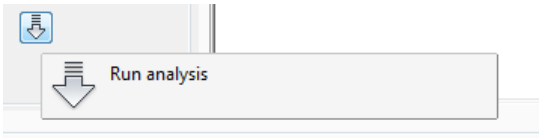
12. **Do NOT Close** the Surface Properties - SR61_Final dialog box

➢ *Process for the Watersheds Analysis*

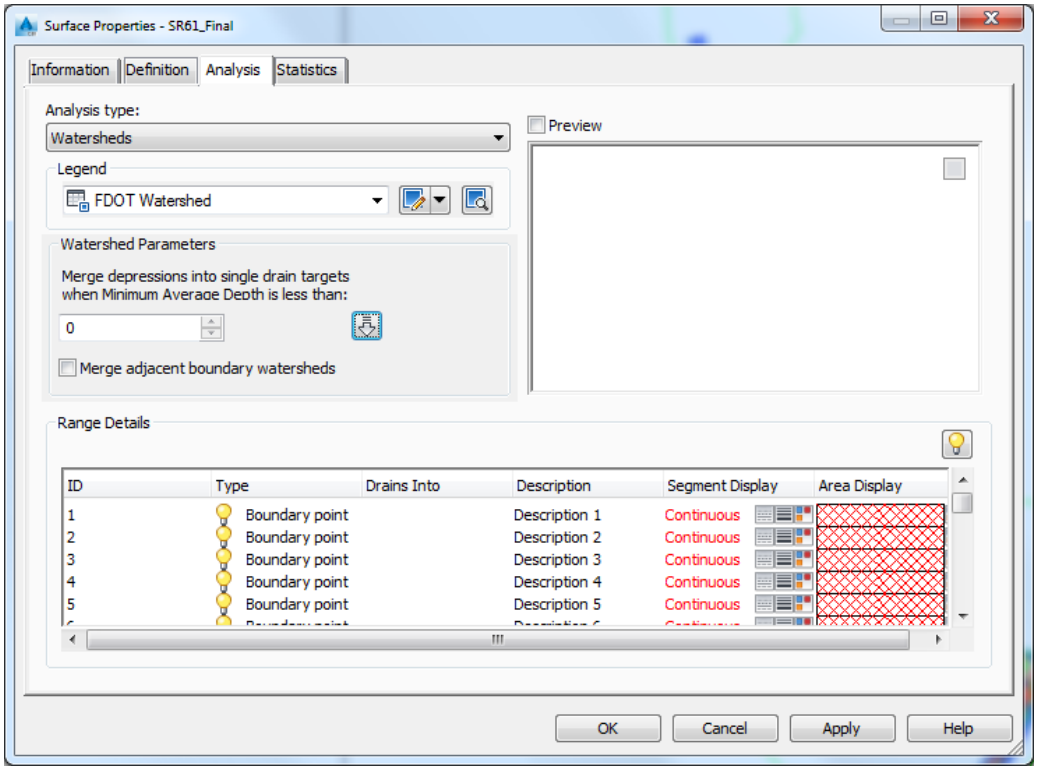
The next steps will show you how to repeat the Analysis process to run a Watersheds analysis.



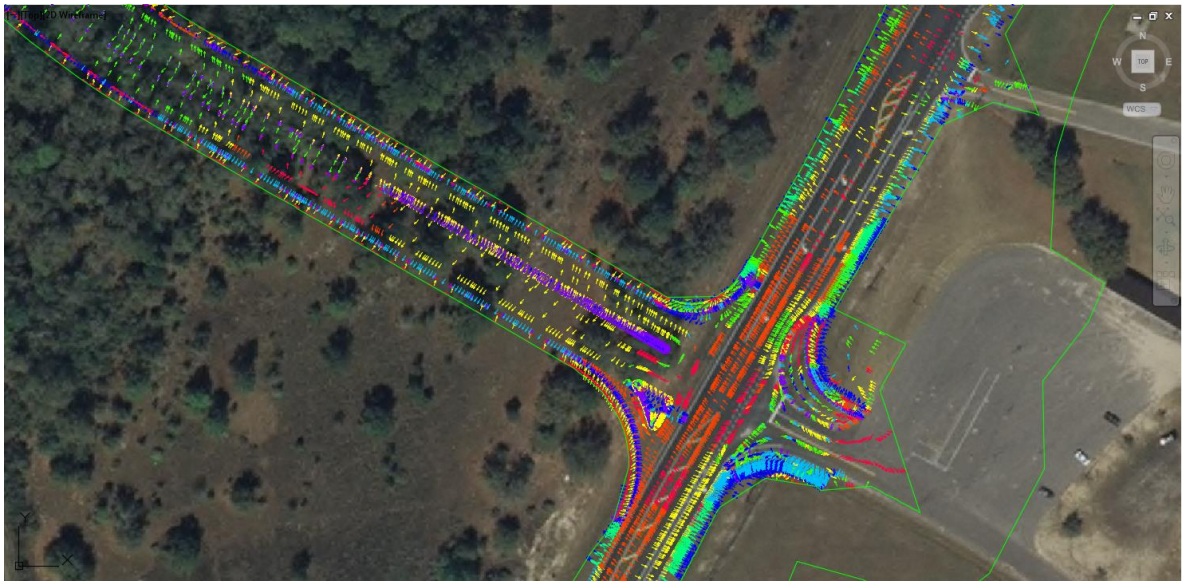
1. From the Surface Properties – SR61_Final dialog, set the *Analysis type:* to **Watersheds** and *Legend* to **FDOT Watershed** from the drop down list.



2. Click the down **arrow** to *Run analysis*.



3. Review the Range Details at the bottom that are populated with *calculated values* from the surface.
4. Click the **Help** button at the bottom right to learn more about *Watershed types*.
5. Click **Apply** then **OK** to close the Surface Properties - SR61_Final dialog box.



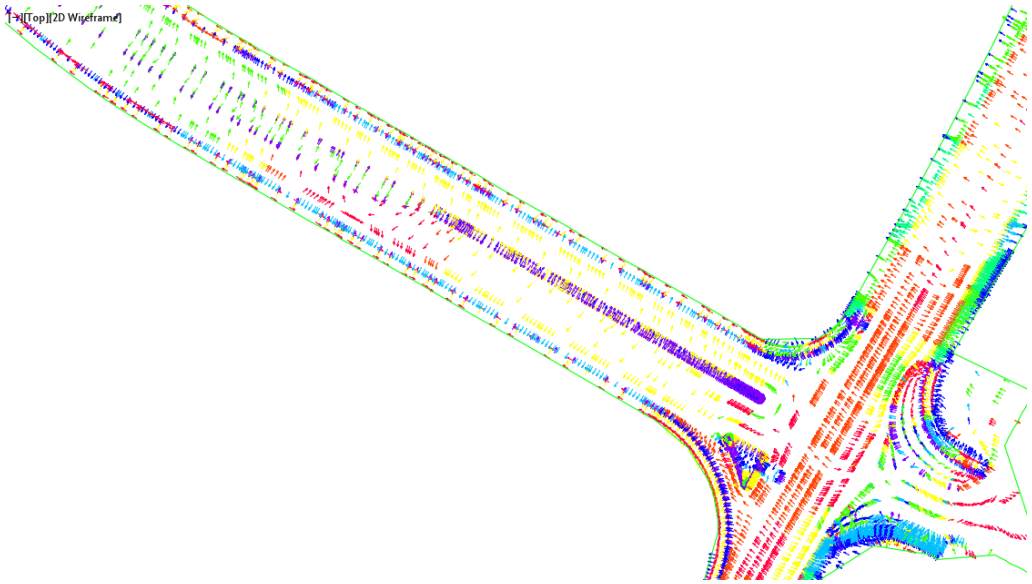
6. Review the surface SR61_Final display of the slope arrows and watershed boundaries in the drawing editor.

Exercise 4.3 XREF'S Files

➢ *Unload Attached Xrefs From DRMPRD01*

The next steps will show you how to Unload attached Xrefs from the DRMPRD01.dwg.

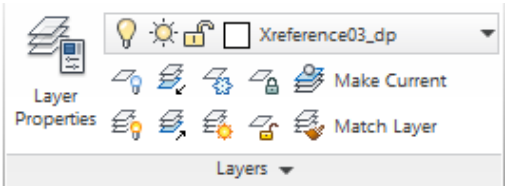
1. On the *command line* Type **Xref** to open Xref Manager.
2. In the list, right-click on **5136L-08** and select **Unload**. By unloading the external reference 5136-08 the drawing editor no longer displays the 5136-08.sid aerial image.



3. **Save** your file before continuing.

➢ *Attach DSGNRD01 as Xref*

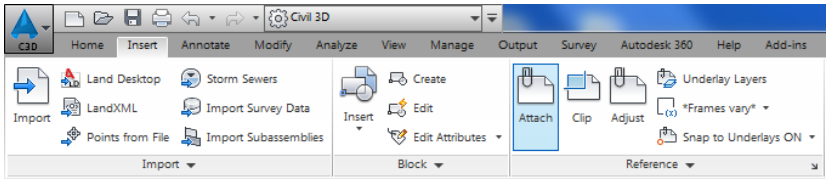
The next steps will show you how to attach the DSGNRD01.dwg as an Xref file so it displays in your file at the correct coordinates.



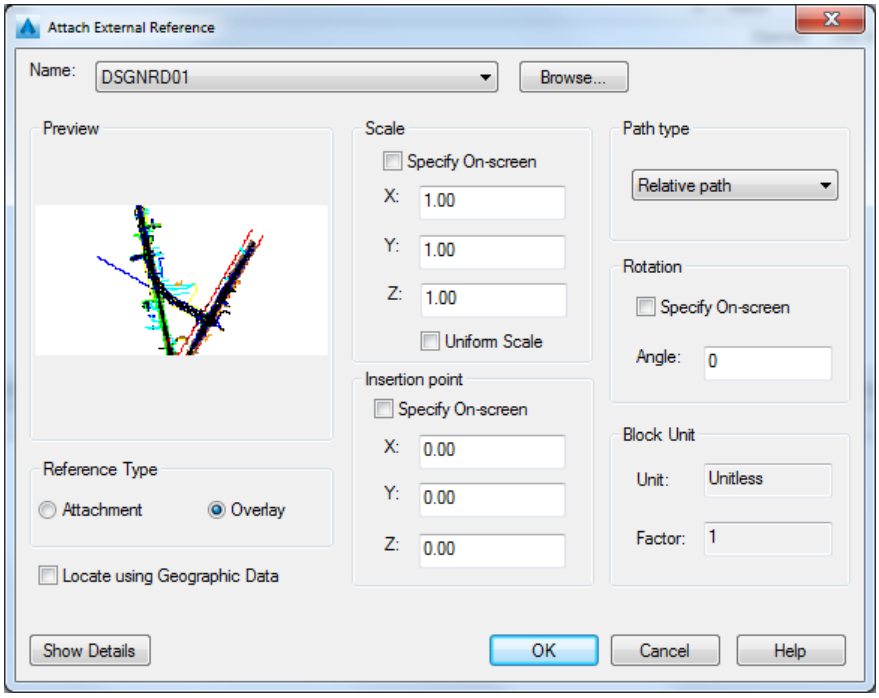
1. From the *Home tab on the Ribbon* > *Layers Properties panel* > Layer *list drop down list*, use the **scroll bar** <OR> Type the letter **X** to quickly scroll and select **Xreference03_dp** *layer* within the list of Layer Names.

Note Keep your cursor on the list or it will disappear and you must start the process over.

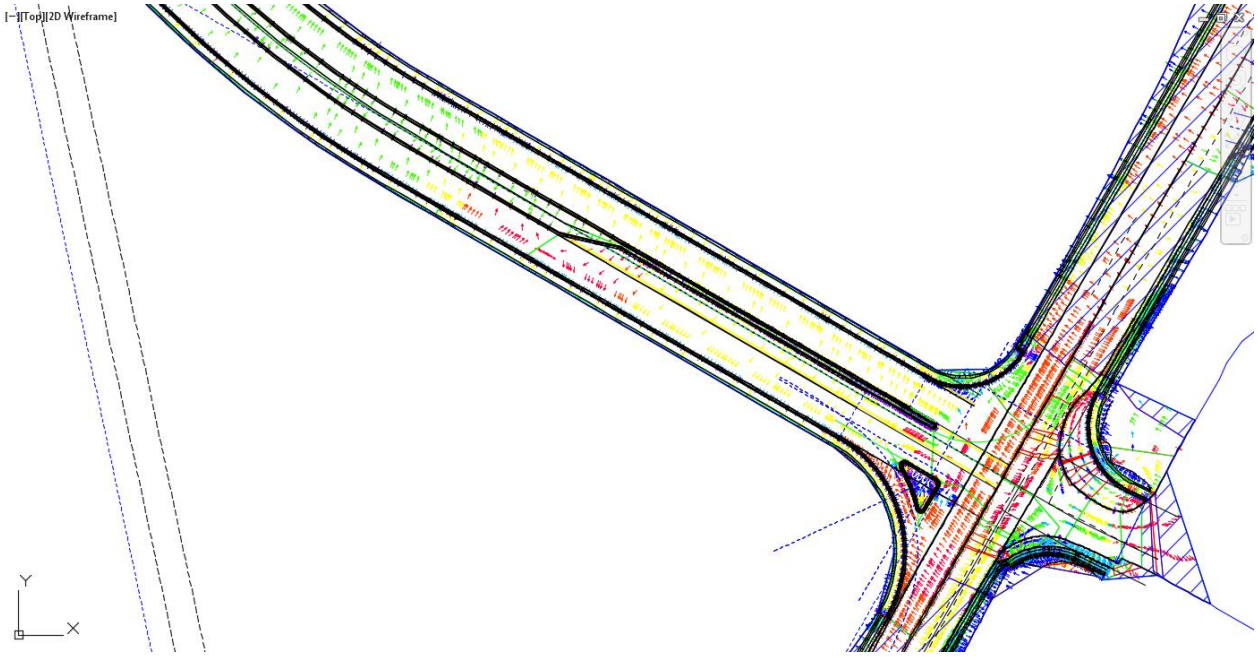
2. From the *Insert tab* > *Reference panel*, click **Attach** to open the Select Reference File dialog box.



3. From Select Reference File dialog box, use the *Look in:* drop down list to navigate to the *C:\Civil 3D Projects\22049555201\roadway* folder and select **DSGNRD01.dwg** in the *Name* column.
4. Click **Open** to close the Select Reference File dialog box and the Attach External Reference dialog box displays.



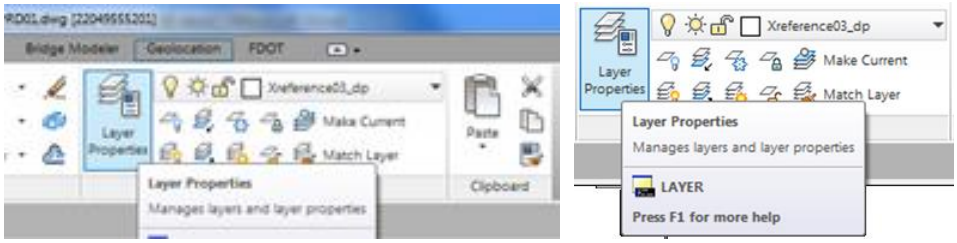
5. From the Attach External Reference dialog box, clear all **check boxes** if any are checked.
6. Set the *Reference Type* to **Overlay** using the radio button and click **OK** to close the Attach External Reference dialog box.



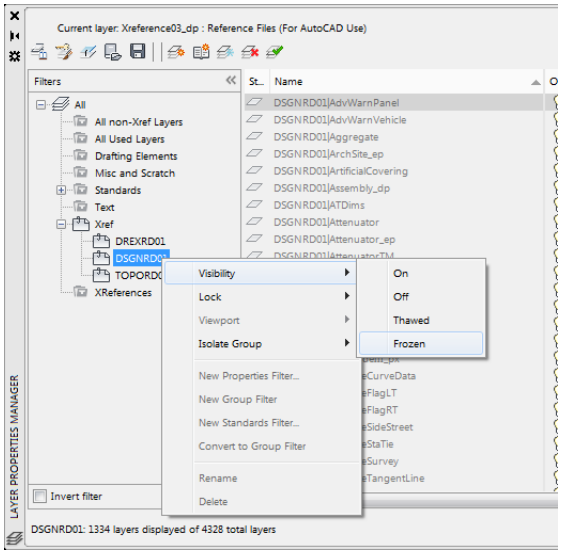
7. Review the external reference *DSGNRD01.dwg* file that displays in the drawing editor.

➢ *Freeze layers in the Xref*

1. **Freeze** any layers in the Xref that are obscuring your view of the pavement layers you wish to display from this file.

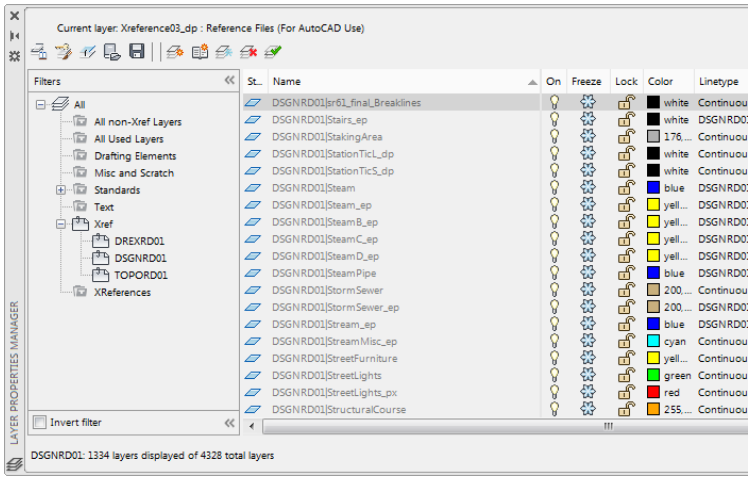


2. From the *Home tab* > *Layers panel*, click the **Layer Properties** button.



3. In the *Filters area* expand the **Xref** collection by clicking the plus sign, right-click on **DSGNRD01** and hover over *Visibility*, then select **Frozen**.

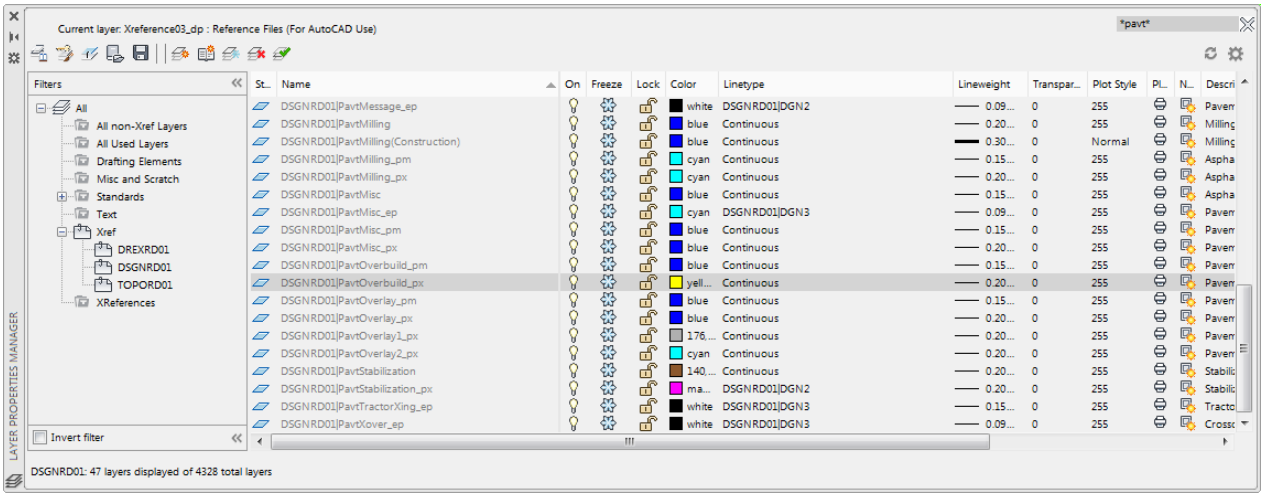
Note There are no Apply or OK buttons. Changes take effect as soon as they are selected.



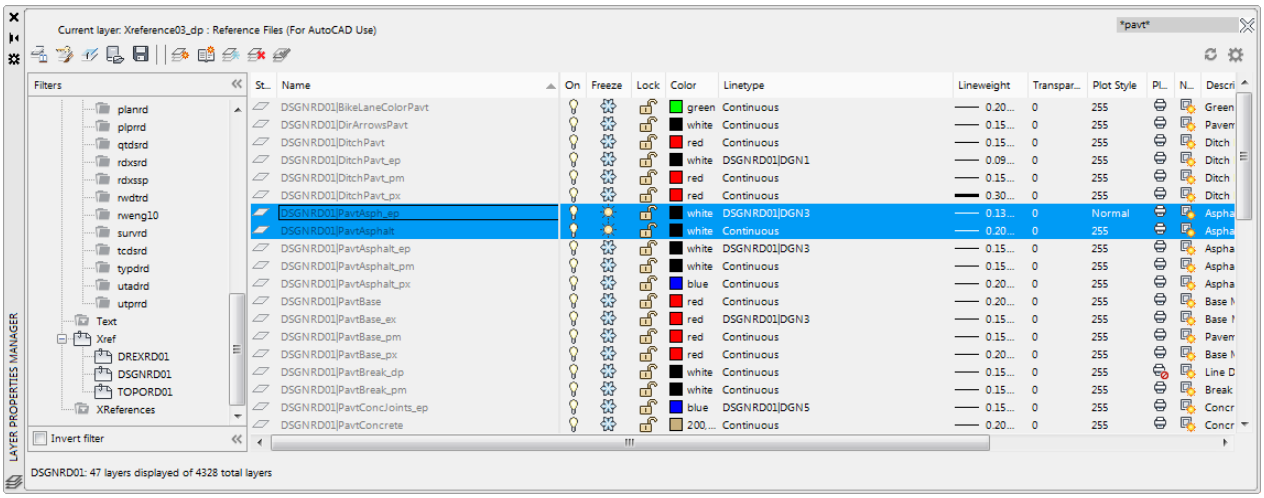
4. Notice that the Layer Properties Manager tool palette shows all the *Light Bulb* icons in the *Freeze* column are set to **Frozen**.

5. While DSGNRD01 is still highlighted in the *Filters area*, use the *Search* field in the upper right to display only layers containing "**pavt**" by typing *pavt* in the field.

HINT The * character is a wildcard.

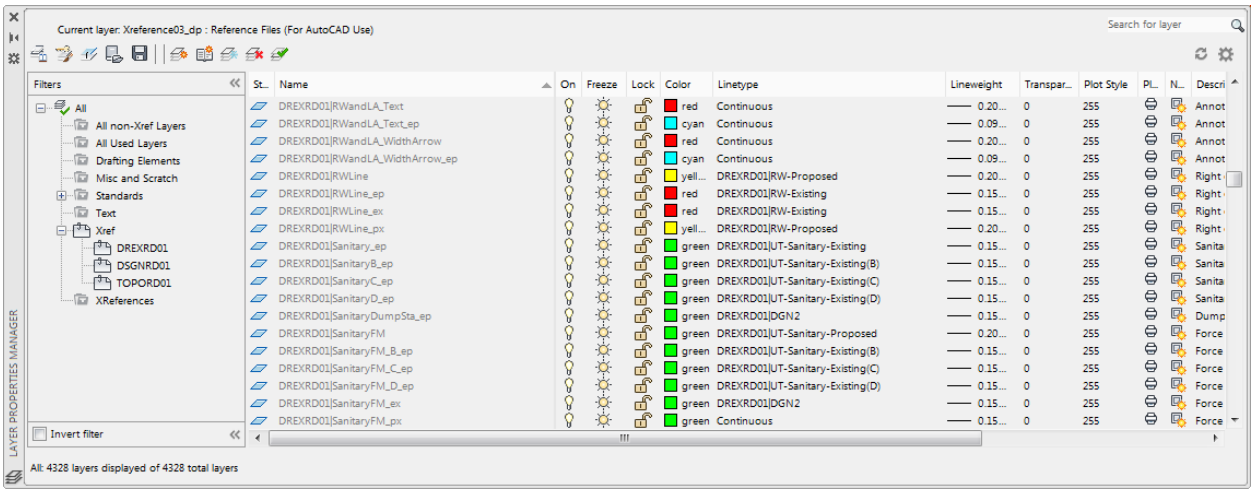


6. Notice the bottom left indicates how many layers are being displayed of the total number of layers: DSGNRD01: 47 layers displayed of 4328 total layers.

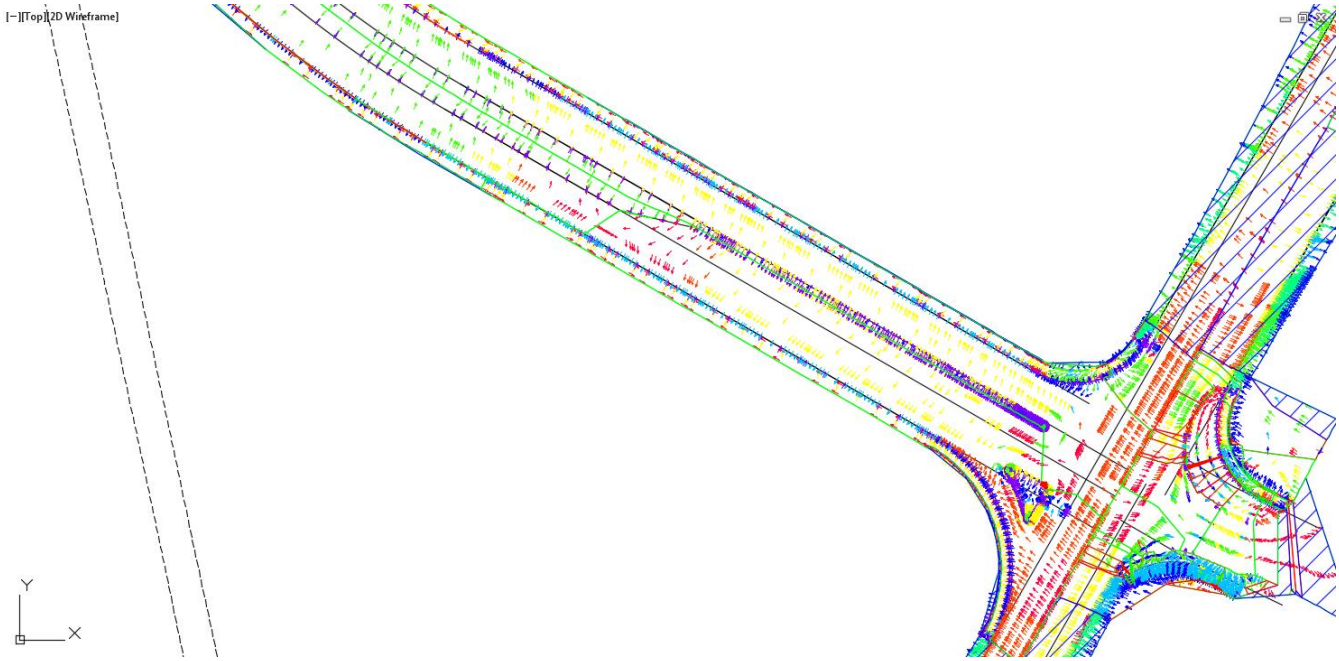


7. Highlight both the **DSGNRD01|PavtAsph_ep** and **DSGNRD01|PavtAsphalt** *layers*, then click the **Snowflake** icon to *toggle* it to a **Sunshine** icon.

Note This action is referred to as “thawing the layer”. Thawing the layer changes the not visible status to visible.



8. In the *Filters area* scroll up the list, click on **All** to display all *layers*.
9. Click the **X** at the top of the panel title to close the *Layer Properties Manager* tool palette.

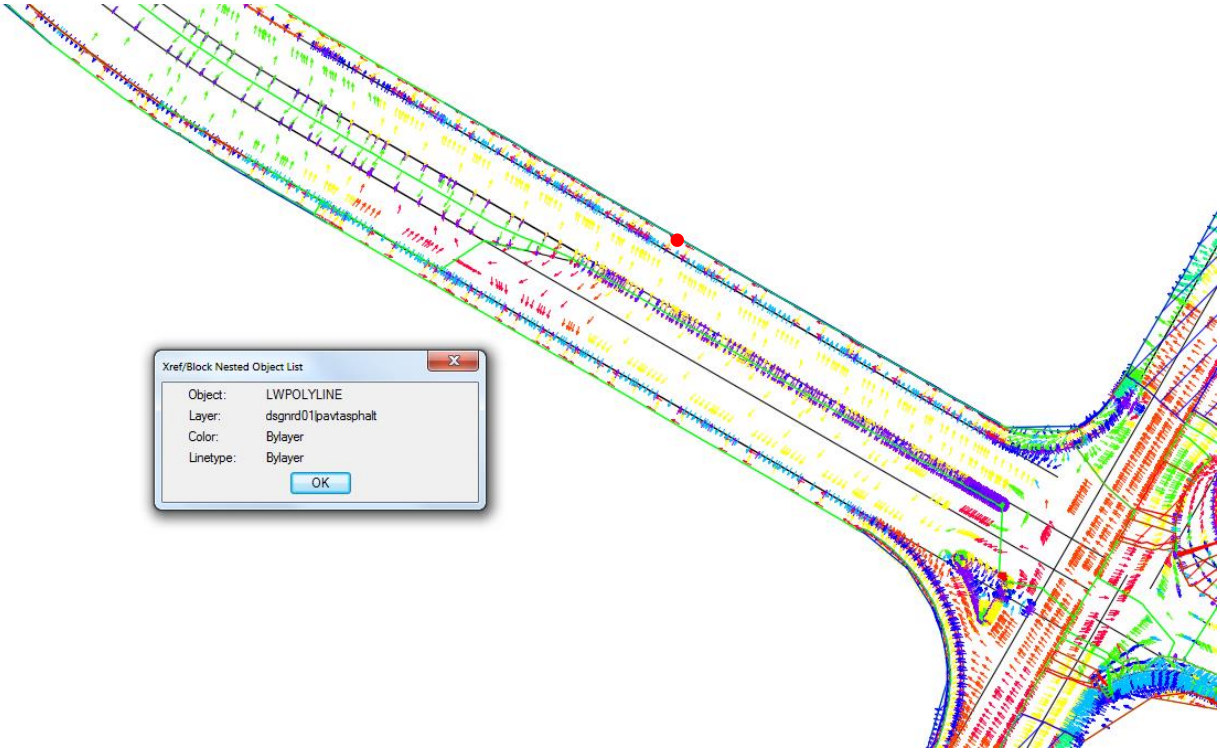


10. Note in the *Model* space, the thawed pavement *layers* **DSGNRD01|PavtAsph_ep** and **DSGNRD01|PavtAsphalt** from the DSGNRD01 Xref are displayed.

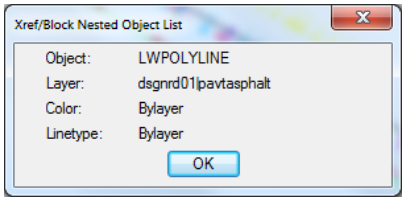
Exercise 4.4 Using the Xlist Command

The next steps will show you how to use the Xlist command. The Xlist command allows you to list objects that are in Xref files, such as layers, colors, line types, etc.

1. On the *command line*, type **XLIST**, select **ENTER**, then **data point** on the pavement line as shown below by the red circle.



2. The Xref/Block Nested Object List dialog box is displays. Notice the *Object* and *Layer* are listed within this dialog box.



   - *LWPOLYLINE* indicates a **Polyline** is displayed.
   - *Layer: dsgnrd01|pavtasphalt* is the *Xref layer name* prefixed with the *Xref file name* separated by a vertical bar.

3. Click **OK** to close the Xref/Block Nested Object List dialog box.

4. **Save** the *DRMPRD01.dwg* file before continuing.

Exercise 4.5 Define Catchments Using Surface & Water Drop

The next steps will show you how to define catchments conceptually using a Surface and the Water Drop command.

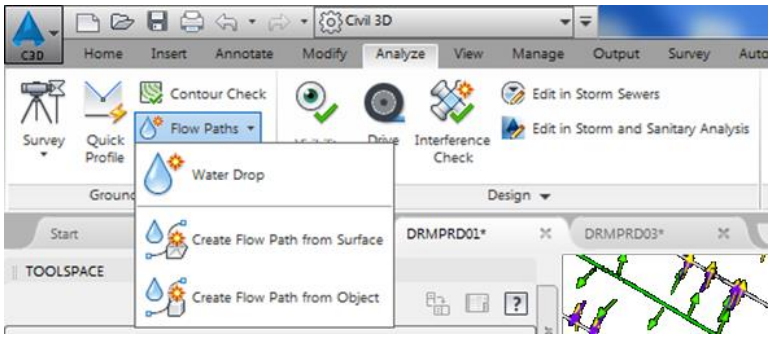
The Watershed Analysis displays the same boundaries you make with the Define Catchments from Surface command. It is a good starting point for delineating sub-basins which you will define later by creating polylines then use those polylines to create Catchments that will be assigned to inlets.

Use the Water Drop command to draw polylines. The polyline defines the path water takes as it goes from triangle to triangle along the surface. This command draws a 3D polyline from the high point you click to the corresponding low point on the surface. The opposite end of the polyline may be a good location for an inlet.

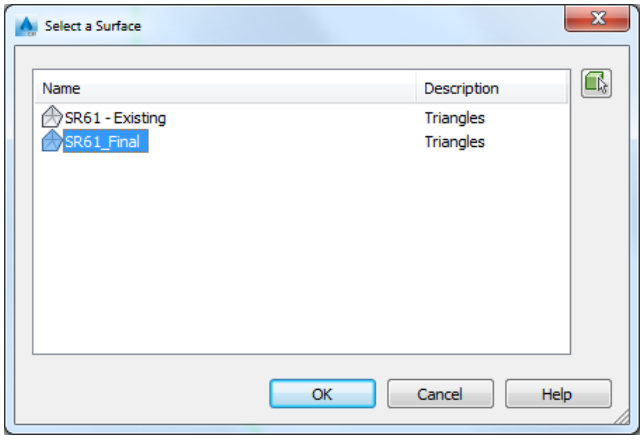
HINT We use a 2D Polyline as the Path Object Type, because 3D polylines do not display linetypes.

➢ *Perform Water Drop*

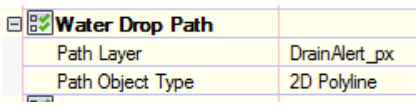
The next steps will show how to use the Water Drop command.



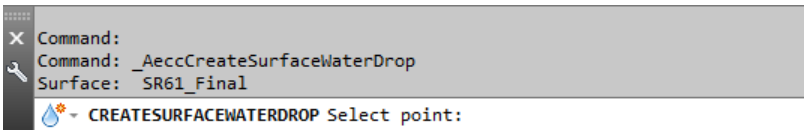
1. From the *Analyze tab* > *Ground Data panel* > *Flow Paths* drop down, select the **Water Drop** command. Press Enter to select a surface from a dialog box.



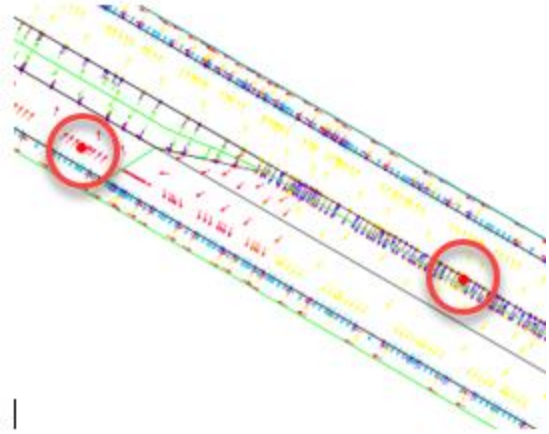
2. From the Select a Surface dialog box, select **SR61_Final**, then click **OK** to close the Select a Surface dialog box.



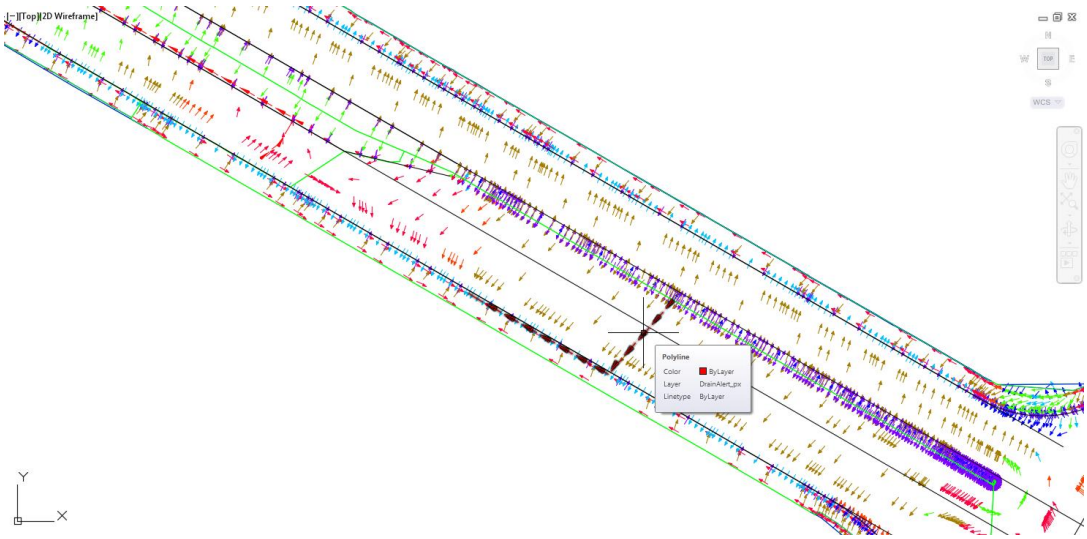
3. The Water Drop dialog displays. Make sure the *Path Layer value* is set to **DrainAlert_px**.
4. The *Path Layer* is now set to **DrainAlert_px**. Click **OK** to close the Water Drop dialog box.



5. Notice the *command line* prompts you for the next action to take: *Select point:*



6. **Data Point** on the *pavement* near the south side of the median as shown by the red circle above. The *Water Drop* command will draw a polyline from the Point you set in a direction downslope until it reaches a low point.
7. **Data Point** on the *outside of the edge pavement* as shown by red circle above, then click **ENTER** to end command.



8. Hover over the polyline to display the **tooltip** showing the *Object Name (Polyline)*, *Color*, *Layer* and *Linetype* properties.

Note In practice you would use the *Water Drop* command to create Polylines in the areas of investigation where you wish to place drainage inlet structures.

9. **Save** and **Close** the *DRMPRD01.dwg* file.

5 SURFACE ANALYSIS FOR INLET PLACEMENT

DESCRIPTION

In this chapter, you will mark the location of low areas in a closed drainage system with circles. You will learn how to recognize high and low areas with the help of surface styles then apply best practices for choosing possible inlet placement. The marked locations are a preliminary step in choosing inlet placements and serve as a guide when laying out a pipe network using Civil 3D. Marking locations with circles is a simplified and quick way to visually indicate better choices for inlet placement without getting distracted by the steps required in pipe network creation.

OBJECTIVES

In this chapter, you will learn about:

- Applying Common Sense Rules of Thumb
- A Technique Offering Speed and Flexibility for Inlet Placement

CHAPTER SETUP

Run the Chapter 5 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

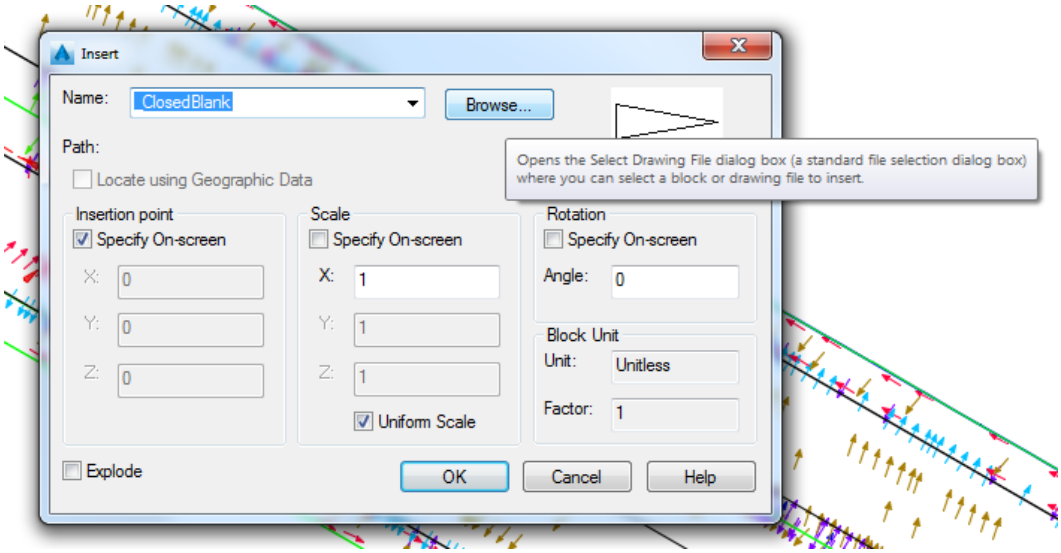
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 5.1 Insert the Water Drop.dwg File

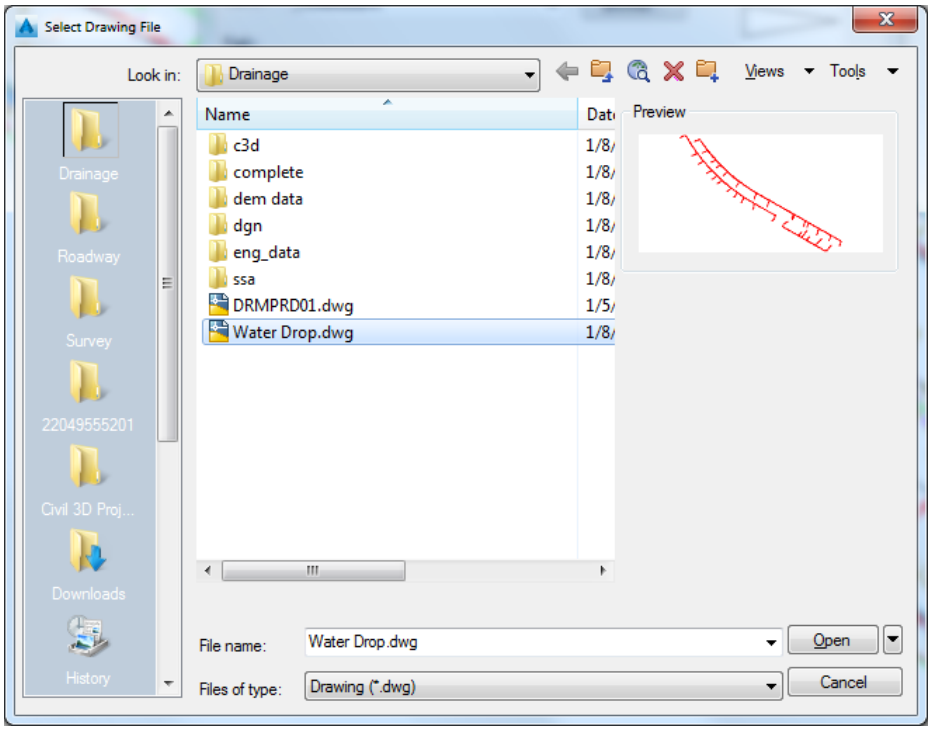
The next steps will show you how to insert Water Drop.dwg file using the Insert command and change the current layer to DrainMisc.

In Chapter 4 you used the Water Drop command to create Polylines in the areas of investigation where you want to place drainage inlet structures. A file named Water Drop.dwg has been created for you. The Water Drop.dwg contains the completed Water Drop polylines from Chapter 4 which will be used for the Inlet Placement Technique's used in Chapter 5.

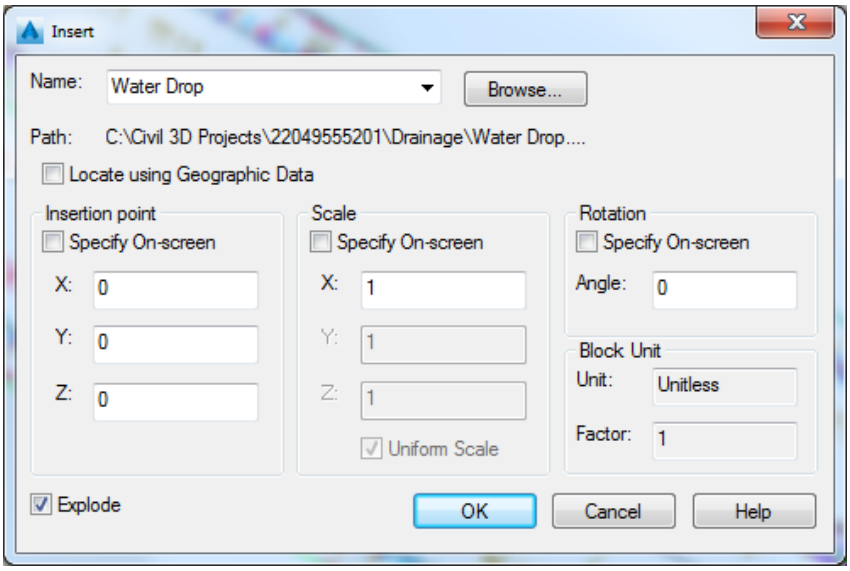
1. Start the FDOT Civil 3D State Kit and from the Select File dialog box, navigate to the C:\Civil 3D Projects\22049555201\Drainage folder and open the **DRMPRD01.dwg** file.



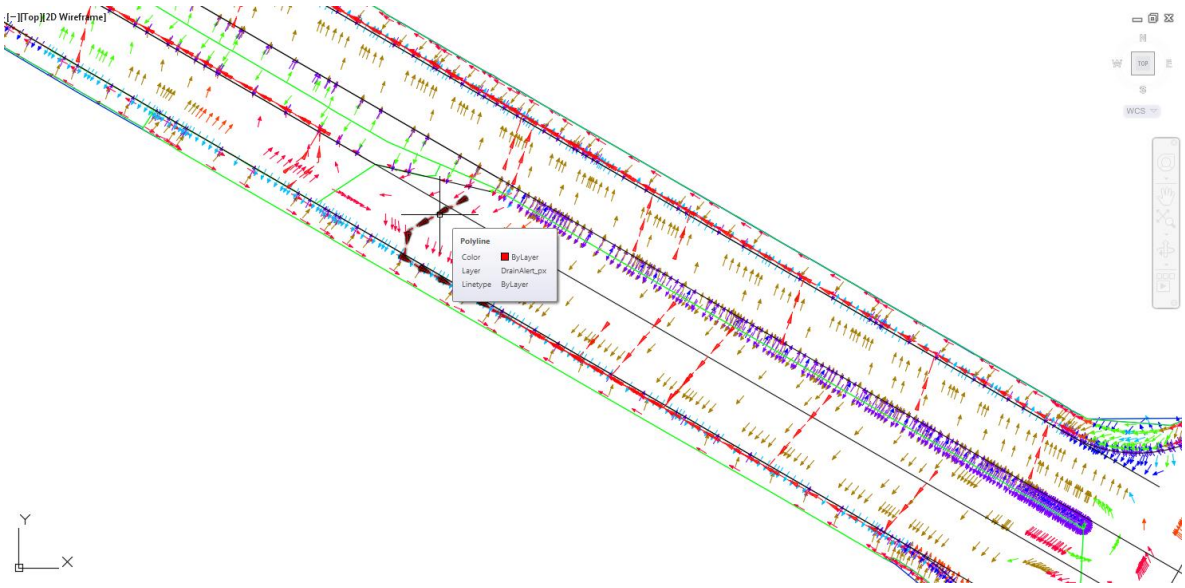
2. On the *command line* Type **I** for Insert to open the Insert dialog box as shown above. Click **Browse**.



3. From the Select Drawing File dialog box navigate to the *Drainage* folder and select **Water Drop.dwg.** Click **Open** to close the Select Drawing File dialog box.



4. From the Insert dialog box, **Uncheck** *Insertion Point, Scale*, and *Rotation* boxes, then **Check** *Explode* box.
5. Click **OK** to close the Insert dialog box.
6. Set the current layer to **DrainMisc**, by typing DrainMisc on the command line or setting it using the Layer Properties dialog.



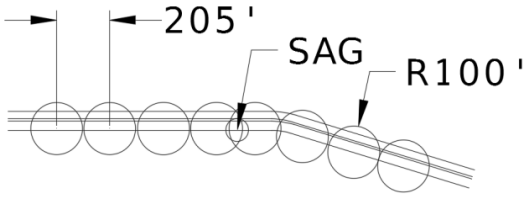
7. Review the results of inserting the *Water Drop.dwg* file into the *DRMPRD01.dwg* file.

Exercise 5.2 *Mark Locations of Proposed Drainage Inlet Structures*

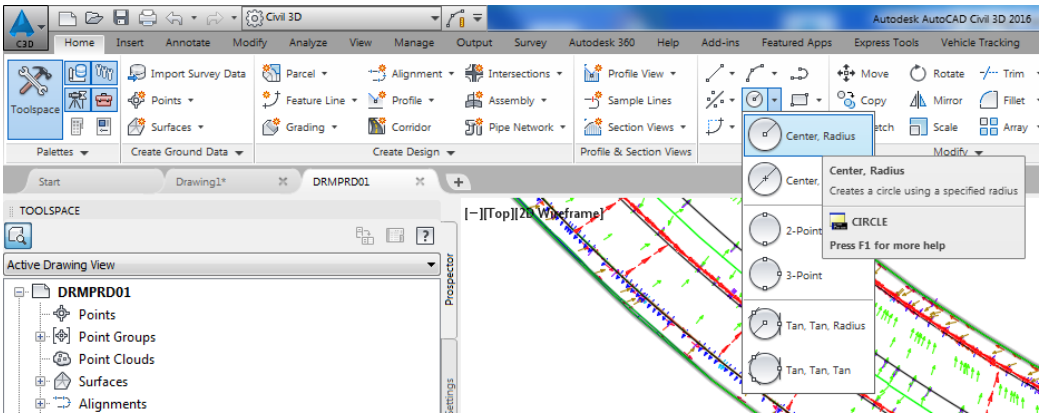
In this process, you will mark the locations of proposed drainage inlet structures using circles. This is a suggested procedure, not a requirement.

Guidelines for Inlet Placement

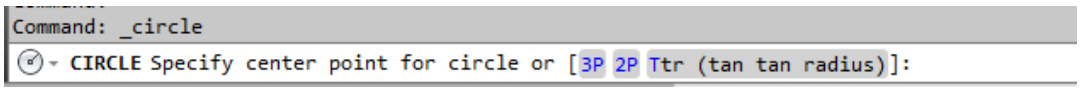
Low points in the gutter
Upstream of pedestrian cross walks
Upstream of curb returns
Prior to the flat point of superelevation transitions
Outside of driveway turnout
Where needed to limit spread



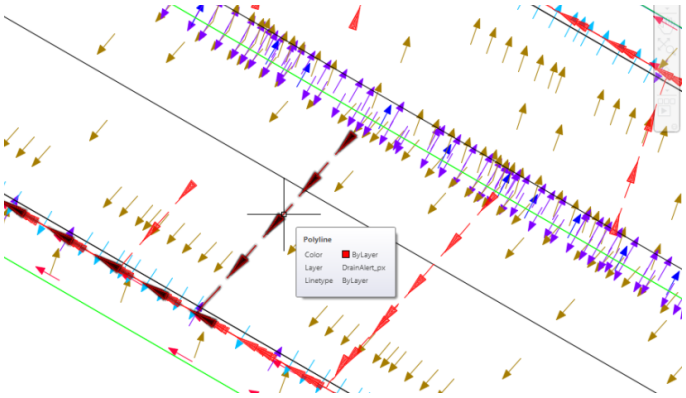
Note The diameter of the circles you use can help you graphically click the inlet placement at a desired separation between structures. The circles are simply guides to provide a sense of scale as you click inlet locations.



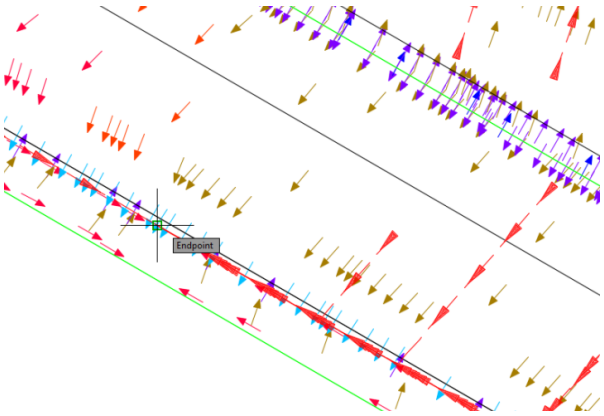
1. From the *Home tab* > *Draw* panel > *Circle command* drop down list, select **Center, Radius**.



2. On the *command line* you are instructed to: *Specify center point for circle.*



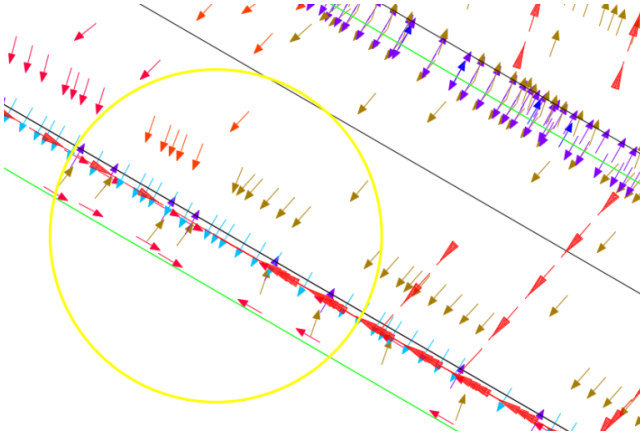
3. Hover over a **polyline** on the **DrainAlert_px** layer (Created in a previous step.) to highlight it. Notice where the *downstream end* of the polyline is located.



4. Hover over the *end of the polyline* and the Endpoint tooltip displays. Left-click to place the center of the circle at the **endpoint** of the polyline.

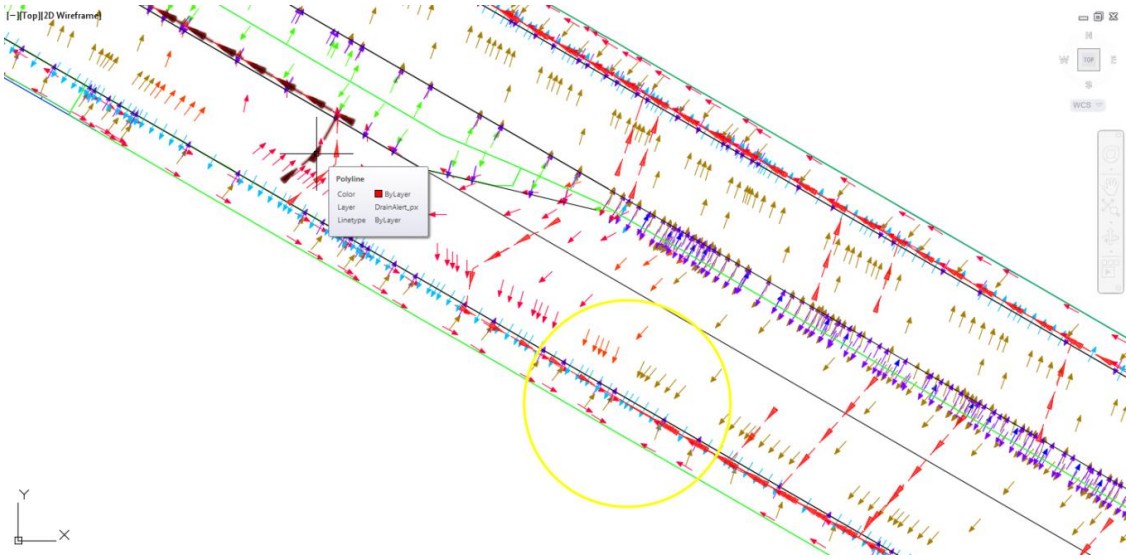
```
CIRCLE
Specify center point for circle or [3P/2P/Ttr (tan tan radius)]:
CIRCLE Specify radius of circle or [Diameter]: 30
```

5. The *command line* now prompts you to: *Specify radius of circle*. Type **30** and press **ENTER**.

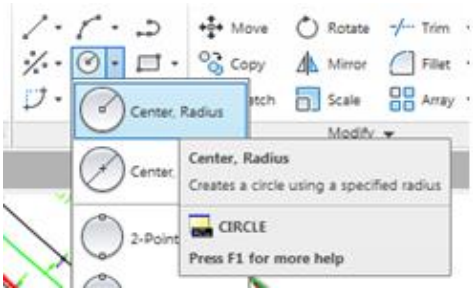


6. Observe a **Sag Inlet** *condition* where the flow direction arrows are pointing towards each other. This indicates a low point in the terrain model where water will accumulate.

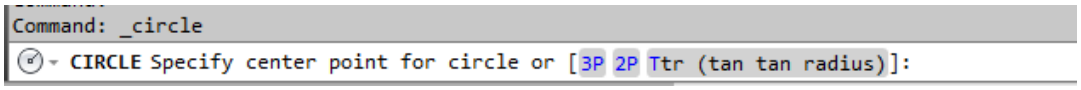
7. **Draw** a *circle* with the center at the sag location on the pavement with a *radius* of **30**. The larger circles will help you quickly identify *sag conditions* –vs- *on grade shallow flow*.
8. Place another **Inlet** *location* of a proposed drainage inlet structures using a circle.



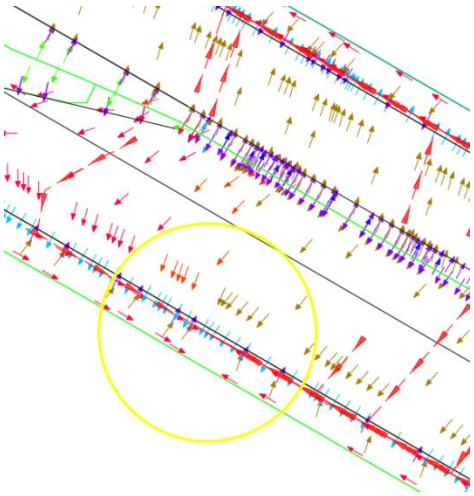
9. The green lines are Watershed Area boundaries. Notice the flow direction arrows are pointing toward the median on one side of the green line and away from the median on the other side. This represents the flat area of a transition on a super elevated road.



10. From the *Home tab* > *Draw* panel > *Circle command* drop down list, select **Center, Radius**.



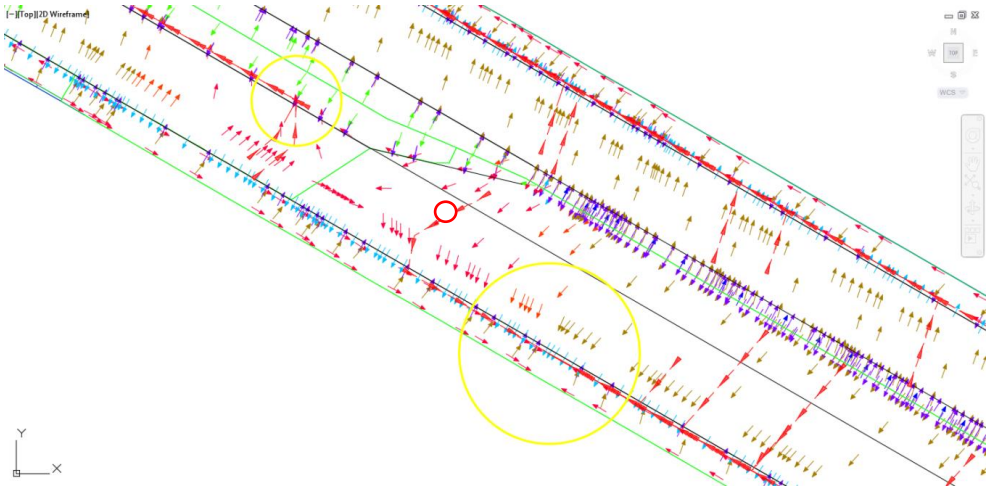
11. Specify *center point* for circle at the **edge of pavement** at the median.



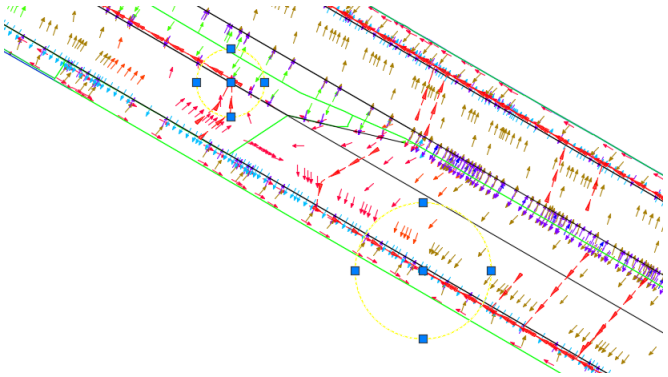
12. Select the **edge of pavement** along the *flow direction polyline*.

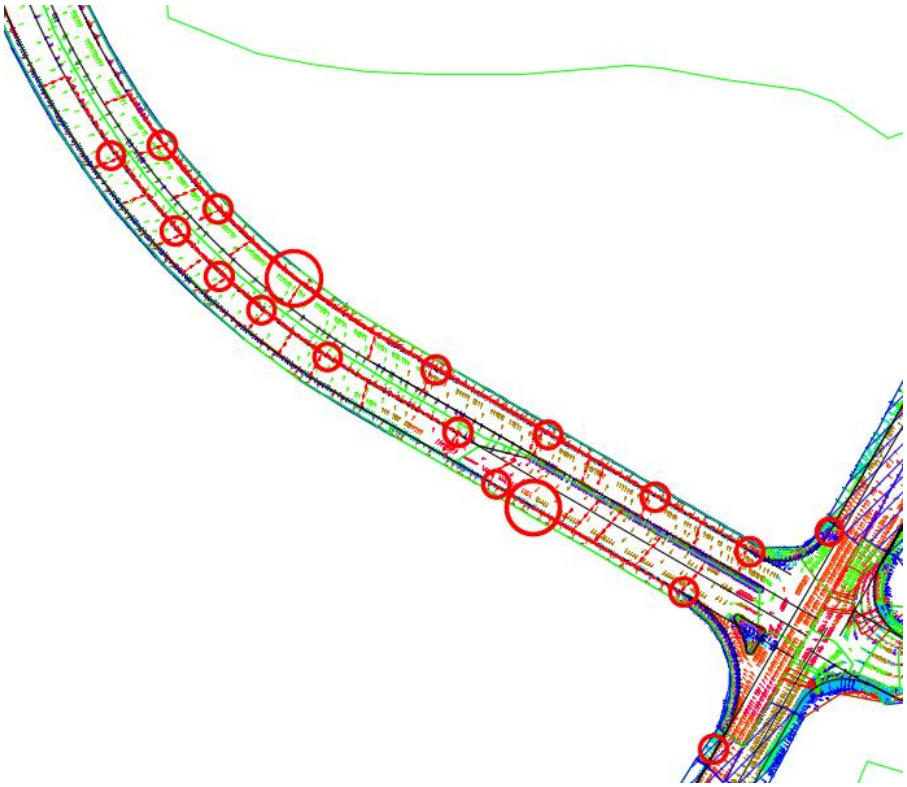
```
Command: C CIRCLE
Specify center point for circle or [3P/2P/Ttr (tan tan radius)]:
CIRCLE Specify radius of circle or [Diameter] <30.0000>: 15
```

13. On the *command line*, Type **15** for the *radius* and press **ENTER**.



14. Before moving on to the next process, click on the two Inlet placement circles created in the previous step, then press DELETE.





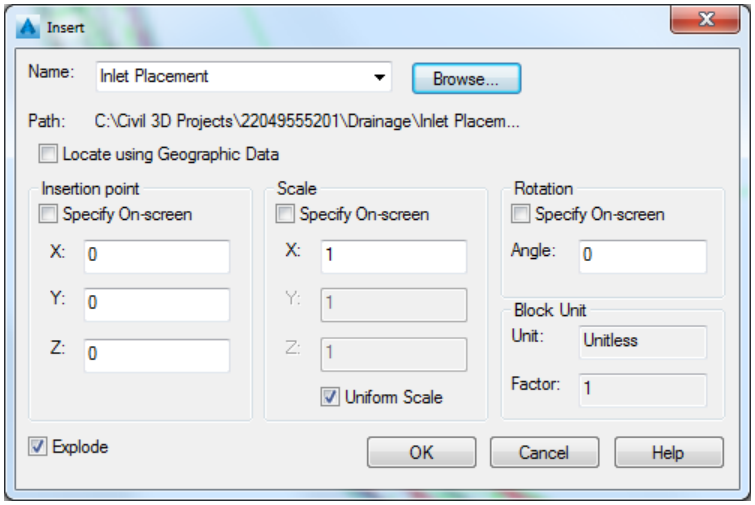
15. Review the sample displayed locations of circles representing the Inlet Placements as shown above by the red circles. In this example, the sag locations have larger radii. This example has been created for you and its use will be explained in the next process.

Exercise 5.3 Insert Inlet Placement.dwg

The next steps will show you how to insert the *Inlet Placement.dwg* file using Block Insert command.

A file named Inlet Placement.dwg has been created for you. The Inlet Placement.dwg contains the completed Inlet Placement circles. You'll use these Inlet Placement circles to aid in the placement of the Inlets using an AutoCAD Center Object Snap. This will help in making the chapter exercises results repeatable throughout the manual.

1. On the *command line*, Type **I** for insert. Browse to the file ***Inlet Placement.dwg*** located in the *Drainage* folder.



2. On the Insert dialog box, keep options the same as the image above and click **OK** to insert file and close dialog box.

3. **Zoom** and **Pan** to display the results of inserting the *Inlet Placement.dwg*.
4. **Save** and **Close** the *DRMPRD01.dwg* file.

6 LAYOUT PIPE NETWORK

DESCRIPTION

This chapter is where you create a pipe network using Civil 3D. Then place drainage structures using Structure Offset and Rotation Rule Set and connect pipes to the structures. Decisions about where to place the structures have been made in a previous chapter so you can focus on the details of the pipe network creation and layout processes.

OBJECTIVES

In this chapter, you will learn about:

- Creating a Proposed Drainage Structures Drawing File
- Apply Structure Offset and Rotation Rule to FDOT Structures Rule Set
- Creating a Pipe Network in Civil 3D
- Laying Out Structures
- Connecting Pipes to Structures

CHAPTER SETUP

Run the Chapter 6 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

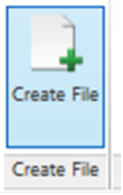
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

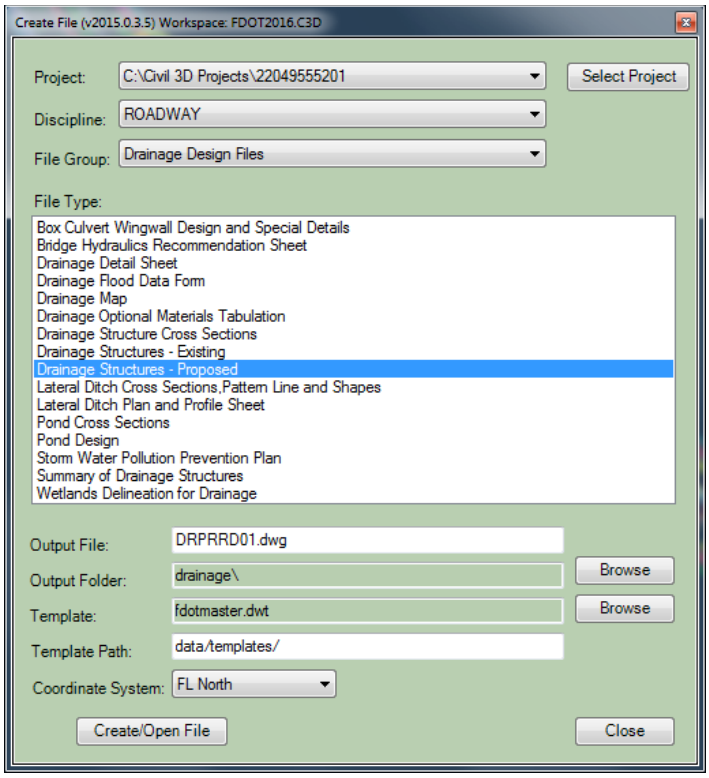
Exercise 6.1 Creating a Proposed Structures Drawing File

➢ *Create the DRPRRD01 File*

The next steps will show you how create the Proposed Drainage DRPRRD01.dwg project file.

1. Start the FDOT Civil 3D State Kit by clicking on the **FDOT Civil 3D** desktop icon.
2. On the FDOT Ribbon click the **Create File** icon to launch the application and create the *DRPRRD01.dwg* file.

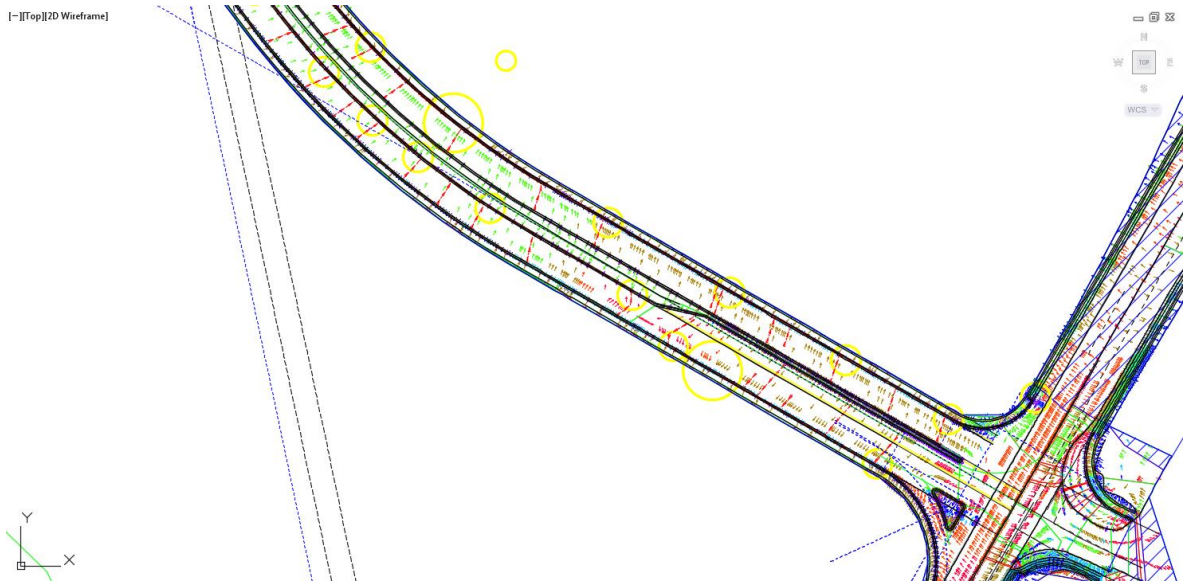




3. In the Create File dialog set the following:
   a. Set the *Project:* to **C:\Civil 3D Projects\22049555201**.
   b. Set the *Discipline:* to **ROADWAY**.
   c. Set the *File Group:* to **Drainage Design Files**.
   d. Set the *File Type*: to **Drainage Structures – Proposed**.
   e. Set the *Coordinate System:* to **FL North**.
4. Click the **Create/Open File** button. After the drawing opens in Civil 3D click the **Close** button to close the Create File dialog box.
5. Associate the DRPRRD01 drawing to the Project. Refer to Chapter 3 for the steps if you need a refresher.

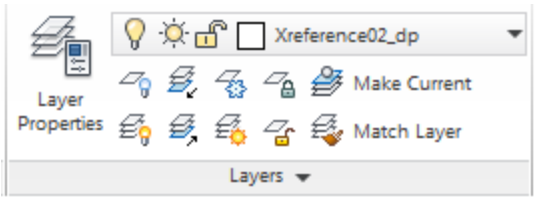
➢ *Attach External References Xrefs to the DRPRRD01 Drawing*

1. Set the current *Layer* to **Xreference01_DP** before continuing. You can set the Layer either through the *Layer Properties* <OR> type the Layer Name on the *command line*.
2. Using the same steps used in earlier exercises, insert the *DRMPRD01.dwg* file as an **Xreference**. Refer to Chapter 3 for the steps if you need a refresher.
3. Change *Layer* to **Xreference02_DP** and insert the *DSGNRD01.dwg* as an **Xreference**.

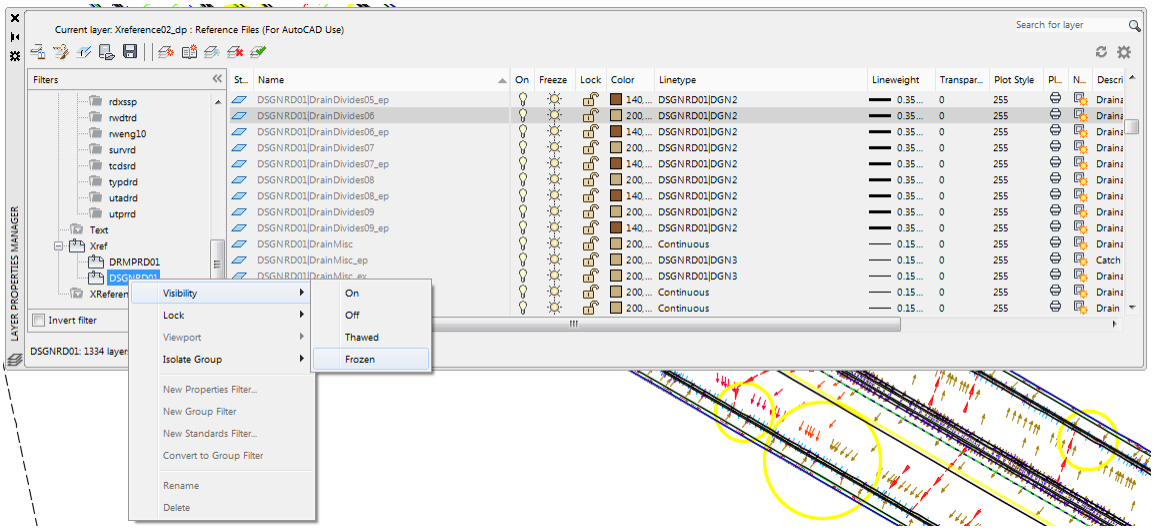


4. **Zoom** and **Pan** to display the attached *DSGNRD01.dwg.*

5. **Freeze** any *Layers* in the Xref that are obscuring your view of the pavement layers you wish to display from this file.

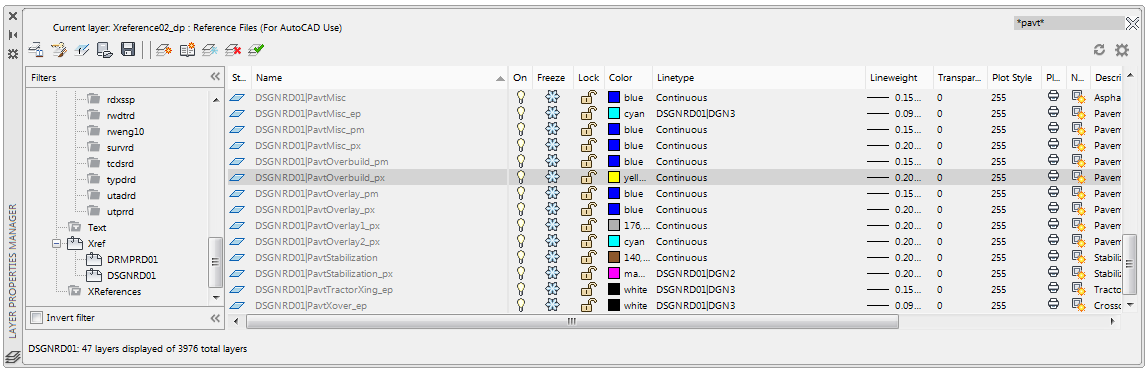


6. From the *Home tab > Layers panel*, click the **Layer Properties** button.



7. In the *Filters* area expand the **Xref** collection by clicking the plus sign, right click on **DSGNRD01,** hover over **Visibility**, then select **Frozen**.

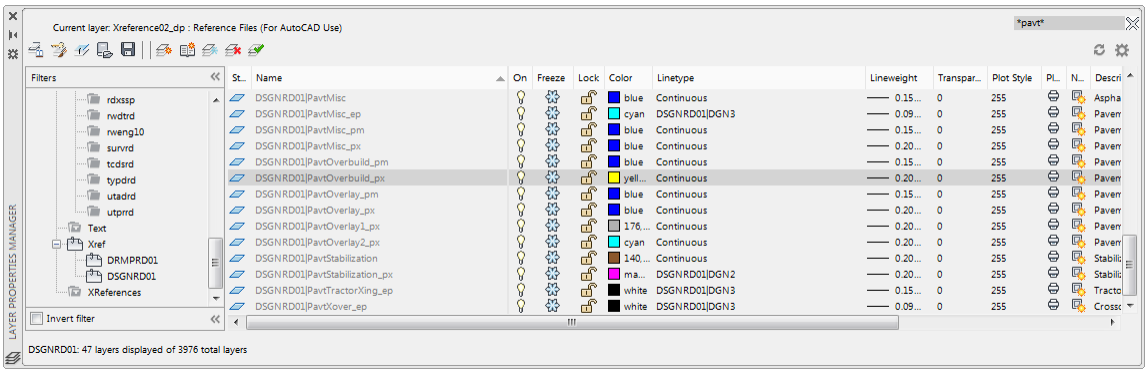
Note There are no Apply or OK buttons. Changes take effect as soon as they are selected.



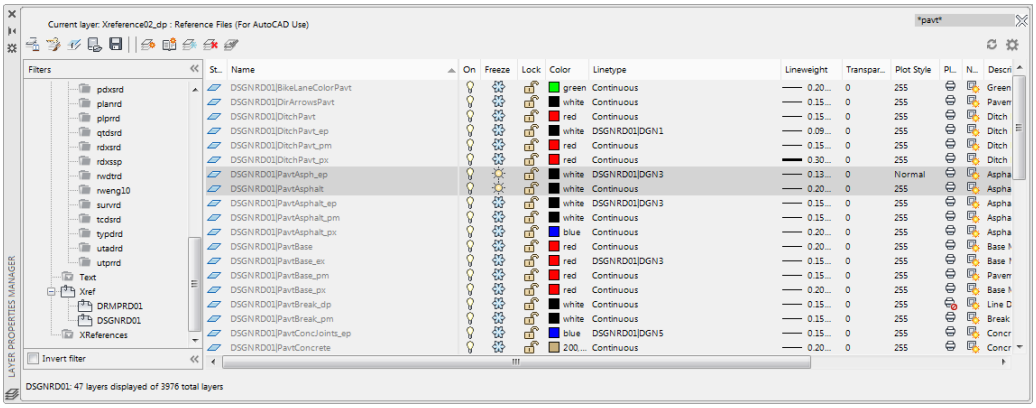
8. The Layer Properties Manager tool palette displays all the *Light Bulb* icons in the *Freeze column* are set to **Frozen**.

9. While *DSGNRD01* is still highlighted in the *Filters* area use the search field in the *upper right* to display only layers containing "**pavt**". Type *pavt* in the field.

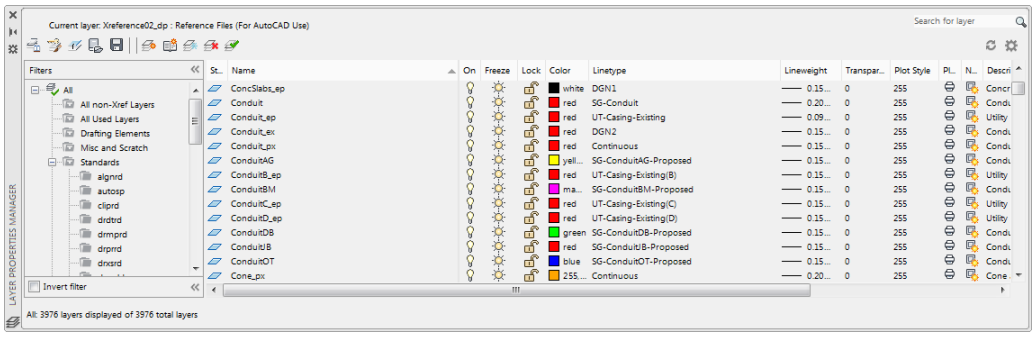
HINT The * character is a wildcard.



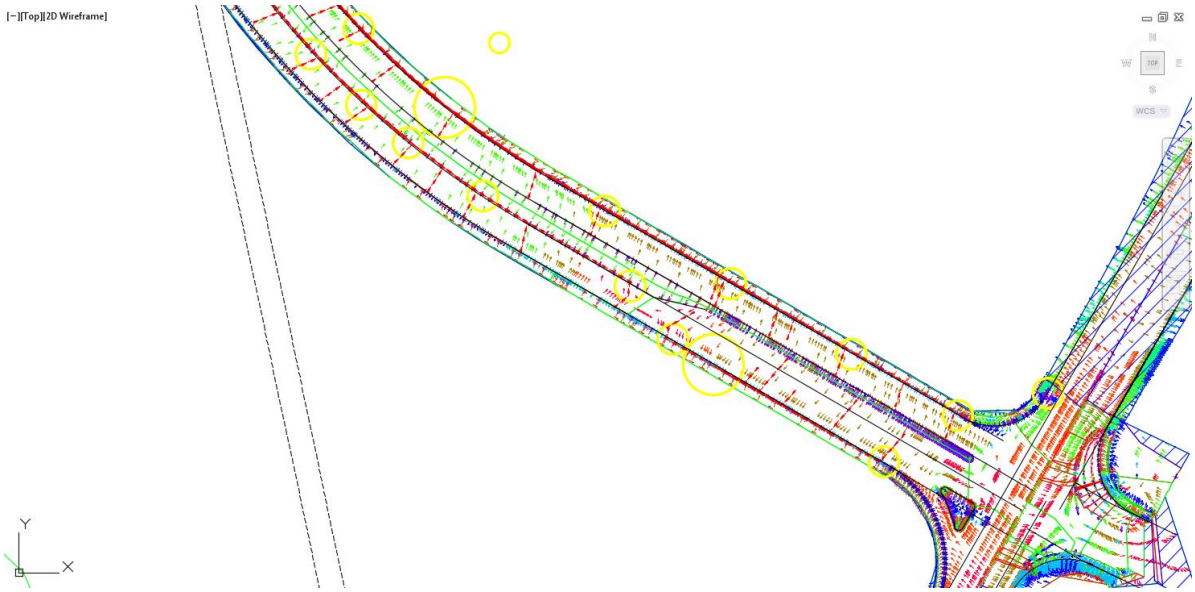
10. Notice the bottom left indicates how many layers are being displayed of the total number of layers: **DSGNRD01: 47 layers displayed of 3976 total layers**



11. Highlight both the **DSGNRD01|PavtAsph_ep** and **DSGNRD01|PavtAshpalt** *layers*, then click the **Snowflake** icon to *toggle* to a **Sunshine** icon. This action is referred to as "*thawing the layer*". Thawing the layer changes its status from **Not Visible** to **Visible**.



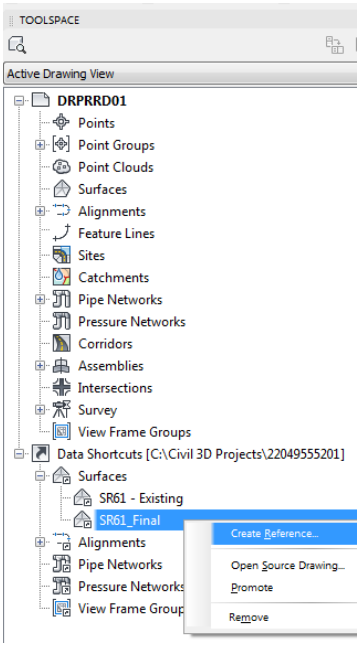
12. In the *Filters* area scroll up the list of filters, click **All** to display all the Layers.
13. Click the **X** at the top of the panel title to close the Layer Properties Manager tool palette.



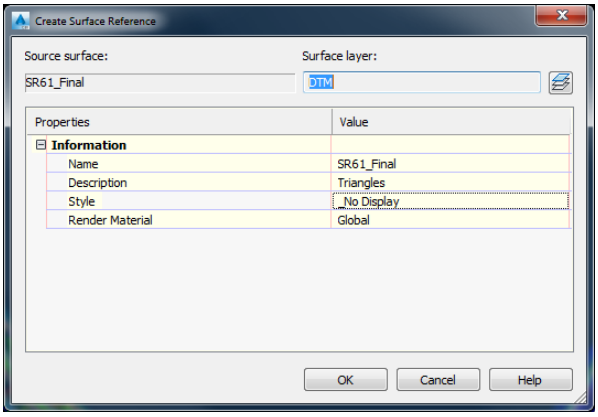
14. In Model Space the **Layers** from *DRMPRD01* and the **Thawed Pavement Layers** *DSGNRD01|PavtAsph_ep* and *DSGNRD01|PavtAshpalt* from *DSGNRD01 Xrefs* display.
15. **Save** the *DRPRRD01.dwg* file

Exercise 6.2 Create Data Reference to Surface SR61_Final Surface

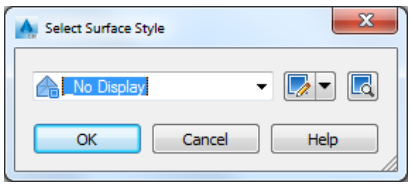
In the next steps create a Data Reference to the Surface SR61_Final Surface.



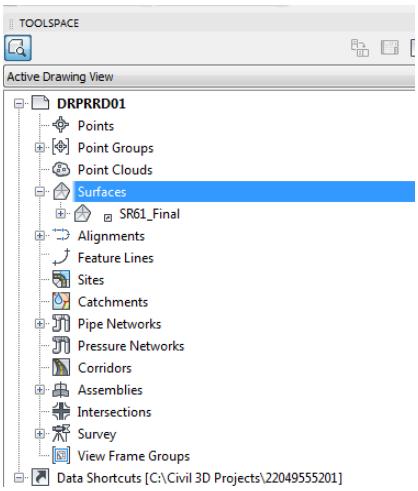
1. From *TOOLSPACE > Prospector tab > Data Shortcuts [C:\Civil 3D Projects\22049555201]*, expand **Surfaces**, right click on **SR61_Final**, and select **Create Reference.**



2. From the Create Surface Reference dialog box, under *Properties > Information*, select the **Style Value** column,

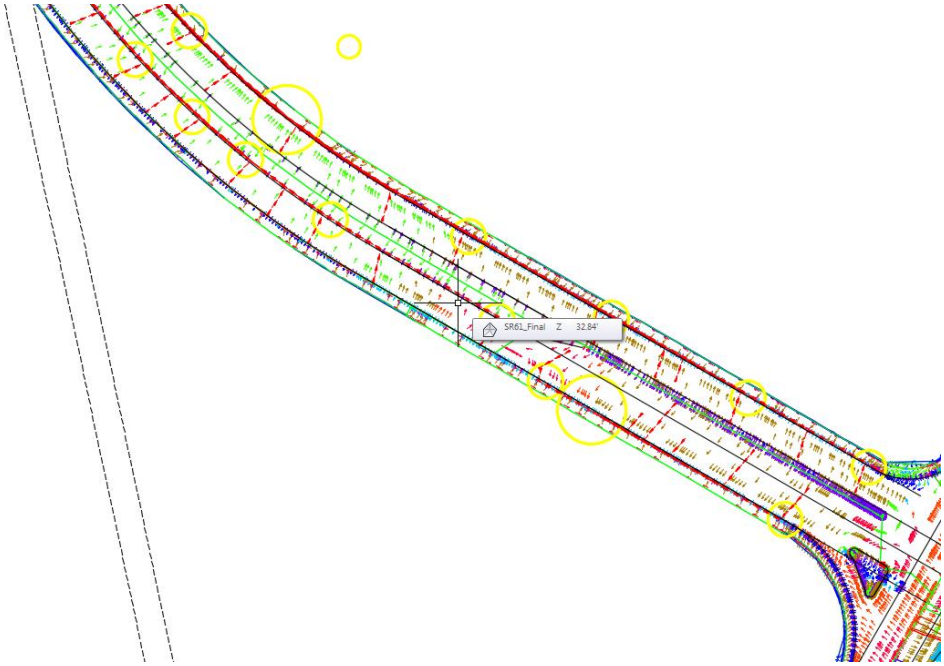


3. From the Select Surface Style dialog box, under the *Style drop down list*, select **_No Display**.
4. Click **OK** to close the Select Surface Style dialog box.
5. Click **OK** to close the Create Surface Reference dialog box.



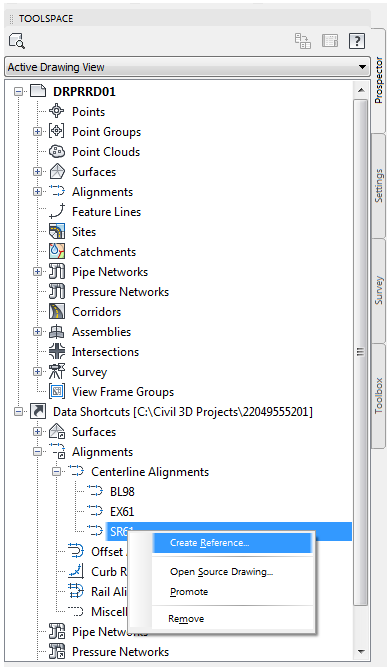
1. From the *TOOLSPACE > Prospector tab*, expand the **Surfaces** collection to confirm the **SR61_Final** *Surface* has been added as a reference surface.

HINT Reference objects are indicated by the ▣ symbol to the left of the object name.

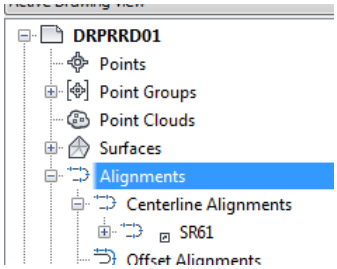


2. In Model Space hover your cursor in a blank area to display a tool tip showing the *Surface* N*ame* and *Elevation* where the cursor is located.

Exercise 6.3 Create Data Reference to Alignment SR61



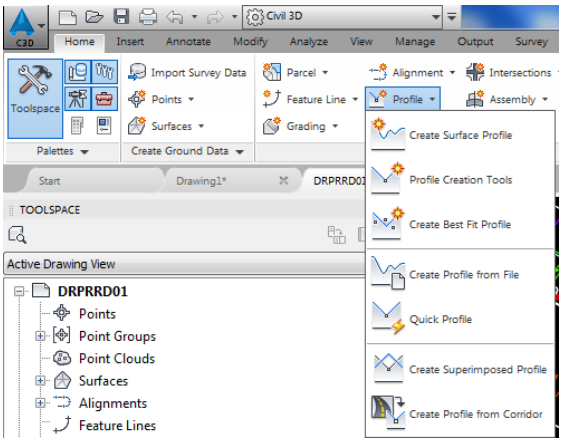
1. Using the steps just used, create a *Data Reference* to the **Alignment SR61.** Use the default settings in the dialog box and select **OK**.
2. The *SR61 alignment* is displayed with Station labels.



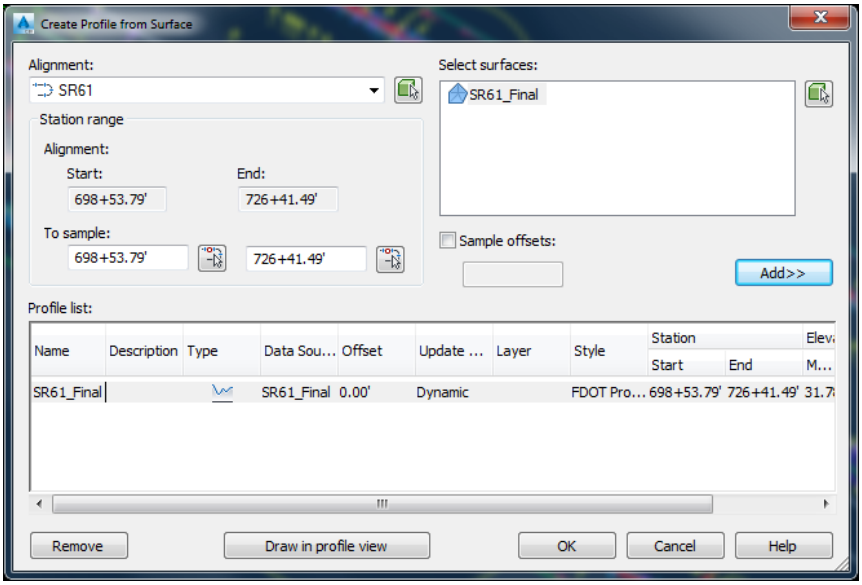
3. To see the *Data Reference* in the **Alignments** collection, expand the **Centerline Alignments**.

Exercise 6.4 Create Surface Profile for SR61 Alignment and SR61_Final Surface

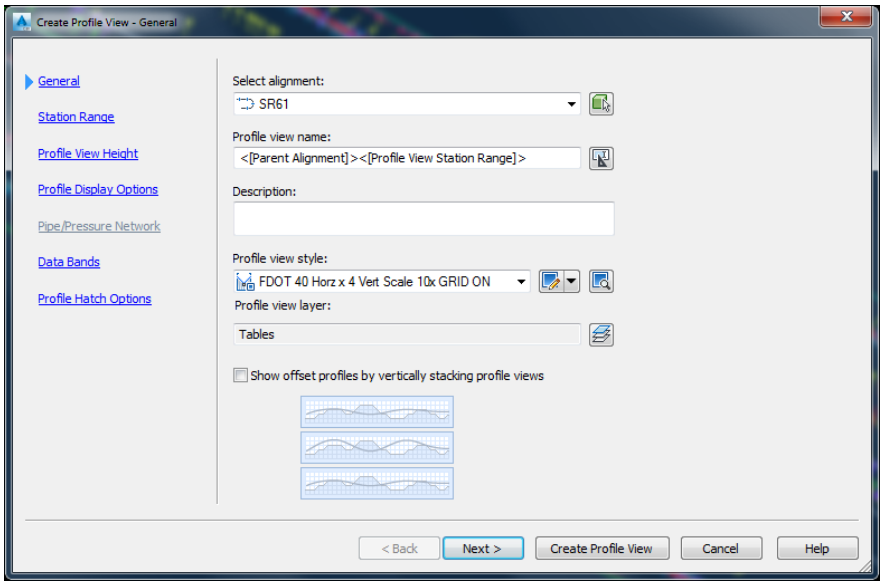
The next steps will show you how to create a Surface Profile for SR61 Alignment and SR61_Final Surface.



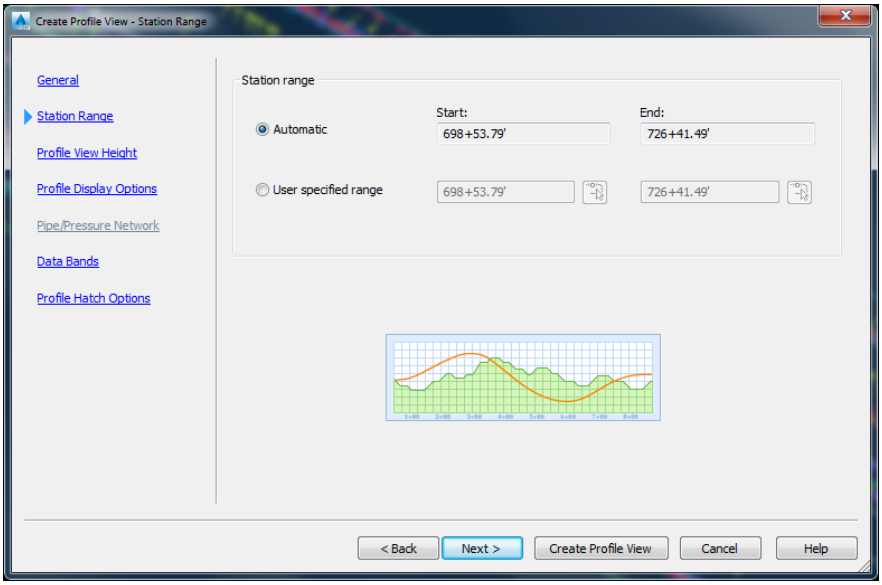
1. From the *Home tab* > *Create Design panel* > *Profile* drop down list, select **Create Surface Profile**.



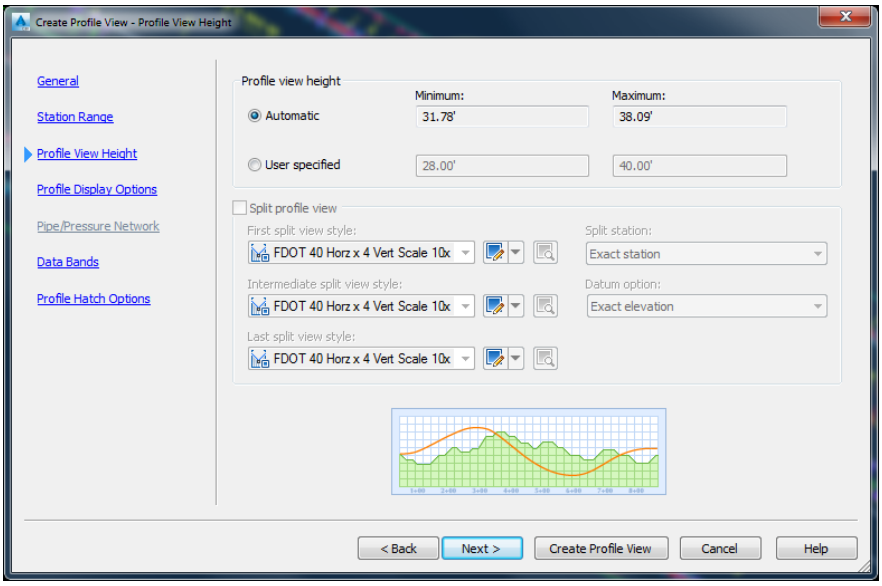
2. From the Create Profile from Surface dialog box, set the following:
   a. Under *Alignment*: from the drop down list select **SR61**.
   b. Under *Select surfaces*: highlight **SR61_Final**.
3. Click the **Add** button (found on the right side). The *Profile list*: area populates with the newly defined surface profile content.
4. Click the **Draw in profile view** button at the bottom of dialog box. This will launch the Create Profile View wizard.
5. The blue links on the left side display an arrow next to the current panel title being displayed. Visit each panel in the Create Profile View wizard setting the values as instructed, then click the **Next** button at the bottom to continue to the next panel in the wizard.



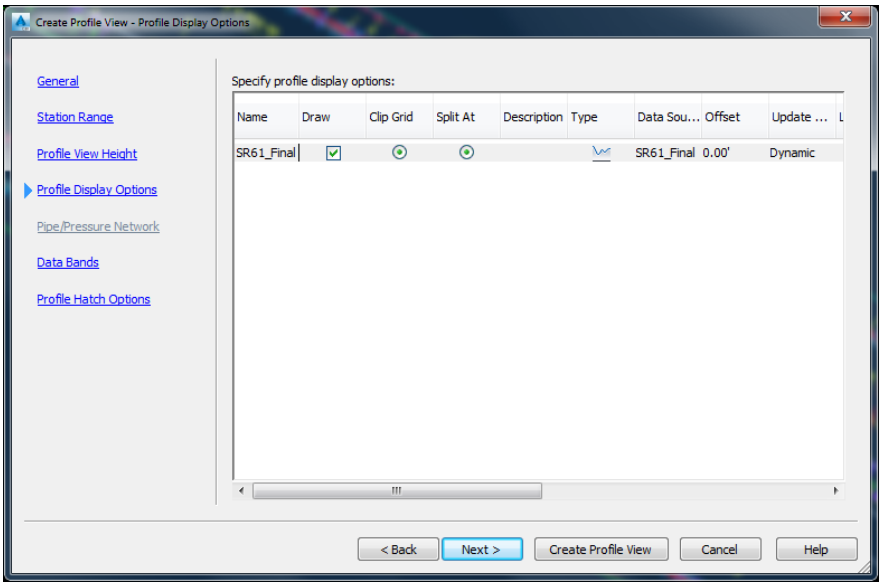
6. In the *General* panel, from the *Profile view style:* drop down list select **FDOT 40 Horz x Vert Scale 10x GRID ON**, then click the **Next >** button.



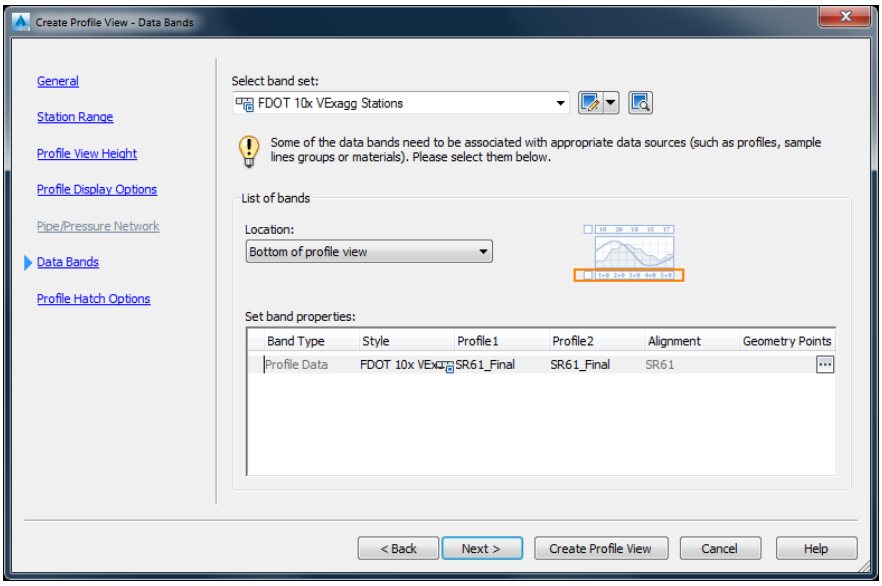
7. In the *Station Range* panel, do not change anything, then click the **Next >** button.



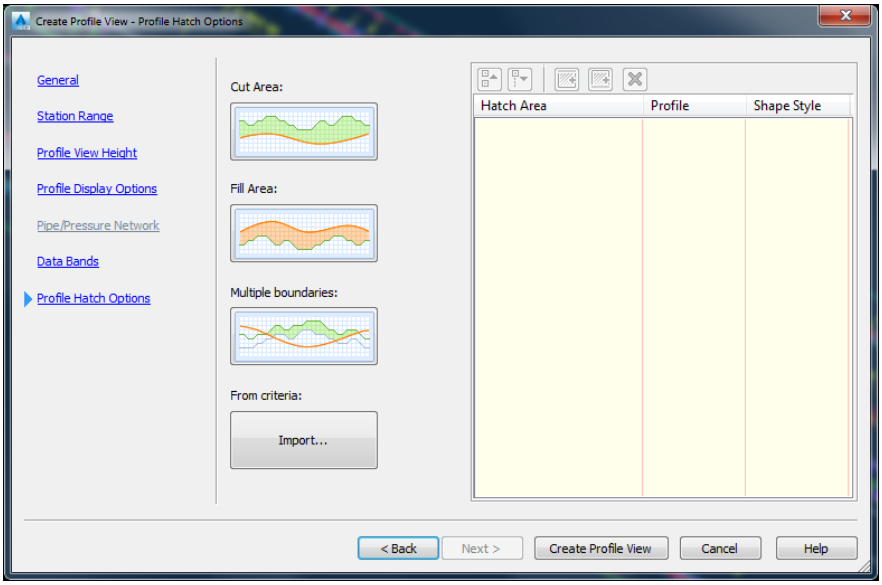
8. In the *Profile View Height* panel, do not change anything, then click the **Next >** button.



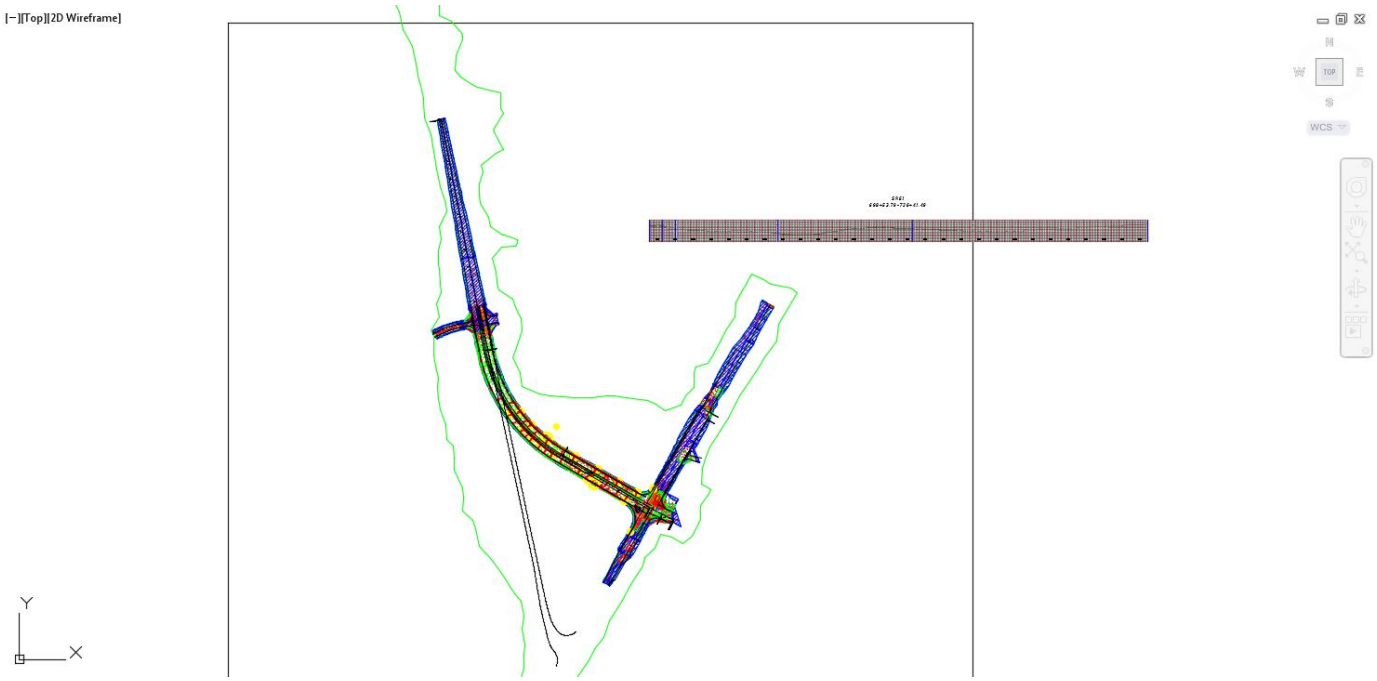
9. In the *Profile Display Options* panel, do not change anything, then click the **Next >** button.



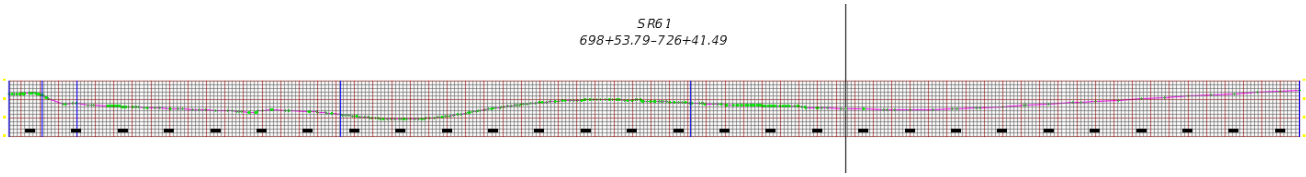
10. In the *Data Bands* panel, from the *Select band set:* drop down list select **FDOT 10x VExagg Stations** style, then click the **Next >** button.



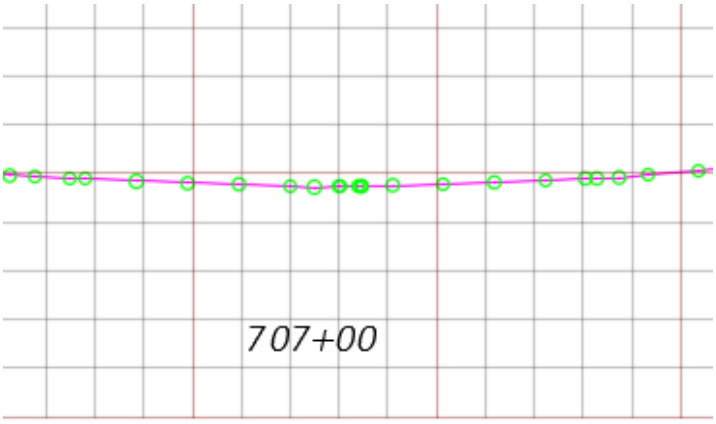
11. In the *Profile Hatch Options* panel do not change anything, then click the **Create Profile View >** button.



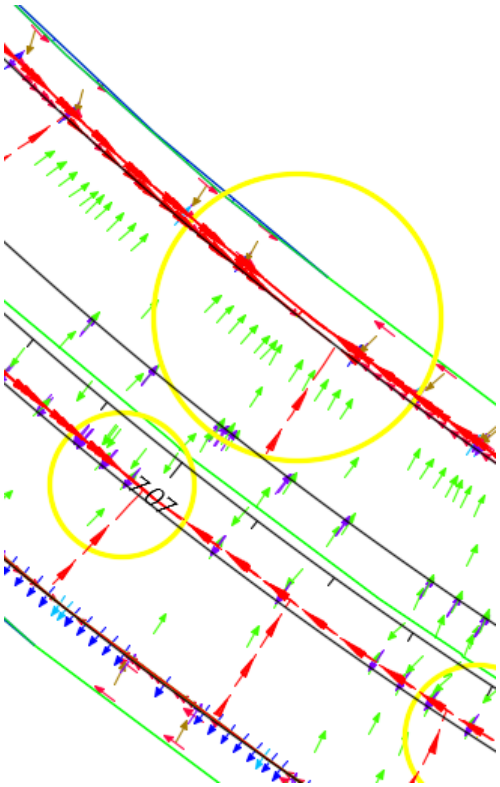
12. In model space pick the insertion point to the right of the plan view of the project for the Profile View. The profile's insertion point is the lower left of the grid.



13. **Zoom in** to see the *Profile View*, *the grid*, *the labels*, *the surface profile* of **SR61_Final**, and the *title* containing the alignment name and station range.



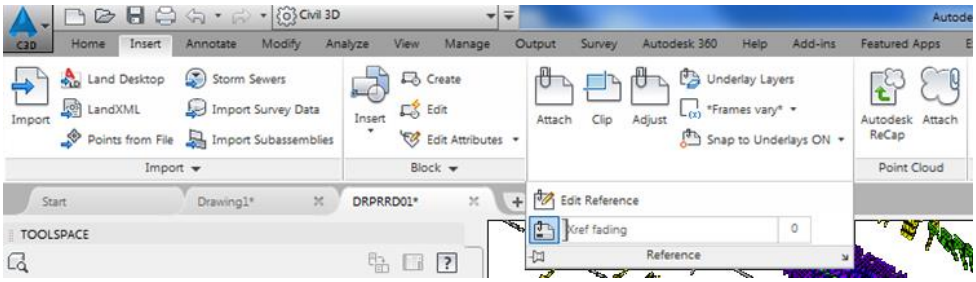
14. Locate the **low point** in the Profile View near *station 707+00*.



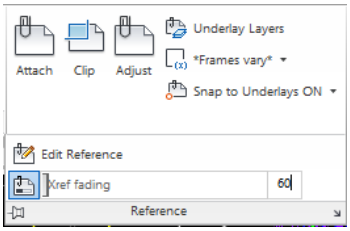
15. The image above shows the matching **low point** in Plan View near *station 707+00*.

Exercise 6.5 Set Xref Fading

The next steps will show you how to set Xref Fading for all attached Xrefs. The higher the number the lighter the Xref line work will appear.



1. From the *Insert tab > Reference panel*, select the title to display the commands hidden behind the panel title.

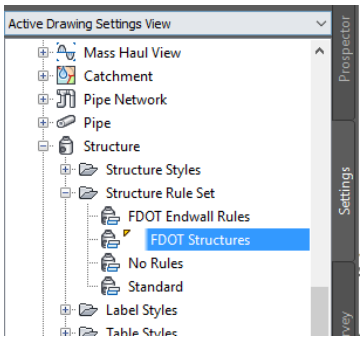


2. Set the *Xref Fading* value to **60**.

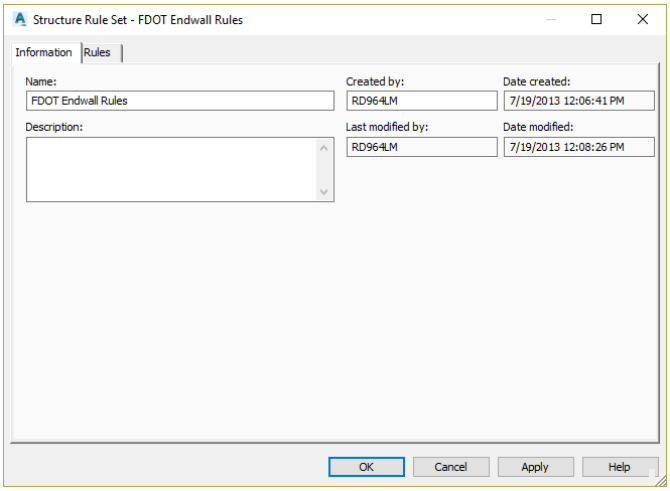
3. Notice in the drawing editor the Xrefs appear lighter and alignment's display remains at full intensity.

Exercise 6.6 Apply Structure Offset and Rotation Rule to FDOT Structures Rule Set

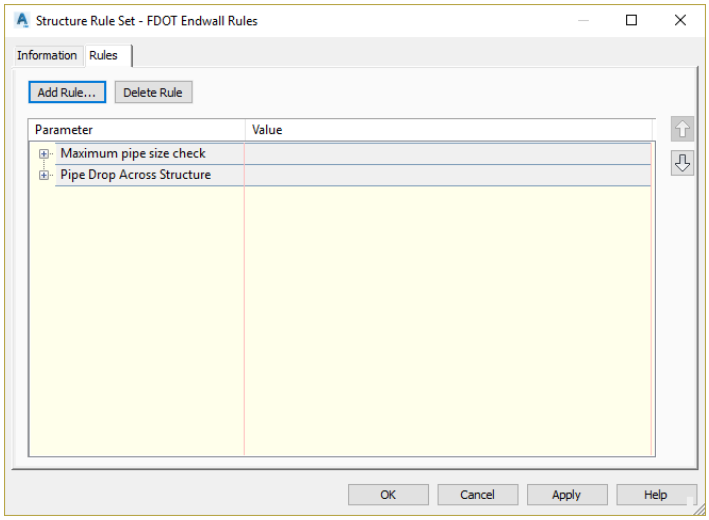
The next steps show you how to apply Structure Offset and Rotation Rule Set to structures as you place them in the drawing. The rule set simply provides a way for you to create a set of custom rules. You can add or exclude certain rules, or edit certain rule values, and save the, in a named rule set designed to control the behavior for a specific pipe network or project. The FDOT Civil 3D State kit has rules already defined for you.



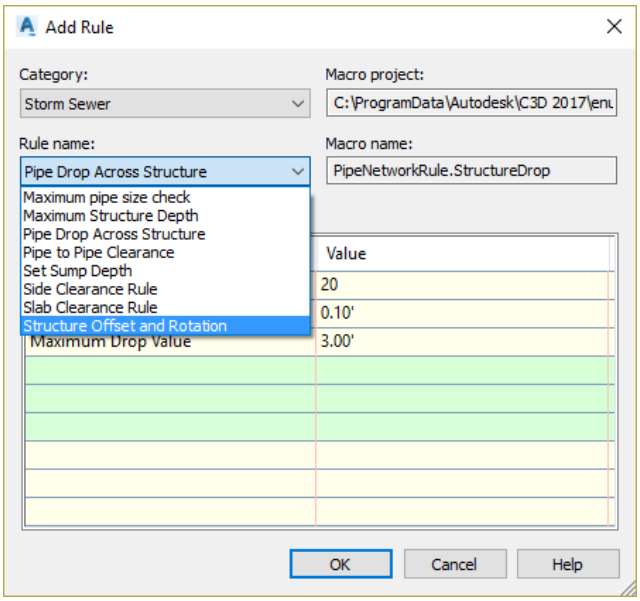
1. From the *TOOLSPACE > Settings tab*, expand the *Structure* collection, expand the *Structure Rule Set* collection, right click on *FDOT Structures* and select **Edit.**



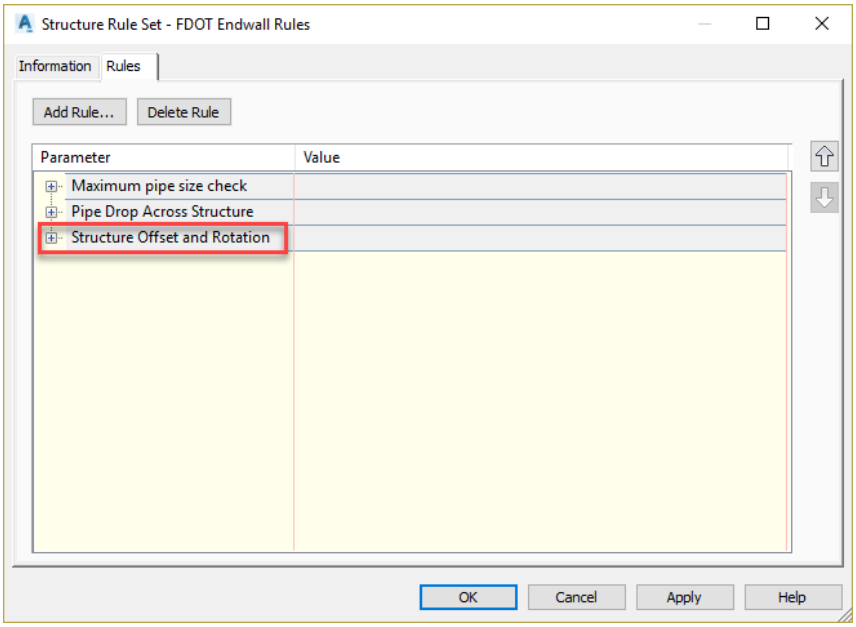
2. The Structure Rule Set dialog box appears:



3. Select the Rules tab then select **Add Rule**.



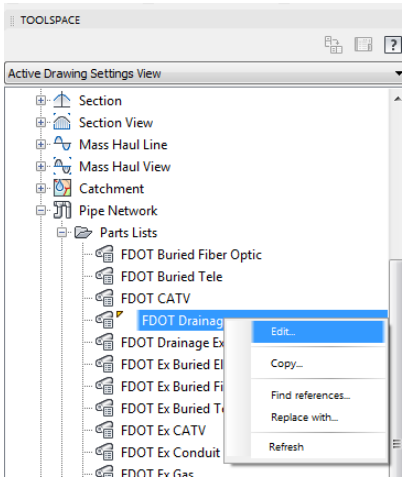
4. Click on the drop down list under Rule Name and select **Structure Offset and Rotation** then click **OK.**



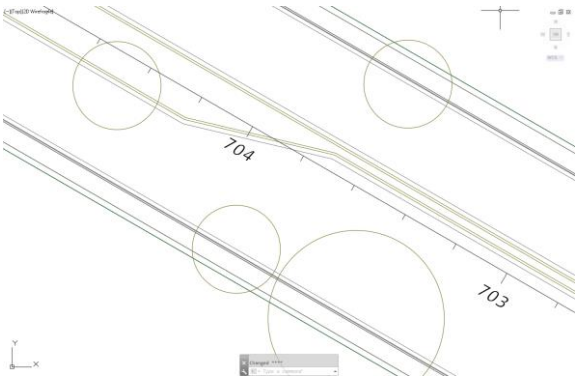
5. The Structure Offset and Rotation rule has now been added to the Structure Rule Set. Click **OK** to apply and close out of the dialog box.

Exercise 6.7 Copy and Define Line Work from which to Rotate and Offset Structures

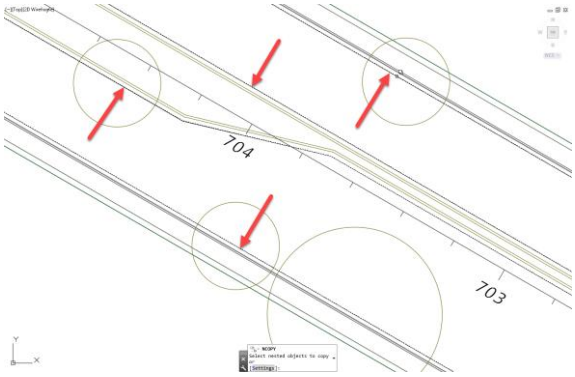
The Structure Offset and Rotation rule only works with an Alignment, Corridor Feature Line, Feature Line, and 3D Polyline. In the following steps, we will copy Pavement Asphalt polylines from the Xref DSGNRD01 drawing using the NCOPY command This will set us up to Convert them to Feature Lines.



1. Zoom in to Station 704. Notice how the center of each circle lands on edge of pavement geometry. Use the LAYOFF option to turn off the Flow Arrows to for clarity.



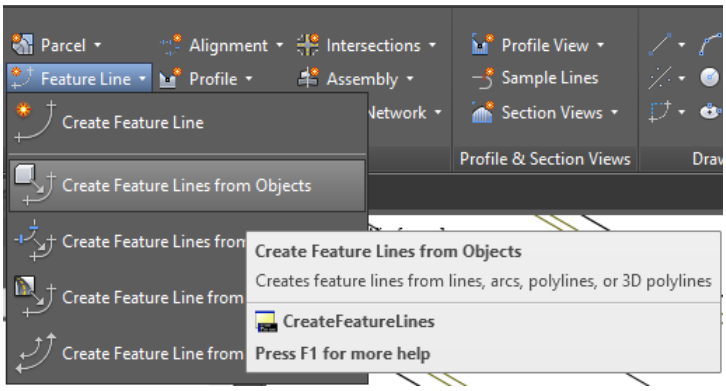
2. Type NCOPY at the command line. You are then prompted to select nested object to copy.



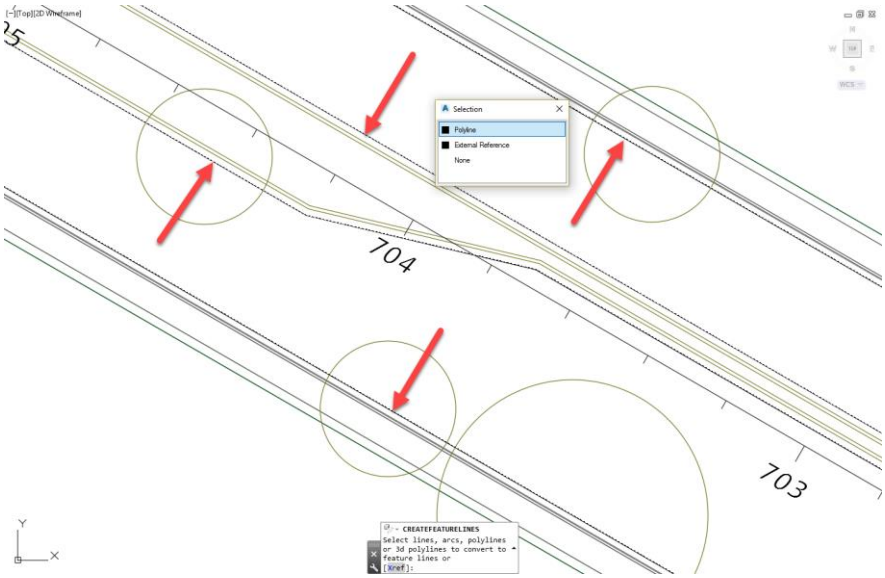
3. Select the four lines as shown in the image above. Press Enter three times to accept the default base point and displacement values. You now have successfully copied Nested object from the Xref drawing into your current drawing.

Exercise 6.8 Create Feature Lines from Polylines

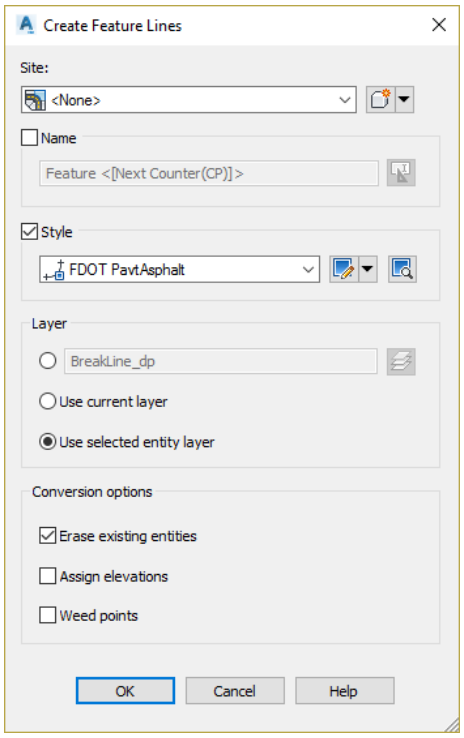
Next we convert the copied polylines to Feature Lines



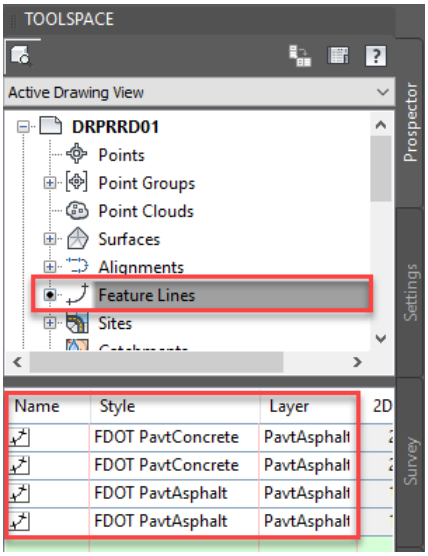
1. On the Home Ribbon on the Create Design panel, click on the Feature Line icon to expose the pull down menu options. Select Create Feature Line from Objects.



2. Select the four copied Polylines. If you are using the Selection tool, make sure that you select the Polyline option for each one. After the fourth polyline line selected, press enter to bring up the Create Feature Lines dialog box.



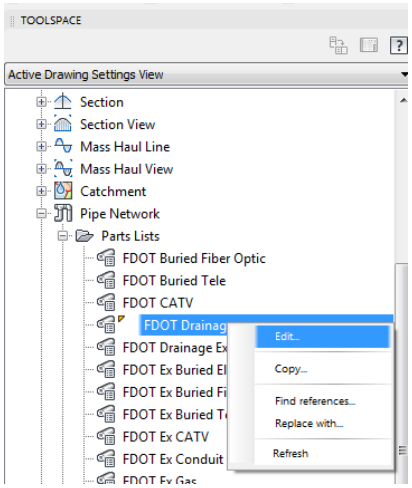
3. From the Create Feature Lines dialog box
   a. Set Site to **<None>**
   b. From Style drop down list select **FDOT PavtAsphalt**
   c. Select **Use selected entity layer** option for layer.
   d. Check **Erase existing entities for Conversion** options
   e. Click **OK**.



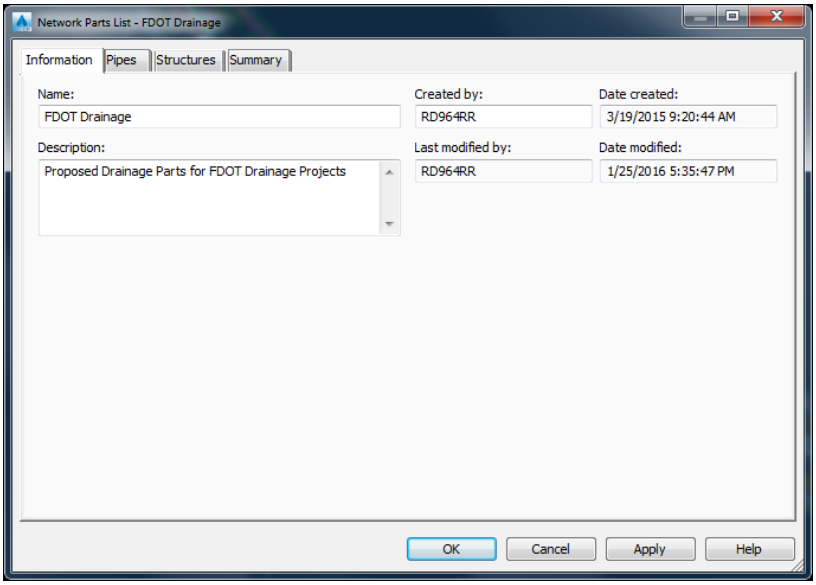
4. Select the **Feature Lines** category on the Toolspace/Prospector tab. You will see four Feature lines defined in the bottom preview.

Exercise 6.9 Review the Parts List Contents

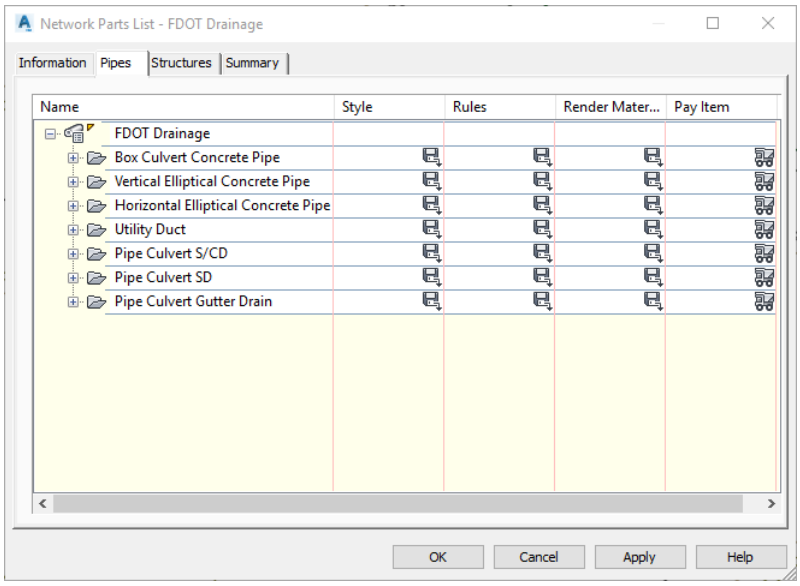
The next steps will show you how to review the parts list FDOT Drainage.



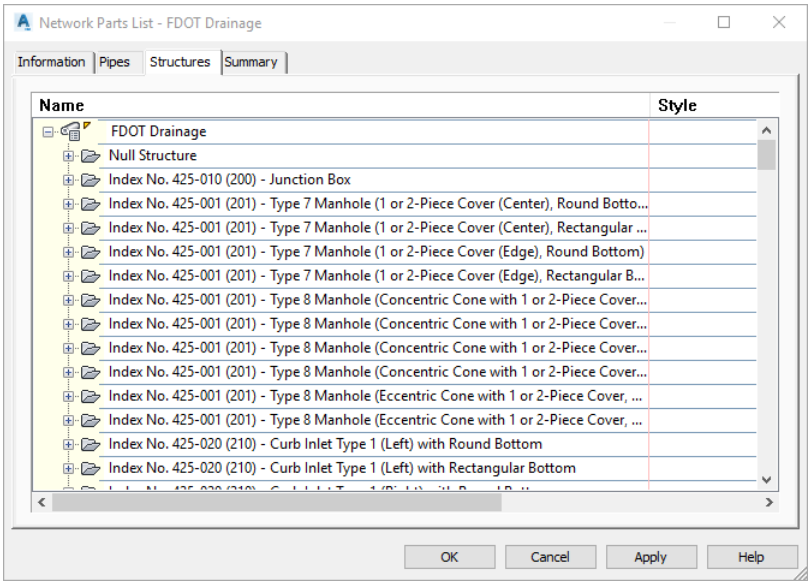
1. From the *TOOLSPACE > Settings tab*, expand the *Pipe Network* collection, expand the *Parts List* collection, right click on *FDOT Drainage* and select **Edit.**



2. From the Network Parts List dialog box:
    a. Information tab, the *Name:* field contains the name of the Parts List, **FDOT Drainage**.



b. *Pipes tab*, expand **FDOT Drainage** to display the pipe families.



c. *Structures tab*, expand **FDOT Drainage** to display the structures families.

3. Click **OK** to close the Network Parts List dialog box.
4. **Save** the *DRPRRD01.dwg* file

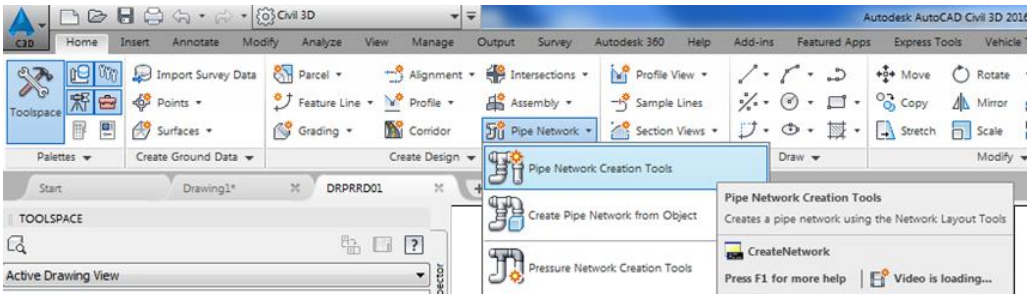
Exercise 6.10 Create Pipe Network

The next steps will show you how to create a Pipe Network

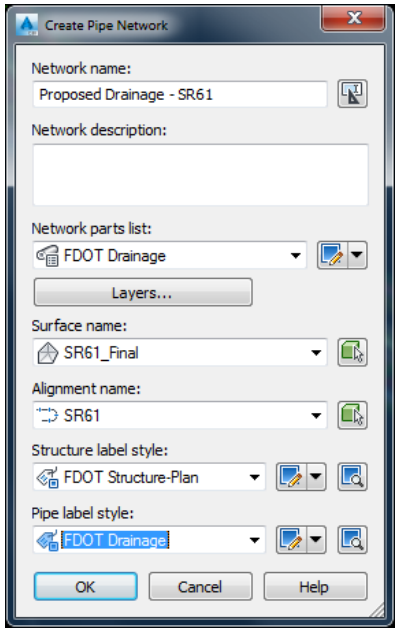
➢ *Pipe Network Creation Tools*

The next steps will show you how to lay out a Pipe Network using the Pipe Network Creation Tools

1. From the *Home tab* > *Create Design panel* > Pipe Network drop down list, select **Pipe Network Creation Tools**.



2. From the Create Pipe Network dialog box set the following:
   a. *Network name*: type **Proposed Drainage – SR61** which replaces the existing text in the field.
   b. *Network parts list*: from drop down list select **FDOT Drainage**.
   c. *Surface name:* from drop down list select **SR61_Final**.
   d. *Alignment name:* from drop down list select **SR61**.
   e. *Structure label style:* from drop down list select **FDOT Structure-Plan**.
   f. *Pipe label style:* from drop down list select **FDOT Drainage**.

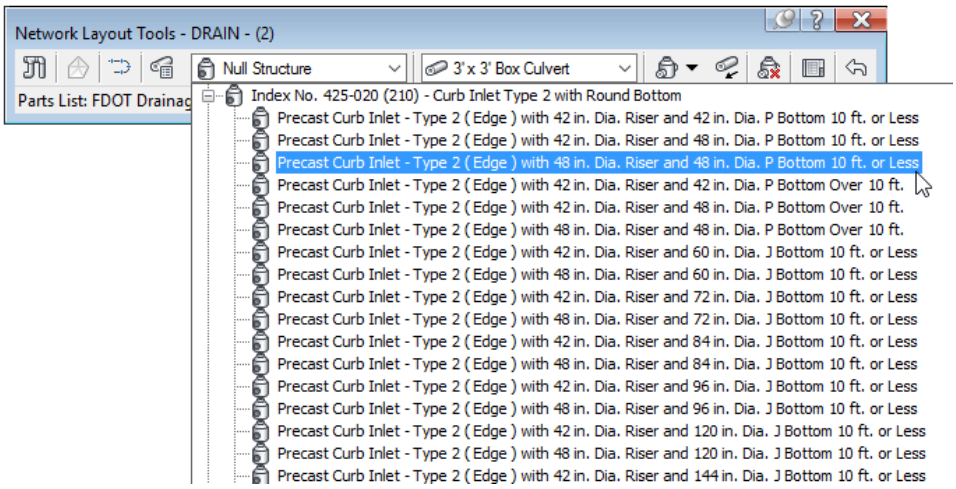


3. Click **OK** to close the Create Pipe Network dialog box.

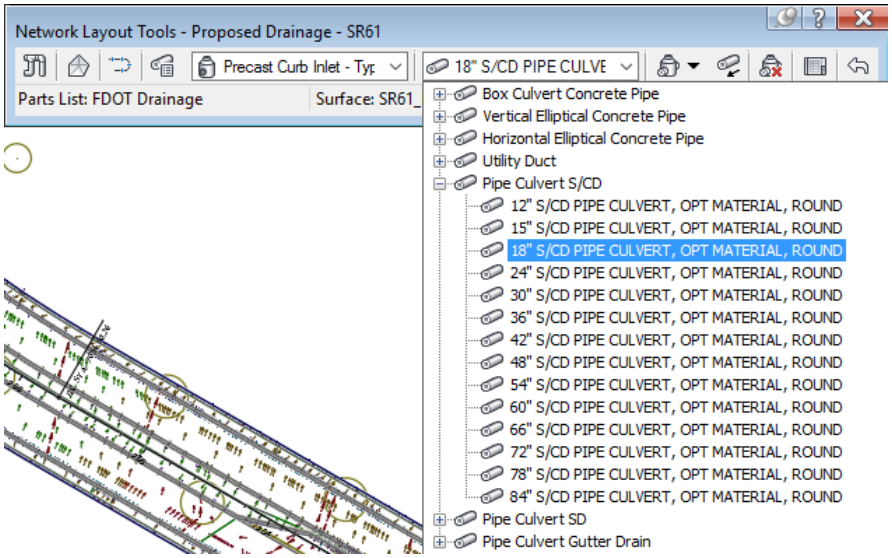
➢ *Network Layout Tools*

The Network Layout Tools toolbar displays after closing the Create Pipe Network dialog box.

HINT If you have difficulty finding it look at the upper left corner of Civil 3D. You can click and drag on the title bar of this toolbar to move it to a different position on your screen.



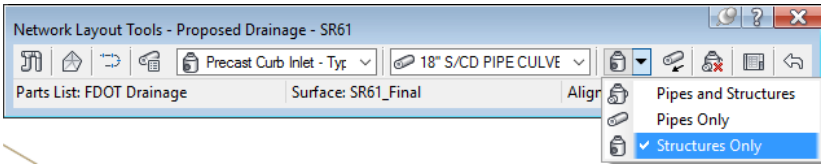
1. The Network Layout Tools toolbar drop down list for structures is set to *Null Structure*. From the drop down list display the structure part families. Expand the *Index No. 425-020 (210) – Curb Inlet Type 2 with Round Bottom* family and select **Precast Curb Inlet – Type 2 (Edge) with 48 in. Dia. Riser and 48 in. Dia. P Bottom 10 ft. or Less.**



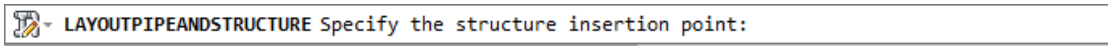
2. The Network Layout Tools toolbar drop down list for Pipes, expand *Pipe Culvert S/CD* and choose ***18"S/CD PIPE CULVERT, OPT MATERIAL ROUND***.

➢ *Adding Structures Only*

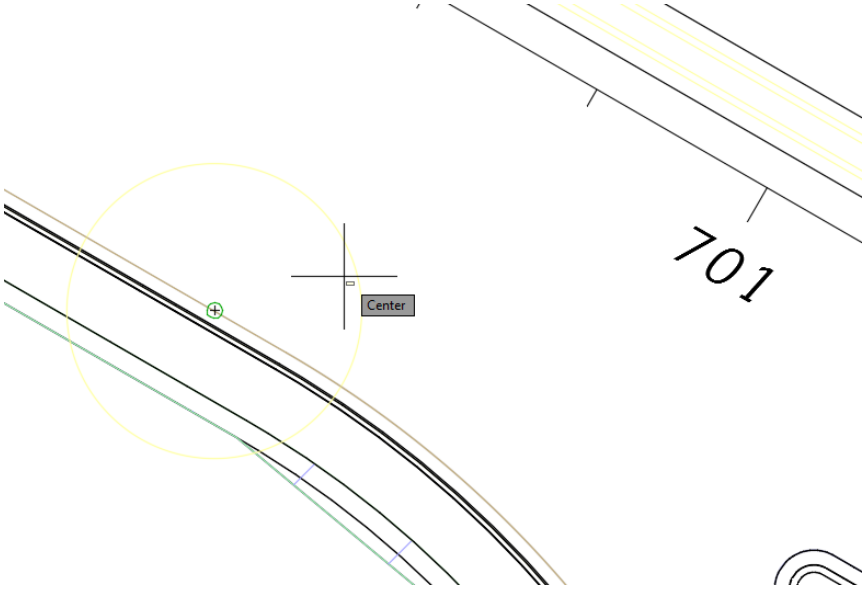
The next steps will show you how to place *Structures Only* using the FDOT Structures Rule Set.



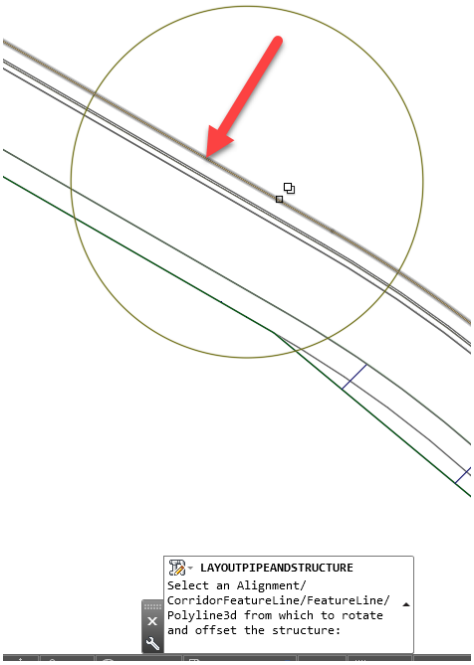
1. From the Network Layout Tools toolbar > *Pipes and Structures* drop down list, select **Structures Only**.When laying out structures the direction of flow does matter. Flow direction will be set when the pipes are added to connect the structures.



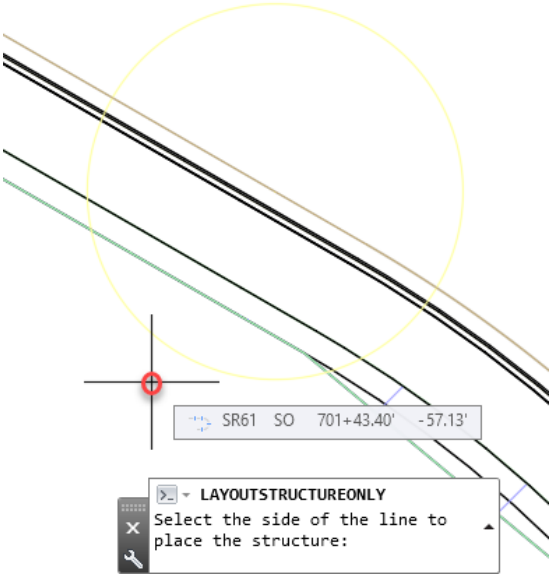
2. Zoom in to the Circle South West of station 701.
3. Command line displays the prompt *Specify the structure insertion point*.



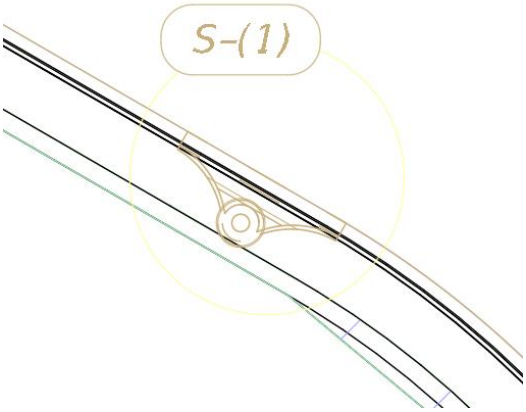
4. In the drawing as displayed above, use a **Center Object Snap** to snap to the center of the circle representing the position of the first inlet. These circles were inserted into the DRMPRD01 file as an aid when you were deciding where the inlets should be placed.



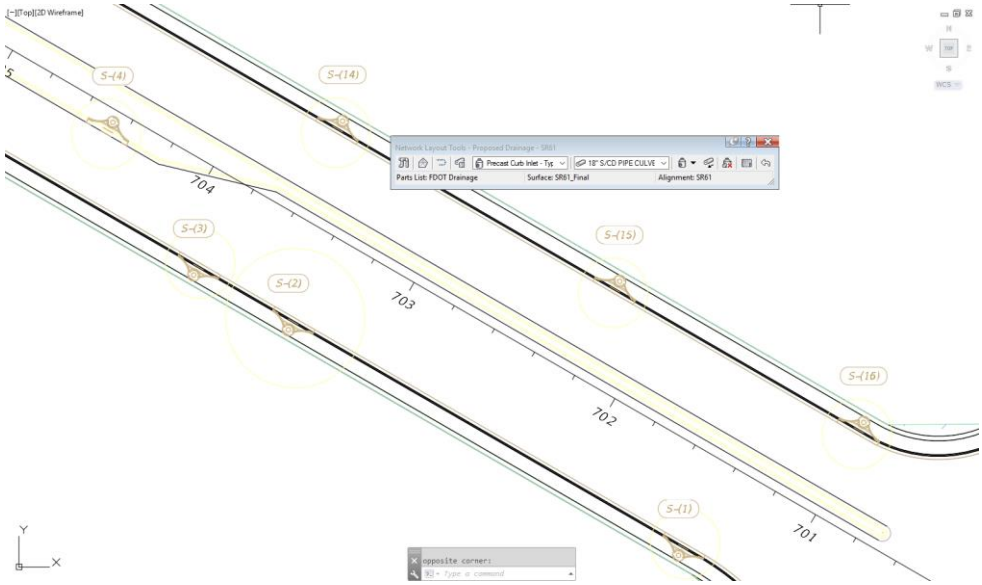
5. When prompted to *Select an Alignment/CorridorFeatureline/Featureline/Polyline3D from which to rotate and offset the structure*, select the Pavement Asphalt feature line.



6. When prompted to *Select the side of the line to place the structure:* click south of the feature line. This is the side you want the structure to offset to.

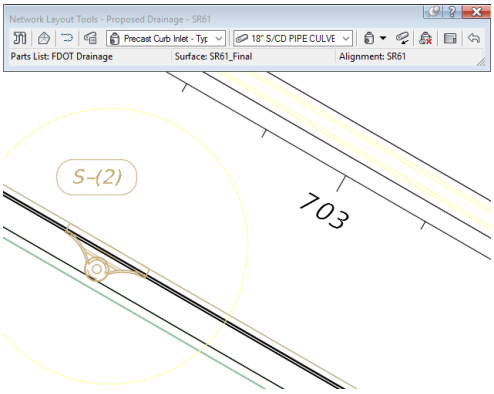


7. You should end up with a property placed structure Offset and Rotated to the feature line.

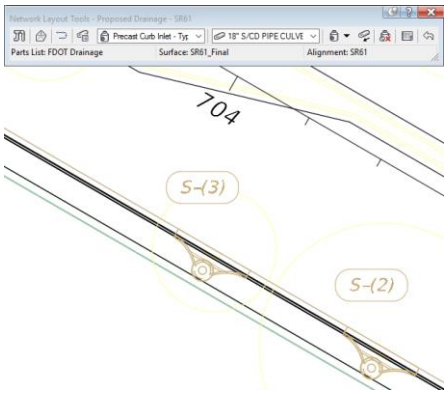


8. Continue placing structures at each circle. Place the new structures going in order starting after the *S-(1) structure:* going up the left side below the SR61 centerline, then going down the right side above the SR61 centerline ending with the new S-(16) structure placement.

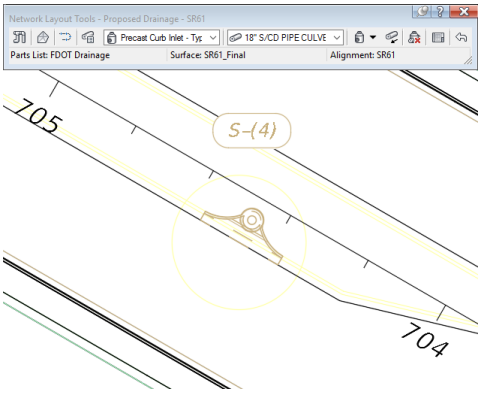
Notice the structure labels containing the name of the structure (i.e. S-(1)) are created as each structure is placed.



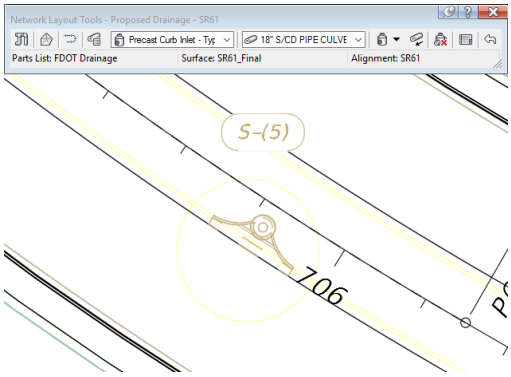
9. **Zoom** and **Pan** to display the location of the next *structure* **S-(2).** Use a **Center Object Snap** to snap to the center of the circle representing the new position of structure S-(2) then select the feature line finally click on the side to offset the structure to.



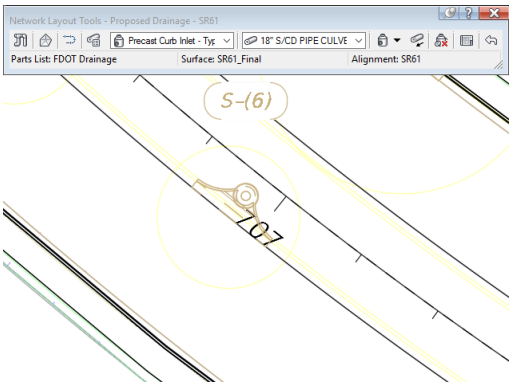
10. **Zoom** and **Pan** to display the location of the next *structure* **S-(3).** Use a Center Object Snap to snap to the center of the circle representing the new position of structure S-(3) then select the feature line finally click on the side to offset the structure to.



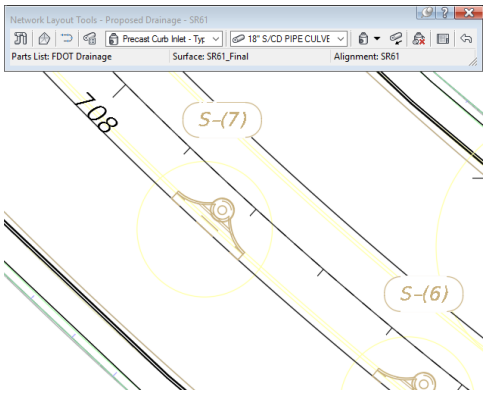
11. **Zoom** and **Pan** to display the location of the next *structure* **S-(4)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(4)** then select the feature line finally click on the side to offset the structure to.



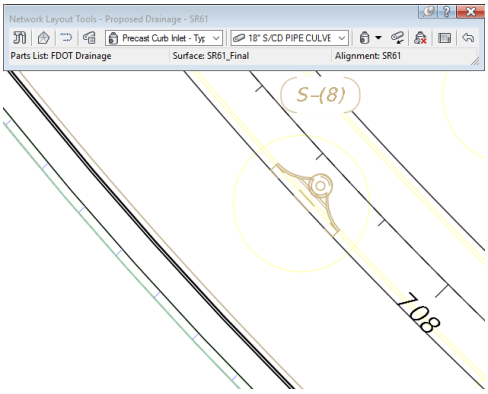
12. Zoom and Pan to display the location of the next *structure* **S-(5)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(5)** then select the feature line finally click on the side to offset the structure to.



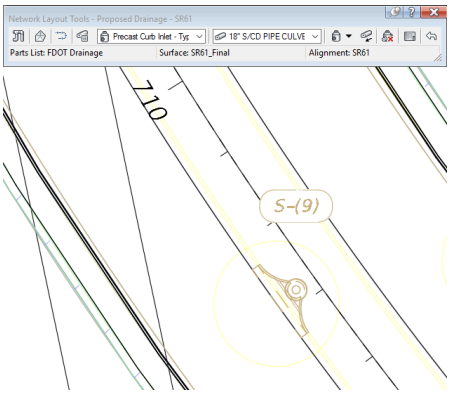
13. **Zoom** and **Pan** to display the location of the next *structure* **S-(6)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(6)** then select the feature line finally click on the side to offset the structure to.



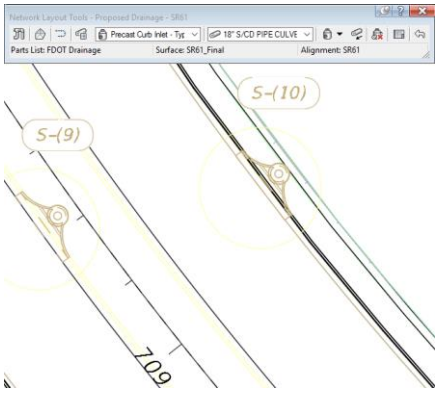
14. **Zoom** and **Pan** to display the location of the next *structure* **S-(7)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(7)** then select the feature line finally click on the side to offset the structure to.



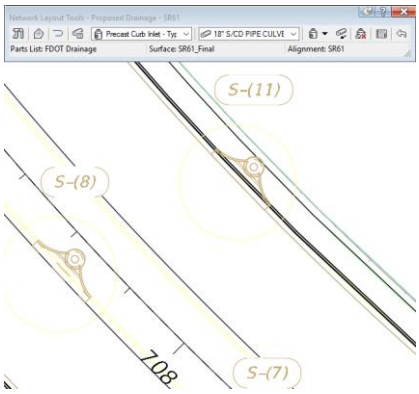
15. **Zoom** and **Pan** to display the location of the next *structure* **S-(8)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(8)** then select the feature line finally click on the side to offset the structure to.



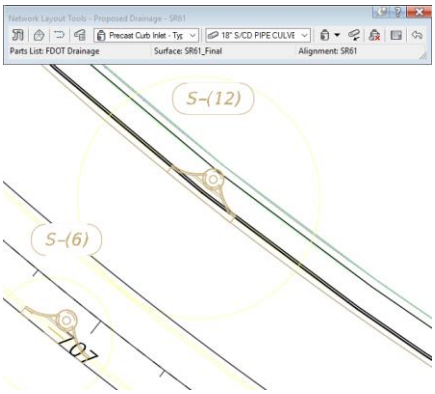
16. **Zoom** and **Pan** to display the location of the next *structure* **S-(9)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(9)** then select the feature line finally click on the side to offset the structure to.



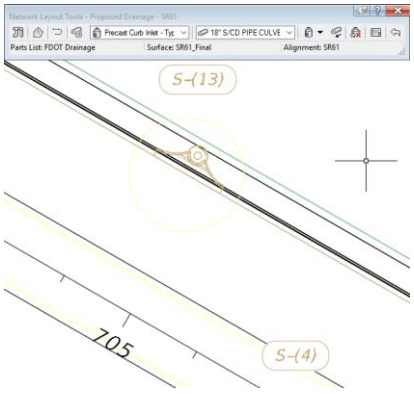
17. **Zoom** and **Pan** to display the location of the next *structure* **S-(10)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(10)** then select the feature line finally click on the side to offset the structure to.



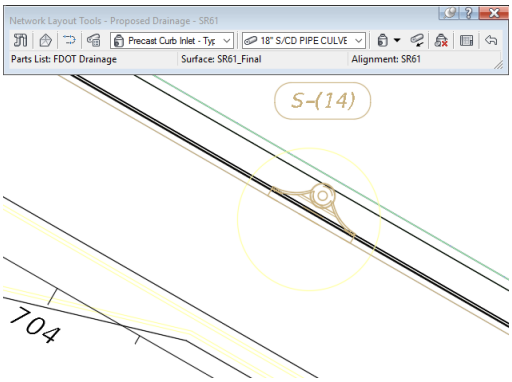
18. **Zoom** and **Pan** to display the location of the next *structure* **S-(11)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(11)** then select the feature line finally click on the side to offset the structure to**.**



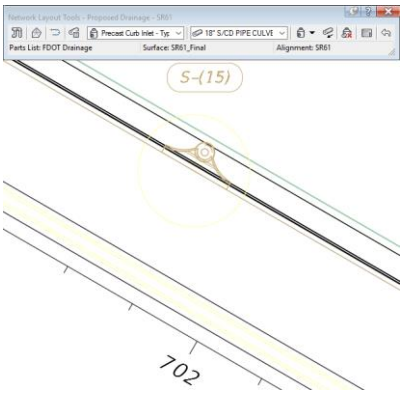
19. **Zoom** and **Pan** to display the location of the next *structure* **S-(12)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(12)** then select the feature line finally click on the side to offset the structure to**.**



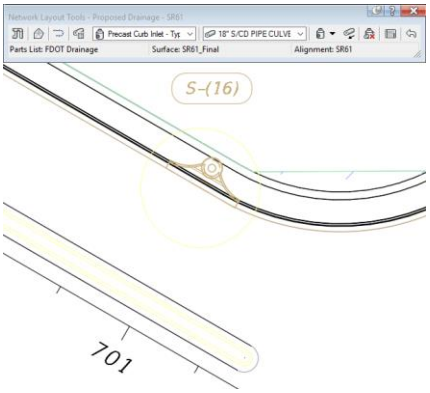
20. **Zoom** and **Pan** to display the location of the next *structure* **S-(13)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(13)** then select the feature line finally click on the side to offset the structure to**.**



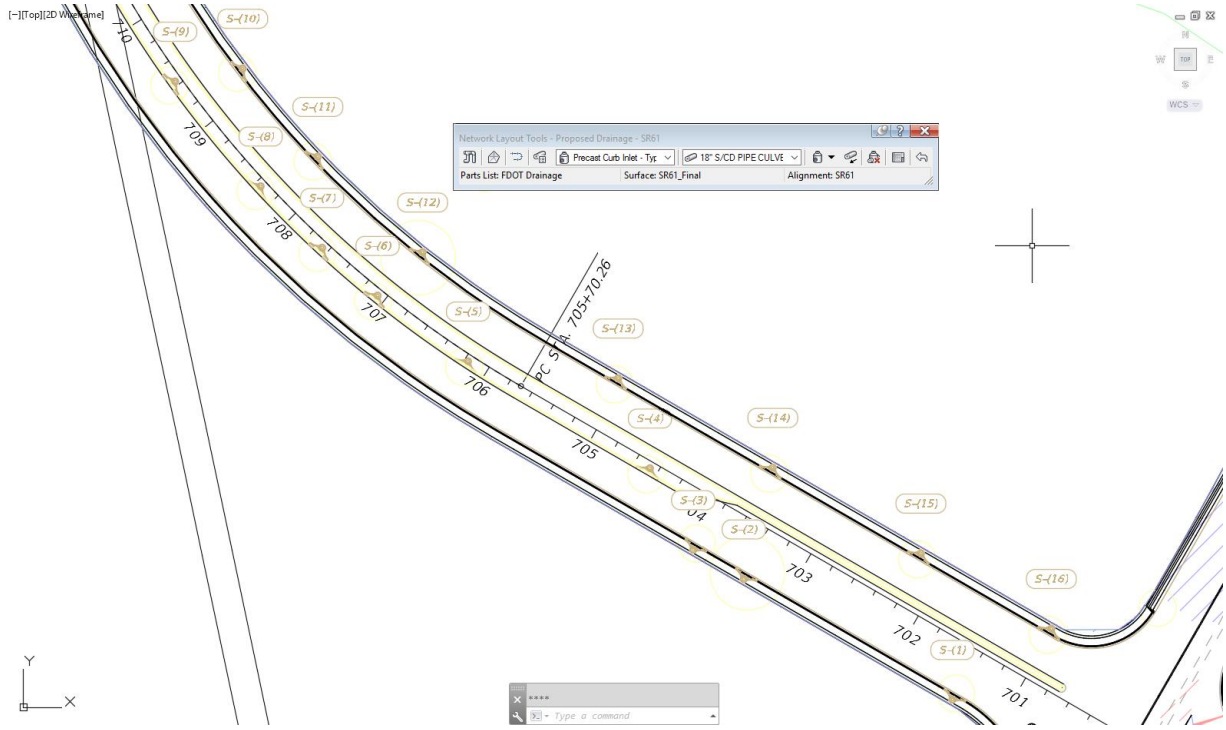
21. **Zoom** and **Pan** to display the location of the next *structure* **S-(14)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(14)** then select the feature line finally click on the side to offset the structure to**.**



22. **Zoom** and **Pan** to display the location of the next *structure* **S-(15)**. Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(15)** then select the feature line finally click on the side to offset the structure to**.**



23. **Zoom** and **Pan** to display the location of the next *structure* **S-(16).** Use a Center Object Snap to snap to the center of the circle representing the new position of *structure* **S-(16)** then select the feature line finally click on the side to offset the structure to**.**
24. Press the **ENTER** key when done to end the command.



25. **Zoom** and **Pan** to display the newly placed structure inlets for the Proposed Drainage – SR61 Pipe Network.

26. **Save** the *DRPRRD01.dwg* file before continuing.

Exercise 6.11 Add Pipes Only to Structures

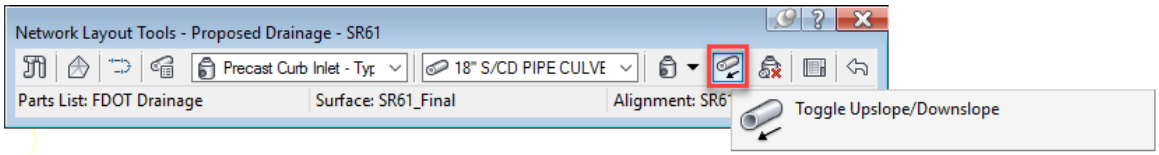
The next steps will show you how to add only Pipes to Structures.

The next steps you will create pipes that connect to structures. The table below can be used to assign the Pipe name as it relates to the starting Structure name. You will see how the order affects flow direction.

PIPE TABLE						
QTY	STRT #	NAME#	SIDE	DESCRIPTION	SIZE INCHES	LENGTH
1	S-(1)	PIPE-(1)	-37.83 Lt.	18" Round Concrete Pipe	18.0"	194.35'
1	S-(2)	PIPE-(2)	-39.51 Lt.	18" Round Concrete Pipe	18.0"	47.17'
1	S-(3)	PIPE-(3)	-37.99 Lt.	18" Round Concrete Pipe	18.0"	67.75'
1	S-(4)	PIPE-(4)	-13.34 Lt.	18" Round Concrete Pipe	18.0"	77.97'
1	S-(13)	PIPE-(5)	38.23 Rt.	18" Round Concrete Pipe	18.0"	188.61'
1	S-(12)	PIPE-(6)	38.66 Rt.	18" Round Concrete Pipe	18.0"	97.28'
1	S-(5)	PIPE-(7)	-10.68 Lt.	18" Round Concrete Pipe	18.0"	87.53'
1	S-(6)	PIPE-(8)	-11.47 Lt.	18" Round Concrete Pipe	18.0"	50.65'
1	S-(10)	PIPE-(9)	37.60 Rt.	18" Round Concrete Pipe	18.0"	94.15'
1	S-(11)	PIPE-(10)	38.49 Rt.	18" Round Concrete Pipe	18.0"	115.21'
1	S-(9)	PIPE-(11)	-15.37 Lt.	18" Round Concrete Pipe	18.0"	110.26'
1	S-(8)	PIPE-(12)	-13.33 Lt.	18" Round Concrete Pipe	18.0"	70.76'
1	S-(7)	PIPE-(13)	-13.55 Lt.	18" Round Concrete Pipe	18.0"	59.58'
1	S-(16)	PIPE-(14)	38.18 Rt.	18" Round Concrete Pipe	18.0"	121.55'
1	S-(15)	PIPE-(15)	37.87 Rt.	18" Round Concrete Pipe	18.0"	138.01'
1	S-(14)	PIPE-(16)	38.47 Rt.	18" Round Concrete Pipe	18.0"	144.03'

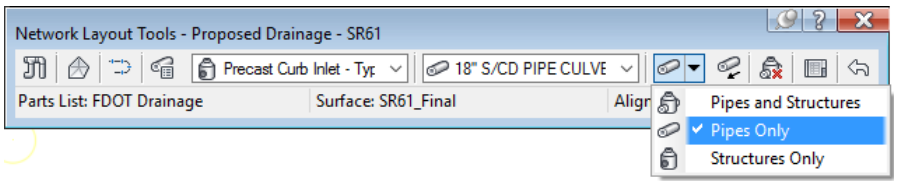
➢ *Setting Pipe Flow Direction*

The next steps will show you how to set the Pipe Flow Direction

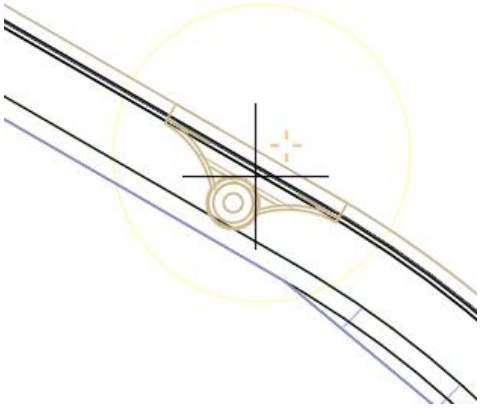


1. From the Network Layout Tools - Proposed Drainage - SR61 toolbar click on the **Toggle Upslope/Downslope** button until the arrow points down.

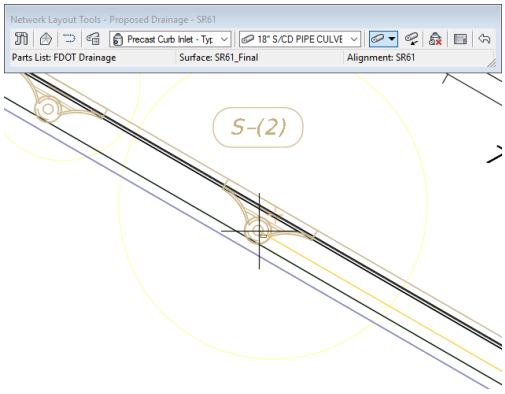
➢ *Add pipes to structures S-(1), S-(2), S-(3), S-(4), S-(13), S-(12) & the Pond area*



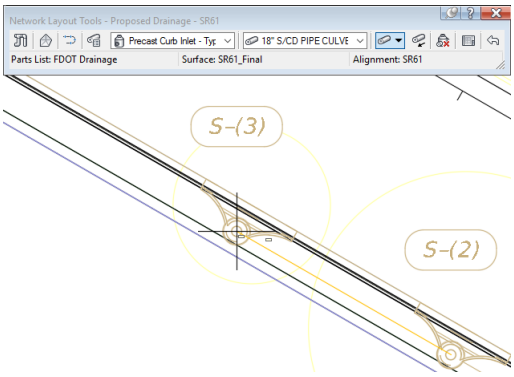
1. From the Network Layout Tools - Proposed Drainage - SR61 toolbar> *Pipes and Structures* drop down list, select the **Pipes Only** command.
2. Turn *OSNAP* **Off** (Use the F3 key).
3. On the command line you are prompted to *Specify first pipe point:* Add pipes to the following *structures* **S-(1), S-(2), S-(3), S-(4), S-(13), S-(12)** and the **Pond** area in that order.



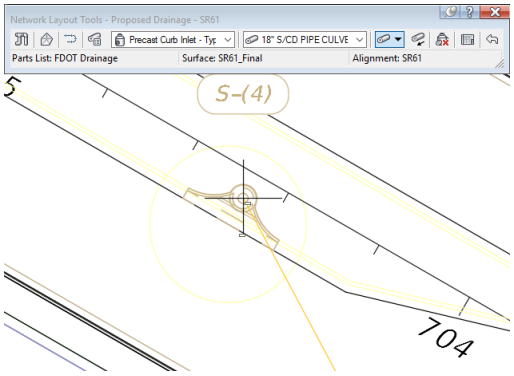
4. **Zoom** and **Pan** to display *structure* **S-(1).** Hovering over *structure* **S-(1)** you see a glyph indicating the pipe will connect with that structure. Click the *structure* **S-(1)** while the glyph displays.
5. The *command line* now prompts you to: *Specify next pipe point.*



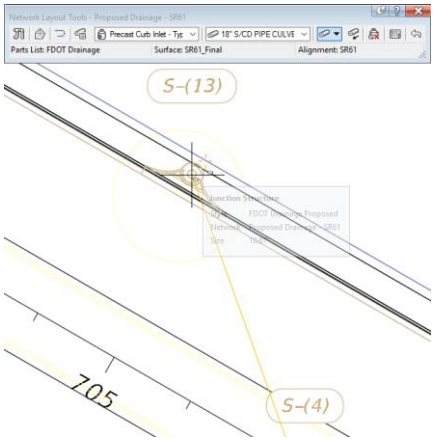
6. **Zoom** and **Pan** to display **structure S-(2)**. Continue by clicking the structure S-(2) when the glyph appears as you hover over structure S-(2).



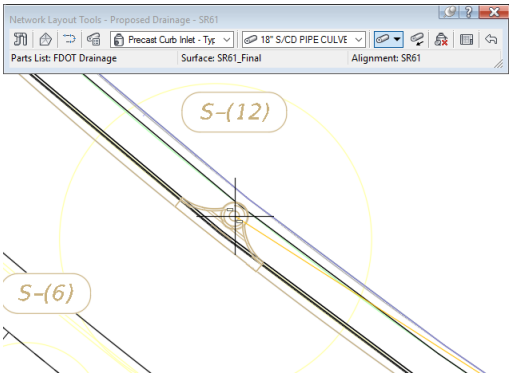
7. **Zoom** and **Pan** to display *structure* **S-(3)**. Continue by clicking the *structure* **S-(3)** when the glyph appears as you hover over *structure* **S-(3)**.



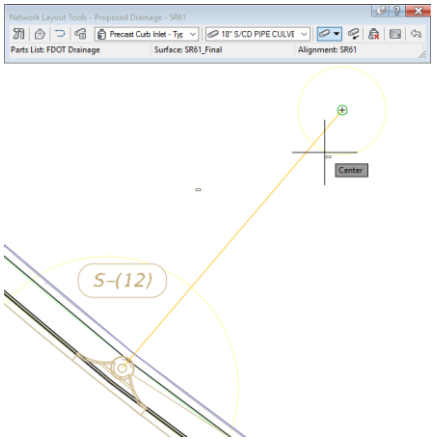
8. **Zoom** and **Pan** to display *structure* **S-(4)**. Continue by clicking the *structure* **S-(4)** when the glyph appears as you hover over *structure* **S-(4).**



9. **Zoom** and **Pan** to display *structure* **S-(13)**. Continue by clicking the *structure* **S-(13)** when the glyph appears as you hover over *structure* **S-(13).**

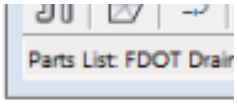


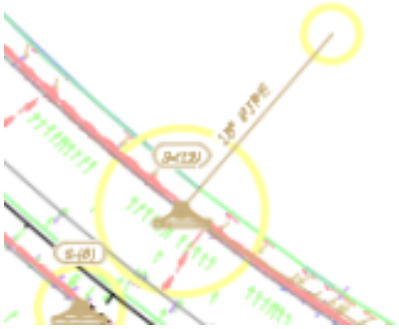
10. **Zoom** and **Pan** to display *structure* **S-(12).** Continue by clicking the *structure* **S-(12)** when the glyph appears as you hover over *structure* **S-(12).**



11. Continue by clicking in the **Pond** area where there is no structure. Use a **Center Object Snap** to snap to the center of the circle to locate the end of the Outfall pipe.

12. Press the **ENTER** key to end the command.

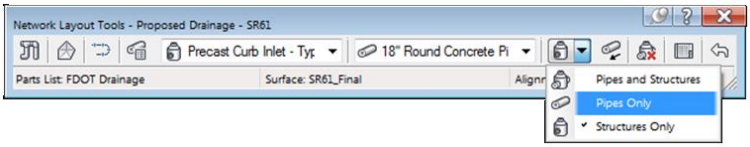




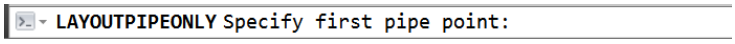
13. Pipe labels display between *structures* **S-(1), S-(2), S-(3), S-(4), S-(13), S-(12)** and the proposed *Pond Area*.

➢ *Add pipes to the following structures S-(5), S-(6), and S-(12)*

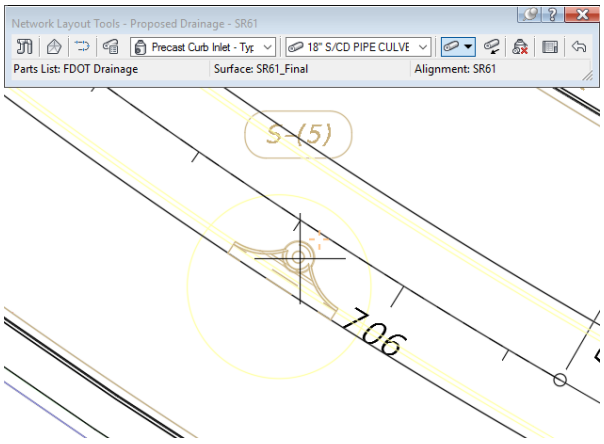
The next steps will show you how to add pipes to the following structures S-(5), S-(6), and S-(12)



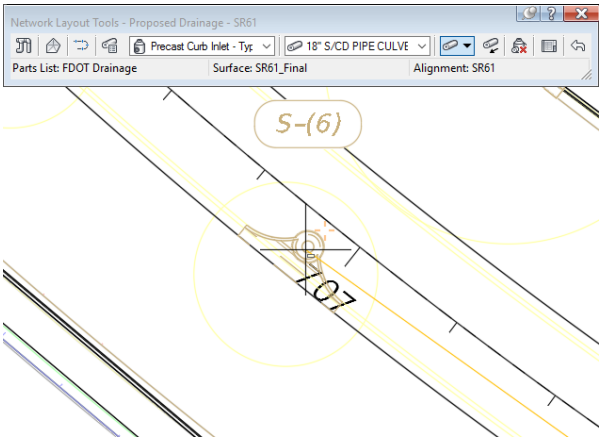
1. From the Network Layout Tools - Proposed Drainage - SR61 toolbar select the **Pipes Only** command.



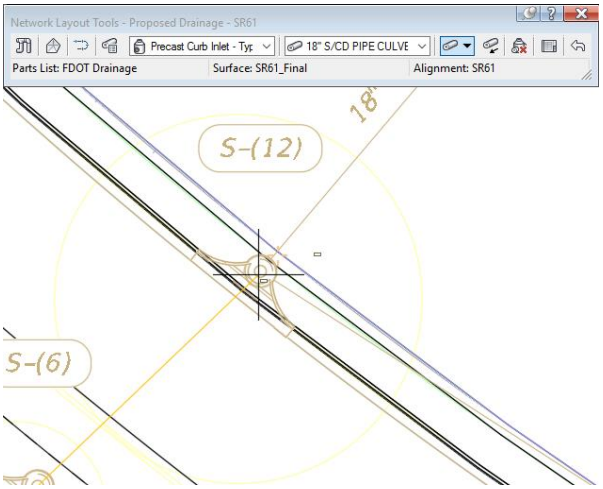
2. On the *command line* you are prompted to: *Specify first pipe point:* Add pipes to the following *structures* **S-(5), S-(6),** and **S-(12)** in that order.



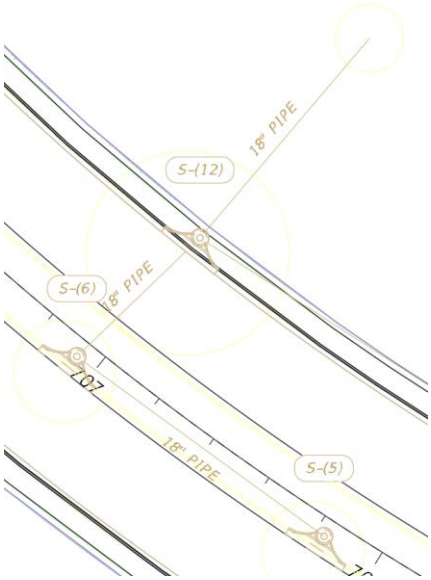
3. **Zoom** and **Pan** to display **structure S-(5)**. Continue by clicking the structure S-(5) when the glyph appears as you hover over structure S-(5).



4. **Zoom** and **Pa**n to display **structure S-(6)**. Continue by clicking the structure S-(6) when the glyph appears as you hover over structure S-(6).



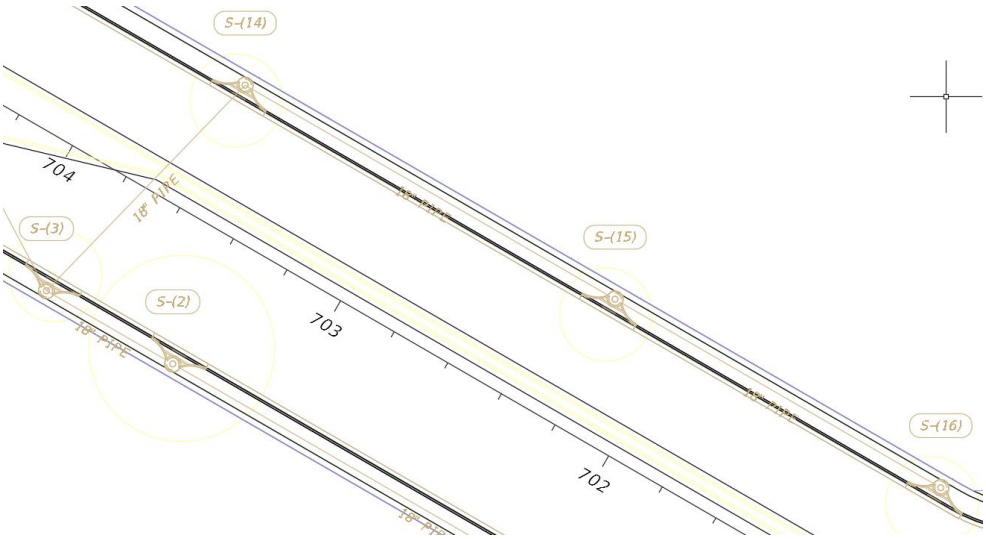
5. **Zoom** and **Pan** to display **structure S-(12)**. Continue by clicking the structure **S-(12)** when the glyph appears as you hover over structure **S-(12).**



Note Press the **ENTER** key to end the command. Pipe labels display between *structures* **S-(5), S-(6),** and **S-(12).**

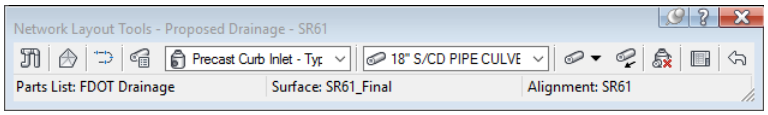
6. Add **Pipes** to the following *structures* **S-(10), S-(11),** and **S-(12).** Press **ENTER** key to end the command when complete.

7. Using the above process add pipes to the following *structures* **S-(9), S-(8), S-(7),** and **S-(6)** in that order. Press **ENTER** key to end the command when complete.



8.)Using the above process add pipes to the following *structures* **S-(16), S-(15), S-(14),** and **S-(13)** in that order. Press **ENTER** key to end the command when complete.

9. **Zoom** and **Pan** to display the completed Proposed Drainage - SR61 Pipe Network.



10. From the Network Layout Tools - Proposed Drainage - SR61 toolbar, click on the red **X** to close the toolbar.

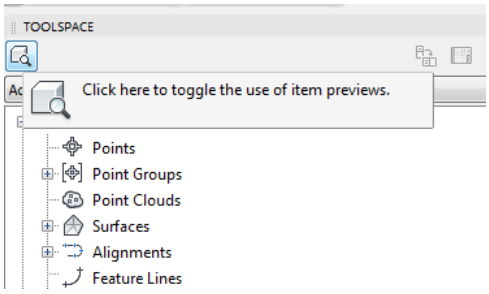
HINT You can also close the Network Layout Tools by pressing Enter twice. To bring back the Toolbar: select a placed part > Right Click > Edit Network.

Exercise 6.12 Display Pipe Network Preview

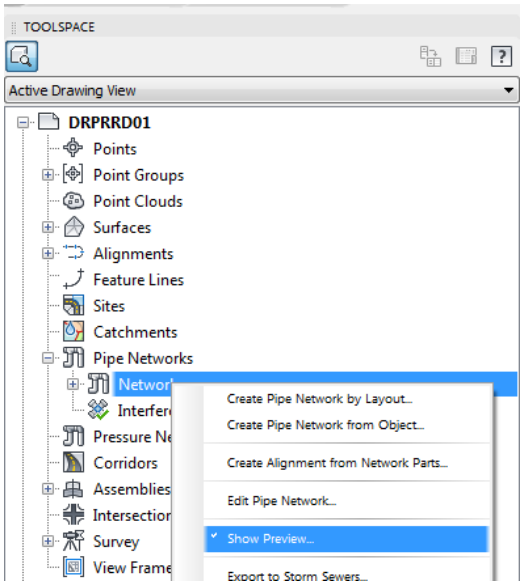
The next steps will show you how to display a Pipe Network Preview

➢ *Toggle on the use of item previews*

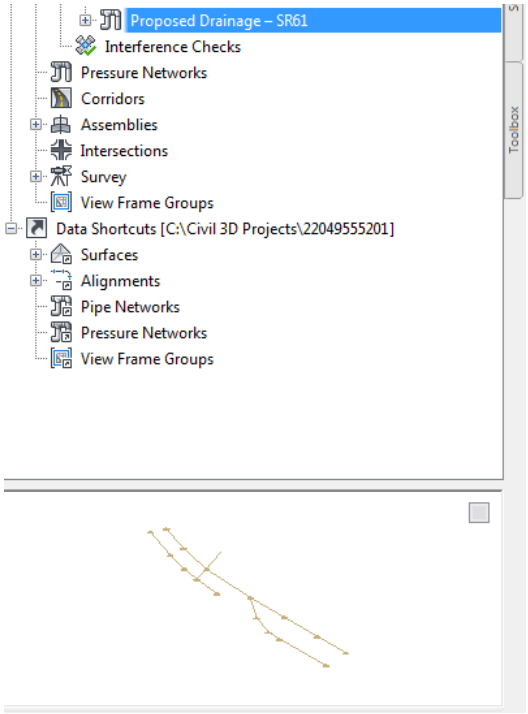
The next steps will show you how to toggle on the use of item previews



1. From the TOOLSPACE click the icon located in the upper left to toggle **On** the use of Item Previews.



2. From the *TOOLSPACE > Prospector tab*, expand **Pipe Networks**, right-click on **Networks**, and select **Show Preview...**



3. From the *TOOLSPACE > Prospector tab*, expand **Pipe Networks**, expand **Networks** then select **Proposed Drainage - SR61** to display in the tool space Preview Window along the bottom.
4. **Save** and **Close** the *DRPRRD01.dwg* file.

7 ALIGNMENTS & PROFILE VIEWS OF NETWORK PARTS

DESCRIPTION

In this chapter, you will create alignments using pipe network parts in Plan View, then display the pipe network parts in profile views, edit pipe invert elevations, and edit a pipe style

OBJECTIVES

In this chapter, you will learn about:

- Creating Alignments from Network Parts
- Adding Pipe Network Parts to Profile Views
- Editing Pipe Invert Elevations
- Editing a Pipe Style

CHAPTER SETUP

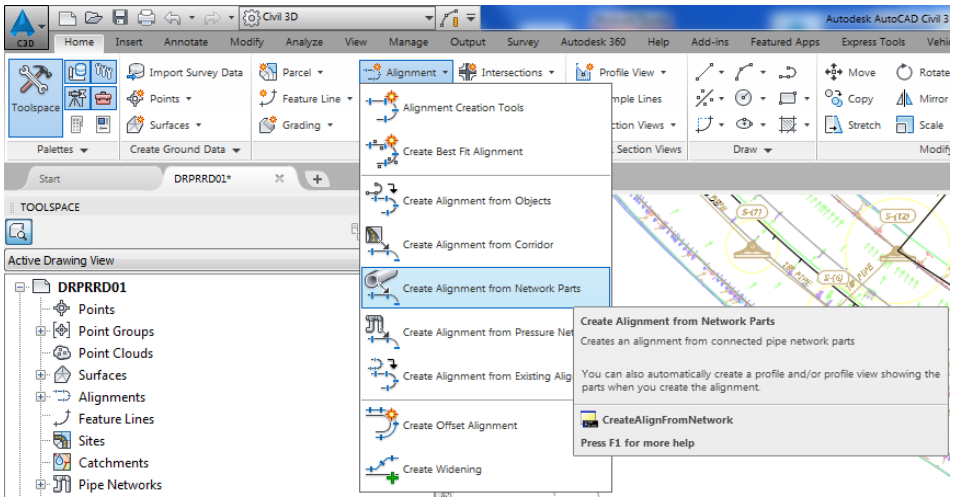
Run the Chapter 7 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 7.1 Create an Alignment and Profile View from Network Parts

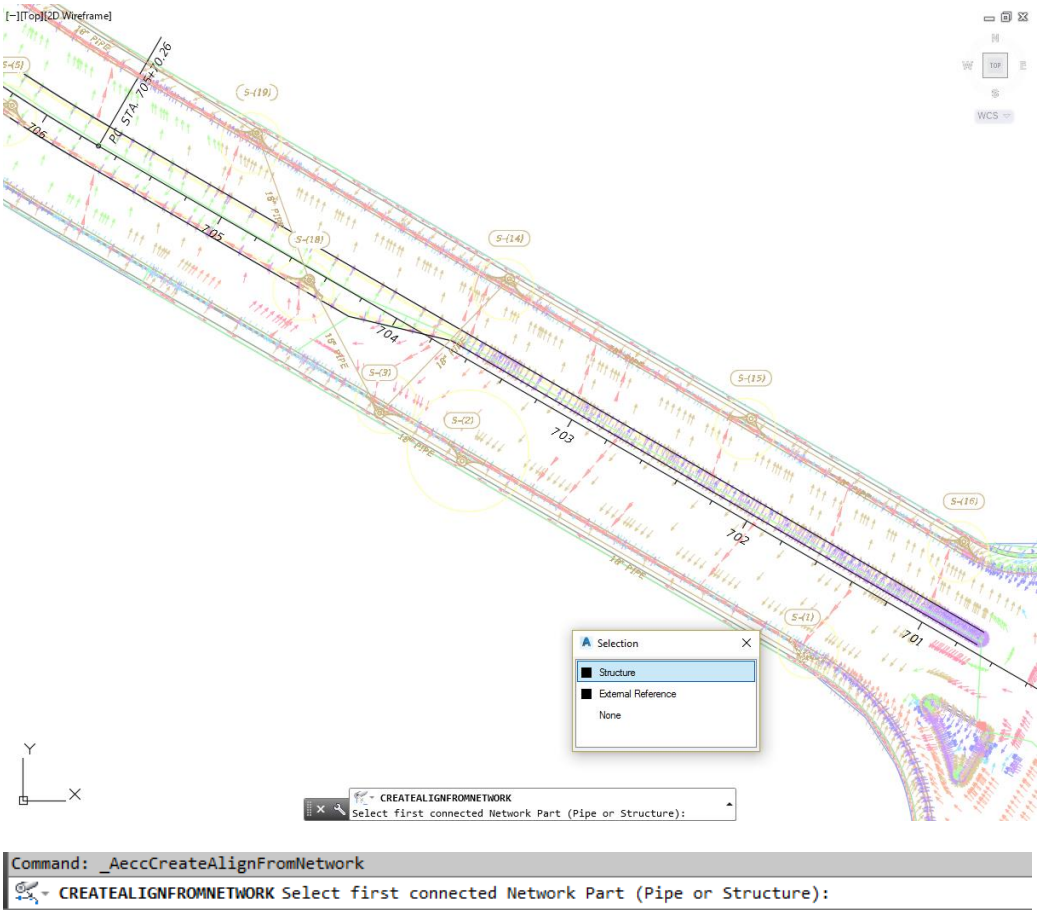
To generate profile views of the network parts you first create alignments. The next steps will show you how to do both from the wizards that are available.

1. Start the FDOT Civil 3D State Kit and open the *DRPRRD01.dwg* located in the Chapter 7 dataset drainage folder.



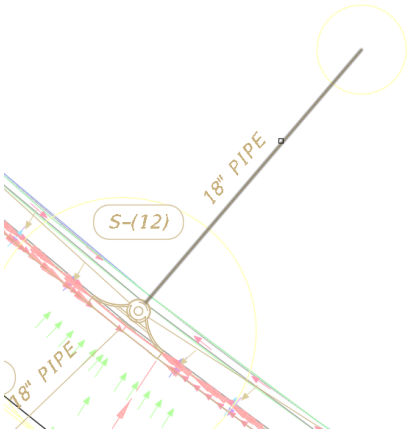
2. From the *Home tab > Create Design panel > Alignment drop down list*, select **Create Alignment from Network Parts**.

HINT When using this command click the first and last Network Part and the command will connect all the Network Parts in between.



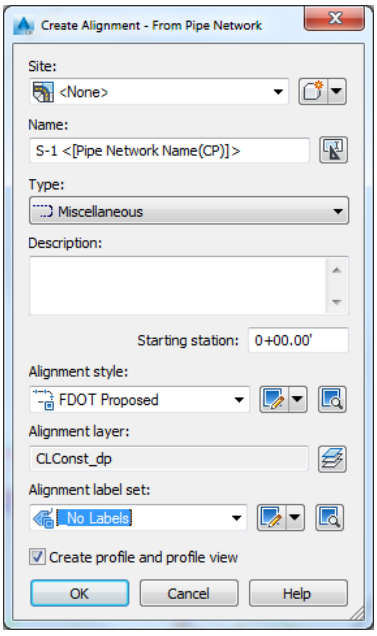
3. From the *command line* you are prompted to: *Select first connected Network Part (Pipe or Structure):* **Zoom** and **Pan** to the area of *structure* **S-(1),** and select *structure* **S-(1).**

4. With *selection cycling* toggled **On,** a Selection dialog box displays. From the Selection dialog box select **Structure**.

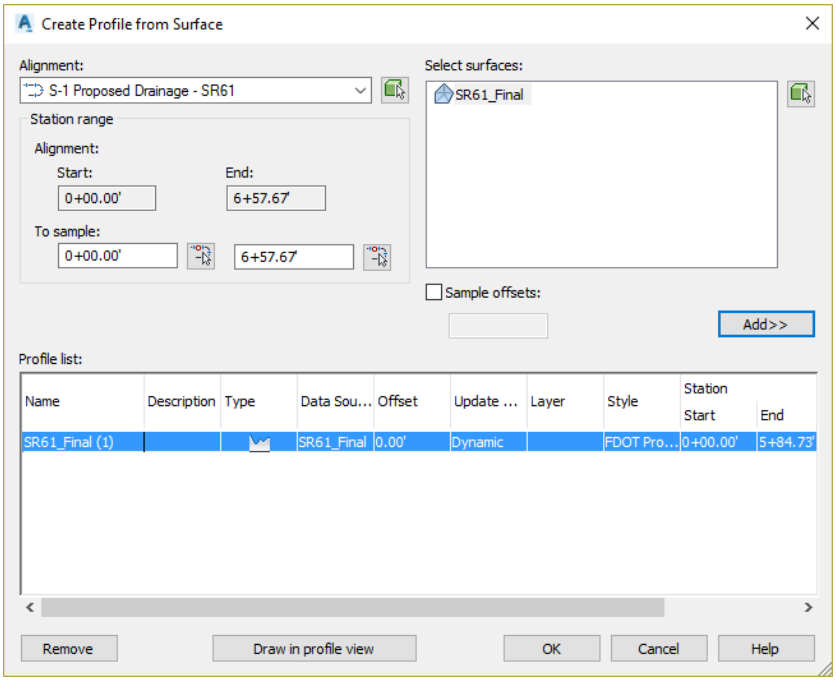


5. From the *command line* you are now prompted to: *Select next Network Part:* **Zoom** and **Pan** to the area of *structure* **S-(12)**, select **Pipe-(6)** the outgoing pipe which we refer to as the *Outfall* pipe. (Where the pipe empties into the proposed Drainage Pond.) Press **ENTER**.

Note Structures S-(1), S-(2), S-(3), S-(4), S-(13), S-(12), and the outfall pipe PIPE-(6) form the alignment geometry because they are connected.



6. From the **Create Alignment - From Pipe Network** dialog box:
   a. Set *Name:* to **S-1** <[Pipe Network Name(CP)]>
   b. Set *Alignment style:* from drop down list select **_No Labels**.
   c. Check **Create profile and profile view** box to enable.
   d. Leave all other settings unchanged.
   e. Click **OK** to close the Create Alignment – From Pipe Network dialog box.



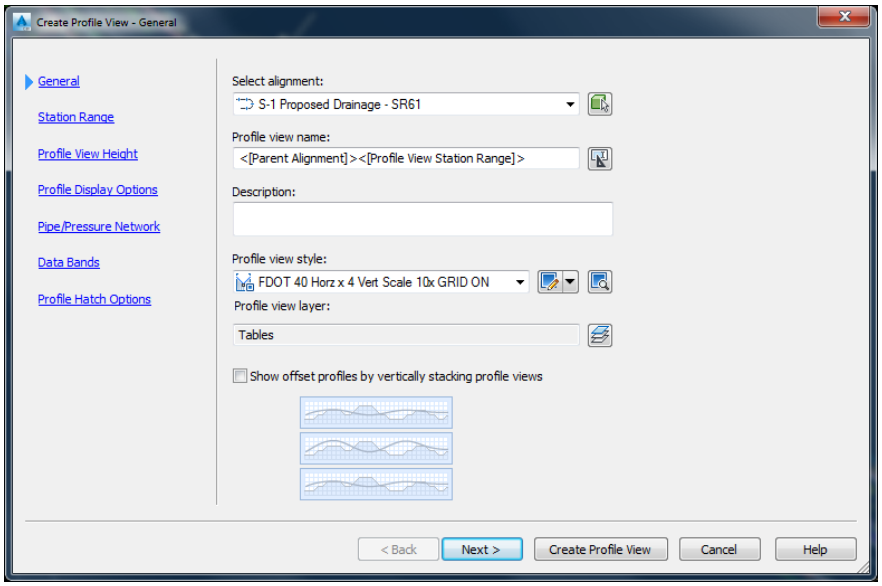
7. The Create Profile from Surface dialog box opens. Set *Alignment:* from drop down list select **S-1 Proposed Drainage – SR61**.

   a. **Select surfaces**: highlight **SR61_Final**.

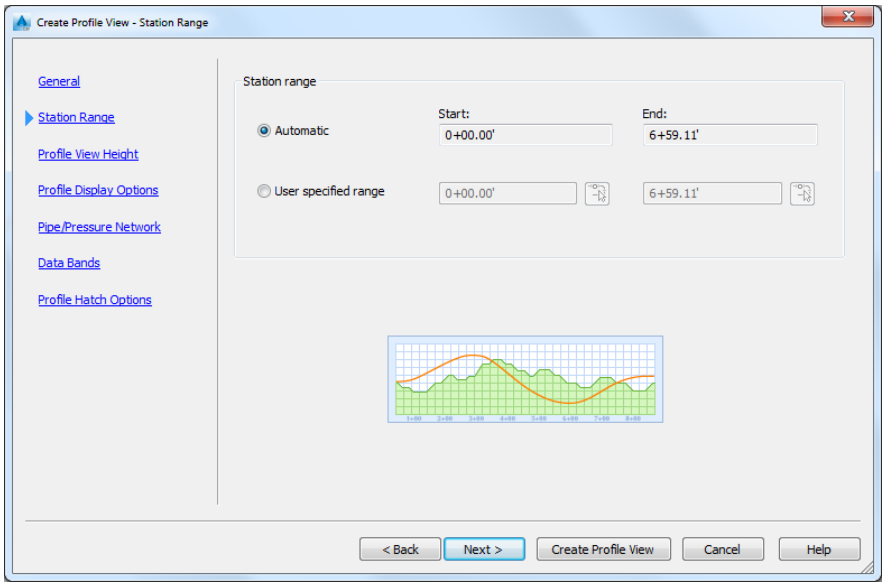
   b. Click the **Add** button (found on the middle right side). Profile list: populates with the newly defined surface profile content.

8. Click the **Draw in profile view** button at the bottom of this dialog box. This will launch the Create Profile View wizard.

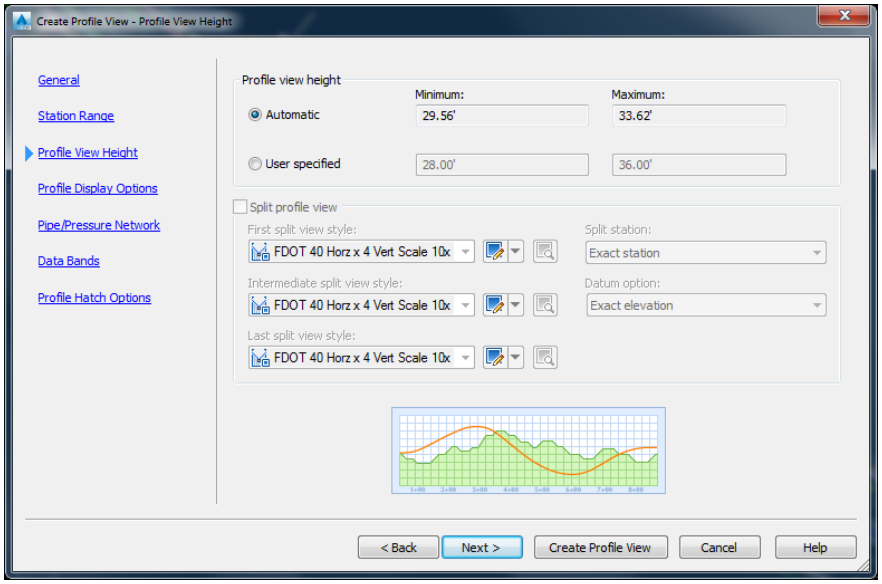
9. In the Create Profile View wizard visit each panel in the Create Profile View wizard setting the values as instructed then click the **Next** button to continue to the next panel in the wizard. The blue links on the left side display an arrow next to the current panel title being displayed.



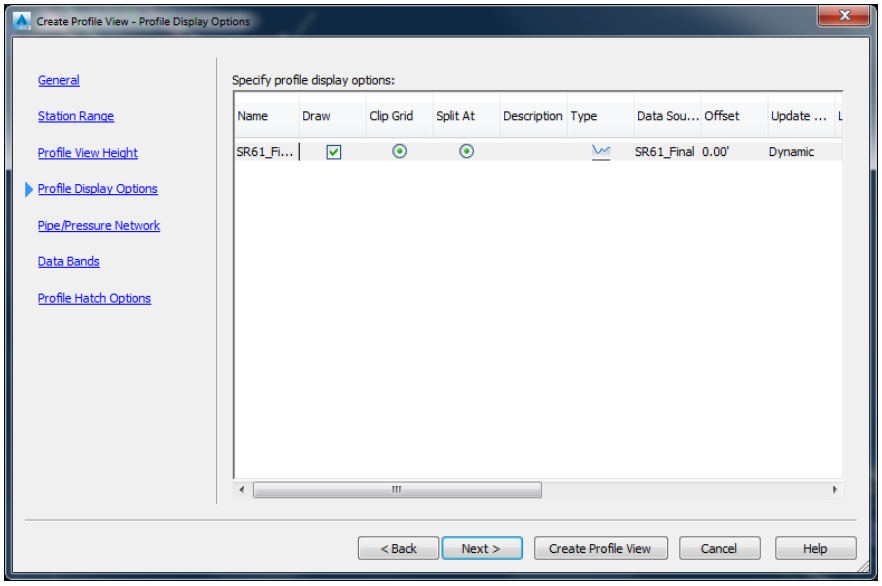
   a. *General panel:* from the *Profile view style*: drop down list select **FDOT 40 Horz x Vert Scale 10x GRID ON**, then click the **Next** > button.



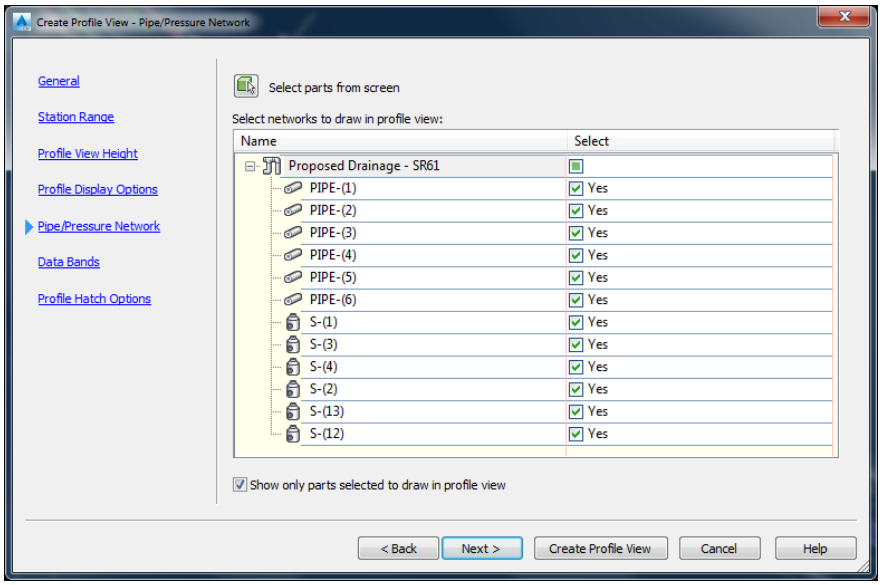
   b. *Station Range panel:* leave as default, then click the **Next** > button.



c. *Profile View Height panel:* leave as default, then click the **Next >** button.

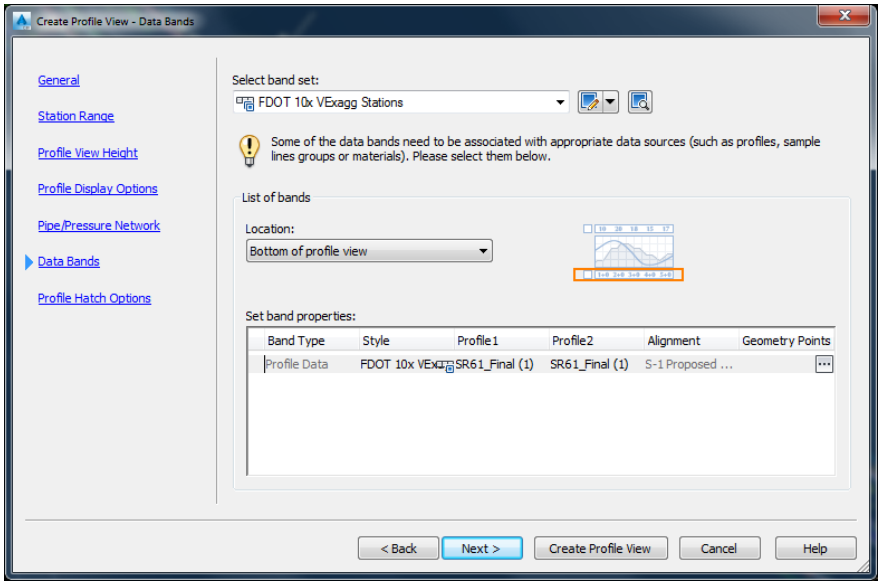


d. *Profile Display Options panel:* leave as default, click the **Next >** button.

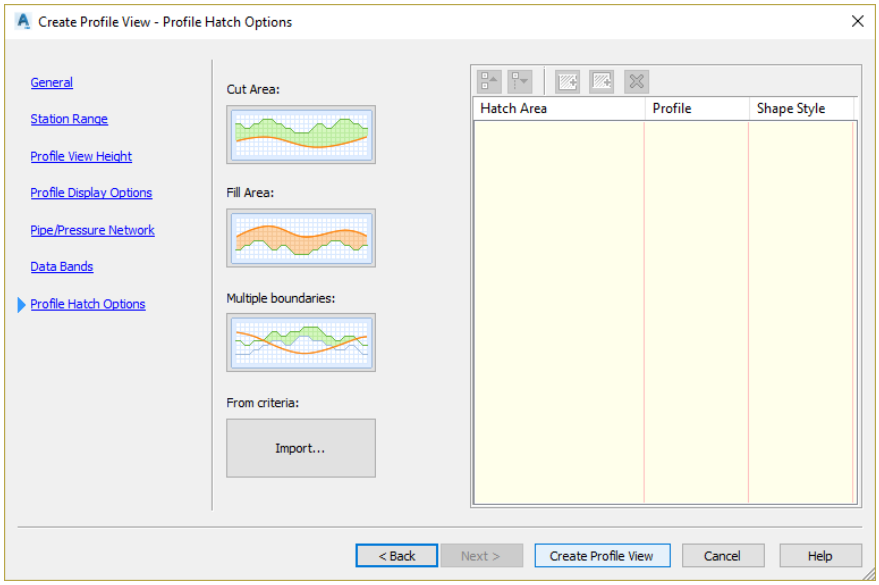


e. *Pipe/Pressure Network panel*: lists the pipes and structures to be displayed in the profile view.

- *Select* column - keep all the checkbox's checked.
- Keep checked the **Show only parts selected to draw in profile view** box.
- Click the **Next >** button.

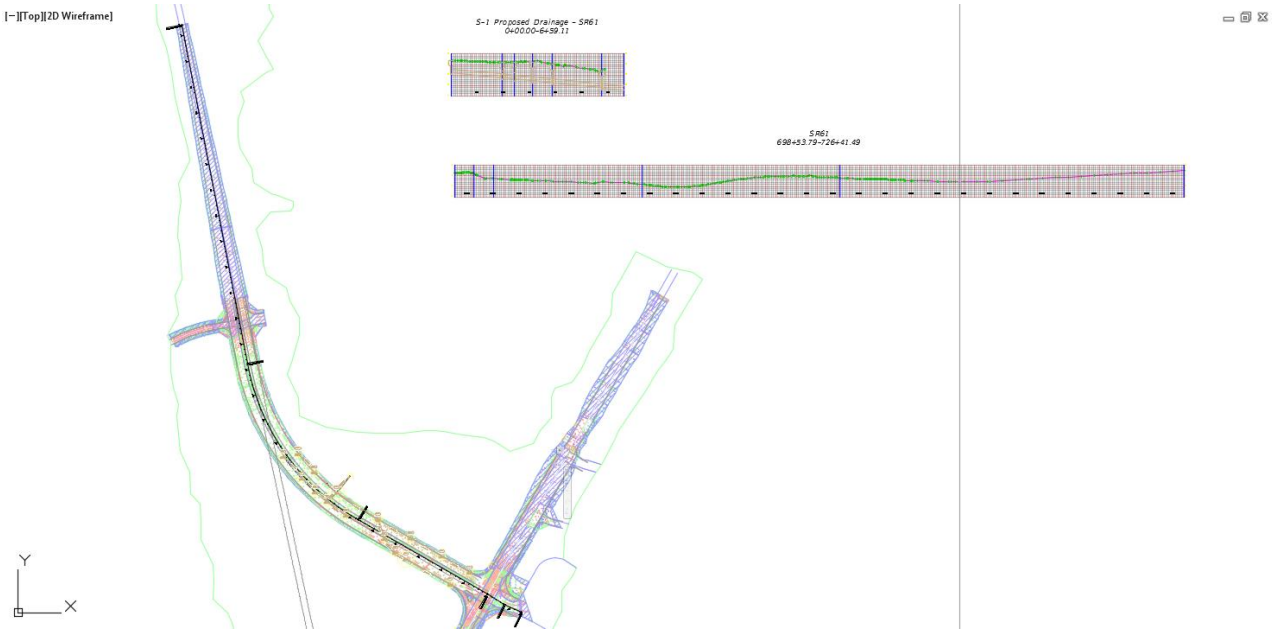


f. *Data Bands panel*: from the *Select band set: drop down list*, select **FDOT 10x VExagg Stations** style, then click the **Next >** button.



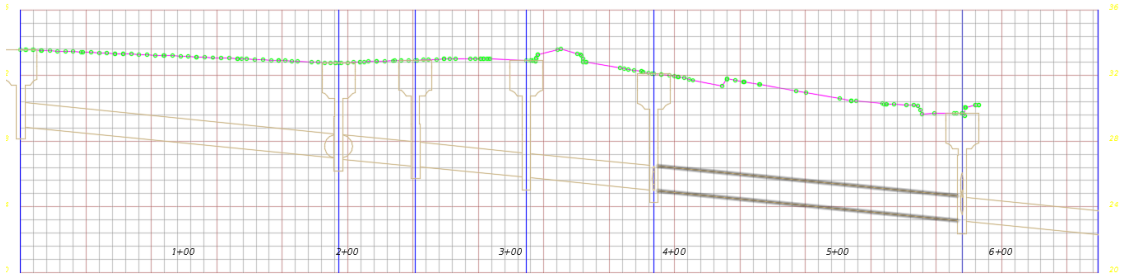
g. *Profile Hatch Options panel:* leave as default.

10. Click the **Create Profile View** button.



11. In Model space pick the *insertion point* for the **S-1 Proposed Drainage - SR61 Profile View**. The insertion point is the lower left corner of the Profile View grid. Place the **S-1 Proposed Drainage - SR61 Profile View** above the **SR61 Profile View**. Your drawing should look like the above image.

S-1 Proposed Drainage – SR61
0+00.00-6+59.11



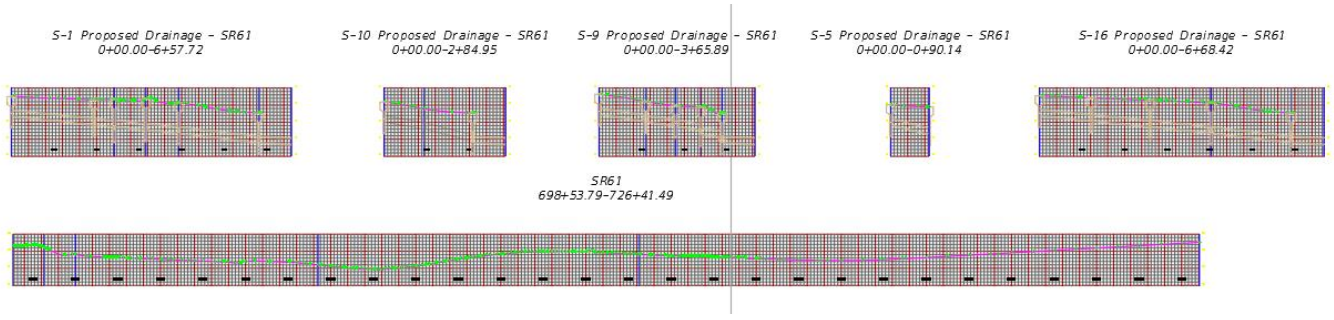
12. **Zoom** in to display **S-1 Proposed Drainage – SR61 Profile View**. The SR61 Surface Profile and the Proposed Drainage – SR61 Pipe Network objects for the S-1 Proposed Drainage – SR61 alignment are displayed in the S-1 Proposed Drainage - SR61 Profile View.
13. **Save** the file before continuing.

➢ *Create an Alignment & Profile View for the Following Network Parts*

Using steps above, create an alignment along with a profile view and place them in model space for the following Network Parts. Save the file after each Profile View is placed.

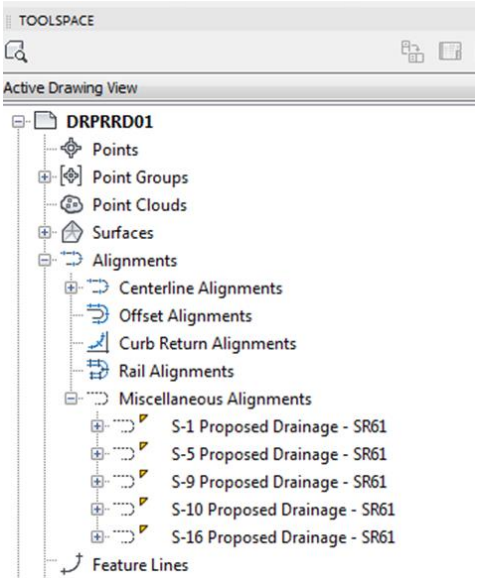
Alignment Path	Parts Included
From S-(10) to Outfall Pipe (6)	S-(10), S-(11), S-(12), Outfall Pipe (6)
From S-(9) to Outlet Pipe (6)	S-(9), S-(8), S-(7), S-(6), S-(12), Outfall Pipe (6)
From S-(5) to S-(6)	S-(5), S-(6)
From S-(16) to Outfall Pipe (6)	S-(16), S-(15), S-(14), S-(12), Outlet Pipe (6)

The drawing should look like the image below:



➢ *Review Miscellaneous Alignments*

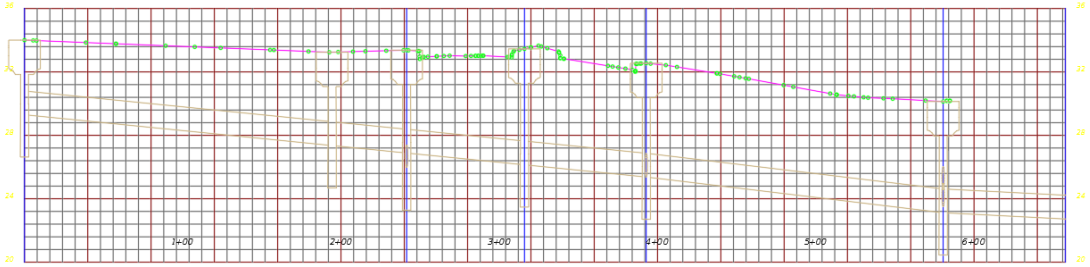
Looking in Prospector under the Misc. Alignments you can see the list of Alignments that were just created. You can also expand the list to see the profiles that you created.



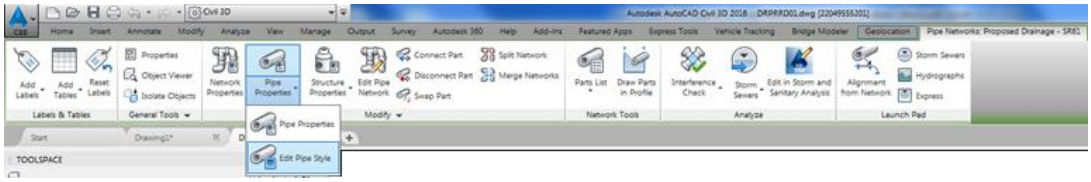
Exercise 7.2 Modify the Pipe Style for FDOT the Drainage Style

The next steps will show you how to modify the Pipe Style for the FDOT Drainage style.

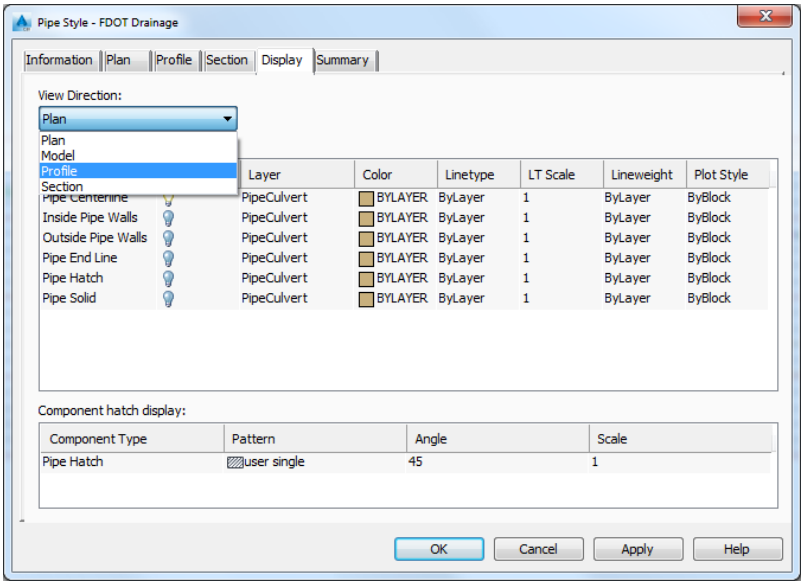
S-1 Proposed Drainage – SR61
0+00.00–6+57.72



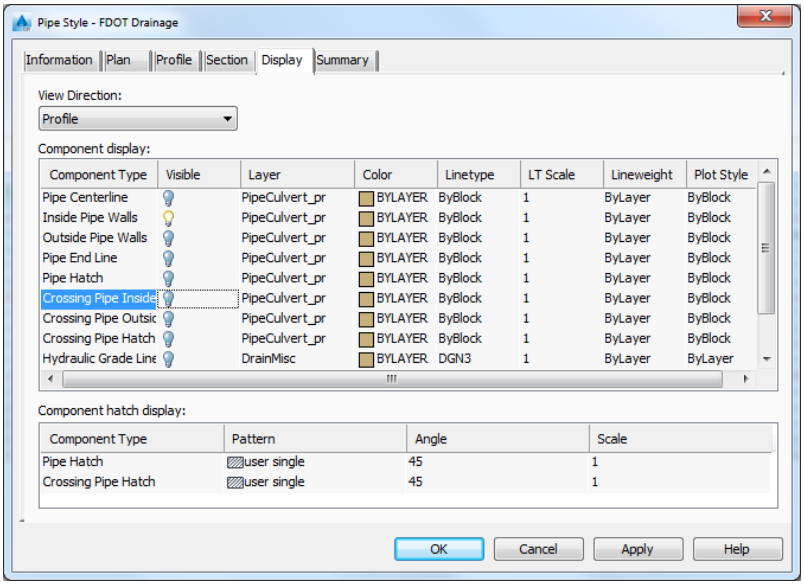
1. **Zoom** and **Pan** to display the **S-1 Proposed Drainage - SR61 Profile View.**
2. The semi-circles that appear next to each structure in the Profile View can be turned **Off** in the Pipe style.
3. In the *S-1 Proposed Drainage - SR61 Profile View* select **PIPE-(1)**.
4. With *selection cycling* toggled **On,** a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**. The context sensitive ribbon displays a **Pipe Network Proposed Drainage - SR61** tab.



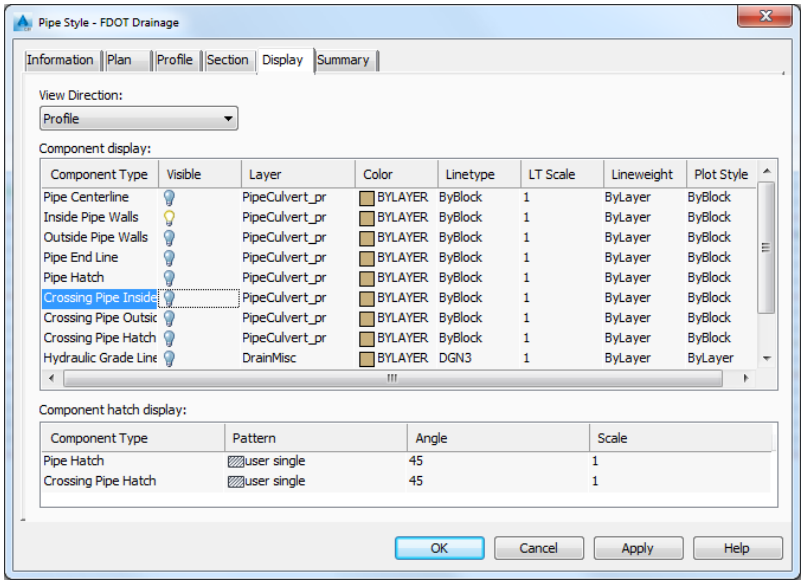
5. From the *Modify panel* > *Pipe Properties* dropdown, select **Edit Pipe Style**.



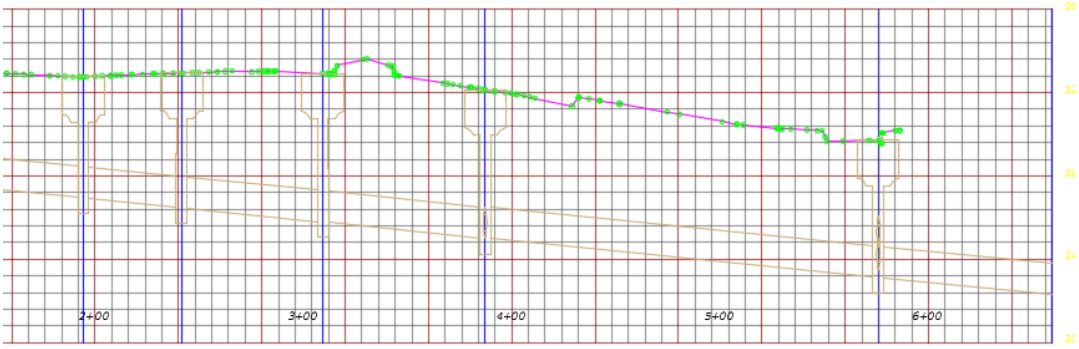
6. From the Pipe Style - FDOT Drainage dialog box > *Display tab* > *View Direction: drop down list*, select **Profile.**



7. Toggle **Off** the *Crossing Pipe Inside* component. A dark light bulb indicates component status is off.



8. Click **Apply,** then click **OK** to close the Pipe Style - FDOT Drainage dialog box.



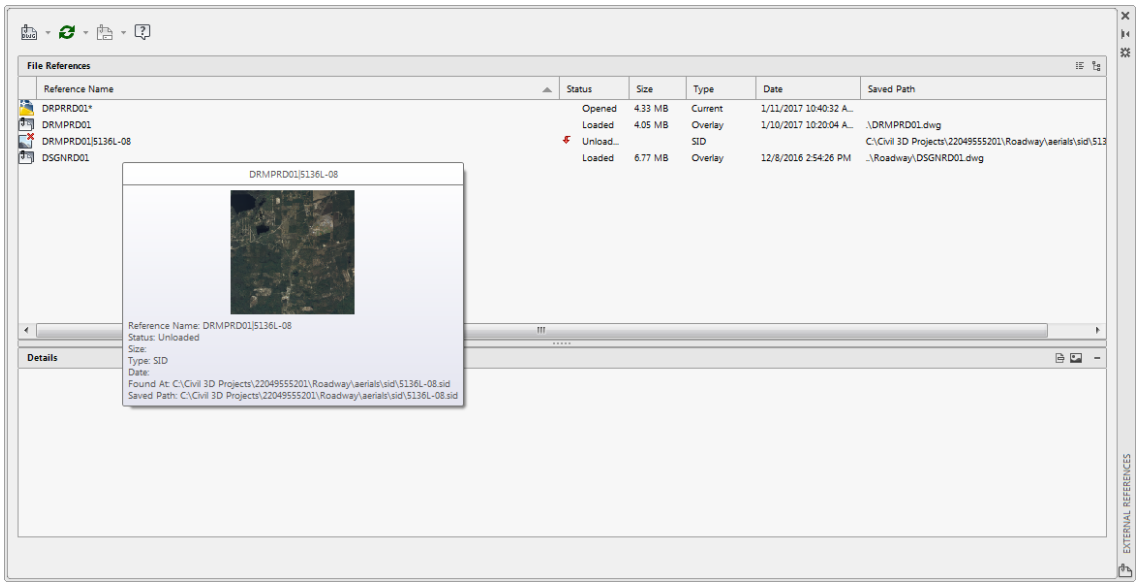
9. Press the **ESC** key to clear grips. The pipes now have a cleaner appearance where they intersect with the structures in the Profile View.
10. **Zoom** and **Pan** to display all the **Proposed Drainage - SR61 Profile Views.**

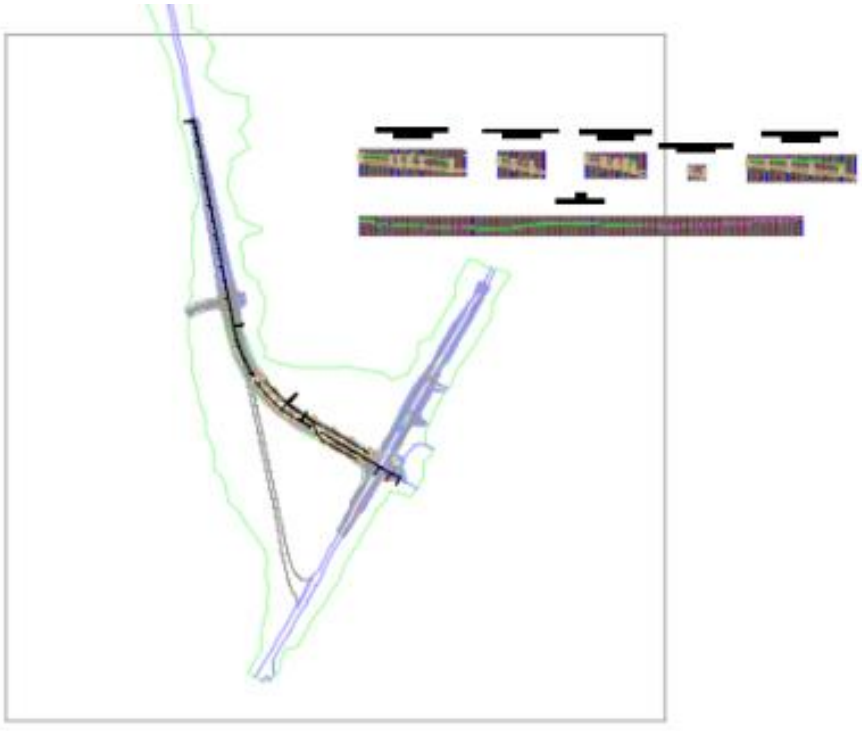
Note This change in the Pipe Style - FDOT Drainage settings applies to all pipes using this style in all the Profile Views.

Exercise 7.3 Freeze the ImageAttachment_dp Layer

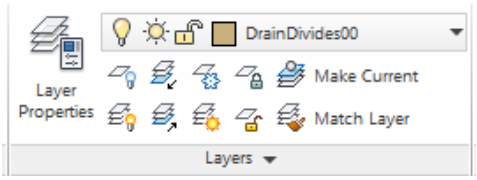
The next steps will show you how to freeze the DRMPRD01|ImageAttachment_dp layer.

There is an issue you need to address. When working in the *DRMPRD01.dwg* file, the *5136L-08.sid* image was unloaded and the *DRMPRD01.dwg* file was saved. Now you have attached the *DRMPRD01.dwg* as an XREF and a rectangle now displays in the *DRPRRD01.dwg* on the *DRMPRD01|ImageAttachment_dp* layer.

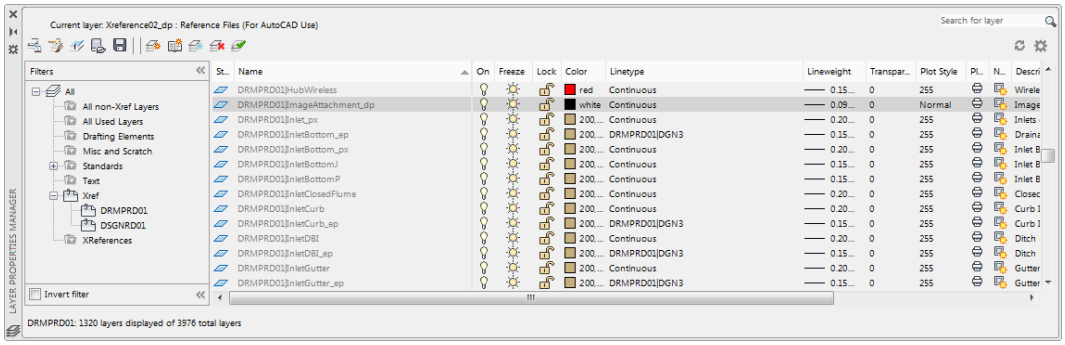




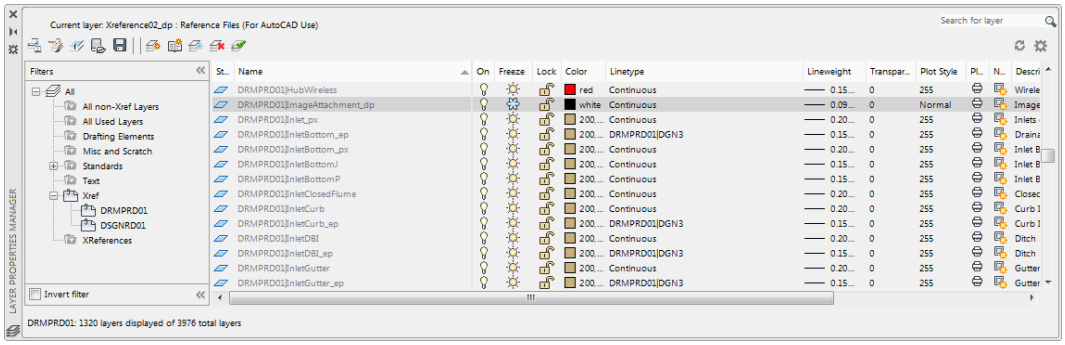
1. **Zoom** Extents to display project.



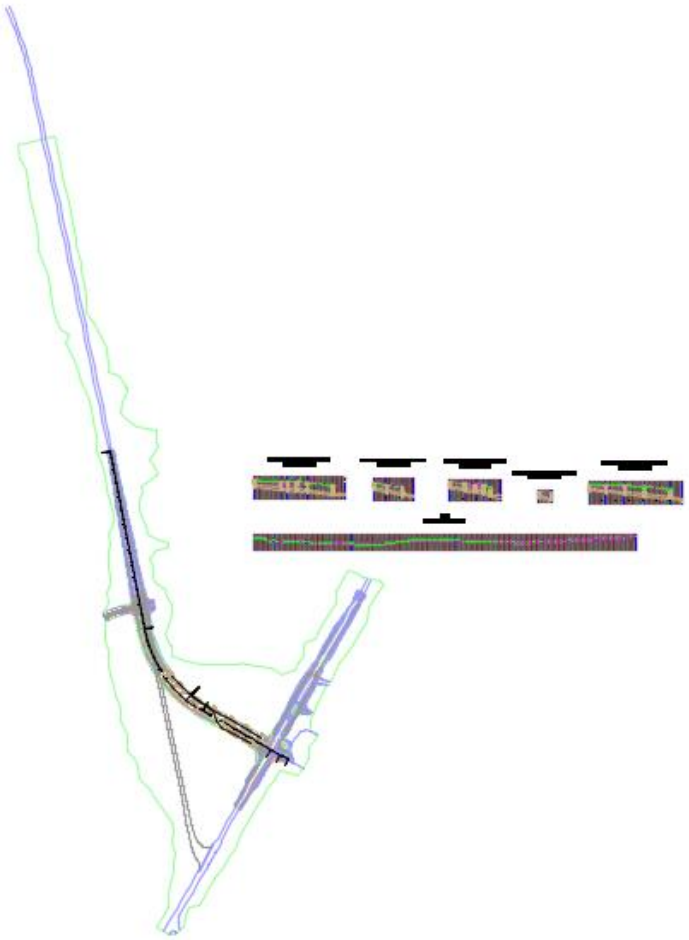
2. From the *Home tab* > *Layers panel*, select **Layer Properties** to open the Layer Properties Manager tool palette.



3. From the Layer Properties Manager tool palette, use the scroll bar to find the **DRMPRD01|ImageAttachment_dp** layer.



4. From the *Freeze* column, click on yellow **Sun** icon to freeze the **DRMPRD01|ImageAttachment_dp** layer changing the icon to a blue **Snowflake** icon.
5. **Close** the Layer Properties Manager tool palette.



6. The rectangle is no longer displayed and the Proposed Drainage – SR61 pipe network is ready for review.
7. **Save** and **Close** the file.

8 EDITING PIPE NETWORK

DESCRIPTION

Review and revision cycles are a normal part of any project. In this chapter, we have a list of comments from our drainage engineer requesting changes to your design. You will respond to those comments by making changes to your design. In this chapter, you will edit pipe network parts in Plan View by adding and deleting structures and pipes. You will also delete alignments that are no longer needed.

OBJECTIVES

In this chapter, you will learn about:

- Pipe Network Editing Tools
- Deleting Structures and Pipes
- Adding Structures and Pipes
- Deleting and Editing Alignments

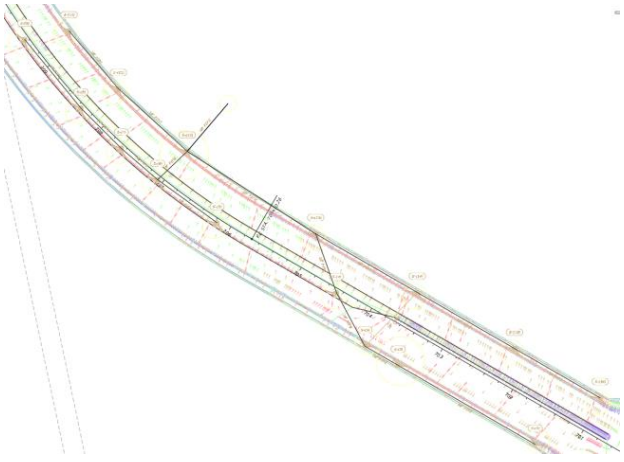
CHAPTER SETUP

Run the Chapter 8 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 8.1 Editing Inlet Placements

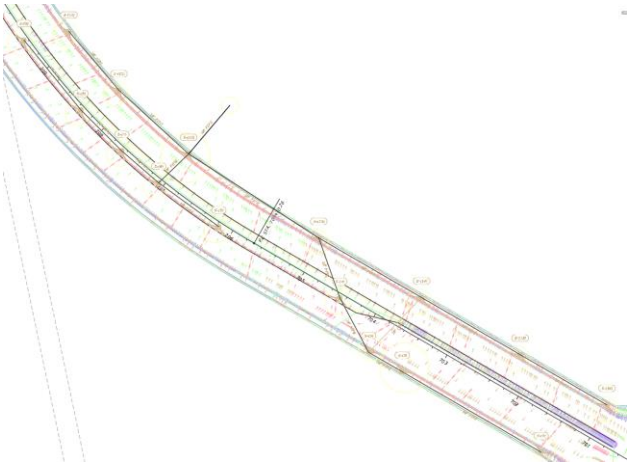
1. Start the FDOT Civil 3D State Kit and open the *DRPRRD01.dwg* located in the Chapter 8 dataset drainage folder.
2. With the drawing file open type in **Save as** re-name the new file ***DRPRRD02.dwg*** and save in the same *drainag*e folder.
3. As shown in previous steps, associate the drawing file to the **22049555201 Project** by right clicking on the *Data Shortcut* working folder and selecting **Associate Project to Current Drawing.**



Exercise 8.2 Review Drainage Engineer's Comments

After the design review, the drainage engineer wants to make some design changes. These are the design comments from the engineer:

- "Do not run parallel trunk lines. Keep one trunk line on one side of the road and eliminate the other."
- "Shorten the overall length of pipe runs."
- "Eliminate S-(14) and S-(15) and move the S-(13) to the same station as S-(3)."



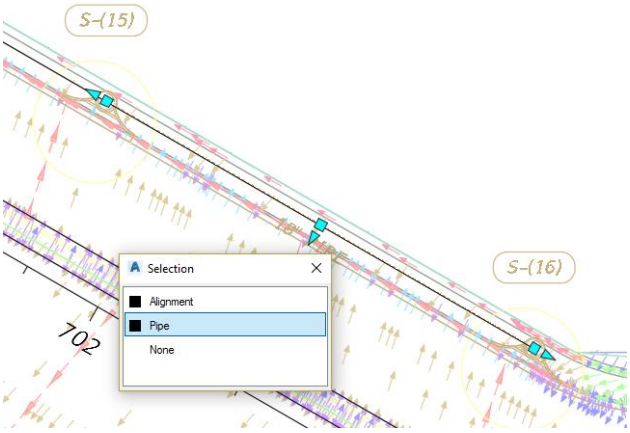
1. **Zoom** and **Pan** to display the area of the **Proposed Drainage – SR61 Pipe Network**.

➢ *Delete Pipes*

The next steps will show you how to delete Pipes connected to Structures from the Proposed Drainage – SR61 pipe network.

Note Turn on Selection Cycling to make sure that you are selecting Pipes and not Alignments.

1. Delete PIPE:



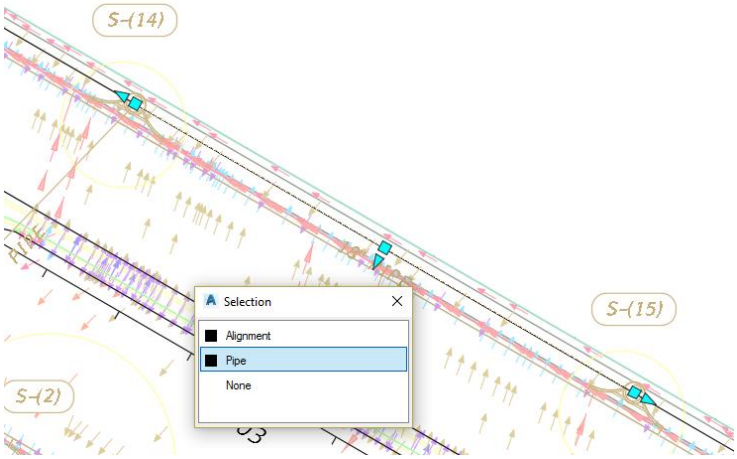
a. **Zoom** and **Pan** to the area of *structure* **S-(16).**

b. Select **18" PIPE** between *structure S-(16)* and *structure S-(15).*

c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.**

d. Press **DELETE**.

2. Delete PIPE:

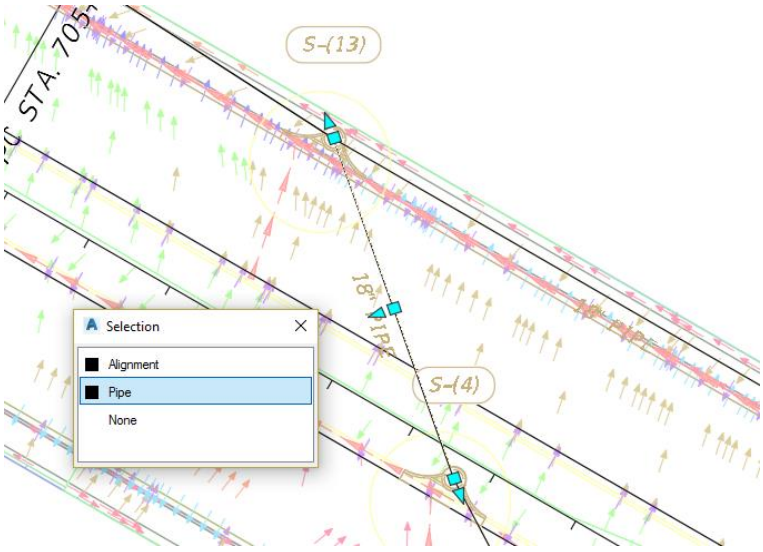


a. **Zoom** and **Pan** to the area of *structure* **S-(15).**

b. Select **18" PIPE** between *structure S-(15)* and *structure S-(14).*

c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.** Press **DELETE**.

3. Delete PIPE:



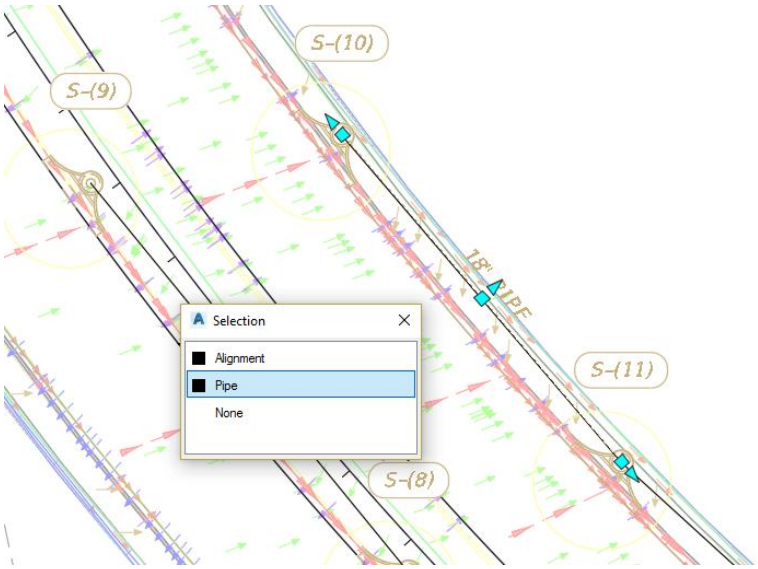
a. **Zoom** and **Pan** to the area of *structure* **S-(4).**

b. Select **18" PIPE** between *structure S-(4)* and *structure S-(13).*

c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.**

d. Press **DELETE**.

4. Delete PIPE:



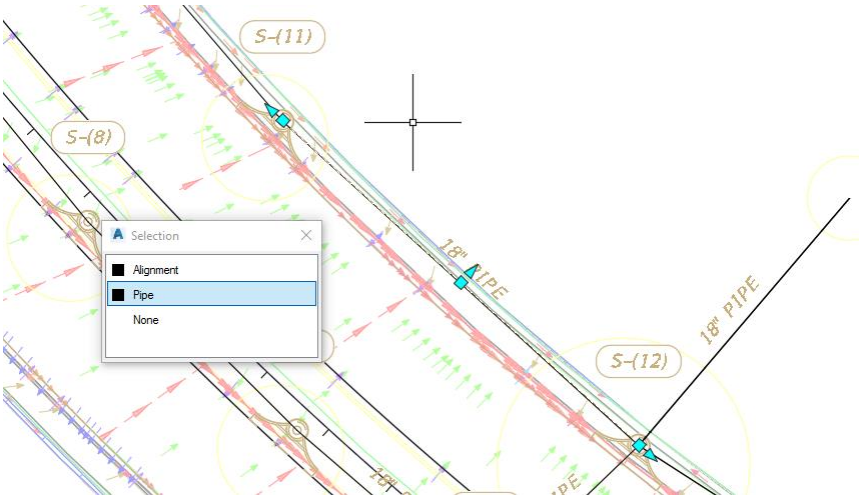
a. **Zoom** and **Pan** to the area of *structure* **S-(10).**

b. Select **18" PIPE** between *structure S-(8)* and *structure S-(9).*

c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.**

d. Press **DELETE**.

5. Delete PIPE:



a. **Zoom** and **Pan** to the area of *structure* **S-(11).**

b. Select **18" PIPE** between *structure S-(7)* and *structure S-8).*

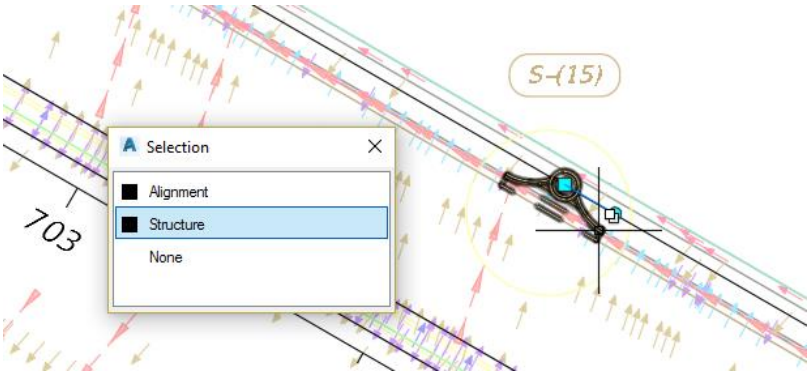
c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.**

d. Press **DELETE**.

➢ *Delete Inlets*

The next steps will show you how to delete Inlets structures from the Proposed Drainage – SR61 Pipe Network.

1. Delete S-(15) Inlet:



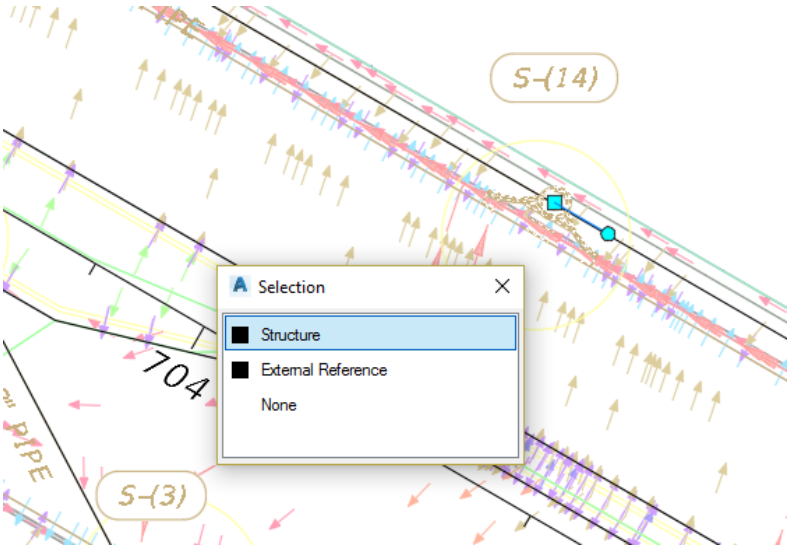
   a. **Zoom** and **Pan** to the area of *structure* **S-(15).**

   b. Select *structure* **S-(15).**

   c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Structure**.

   d. Press **DELETE.**

2. Delete S-(14) Inlet:



   a. **Zoom** and **Pan** to the area of *structure* **S-(14).**

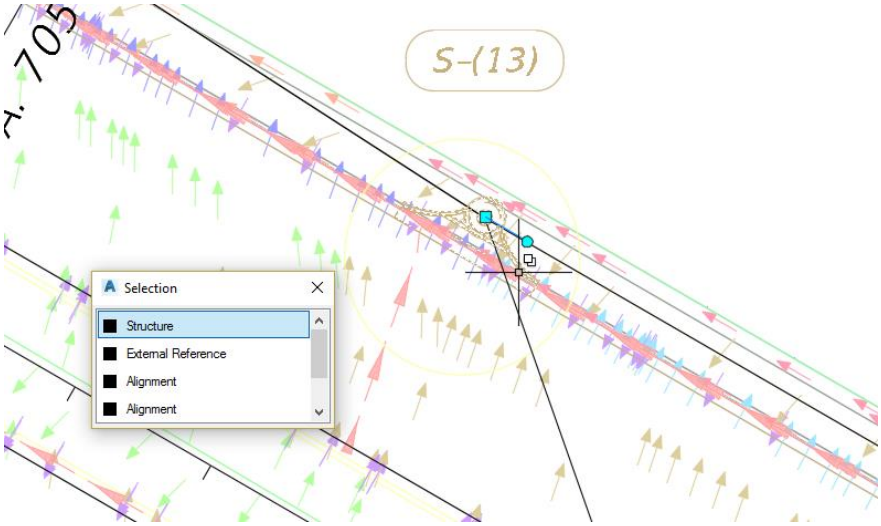
   b. Select *structure* **S-(14).**

   c. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Structure**.

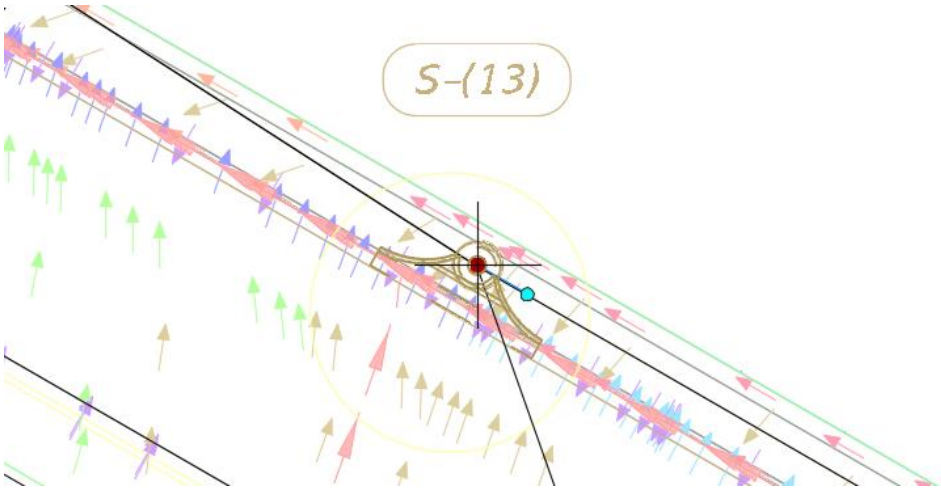
   d. Press **DELETE**.

➢ *Move Inlets*

The next steps will show you how to move S-(13) Inlet structure from the Proposed Drainage – SR61 Pipe Network.



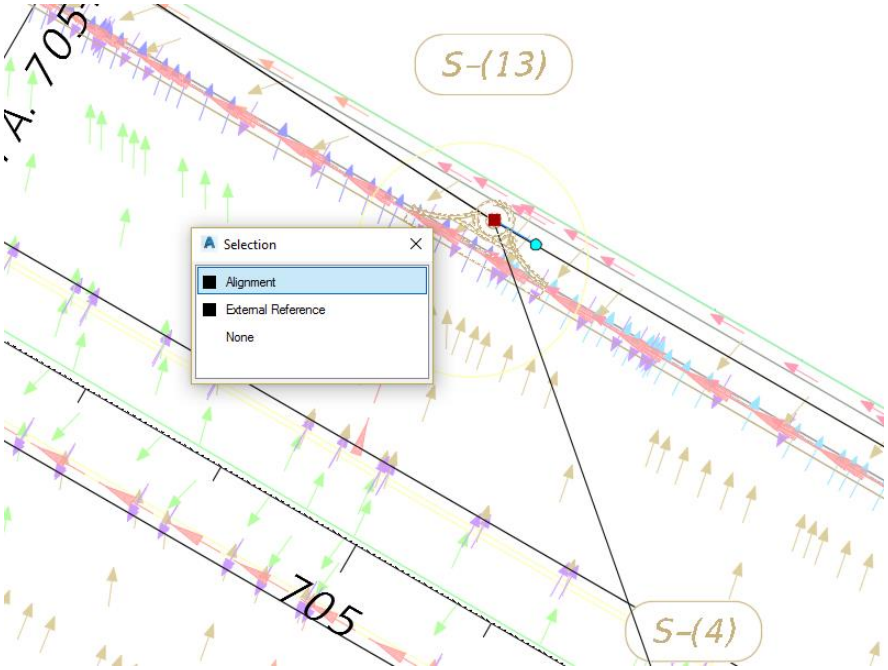
1. **Zoom** and **Pan** to the area of *structure* **S-(13).**
2. Select *structure* **S-(13).**
3. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Structure.**



4. Click the square **Location grip**.

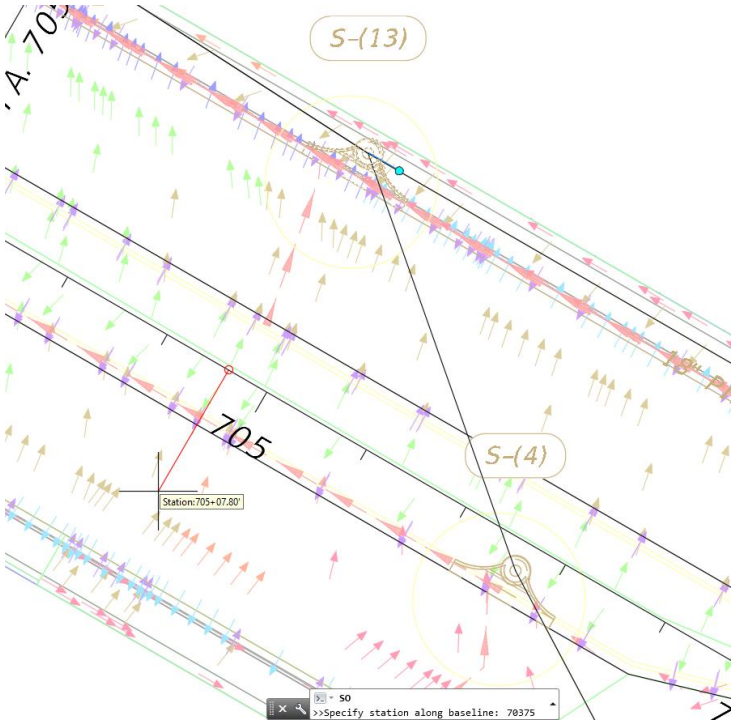
```
** STRETCH **
Specify stretch point or [Base point Copy Undo eXit]: 'SO
```

5. From the *command line* type **'SO**, then press the **ENTER** key to start the *Transparent Station Offset* command.



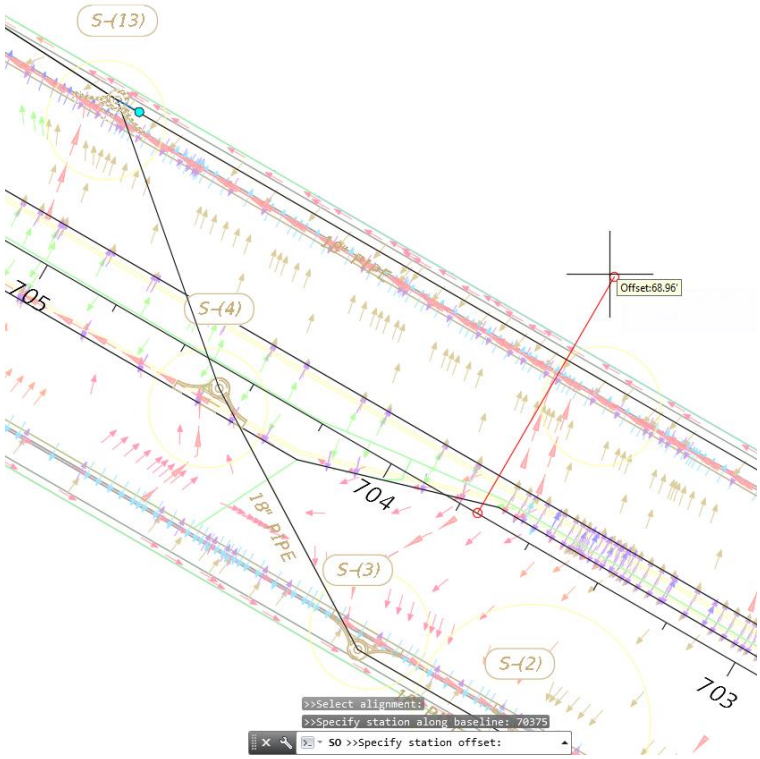
SO >>Select alignment:

6. The command line prompts: Select alignment: select the **SR61** alignment**.**
7. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Alignment.**

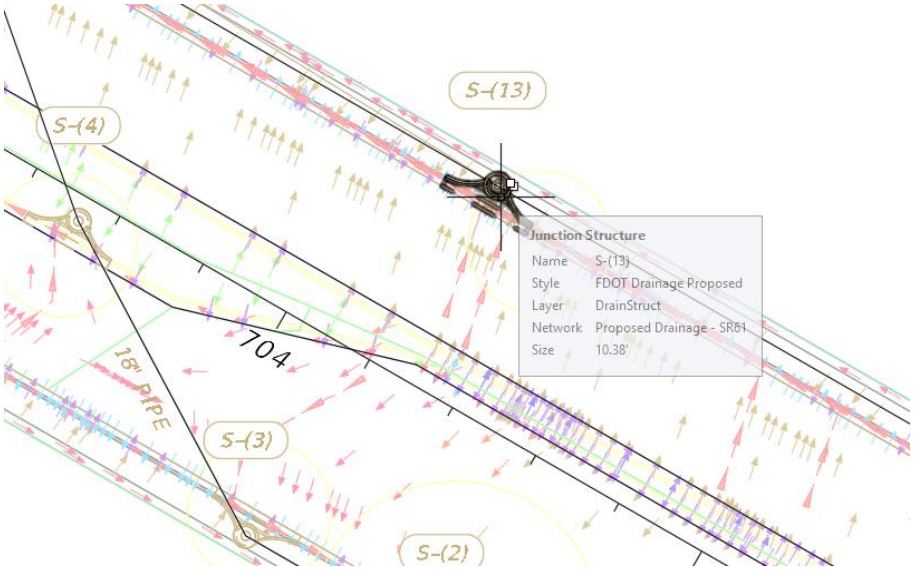


SO >>Specify station along alignment: 70375

8. The *command line* prompts: *Specify station along alignment:* Type **70375** to move the structure S-(13) inlet to *Station 703+75*, then press **ENTER**.



9. Drag sliding red line above the *SR61 Alignment* as shown above.
10. The *command line* prompts: *Specify station offset:* Type **44.8**, then press **ENTER**.



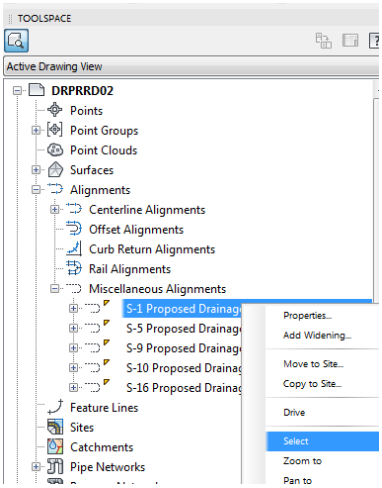
11. The **S-(13) Inlet** has been moved to *Station 703+75*.
12. Press the **ESC** key to clear the grips.
13. **Save** the *DRPRRD02.dwg* file.

Exercise 8.3 Delete Alignments

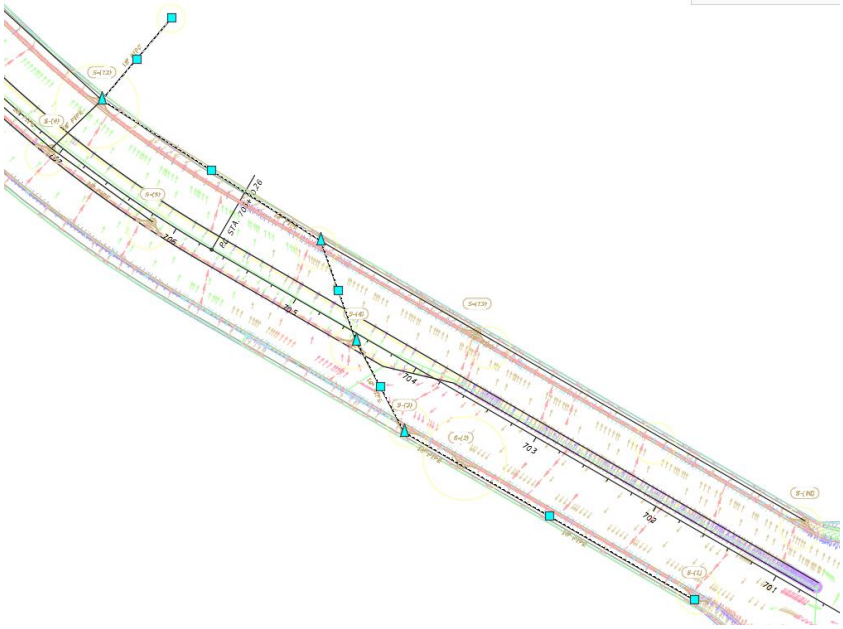
The next steps will show you how under the Miscellaneous Alignments collection to delete the Proposed Drainage - SR61 alignments that have been created.

With the review and comments from the Drainage Design Engineer, there are enough changes to the design where it will be easier to delete the alignments and create new alignments again from Network Parts.

➢ *Delete the S-1 Proposed Drainage - SR61 Alignment*

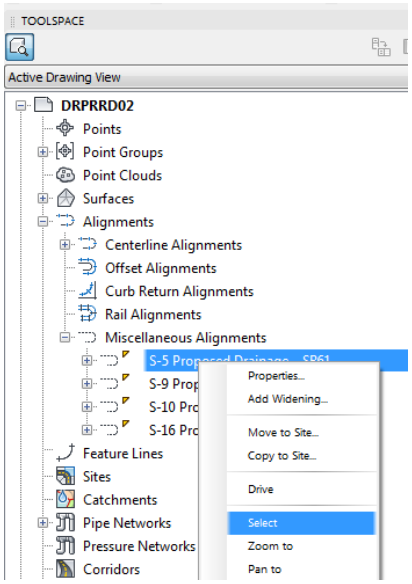


1. From the *TOOLSPACE > Prospector tab*, expand *Alignments*, expand **Miscellaneous Alignments**, right-click on **S-1 Proposed Drainage - SR61 Alignment**, then choose **Select.**

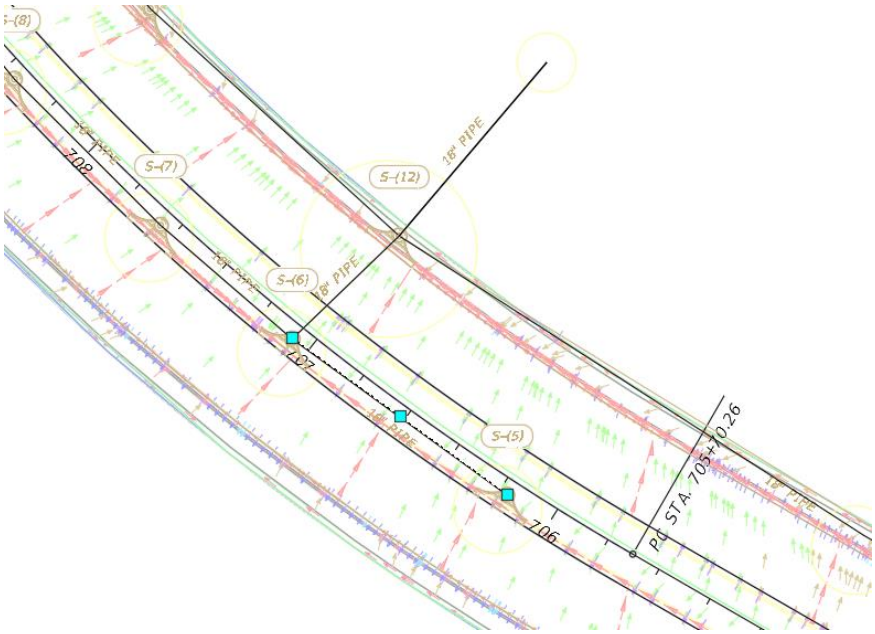


2. **Zoom** and **Pan** to display the **S-1 Proposed Drainage - SR61Alignment**.
3. Press **DELETE**.

➢ ***Delete the S-5 Proposed Drainage - SR61 Alignment***

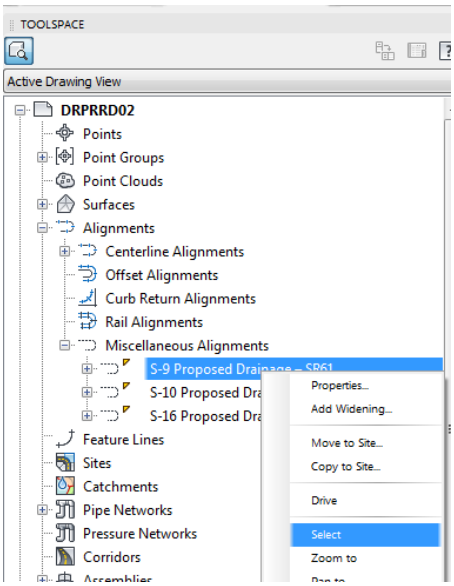


1. Select **S-5 Proposed Drainage - SR61alignment**, right-click then choose **Select.**



2. **Zoom** and **Pan** to display the **S-5 Proposed Drainage - SR61 Alignment.**
3. Press **DELETE**.

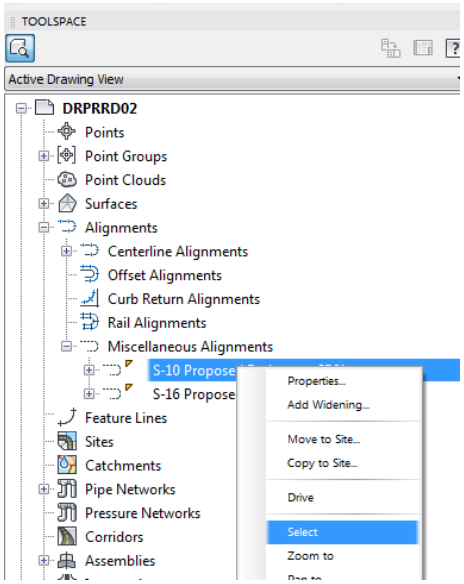
➢ ***Delete the S-9 Proposed Drainage - SR61 alignment***



1. Select **S-9 Proposed Drainage - SR61alignment**, right-click then choose **Select**.

2. **Zoom** and **Pan** to display the **S-9 Proposed Drainage - SR61 Alignment.**
3. Press **DELETE**.

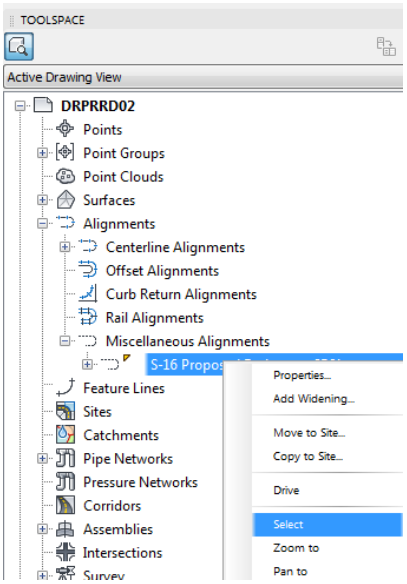
➢ ***Delete the S-10 Proposed Drainage - SR61 alignment***



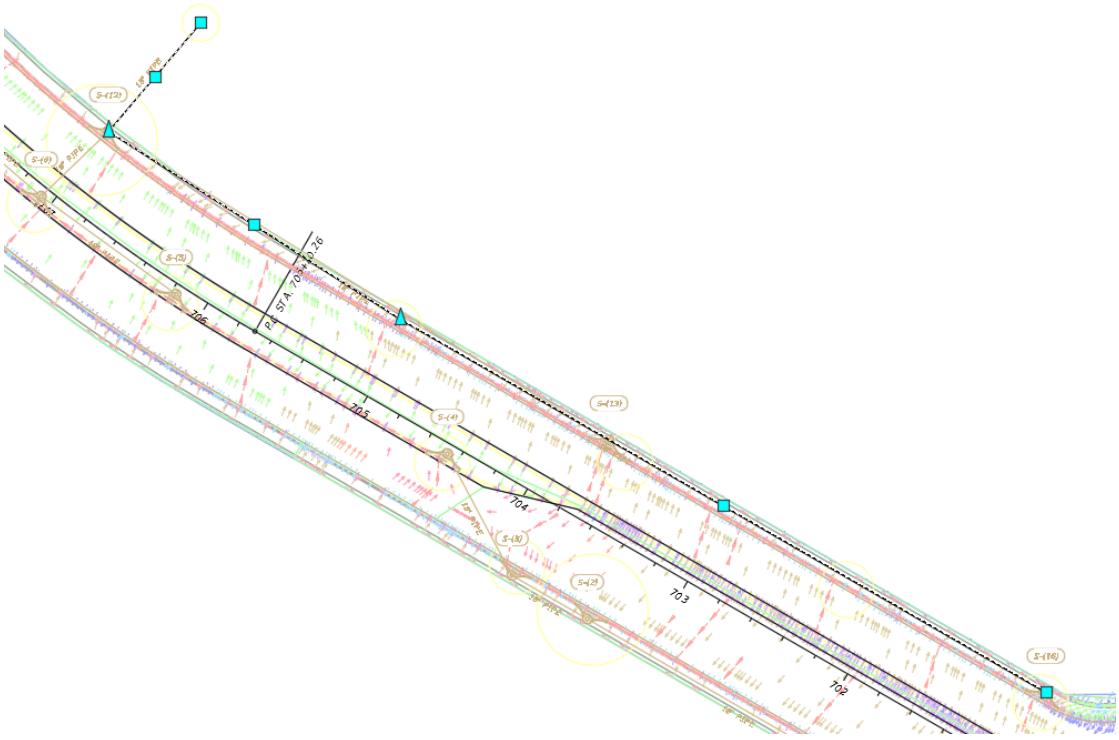
1. Select **S-10 Proposed Drainage - SR61alignment**, right-click then choose **Select.**

2. **Zoom** and **Pan** to display the **S-10 Proposed Drainage - SR61 Alignment**
3. Press **DELETE**.

➢ ***Delete the S-16 Proposed Drainage - SR61 alignment***



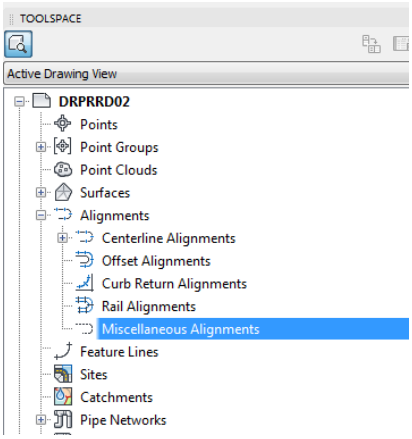
1. Select **S-16 Proposed Drainage - SR61alignment**, right-click then choose **Select.**



2. **Zoom** and **Pan** to display the **S-16 Proposed Drainage - SR61 Alignment.**
3. Press **DELETE**.

➢ *Review Miscellaneous Alignments*

The next steps will show you how to review the Miscellaneous Alignments collection

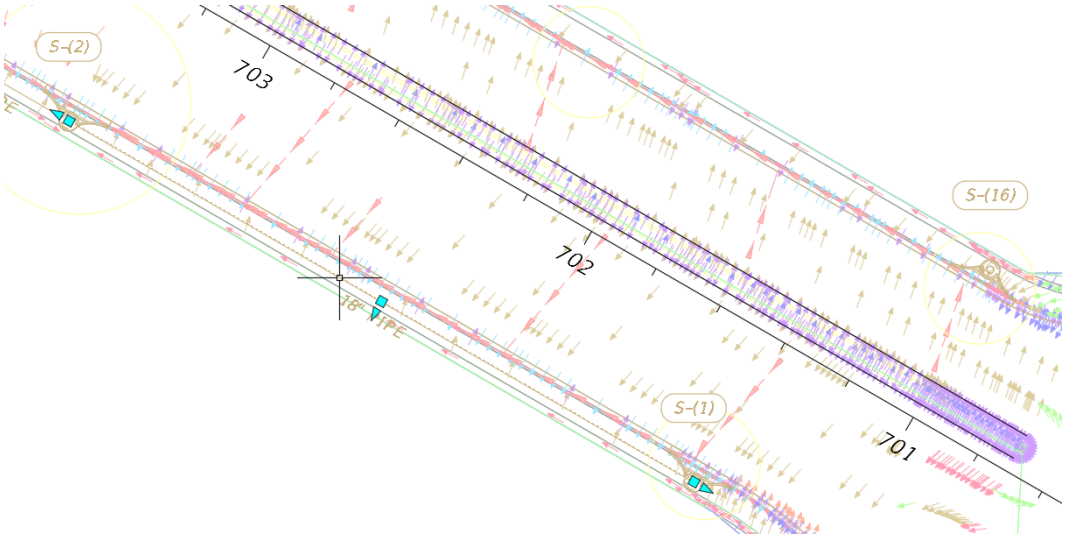


1. From *TOOLSPACE* > *Prospector tab* > *Alignments* > *Miscellaneous Alignments*, review alignments. All of the *Proposed Drainage - SR61 alignments* have been deleted
2. **Save** the *DRPRRD02.dwg* file:

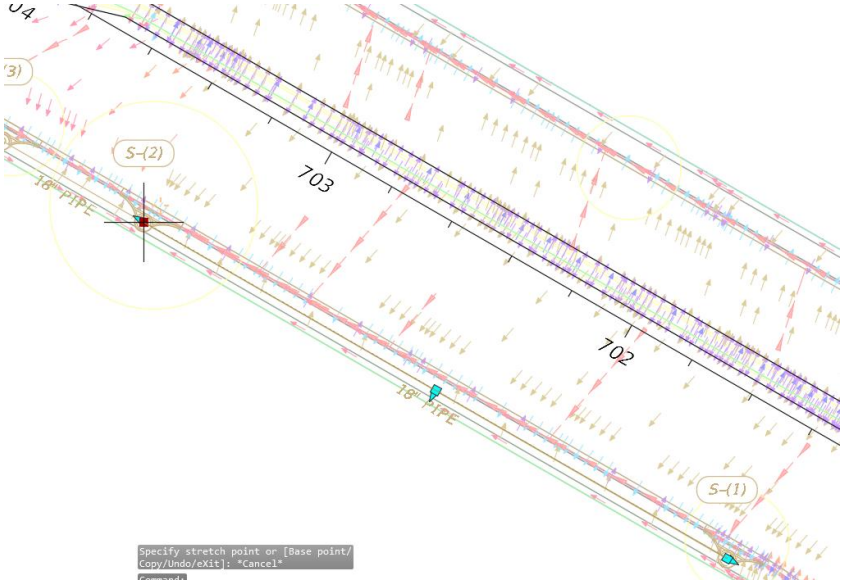
Exercise 8.4 Move Pipes

The next steps will show you how to instead of deleting some pipes reconnect them to different structures.

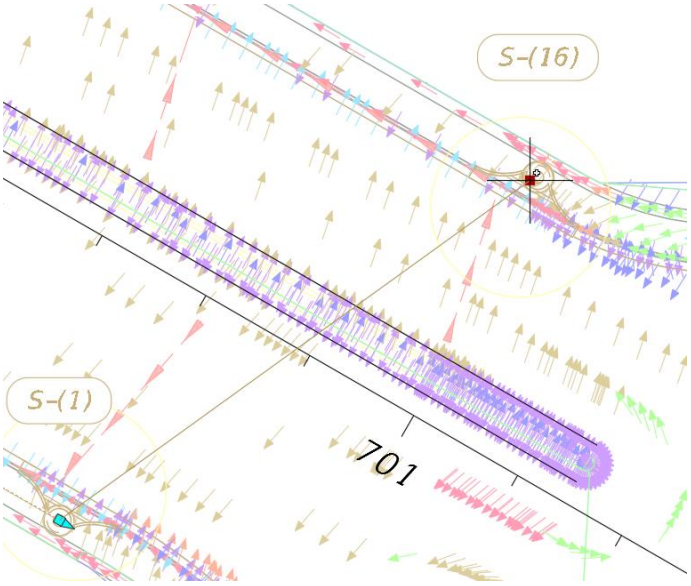
➢ *Move Pipe Between S-(1) And S-(2) To S-(16)*



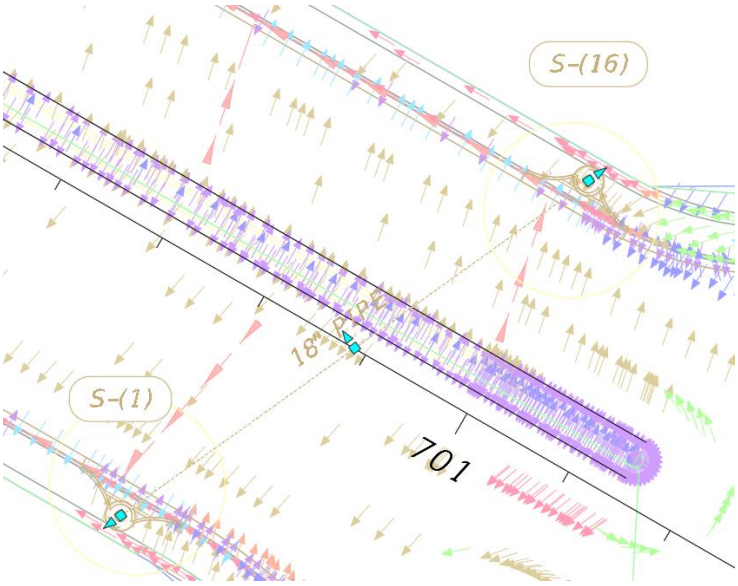
1. **Zoom** and **Pan** to display the *structures* **S-(1), S-(2)** and **S-(16)**.
2. Select **PIPE** between *structures* **S-(1)** and **S-(2).**
3. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Pipe.**



4. Select the **square grip** at S-(2).



5. Hover over structure S-(16). When the glyph appears click the structure S-(16) to connect the **PIPE** to the *structure S-(16).*
6. Press **ESC** to clear grips.

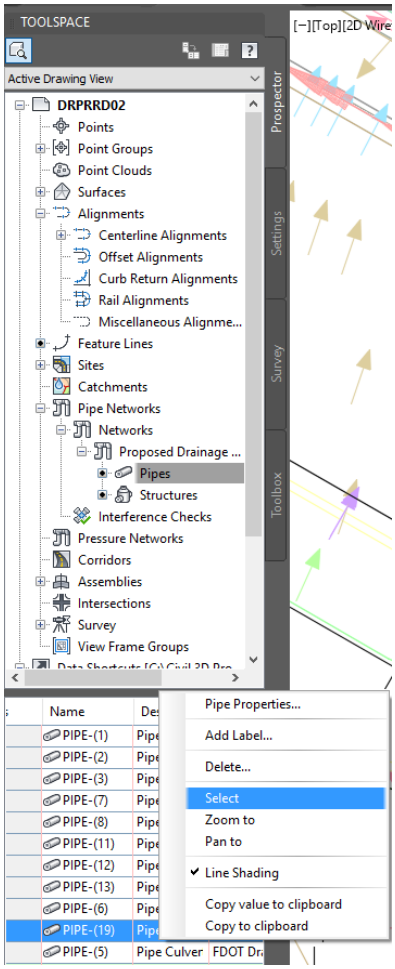


7. Review results of moving **PIPE** from *structure S-(2)* to *structure S-(16).*

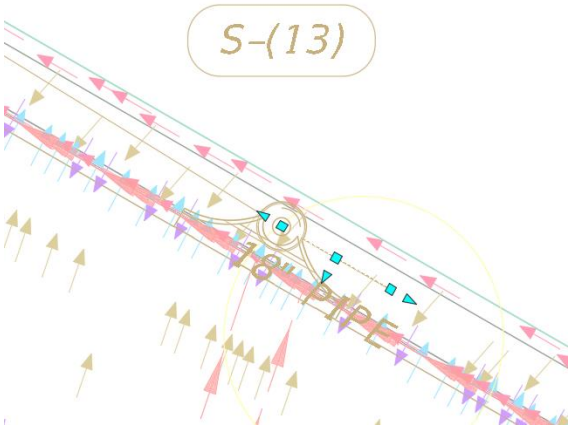
➢ *Reconnect Pipe-(16) Between S-(13) And S-(16)*

The next steps will show you how to select the pipe left after deleting structure S-(14), reconnect from structures S-(13) to S-(16).

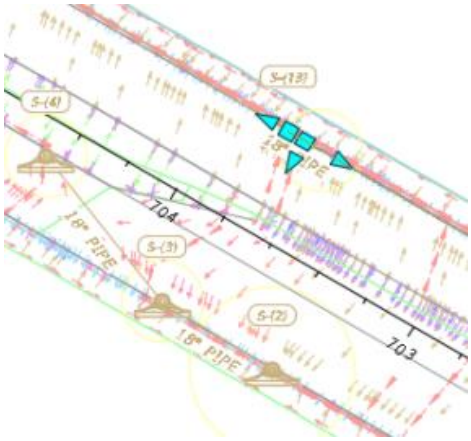
1. You may find it difficult to select the pipe PIPE-(19) in the drawing editor, so find and select **PIPE-(19)** in *Prospector tab*.



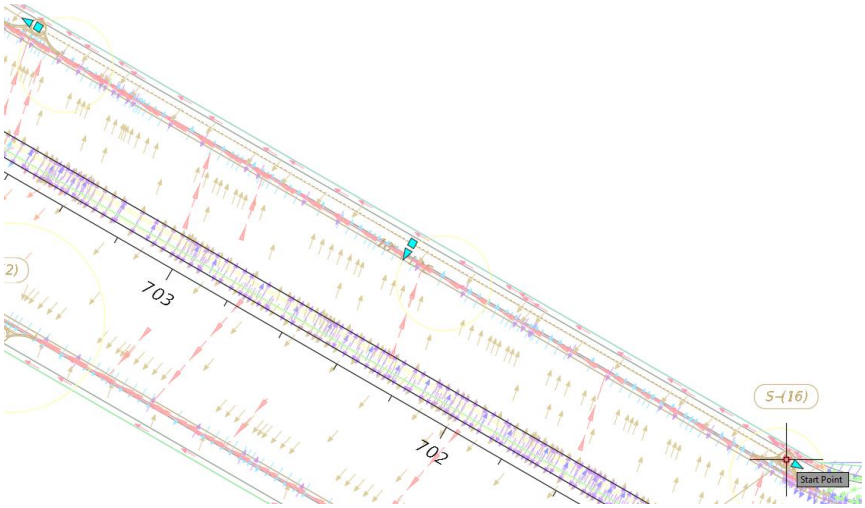
2. From the *TOOLSPACE* > *Prospector tab*, expand *Pipe Networks* > *Networks*, > *Proposed Drainage - SR61*, then left click on Pipes. From the preview list (Bottom window of TOOLSPACE), left click on **PIPE-(19)** then right-click and choose **Select.**



3. **Zoom** and **Pan** to display the **PIPE-(19).**
4. Select the **square grip** on the *PIPE-(19)* not attached to *structure S-(13).*



5. Hover over structure S-(16). When the glyph appears click on the *structure* **S-(16)** to connect the PIPE-(16) to *structure S-(16).*

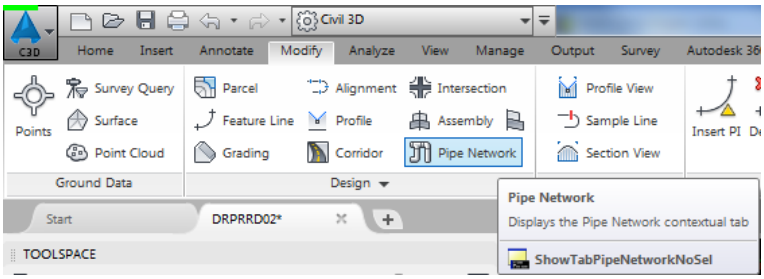


6. Review the results of moving the pipe **PIPE-(16)** to *structure S-(16).*
7. Press **ESC** to clear grips.

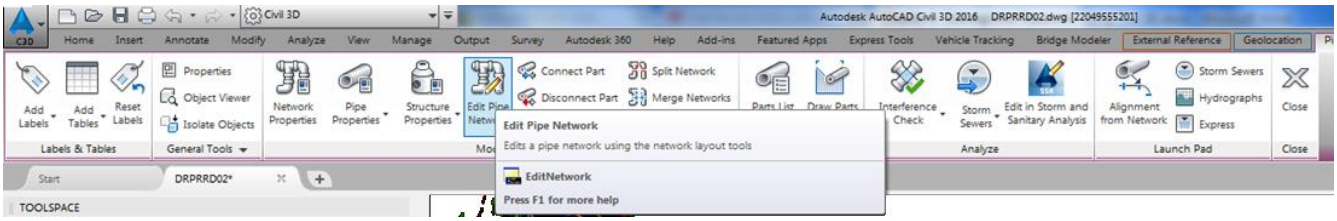
Exercise 8.5 Adding Pipes

The next steps will show you how to add a Pipe from structure S-(3) to structure S-(13).

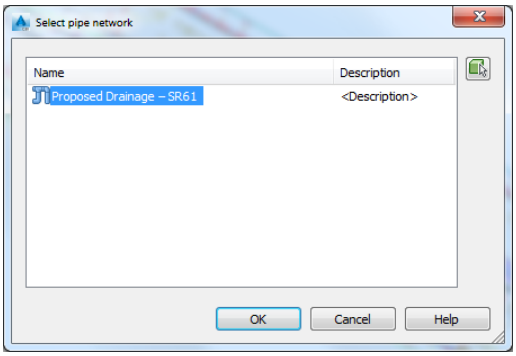
➢ ***Add Pipe From S-(3) To S-(13)***



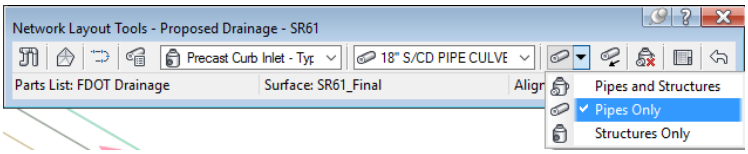
1. From the *Modify tab > Design panel*, select **Pipe Network**.



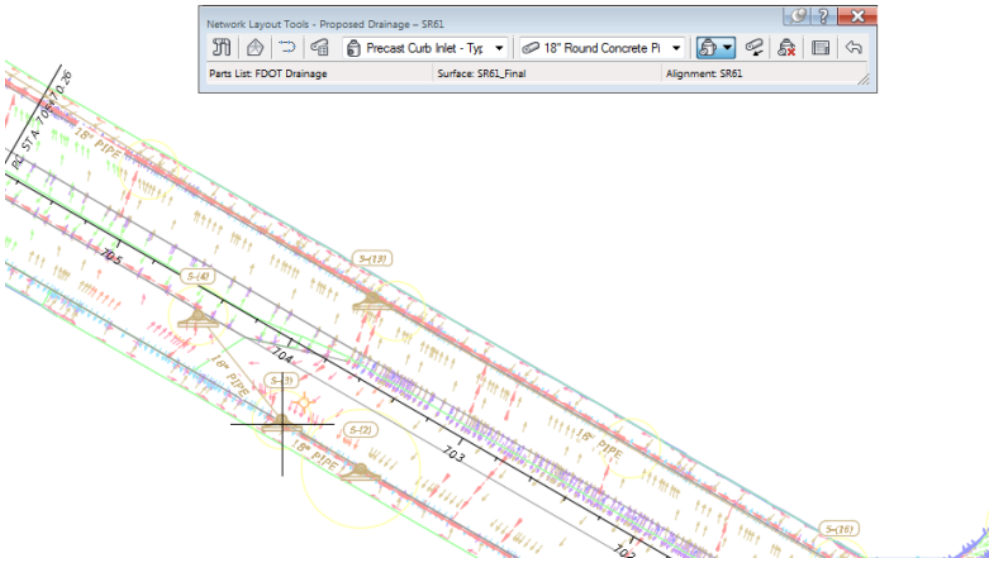
2. From the *Modify panel*, select **Edit Pipe Network**.



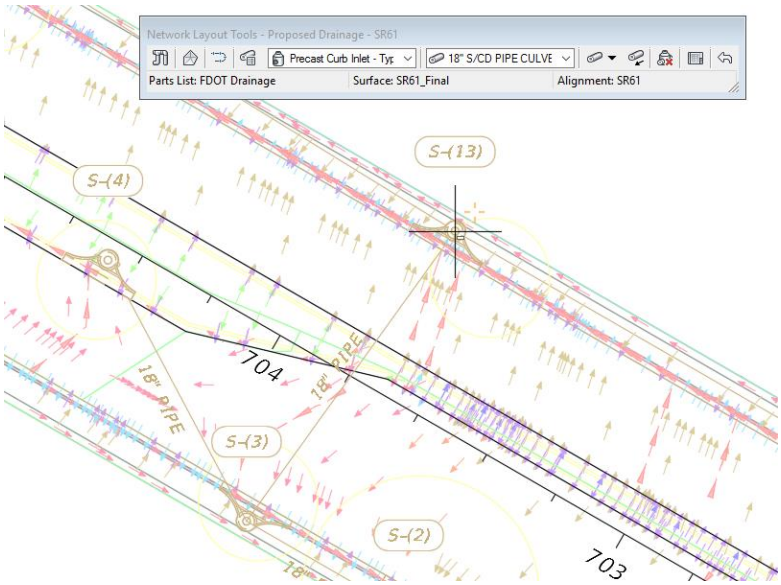
3. From the Select pipe network dialog box, select the **Proposed Drainage – SR61** *pipe network*. Click **OK**.



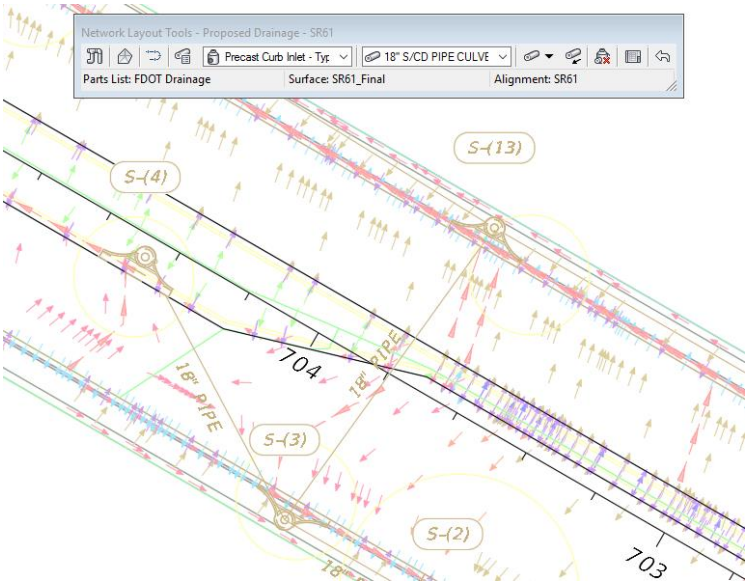
4. From the *Network Layout Tools - Proposed Drainage - SR61 toolbar > Pipes and Structures drop down list*, select the **Pipes Only** command.



5. **Zoom** and **Pan** to display the *structure* **S-(3).**
6. Hover over structure S-(3). When the glyph appears click on the **structure S-(3)** to connect the pipe to *structure S-(3).*

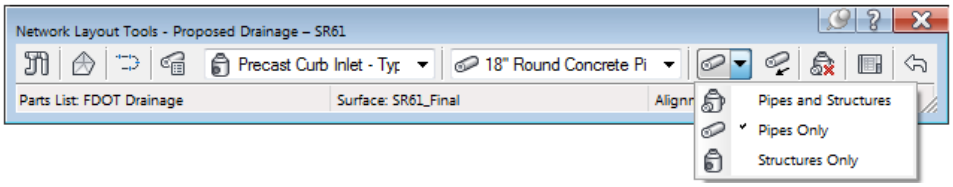


7. **Zoom** and **Pan** to display the *structure* **S-(13).**
8. Hover over structure S-(13). When the glyph appears click on the **structure S-(13)** to connect the pipe to *structure S-(13).*
9. Press **ESC** to end command.

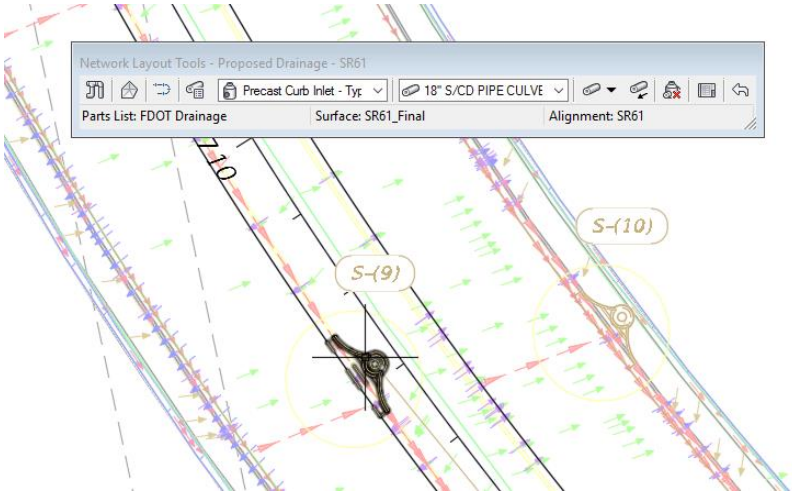


10. Review the results of adding pipe from *structure S-(3)* to *structure S-(13).*

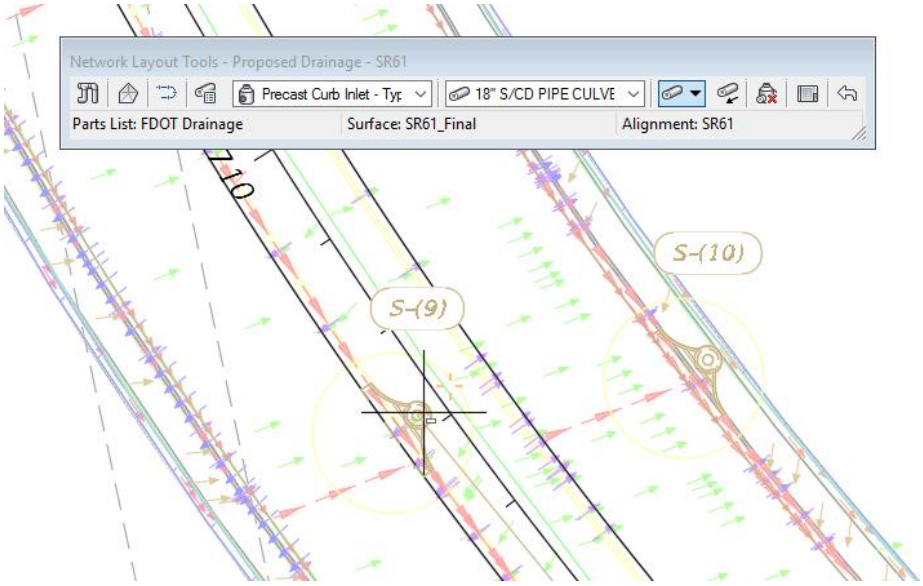
➢ *Add Pipe From S-(9) To S-(10)*



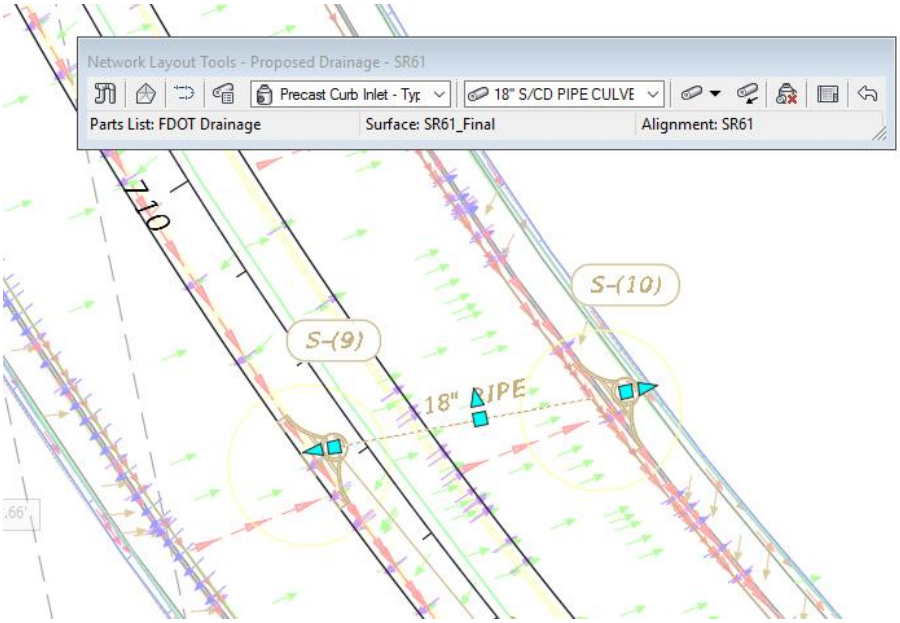
1. From the *Network Layout Tools - Proposed Drainage - SR61 toolbar > Pipes and Structures drop down list*, select the **Pipes Only** command.



2. **Zoom** and **Pan** to display the *structure* **S-(9).**
3. Hover over structure S-(9). When the glyph appears click on the **structure S-(9)** to connect the pipe to *structure S-(9).*

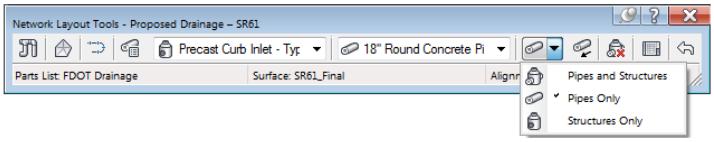


4. **Zoom** and **Pan** to display the *structure* **S-(10).**
5. Hover over structure S-(10). When the glyph appears click on the **structure S-(10)** to connect the pipe to *structure S-(10).*
6. Press **ESC** to end command.

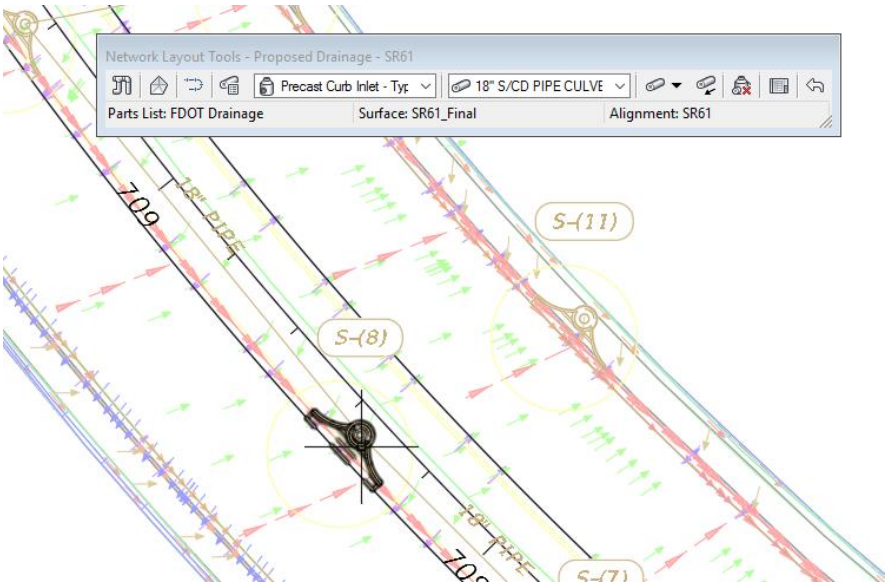


7. Review results of adding **PIPE-(18)** from *structure S-(9)* to *structure S-(10).*

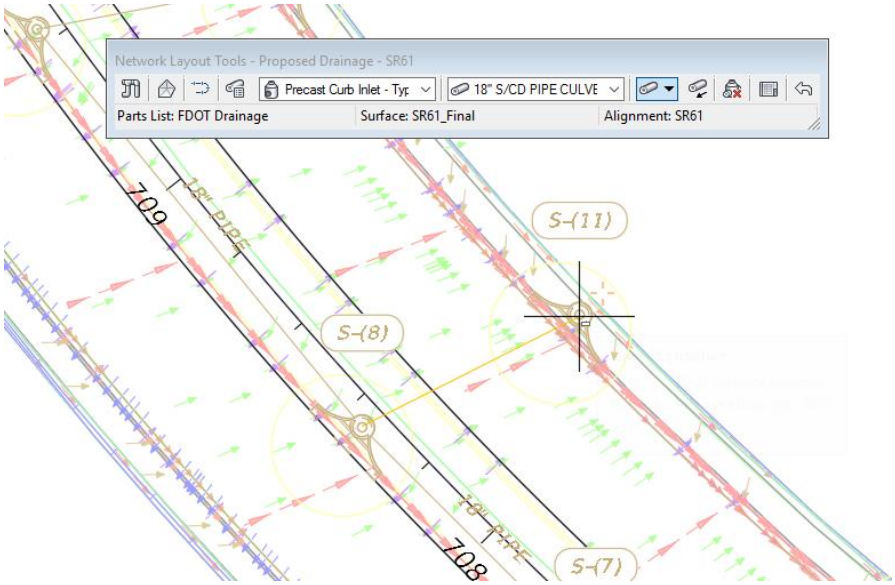
➢ *Add Pipe From S-(8) To S-(11)*



1. From the *Network Layout Tools - Proposed Drainage - SR61 toolbar > Pipes and Structures drop down list*, select the **Pipes Only** command.

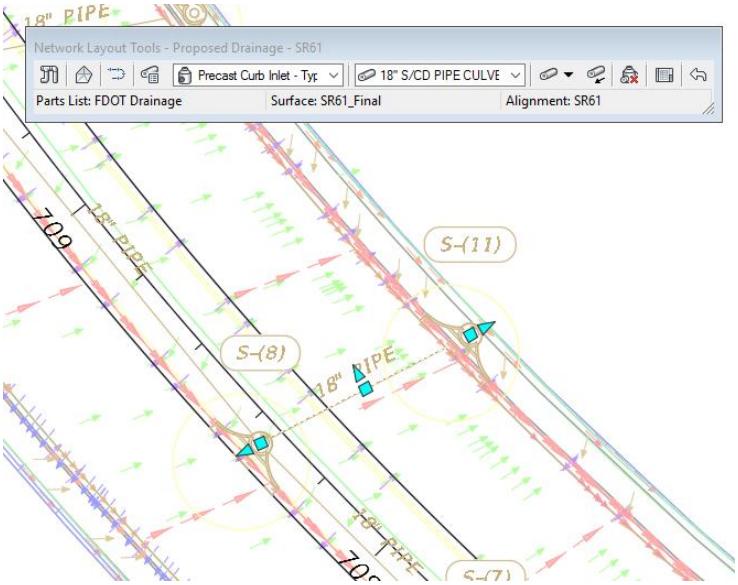


2. **Zoom** and **Pan** to display the *structure* **S-(8).**
3. Hover over structure S-(8). When the glyph appears click on the **structure S-(8)** to connect the pipe to *structure S-(8).*



4. **Zoom** and **Pan** to display the *structure* **S-(11).**

5. Hover over structure S-(11). When the glyph appears click on the **structure S-(11)** to connect the pipe to *structure S-(11).*
6. Press **ESC** to end command.



7. Review results of adding pipe from *structure S-(8)* to *structure S-(11).*
8. **Close** Network Layout Tools by clicking on the X in the upper right corner of the toolbar.
9. **Save** and **Close** the *DRPRRD02.dwg* file.

9 ALIGNMENTS & PROFILE VIEWS OF REVISED NETWORK PARTS

DESCRIPTION

In this chapter, you will review the changes made in the plan view in the previous chapter. With the addition of new alignments and a reconfigured layout of structures and pipes you must now create the alignments and profile views for the new pipe network layout.

OBJECTIVES

In this chapter, you will learn about:

- Defining Alignments from Network Parts (refresher)
- Creating Profile Views
- Adding Network Parts to Profile Views

CHAPTER SETUP

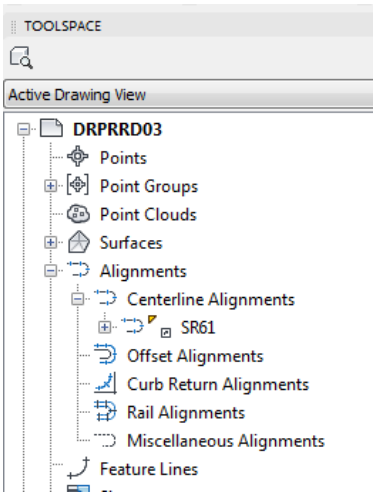
Run the Chapter 9 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 9.1 Create an Alignment and Profile View from Network Parts

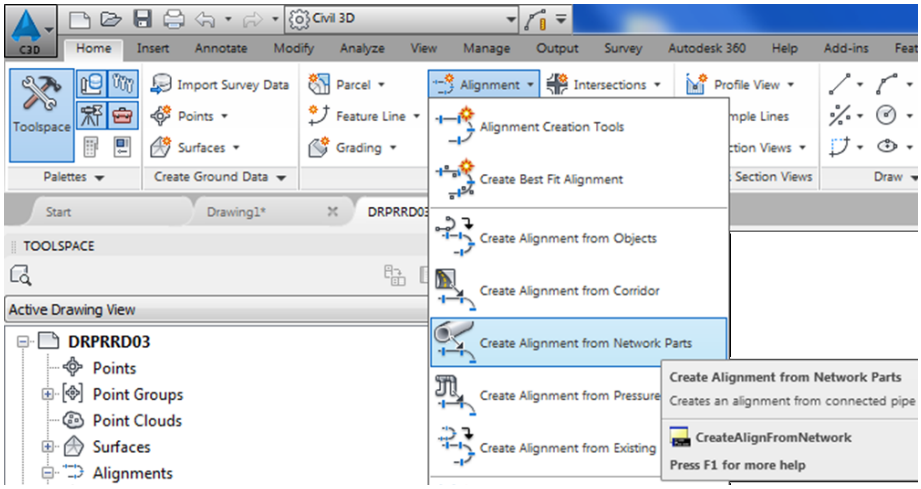
To generate profile views of the network parts you first create alignments. The next steps will show you how to do both from the wizards that are available.

From the TOOLSPACE palette on the Prospector tab, expand the Alignments List, notice that the Miscellaneous Alignments folder is empty. You will create the Alignments that populate this list.

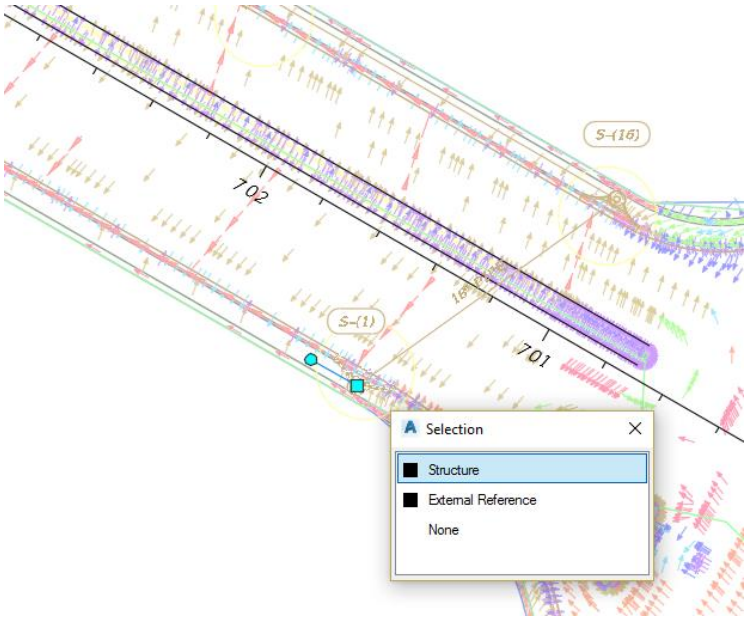


The following steps will show you how to create the Alignment and Profile View. You will use the same steps to finish the exercise for the other network parts.

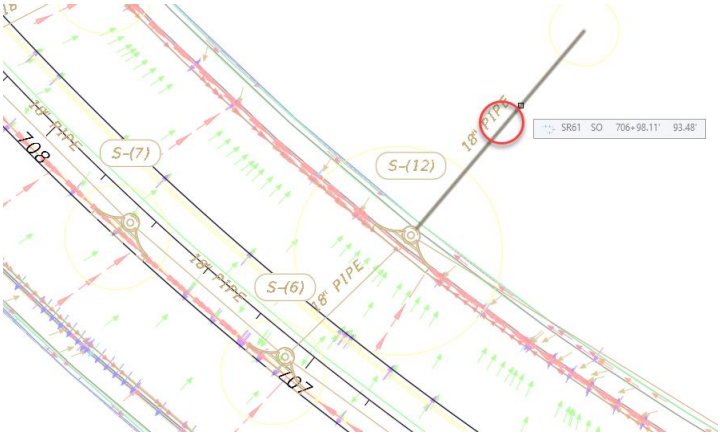
1. Start the FDOT Civil 3D State Kit and open the *DRPRRD02.dwg* located in the Chapter 9 dataset drainage folder.
2. With the drawing file open type in **Save as**, name the new file *DRPRRD03.dwg* and save in the same *drainage* folder.
3. As shown in previous steps, associate the drawing file to the **22049555201 Project** by right clicking on the *data shortcut* working folder and selecting **Associate Project to Current Drawing**.



4. From the *Home tab* > *Create Design panel* > Alignment drop down list, select **Create Alignment from Network Parts.**

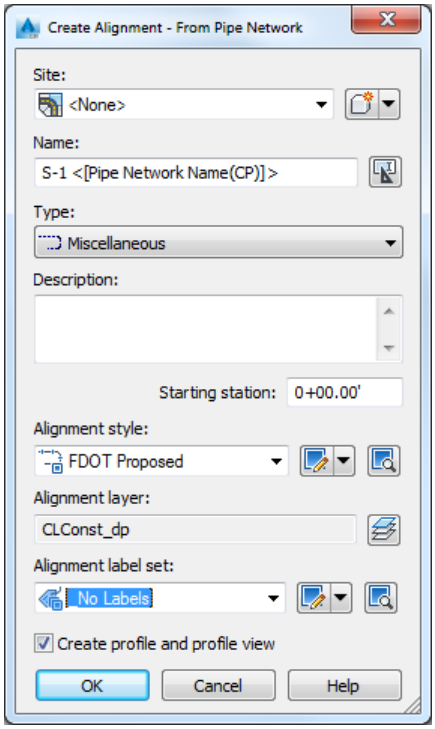


5. **Zoom** and **Pan** to the area of structure S-(1) and select the **structure S-(1).**
6. With *selection cycling* toggled *On*, a Selection dialog box displays. From the Selection dialog box select **Structure**.



7. **Zoom** and **Pan** to the area of structure S-(12), select **Pipe-(6)** the outgoing pipe which we refer to as the *Outfall pipe*. (Where the pipe empties into the proposed Drainage Pond.)
8. Press **ENTER** to complete the alignment creation.

Note Structures S-(1), S-(16), S-(14), S-(12), and the outfall pipe PIPE-(6) form the alignment geometry because they are connected.

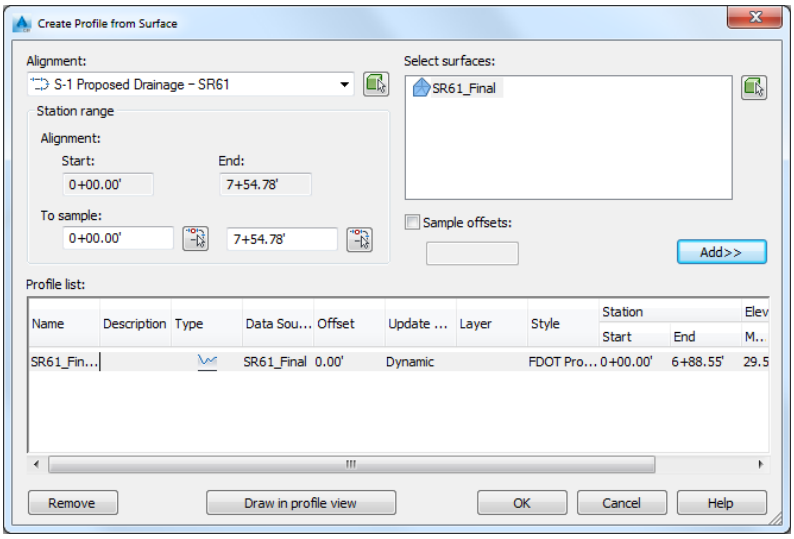


9. The Create Alignment – From Pipe Network dialog box displays.
   a. In the *Name:* field only add **S-1** before <[Pipe Network Name(CP)]>.

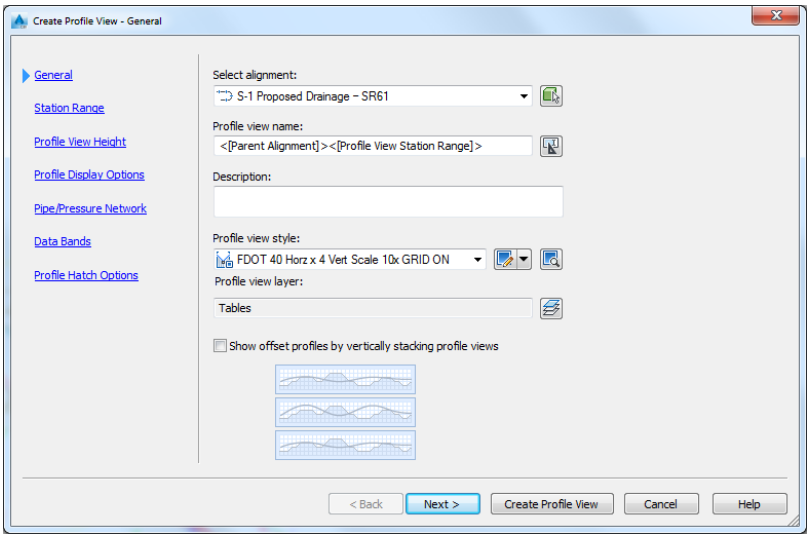
Note Always make the name the beginning structure in the Alignment.

   b. Set *Type*: to **Miscellaneous.**
   c. Give a good *Description*: such as **S-(1) to S-(12) including outlet pipe.**
   d. *Alignment label set*: from drop down list select **_No Labels**.
   e. Check the **Create profile and profile view** check box.

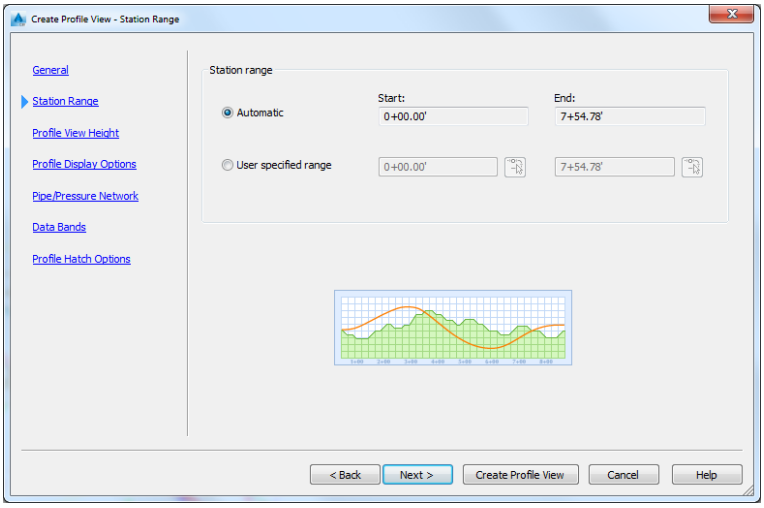
10. Click **OK** to close the Create Alignment – From Pipe Network dialog box.



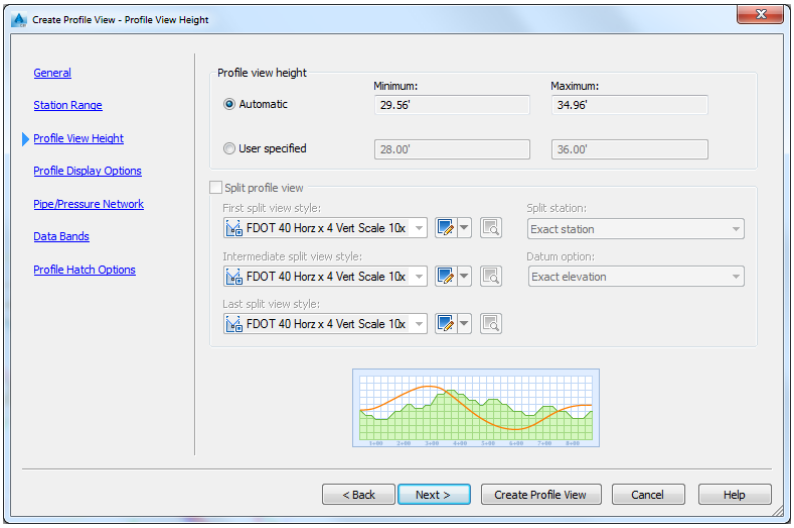
11. From the Create Profile from Surface dialog box, set the following:
    a. Set *Alignment*: to **S-1 Proposed Drainage – SR61**.
    b. In the Select surface: highlight **SR61_Final**, then click the **Add** button to add to *Profile list.*
    c. *Profile list:* area populates with the newly defined surface profile content.
12. Click the **Draw in profile view** button. This will launch the Create Profile View wizard.
13. In the Create Profile View wizard, visit each panel setting the values as instructed and clicking the **Next** button at the bottom to continue to the next panel. The blue links on the left side display an arrow next to the current panel title being displayed.



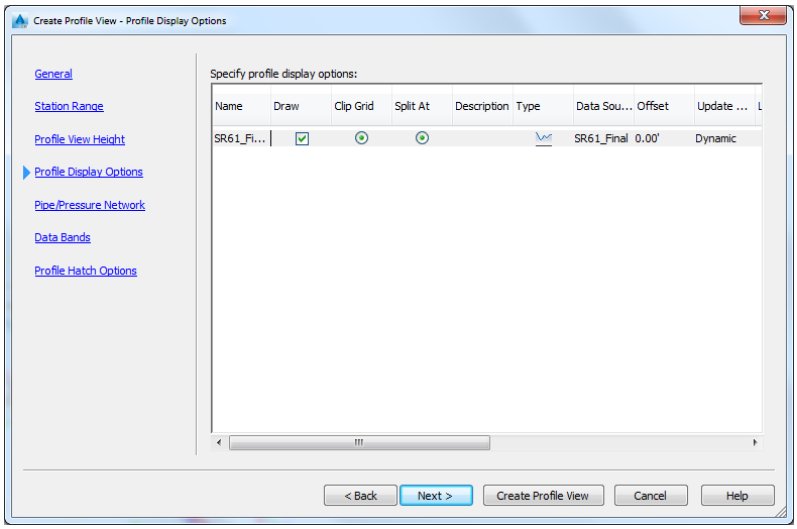
14. In the **General** panel click the Profile view style: drop down list and click **FDOT 40 Horz x 4 Vert Scale 10x GRID ON**. Click the **Next** button.



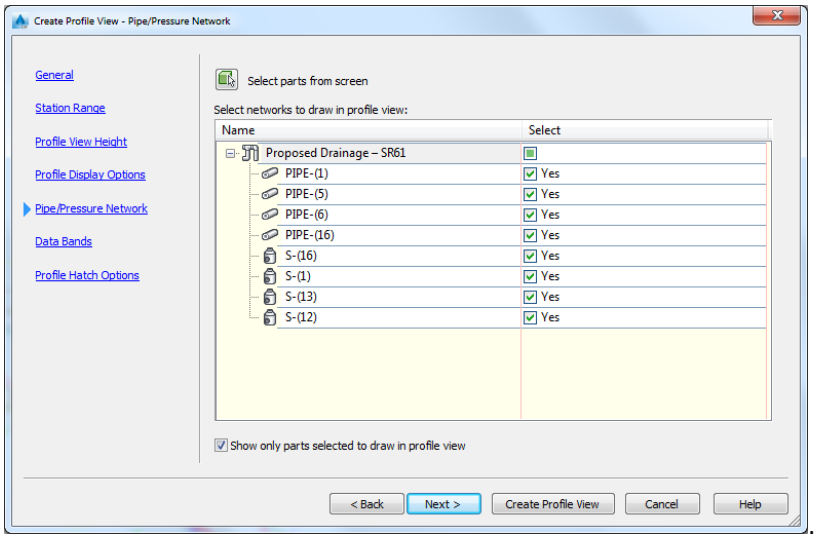
15. Accept the default in the **Station Range** panel. Click the **Next** button.



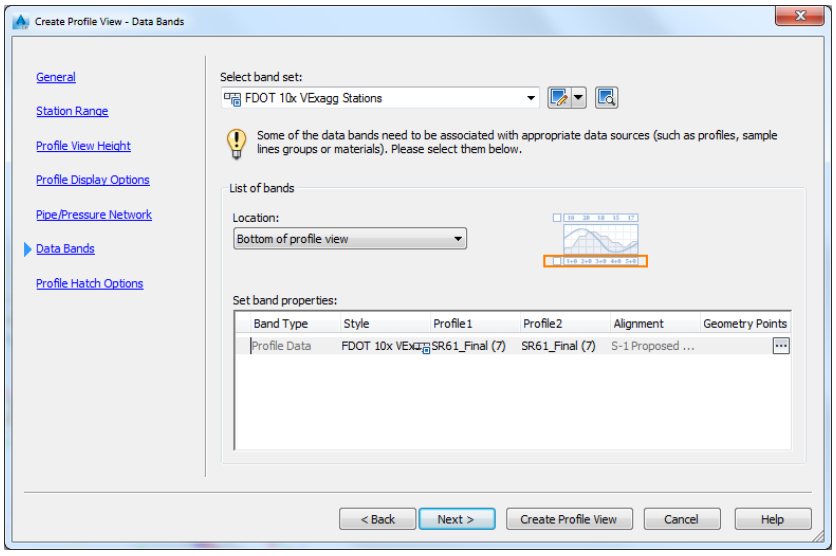
16. Accept the default in the **Profile View Height** panel. Click the **Next** button.



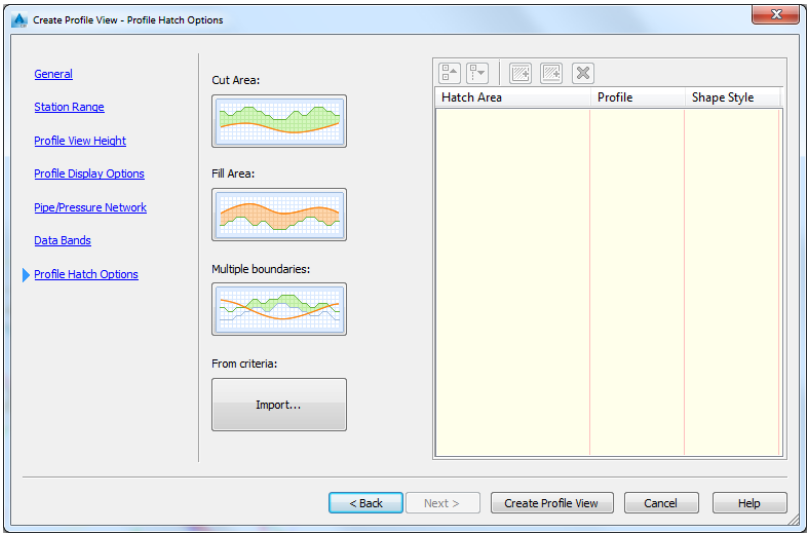
17. Accept the defaults in the **Profile Display Options** panel. Click the **Next** button



18. The Pipe/Pressure Network panel shows the pipes and structures to be displayed in the Profile View. Review and keep all selections checked as shown below. Click the **Next** button.

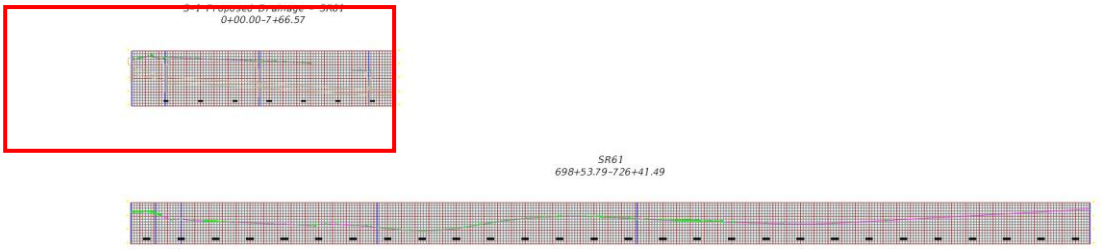


19. In the **Data Bands** panel click the **FDOT 10x VExagg Stations** style from the Select band set drop down list. Click the **Next** button

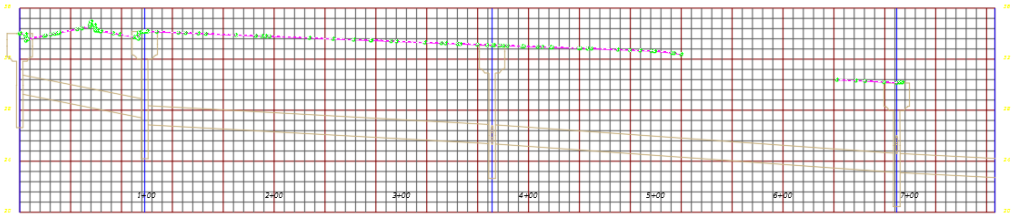


20. Accept the defaults in the **Profile Hatch Options** panel and select **Create Profile View.**

21. In model space pick the *insertion point* for the S-1 Proposed Drainage-SR61 Profile View. The insertion point is the lower left corner of the Profile View grid. Place the S-1 Proposed Drainage-SR61 Profile View above the SR61 Profile View as shown below.



S-1 Proposed Drainage – SR61
0+00.00-7+66.57

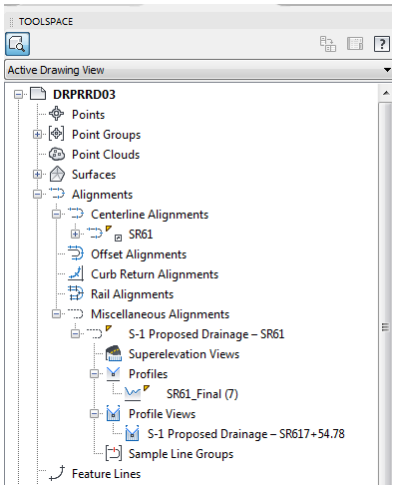


22. **Zoom in** to **the S-1 Proposed Drainage – SR61 Profile View**. The SR61 Surface Profile and the Proposed Drainage Network parts created from the Alignment are displayed.

Note Correcting the pipe invert elevations will be done in a later process

➢ *Review S-1 Proposed Drainage – SR61 Alignment Profiles and Profile Views*

1. From the *TOOLSPACE > Prospector tab > Alignments > Miscellaneous Alignments*, expand **S-1 Proposed Drainage – SR61**, then expand both **Profiles** and **Profile Views**.



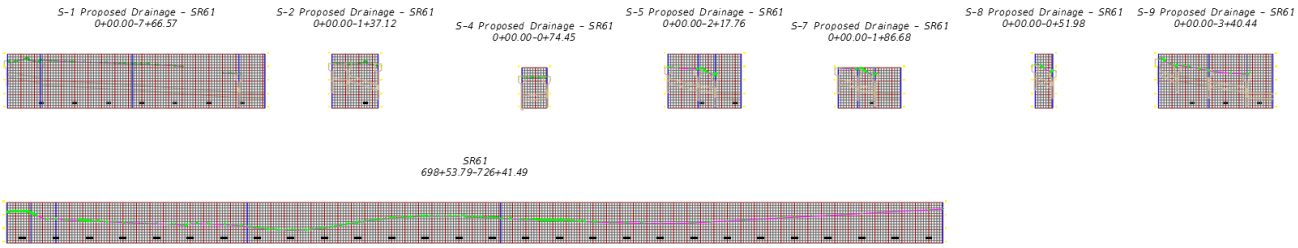
Note Profiles and Profile Views are child objects of the Alignment and are therefore displayed in the hierarchy below the Alignment name.

➢ *Create Additional Alignments with Profile Views*

1. Using steps above, create an alignment along with a profile view and place them in model space for the following network parts

Alignment Path	**Parts Included**
From S-(2) to S-(13)	S-(2), S-(3), S-(13)
From S-(4) to S-(3)	S-(4), S-(3)
From S-(5) to Outfall Pipe	S-(5), S-(6), S-(12), Outlet Pipe
From S-(7) to Outfall Pipe	S-(7), S-(6), S-(12), Outlet Pipe
From S-(8) to S-(11)	S-(8), S-(11)
From S-(9) to Outfall Pipe	S-(9), S-(10), S-(11), S-(12), Outlet Pipe

2. When complete review your drawing which should match the image below.

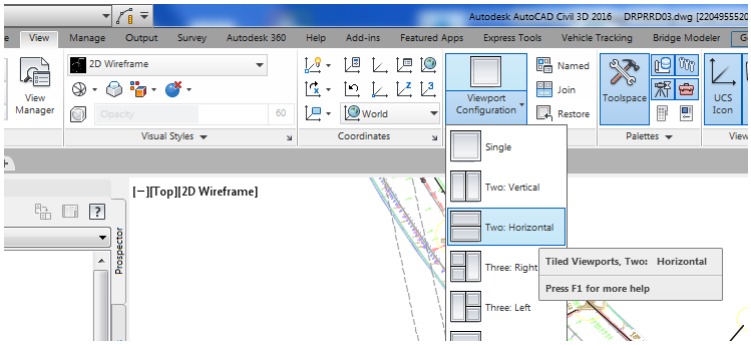


3. **Save** the *DRPRRD03.dwg* file before continuing to the next exercise.

Exercise 9.2 Set Display to Show Both Profile and Plan View

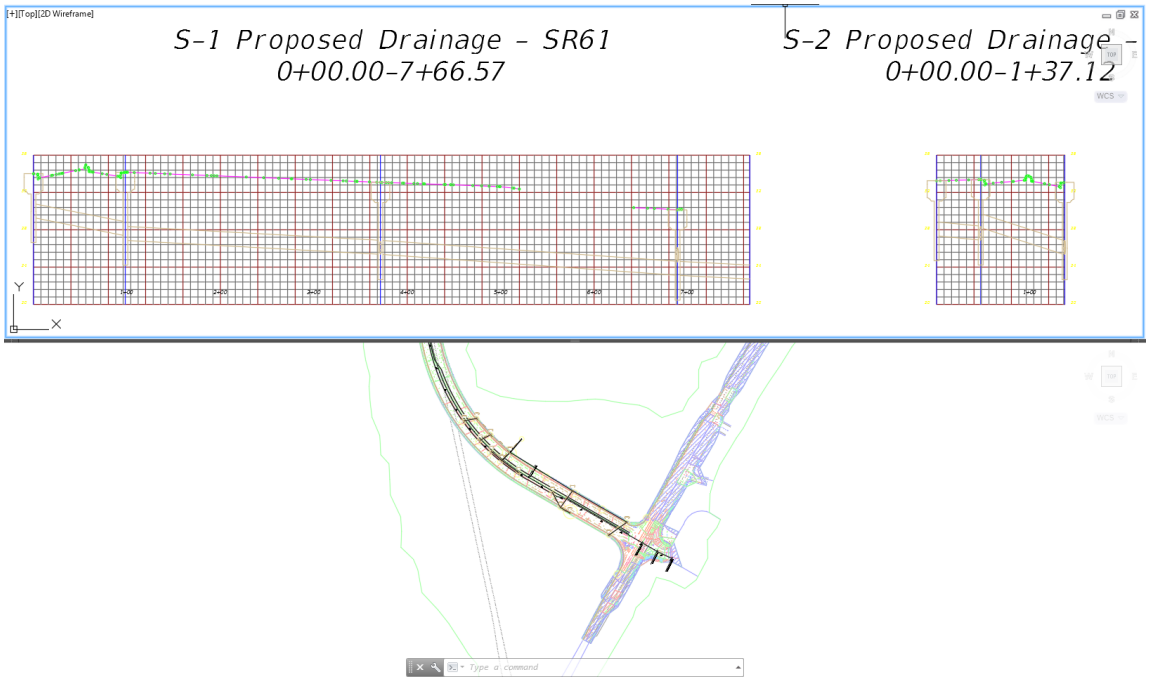
Now you will set your display to conveniently show both the profile and plan views in model space in two horizontal views.

1. From the *View tab > Model Viewports > Viewport Configuration dropdown*, select **Two Horizontal**.



2. Review your Drawing Space which should look like image below.

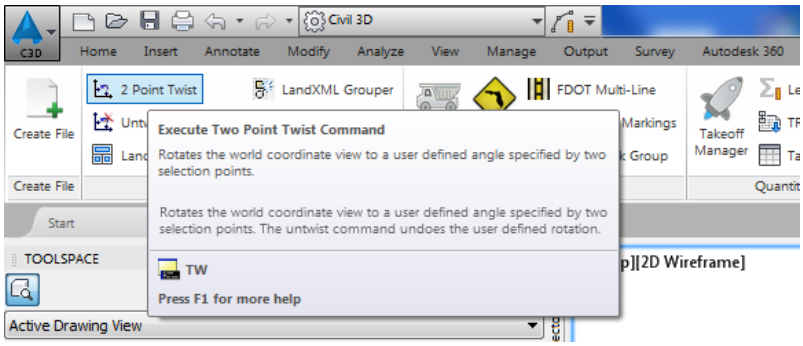
3. Click in **top Viewport** to make active, then **Zoom** and **Pan** to display the **S-1 Proposed Drainage Profile View.**



4. Click **bottom Viewport** to make active, then **Zoom** and **Pan** to show both **structures S-(1)** and the **Outfall PIPE-(6)**. Your drawing should look like the image above.

Exercise 9.3 Use the 2 Point Twist to Rotate the Plan View

Next, you will use the 2 Point Twist command to rotate the plan view. This command rotates your drawing in model space to align parallel with your drawing screen. It mimics a sheet layout and is used to label objects.

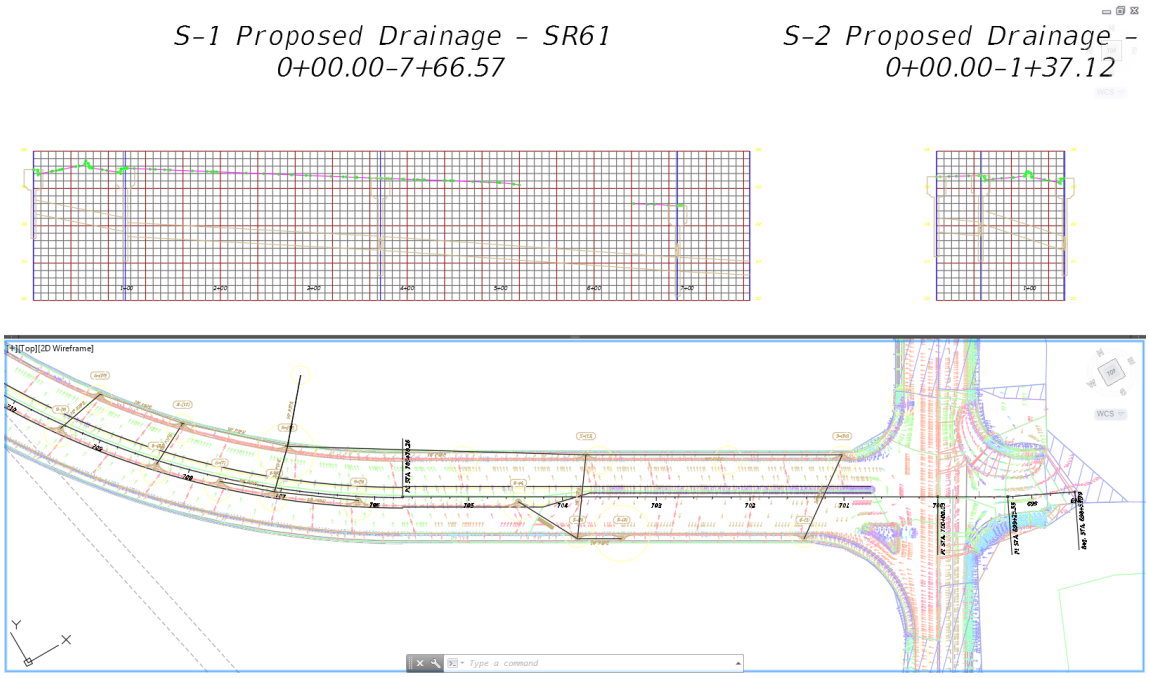


1. From the *FDOT tab > Tools panel*, select **2 Point Twist** command.

HINT If you cannot see the FDOT tab, try typing FDOTRIBBON on the command line and Press ENTER key

2. The command prompt asks you to pick the **left location point**. Use the **Alignment** as your pick object. Select anywhere on the Alignment for the left side and anywhere to the right of the first pick point along the Alignment to complete the command.

3. Review your drawing which should look like the image below where the Plan View is parallel to your Viewport.



4. **Save** the *DRPRRD03.dwg* file.

Exercise 9.4 Insert the Extend Alignment.dwg file

In the next steps, you will insert the *Extend Alignment.dwg* file using Block Insert

A file named Extend Alignment.dwg has been created for you. The Extend Alignment.dwg contains AutoCAD points to be inserted into the *DRPRRD03.dwg*. These AutoCAD points will be used in the later process of extending the miscellaneous alignments that have been created from the Proposed Drainage – SR61 Pipe Network's Structures and Pipes.

1. Continue working with the drawing from the previous task

   <OR>

   Close the *DRPRRD03.dwg* and open the **Chapter 9 - DRPRRD03 - Completed - 9.1A.dwg** from:

   C:\Civil 3D Projects\22049555201\Drainage\complete.

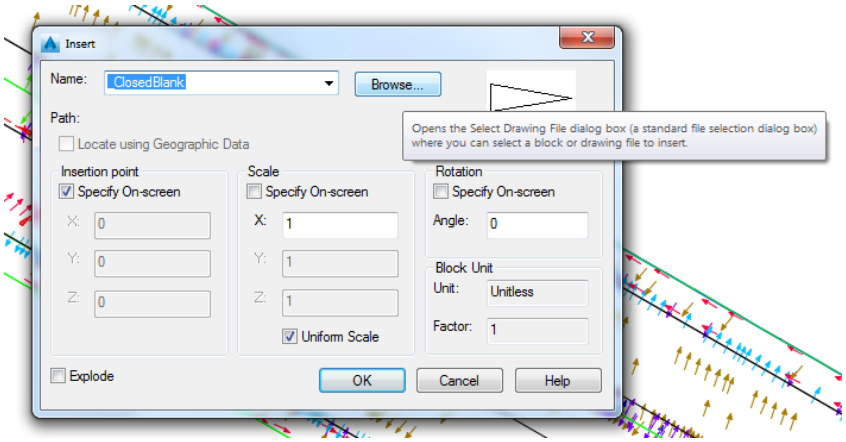
2. Execute a **Save As** using *DRPRRD03.dwg* as the file name to:

   C:\Civil 3D Projects\22049555201\Drainage.

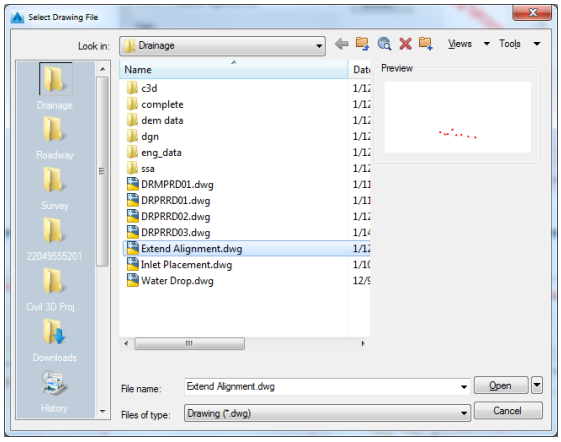
3. When prompted click **Yes** to replace existing *DRPRRD03.dwg*.

4. Type **I** for insert on the command line.

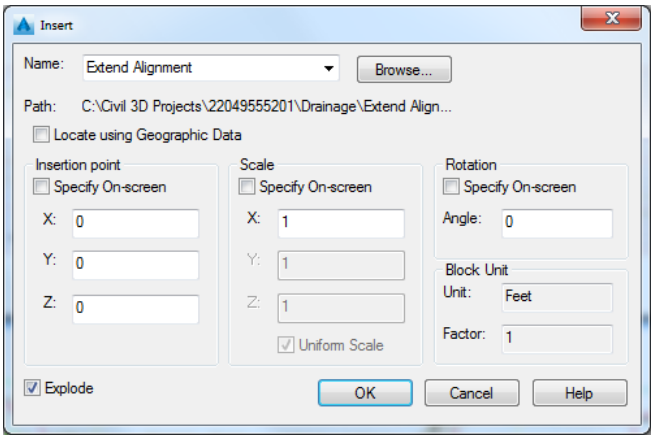
5. From the Insert dialog box click on **Browse**.



6. From the Select Drawing File dialog, navigate to: *C:\Civil 3D Projects\22049555201\Drainage*.



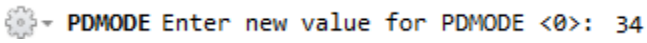
7. Select **Extend Alignment.dwg**, then click **Open** to close the Select Drawing File dialog box.



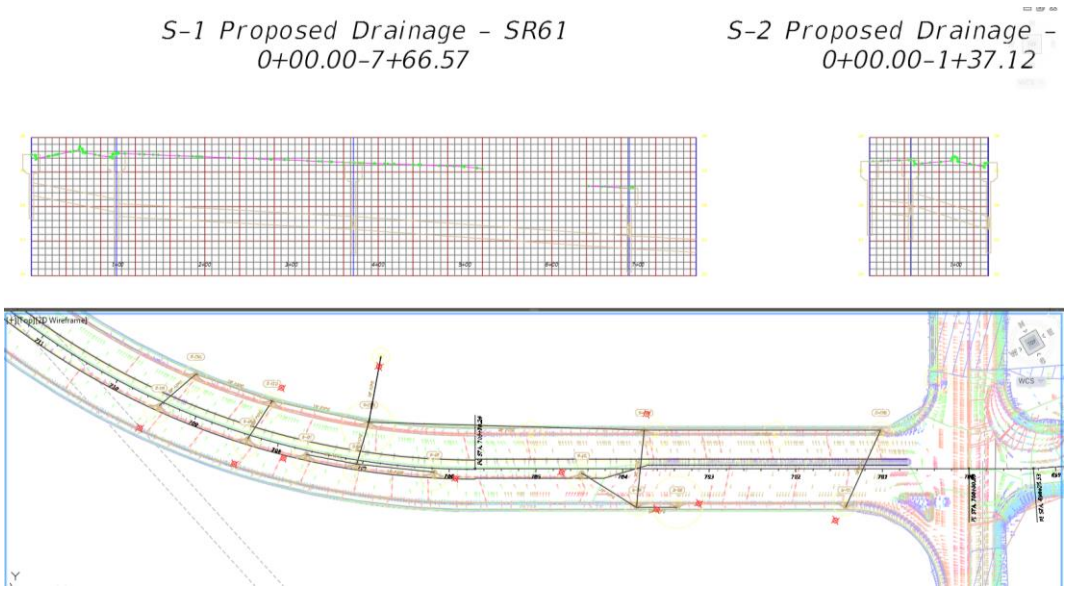
8. From the Insert dialog box, **Uncheck** *Insertion Point, Scale,* and *Rotation* boxes, **Check** *Explode* box, then click **OK** to close the Insert dialog box.

➢ *Set PDMODE to 34*

To view the AutoCAD Points to be used in the next process of Extending Alignments the Point Display Mode PDMODE must be set. PDMODE controls the size of AutoCAD Points which can be increased or decreased, to be better seen in the drawing.



1. From the command line: Type: **PDMODE**, then press **ENTER**.
2. From the command line: Type: **34**, then press **ENTER** again.



3. Review the results of inserting the *Extend Alignment.dwg* file and setting *PDMODE* to **34**.
4. **Save** and **Close** the *DRPRRD03.dwg* file.

10 EXTEND ALIGNMENTS

DESCRIPTION

In this chapter, you will review the changes made to the profile views in the previous chapter. With the addition of new alignments and a reconfigured layout of structures and pipes you used to create the new profile views, you will need to extend the profile view grids so the structures and pipes are entirely within the grid in each of the profile views.

OBJECTIVES

In this chapter, you will learn about:

- Editing Alignment Geometry to Extend the Profile View

CHAPTER SETUP

Run the Chapter 10 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 10.1 Extend Alignments in Profile Views

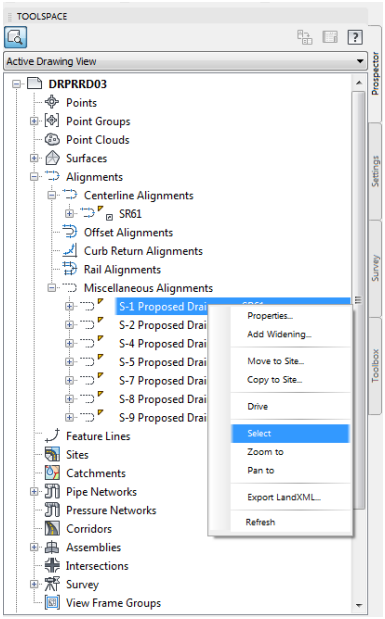
In the next few steps you will extend the Alignment at both ends in Plan View.

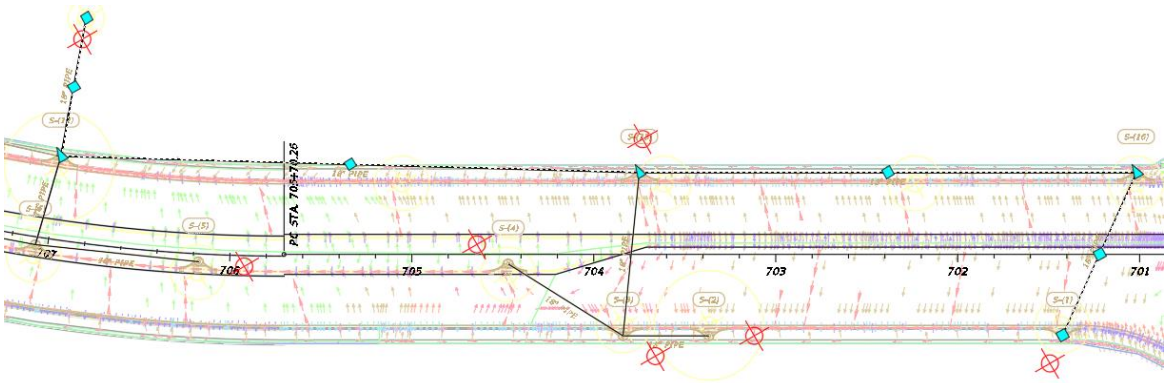
This will extend the Profile View grid so the structures and pipes are entirely within the grid on the Profile View.

➢ ***Extend the S-1 Proposed Drainage – SR61 alignment***

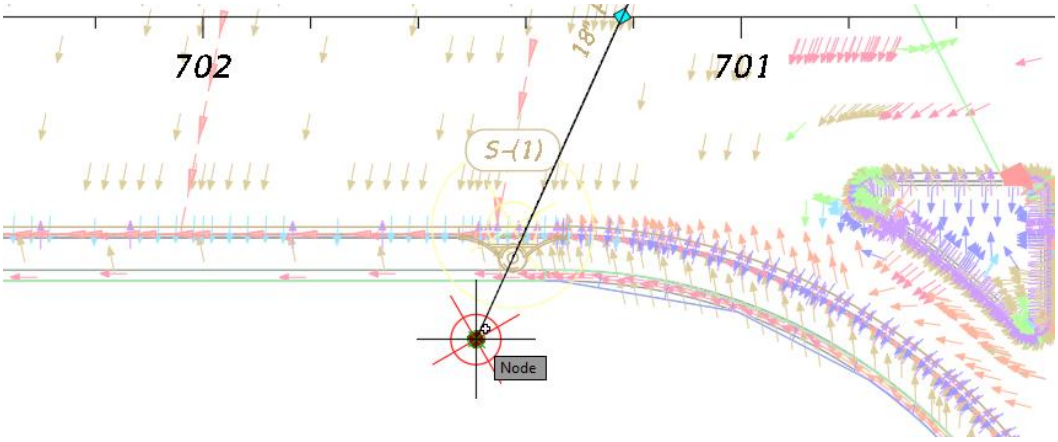
1. Start the FDOT Civil 3D State Kit and open the **DRPRRD03.dwg** located in the *Chapter 10* dataset drainage folder.
2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**.

3. Right click on the **S-1 Proposed Drainage - SR61 Alignment** and choose **Select**.





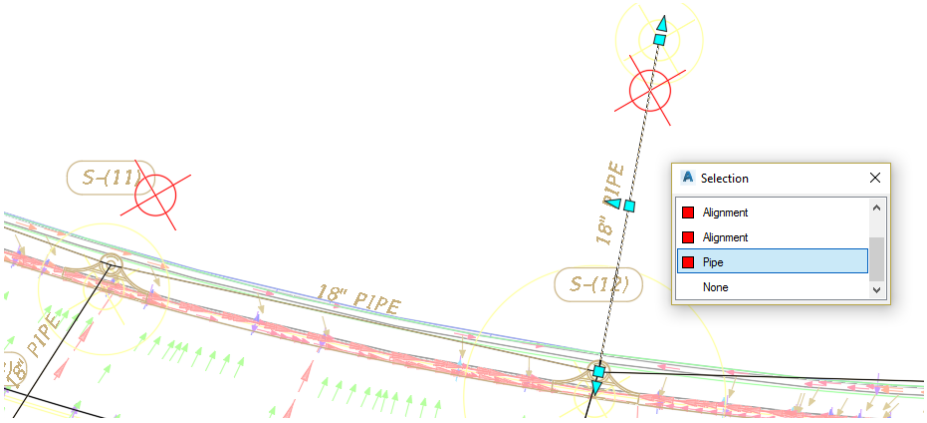
4. Grips display on the selected *S-1 Proposed Drainage - SR61 Alignment*. **Zoom in** to **structure S-(1)**.



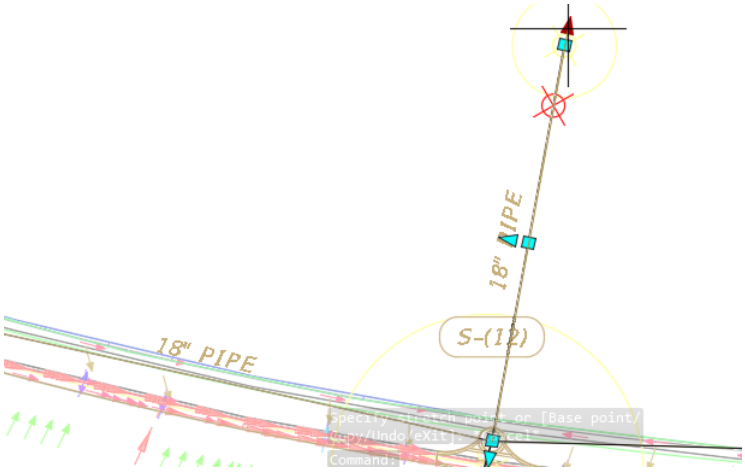
5. Select the **grip** at the end of the *structure S-(1)*, then using a **Node Object Snap**, click on the AutoCAD Point as displayed above.

6. Press **ESC** to clear the grips. By extending the S-1 Proposed Drainage - SR61 Alignment in the S-1 Proposed Drainage-SR61 Profile View, the structure S-(1) is displayed fully in the S-1 Proposed Drainage-SR61 Profile View grid.

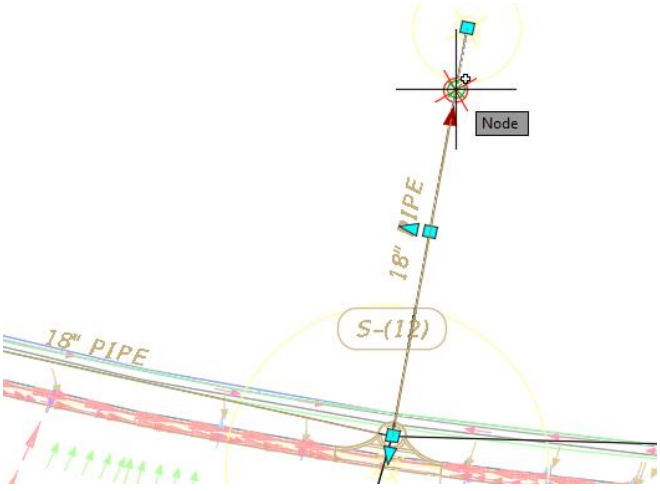
Exercise 10.2 Shorten the Outfall PIPE-(6) Pipe



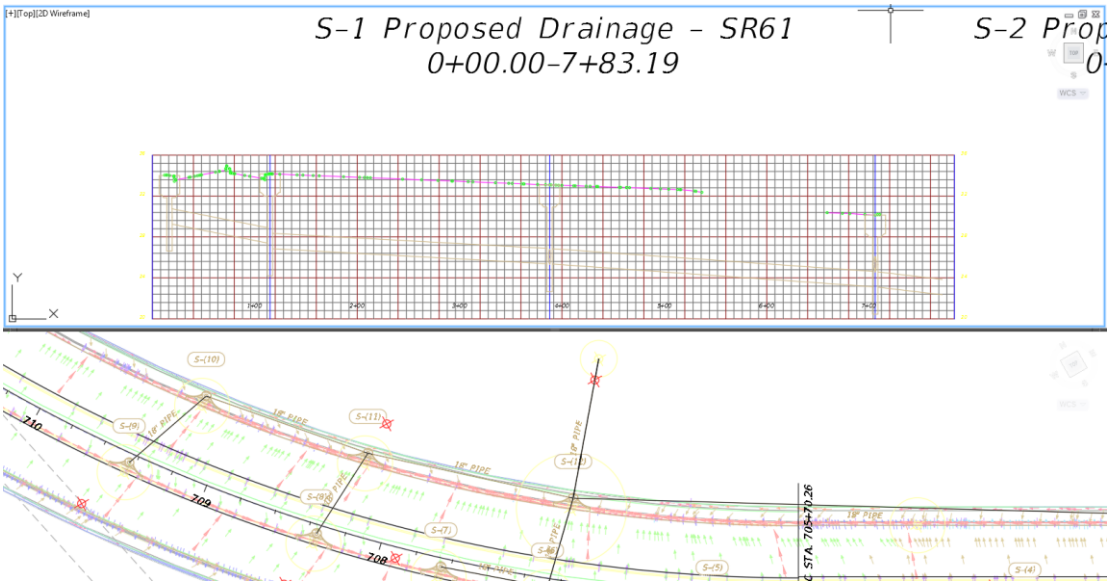
1. **Zoom** and **Pan** to display the **Outfall pipe PIPE-(6)**. Since all the alignments terminate at the Outfall Pipe it is easier to change 1 pipe rather than 7 alignments.
2. Select the **PIPE-(6)** with no command active. From the Selection dialog box, select **Pipe**. *Grips* will display on the pipe object when selected.



3. Select the **triangle grip** to *lengthen* (in this case *shorten*) the pipe.



4. Using a **Node Object Snap,** select the **AutoCAD Point** as displayed above to make the PIPE-(6) shorter.
5. Press **ESC** to clear the grips.



6. Review the *shortened* **PIPE-(6)** now displayed in the S-1 Proposed Drainage-SR61 Profile View**.**

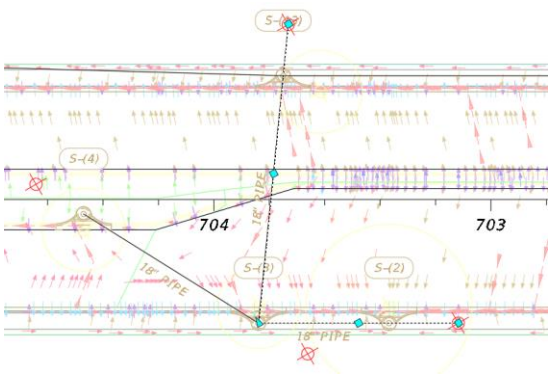
➢ *Extend Additional Alignments*

Using steps from exercise 10.1 above extend the Alignments to the **Red AutoCAD Points** for the following alignments. The images below show how the Alignments will look after adjustments.

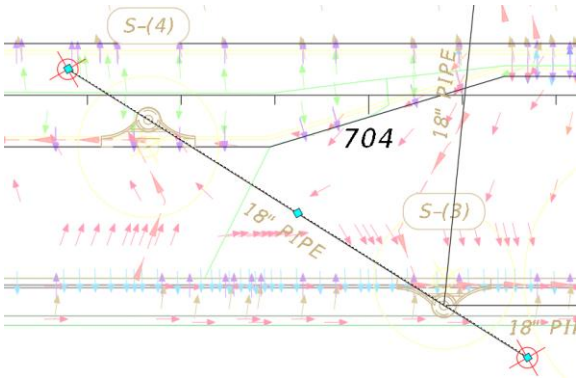
S-2 Proposed Drainage – SR61 S-4 Proposed Drainage – SR61

S-5 Proposed Drainage – SR61 S-7 Proposed Drainage – SR61

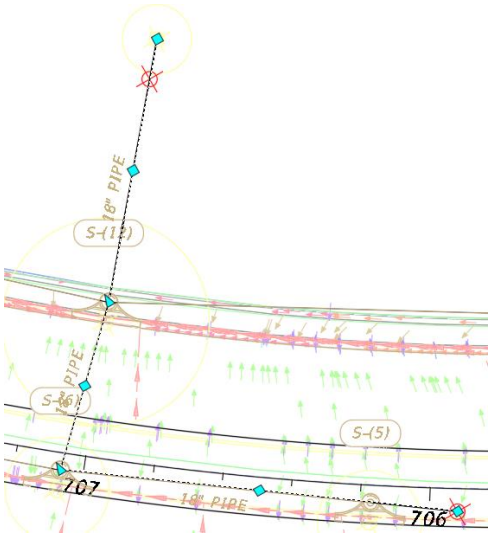
S-8 Proposed Drainage – SR61 S-9 Proposed Drainage – SR61



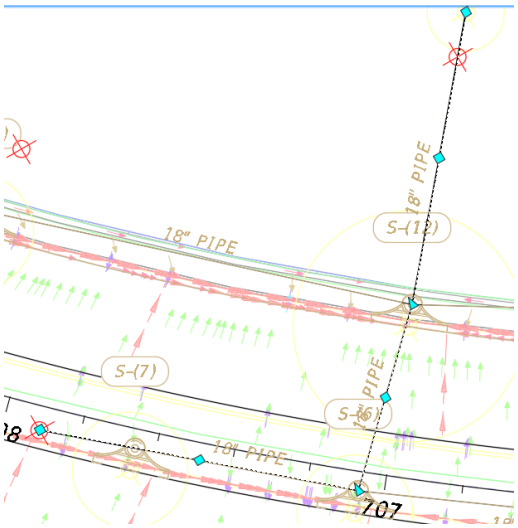
S-2 Proposed Drainage - SR61



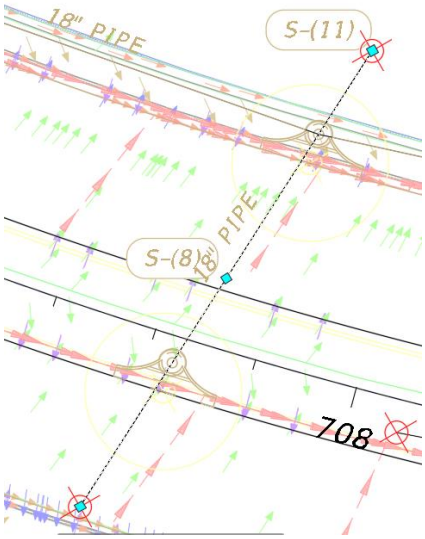
S-4 Proposed Drainage – SR61



S-5 Proposed Drainage - SR61



S-7 Proposed Drainage – SR61



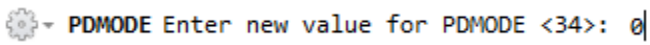
S-8 Proposed Drainage – SR61

S-9 Proposed Drainage – SR61

➢ *Set PDMODE back to 0*

The process of extending the Alignments has now been completed, the AutoCAD Points used in the process of extending the Alignments no longer need to be displayed. The Point Display Mode PDMODE must be set again.

1. From the command line Type: **PDMODE**, then press **ENTER.**
2. From the command line Type: **0**, then press **ENTER** again.



3. Setting *PDMODE* to **0** has now turned **Off** the displaying of the Red AutoCAD Points used for extending the Miscellaneous Alignments.
4. **Save** and **Close** the *DRPRRD03.dwg* file:

11 PIPE NETWORK LABELS

DESCRIPTION

In this chapter, you will add various labels to Structures and Pipes in profile views. Labeling is a necessary step and FDOT has created Label styles that are contained in the State Kit to help your plans match standards. There are label styles specifically for Plan View, Profile View, & Section Views.

OBJECTIVES

In this chapter, you will learn about:

- Adding Labels to Structures and Pipes in Profile Views

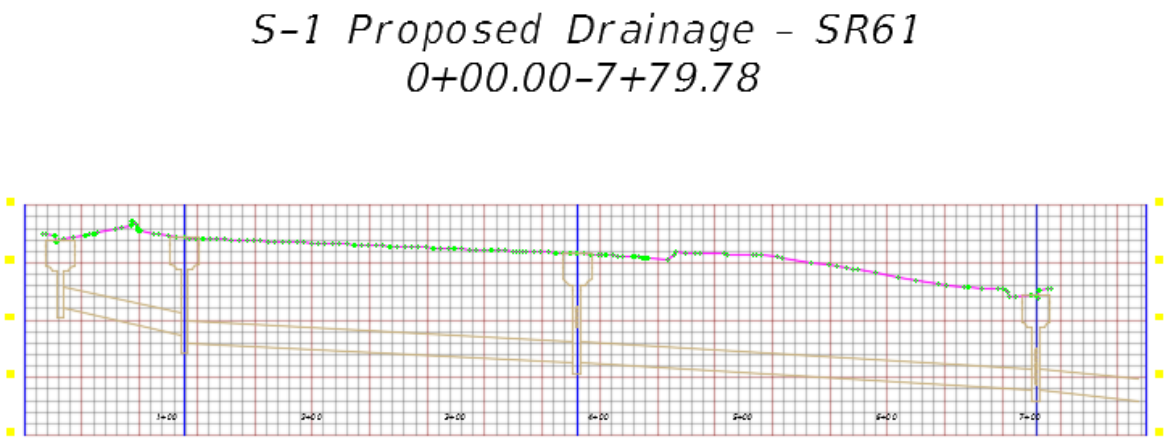
CHAPTER SETUP

Run the Chapter 11 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

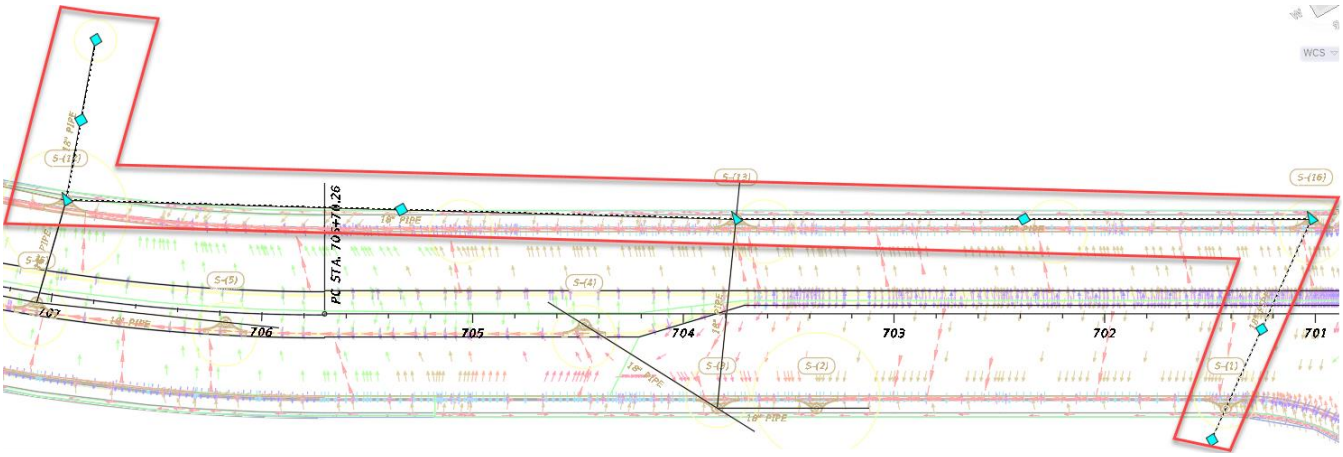
Exercise 11.1 Add Labels to the Drainage Profile Views

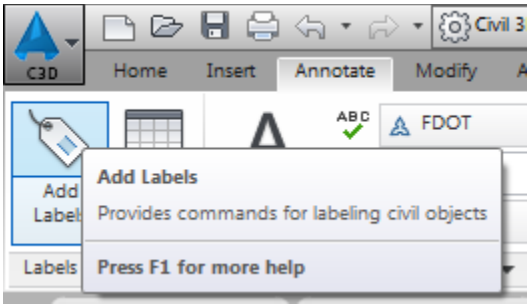
1. Start the FDOT Civil 3D State Kit and open the **DRPRRD03.dwg** located in the Chapter 11 dataset drainage folder.
2. Select the **top Viewport** to make it the active Viewport.
3. Pan to display the **S-1 Proposed Drainage-SR61 Profile View**.



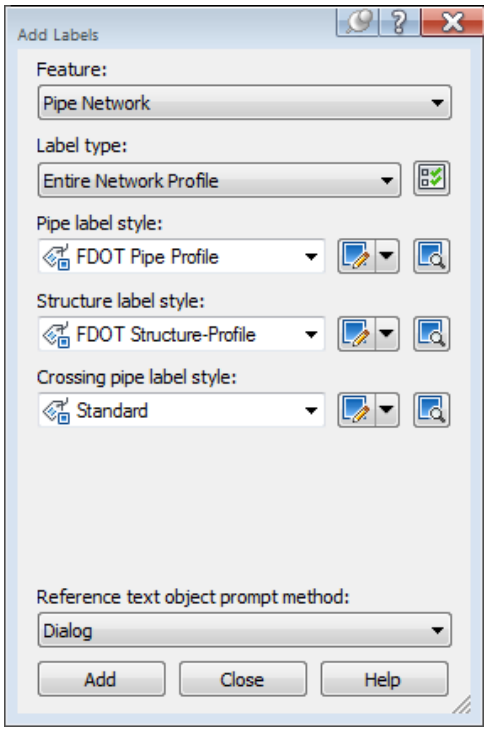
4. Click in the **bottom Viewport** to make it the active Viewport.

5. Pan to display the **S-1 Proposed Drainage-SR61 alignment.**



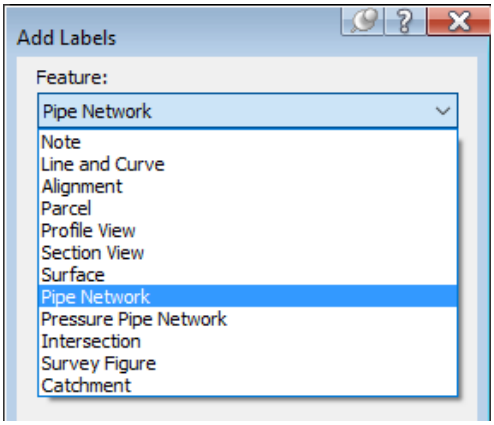


6. From the *Annotate tab > Labels panel*, click the top half of the **Add Labels** button.

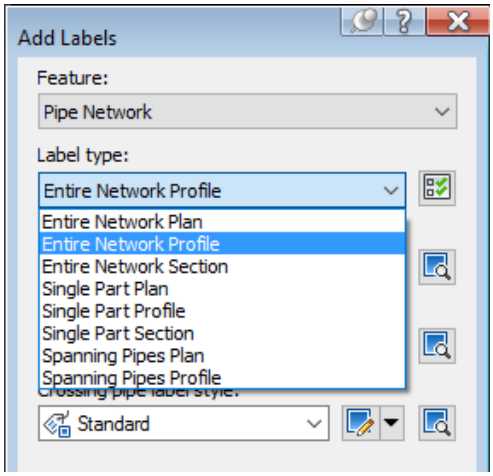


7. The Add Labels dialog box displays. Set the selections as indicated below:

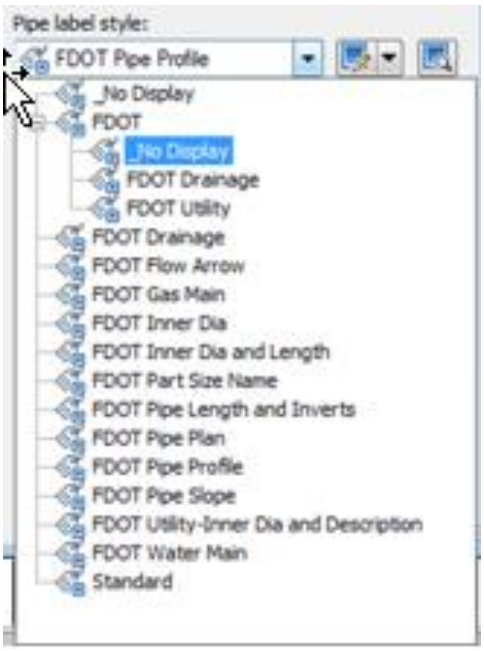
   a. From *Feature: drop down list*, select **Pipe Network**.



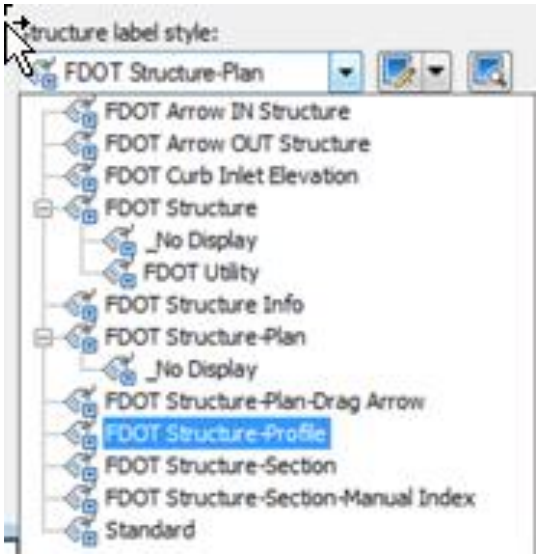
   b. From the *Label type: drop down list*, select **Entire Network Profile**.



   c. From the *Pipe label style: drop down list*, select **FDOT Pipe Profile**.

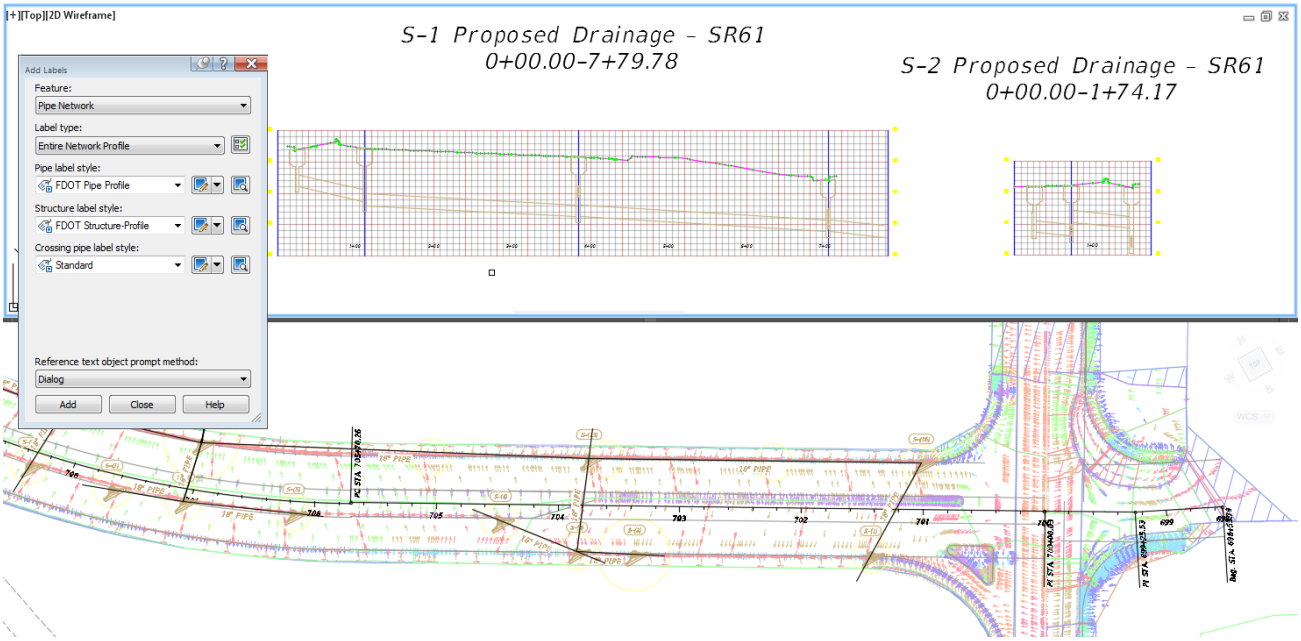


d. From the *Structure label style: drop down list*, select **FDOT Structure-Profile**.



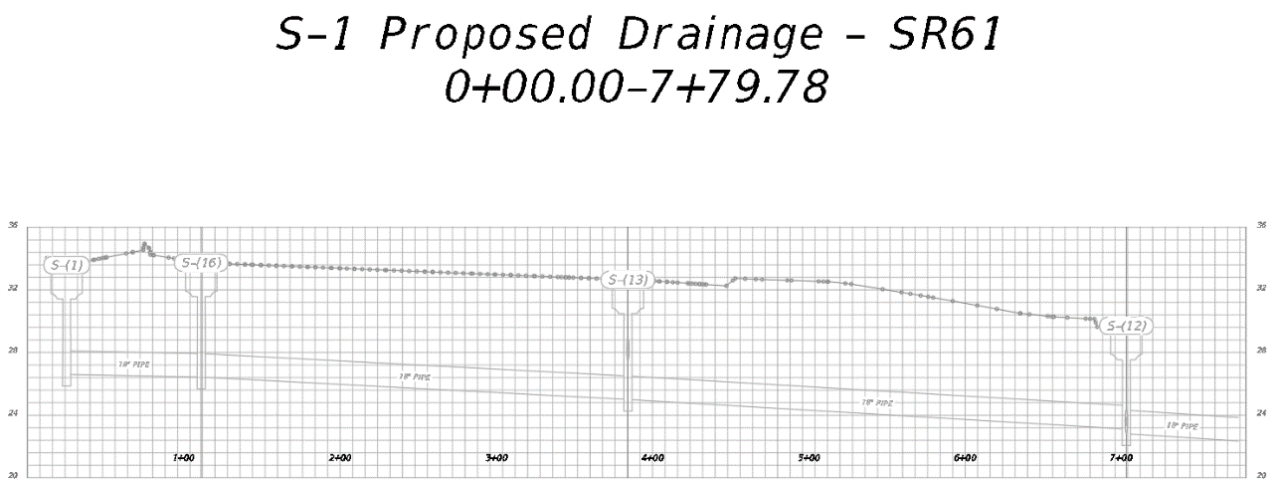
8. From the bottom of the Add Labels dialog box, click **Add**.

9. The command line prompts you to *Select a part (in profile view)*. Select the **top Viewport** to make it the active Viewport.



10. Select any **Pipe** or **Structure** from the *S-1 Proposed Drainage-SR61 Profile View*.

11. With *selection cycling* toggled **On** a Selection dialog box displays. In the Selection dialog box select **Pipe or Structure Profile**.



12. Labels are applied to structures and pipes in the **S-1 Proposed Drainage-SR61 Profile View** as shown above.

13. Using steps from the above exercise, **label** the remaining *Profile Views*. A list is provided below for reference.

S-2 Proposed Drainage – SR61	S-4 Proposed Drainage – SR61
S-5 Proposed Drainage – SR61	S-7 Proposed Drainage – SR61
S-8 Proposed Drainage – SR61	S-9 Proposed Drainage – SR61

14. **Save** and **Close** the *DRPRRD03.dwg* file.

12 ADJUST PIPE INVERTS & PIPE SLOPES

DESCRIPTION

In this chapter, you will adjust Pipe Inverts and Pipe Slopes in Proposed Drainage - SR61 Profile Views. Civil 3D makes editing drainage networks easy, because of the many ways you can edit, such as editing the same network in the Plan View, Profile View, & Section View. The FDOT civil 3D State Kit contains default command settings that allow the user to layout and create Drainage Networks with FDOT Standards already in place, including Pipe Rules which control slope, cover, and run. The Structures contain rules that control sump, depth, and slope within structure. The user can add additional rules or edit the existing ones.

OBJECTIVES

In this chapter, you will learn about:

- Understanding Structure & Pipe Rules
- Editing Pipe Inverts in Profile Views

CHAPTER SETUP

Run the Chapter 12 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

ADJUSTING PIPE INVERTS AND PIPE SLOPES

In the next few steps you will review how structures and pipes are placed based on FDOT pipe and structure rules.

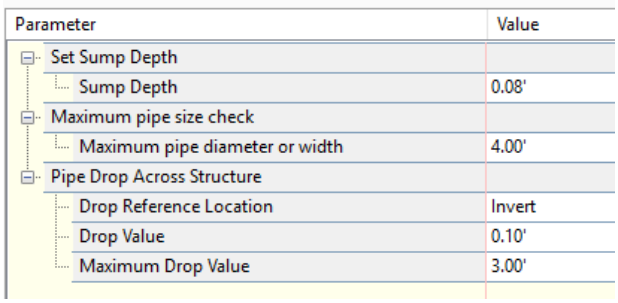
Before you start the process of adjusting pipe inverts and pipe slopes displayed in any of the Proposed Drainage - SR61 Profile Views, you need to review how structures and pipes are placed based on FDOT pipe and structure rules located in the **FDOT Drainage** parts list within the template used to create a DRPRRD (Proposed Drainage) file.

REVIEW STRUCTURE AND PIPE RULES

STRUCTURE RULES

The Structure Rules and their description within the State Kit are as follows:

- **Pipe Drop Across Structure -** This rule compares all pipes connected to a single structure and ensures that pipes enter and exit the structure at logical locations. For more information, see the About the Pipe Drop Across Structure Rule.
- **Drop Reference Location -** Determines the drop location by using the pipe's invert, crown, or centerline elevation.
- **Drop Value -** Specifies what the drop value is between the lowest incoming pipe and any outgoing pipe connected to the structure.
- **Maximum Drop Value -** Specifies the maximum drop value between the lowest incoming pipe and any outgoing pipe connected to the structure. Note that this parameter provides validation only; it does not alter (move or resize) the part in the drawing in any way. It simply produces a rule violation on the part if the specified value is exceeded

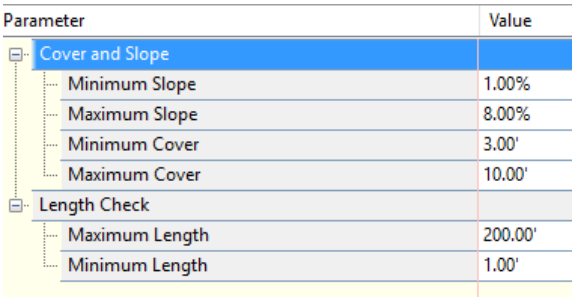


Parameter	Value
Set Sump Depth	
Sump Depth	0.08'
Maximum pipe size check	
Maximum pipe diameter or width	4.00'
Pipe Drop Across Structure	
Drop Reference Location	Invert
Drop Value	0.10'
Maximum Drop Value	3.00'

Default Structure Rules

PIPE RULES

- **Minimum - Maximum Slope -** Specifies the minimum slope of the pipe, expressed in percent. During layout, a pipe will be created per its minimum slope rule value. If the pipe is edited so that its slope is less than the minimum, you can still edit the pipe as desired, breaking the minimum slope rule, but a rule violation occurs for that object. If a pipe exceeds its maximum allowed slope it will give a warning icon telling you the rule was violated.
- **Minimum – Maximum Length -** Specifies the minimum and maximum lengths allowed when laying out a drainage network. The length rules is either a single run of pipe or between structures, if the design violates either one of these rules a notification icon will display warning you of the violation.



Parameter	Value
Cover and Slope	
Minimum Slope	1.00%
Maximum Slope	8.00%
Minimum Cover	3.00'
Maximum Cover	10.00'
Length Check	
Maximum Length	200.00'
Minimum Length	1.00'

Default Pipe Rules

RULES OF THUMB

When adjusting pipe inverts you need to apply some *Rules of Thumb* beyond the Pipe and Structure Rules that you just reviewed.

- Review the Profile View for Flow Continuity.
- Visually Inspect to Check for Adverse Slopes.
- Visually Inspect Each Structure to Check for Node Drop for the Outgoing Pipe.
- Make Note of the Changes Needed.
- Order any Edits from Downstream to Upstream.

➢ *Editing Structures Pipe Inverts:*

- You have been working from Downstream to Upstream to make the elevations work. Changing the Out Invert could invalidate work you have already completed downstream.
- From the Structure Properties dialog box > Connected Pipes tab review **Hold Out Invert**.
- Set incoming inverts currently below Out Invert to 0.1 above Out Invert.
- Higher inverts of incoming pipes can be left unchanged.
- Ideally you should hold slopes of pipes being adjusted so you don't end up with odd values like 1.57% slope.
- In the Structure Properties dialog box, you can edit inverts of connected pipes but you cannot make edits to the slope value column in this dialog.

➢ *Edit Pipe Slopes:*

- To edit pipe slopes, use the Pipe Properties dialog box.
- 1%, 2%, 0.5%, or 0.1% are examples of preferred values for pipe slopes because they are easier to layout during construction.
- Avoid odd slope values such as 1.81% for example.
- Make the mental math easier for determining feet per foot drop.

  Example: For a 10' length of pipe at 2% what is the elevation drop? 2% is 2 feet per 100 feet. That makes it .2 feet in 10 feet.

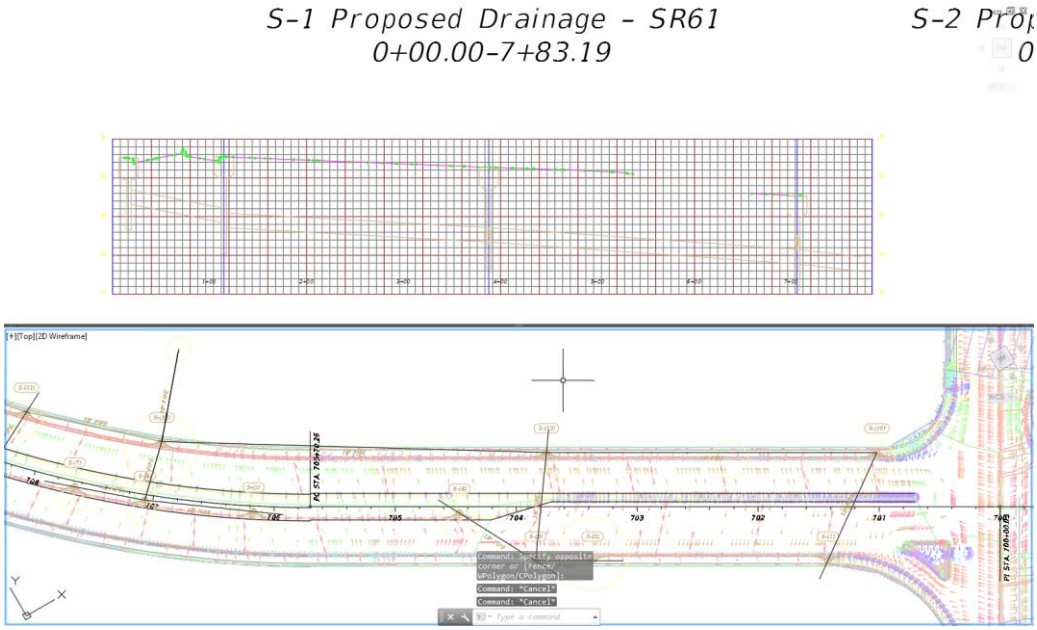
Note The above *Rules of Thumb* will be applied in the following adjustments in each of the Proposed Drainage - SR61 Profile Views that have been created for the project.

Exercise 12.1 Adjust Pipe Inverts & Slopes of Pipes Connected to Structures

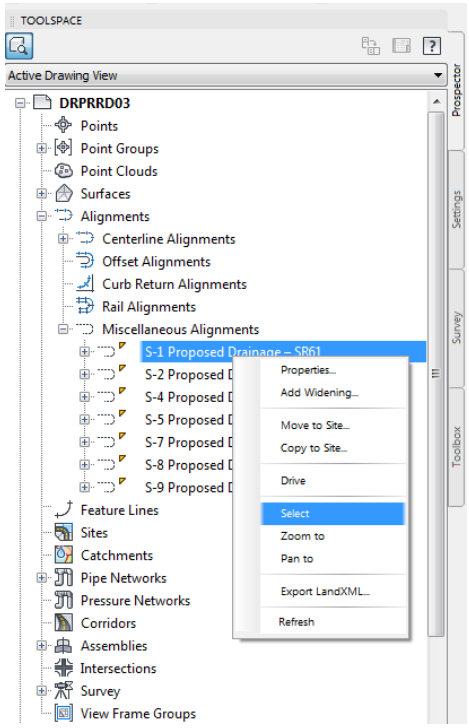
In the next few steps you will either adjust the pipe inverts elevations at a structure or adjust a pipe's slope where necessary in each of the Proposed Drainage - SR61 Profile Views.

The next exercise will show you how to adjust pipe inverts and slopes of the upstream and downstream pipes connected to structures displayed in the S-1 Proposed Drainage-SR61 Profile View**.**

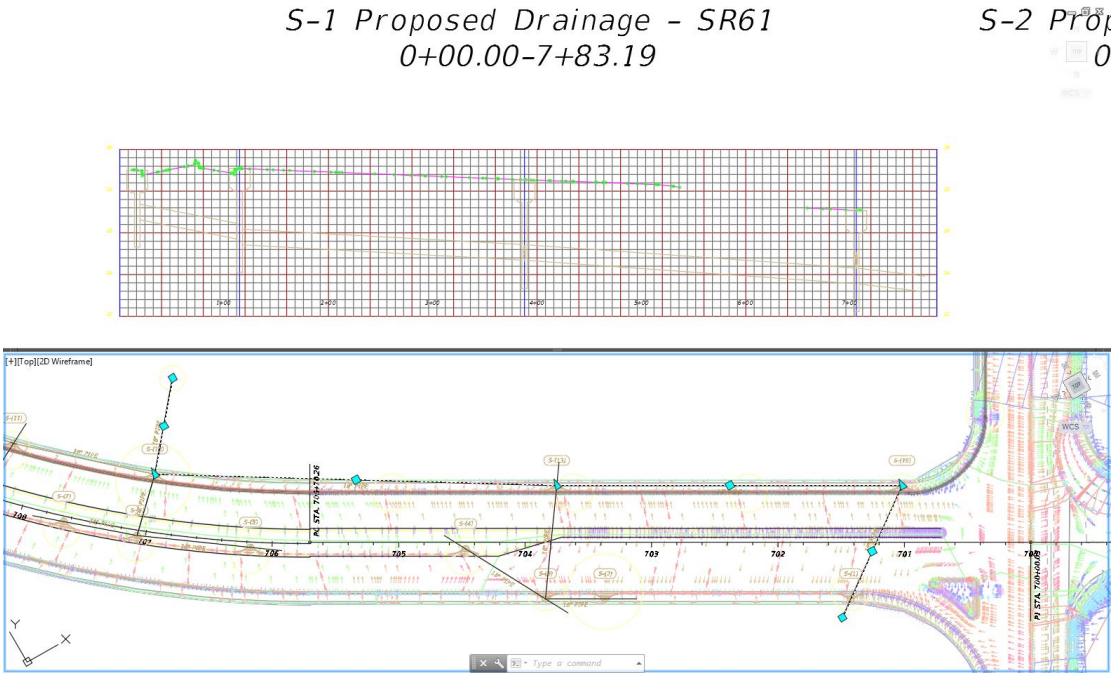
1. Start the FDOT Civil 3D State Kit and open the **DRPRRD03.dwg** located in the Chapter 12 dataset drainage folder.



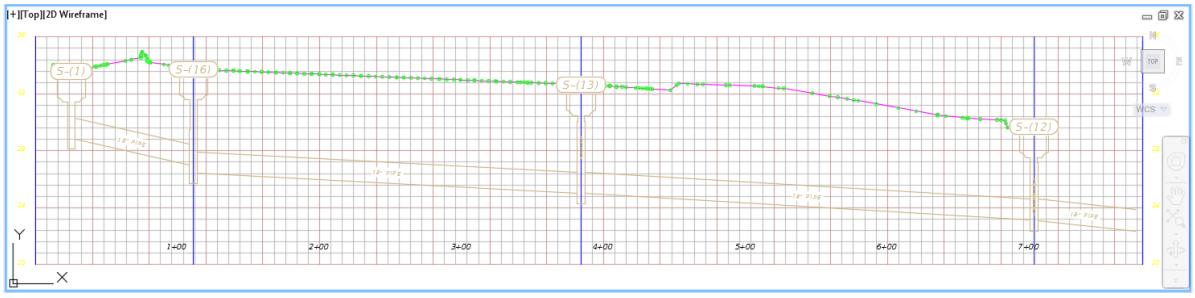
2. Select the **bottom Viewport** to make it the active Viewport as shown above.



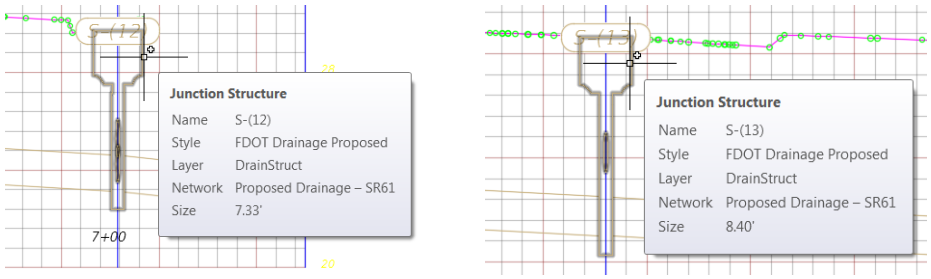
3. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-1 Proposed Drainage - SR61** and choose **Select.**
4. **Zoom** and **Pan** to display the **S-1 Proposed Drainage - SR61 Alignment.**



5. Select the **top Viewport** to make it the active viewport and Pan to display the **S-1 Proposed Drainage-SR61 Profile View.**
6. Press **ESC** to clear the grips. Do you see any **Adverse Slopes** in the *S-1 Proposed Drainage-SR61 Profile View?* No **Adverse Slopes** displayed, you can continue to the next step.

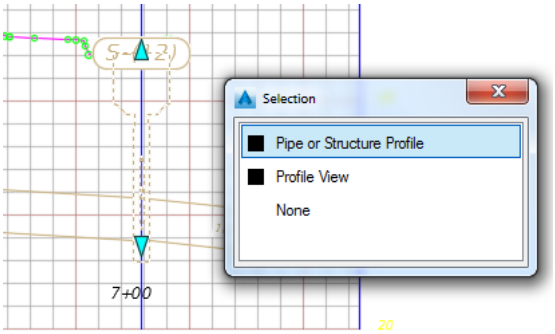


7. **Zoom in** closer to display the **Pipes** connected to the structures displayed the S-1 Proposed Drainage-SR61 Profile View. Do you see any **Outgoing Pipes** that may be equal to or higher than the *Incoming Pipes*? Yes, so you need to make a **list of Structures** to investigate.



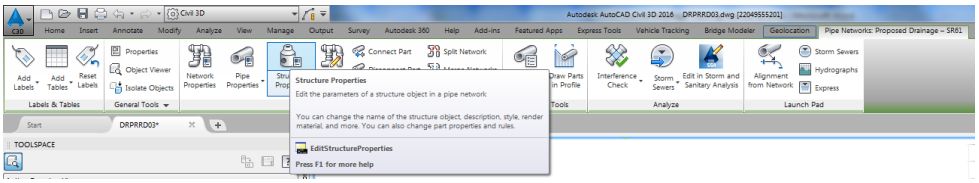
HINT If you hover over a structure a tooltip is displayed listing the name of the structure.

8. Select **structure S-(12)**.

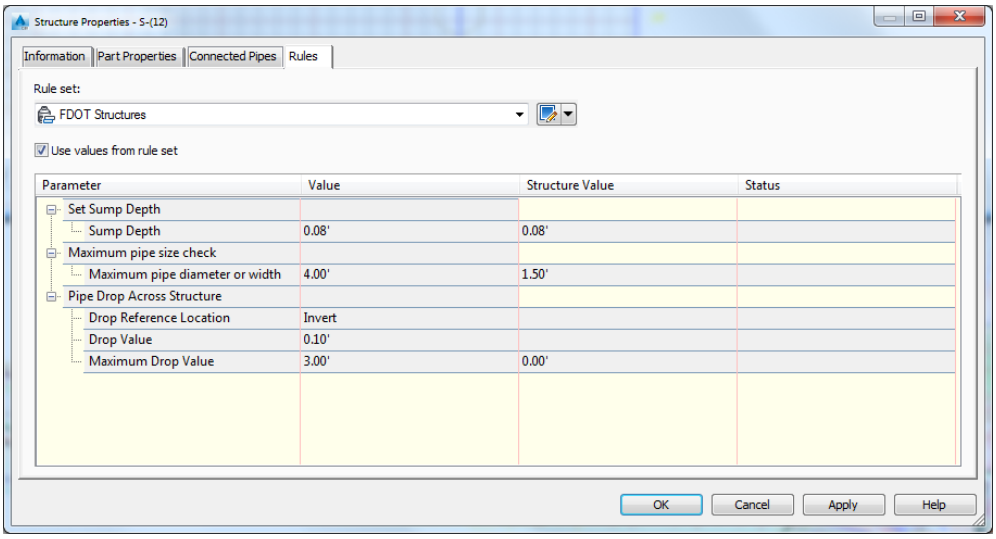


9. With *selection cycling* toggled **On**, a Selection dialog box displays. In the Selection dialog box select **Pipe or Structure Profile**.

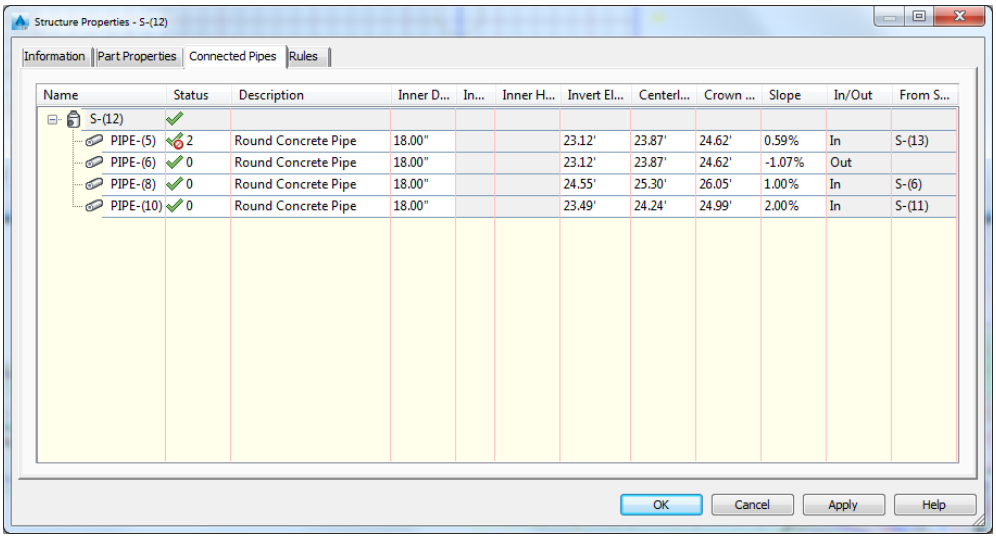
10. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Structure Properties**.



11. From the Structure Properties - S-(12) dialog box, select the **Rules** tab. The Structure S-(12) values are within the desired limits.

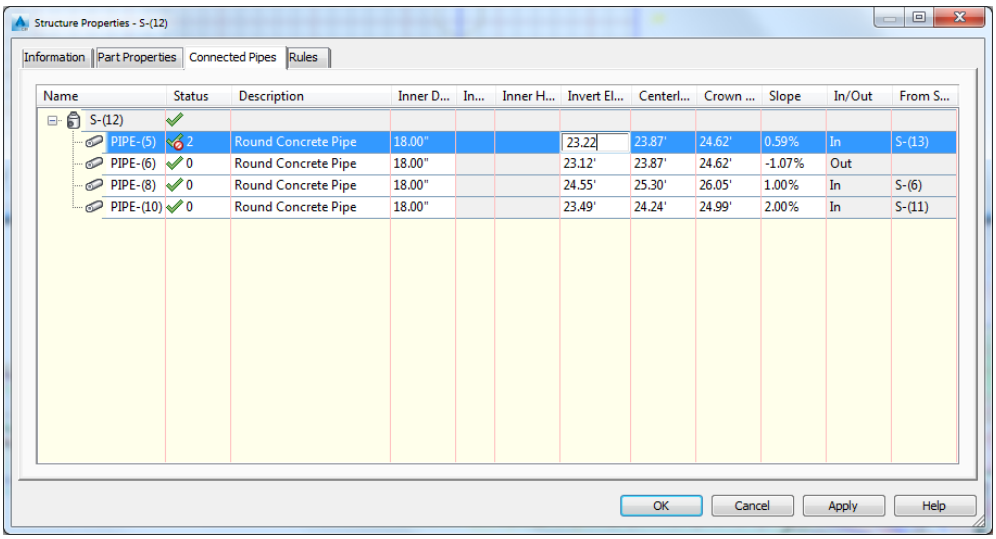


12. From the Structure Properties - S-(12) dialog box, select the **Connected Pipes** tab. This tab displays the pipes connected to structure S-(12).



a. Review the Structure's connected Pipes and their data to make a list of required adjustments.

b. Review the PIPE-(6) Outgoing Pipe Invert value and hold the current **Invert Elevation** of **23.12** for PIPE-(6), the Outgoing pipe.

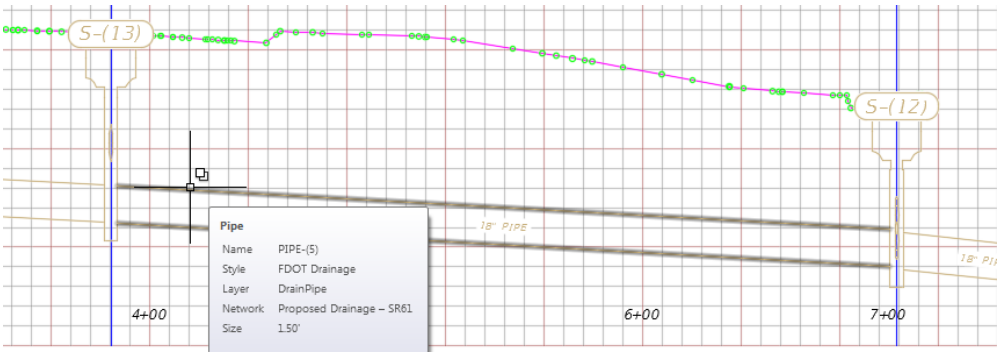


c. PIPE-(5) and PIPE-(6) have the same invert elevations. PIPE-(5) must be 23.22 or greater to meet the node drop requirement of 0.1'. Adjust the **Invert Elevation** for Pipe-(5) to **23.22**

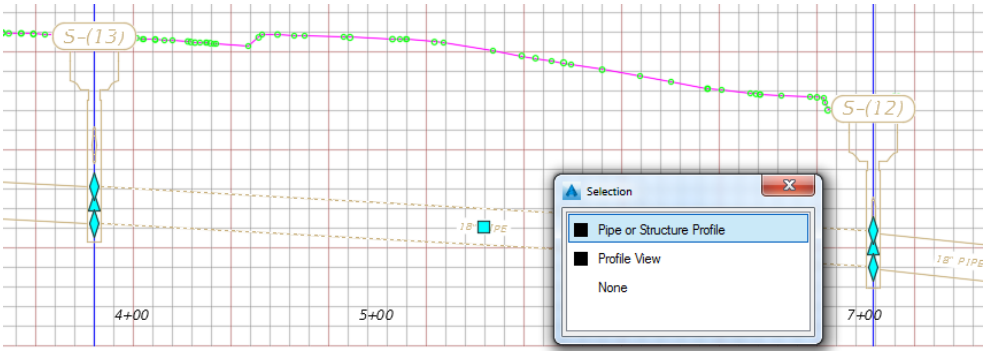
Note Based upon the Rules of Thumb being followed, PIPE-(5) needs the slope adjusted from 0.59% to 0.5%. But this adjustment cannot be done from the Structure Properties - S-(12) dialog box, it must be done by editing the PIPE-(5) properties.

13. Click **Apply** then **OK** to close the Structure Properties - S-(12) dialog box.

➢ *Edit PIPE-(5) Pipe Properties*

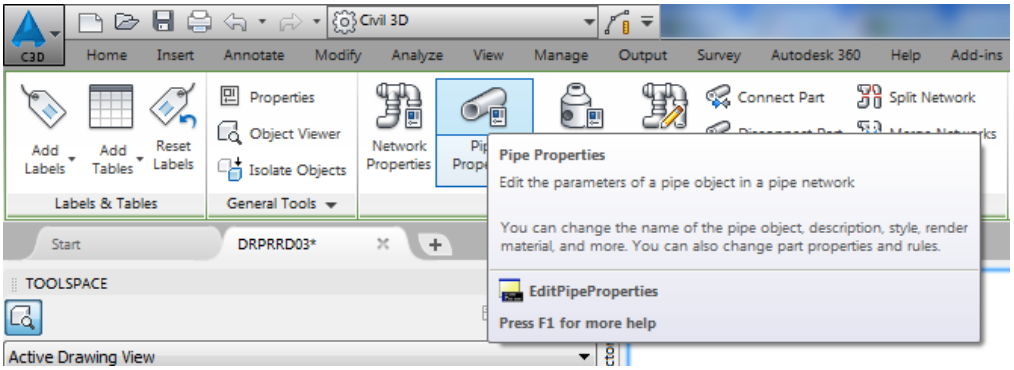


1. **Zoom** and **Pan** in the Profile View to display **structures S-(13)** and **S-(12)**. Hover over the pipe that is between the structures to display a tooltip listing the pipe as **PIPE-(5)**

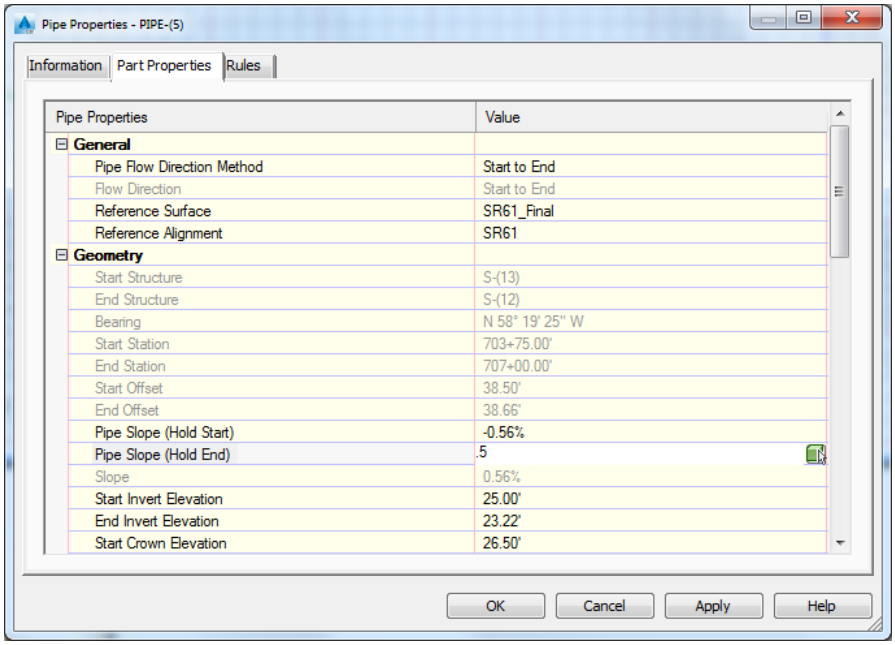


2. Select **PIPE-(5)**. With *selection cycling* toggled On, a Selection dialog box displays. In the Selection dialog box select **Pipe or Structure Profile.**

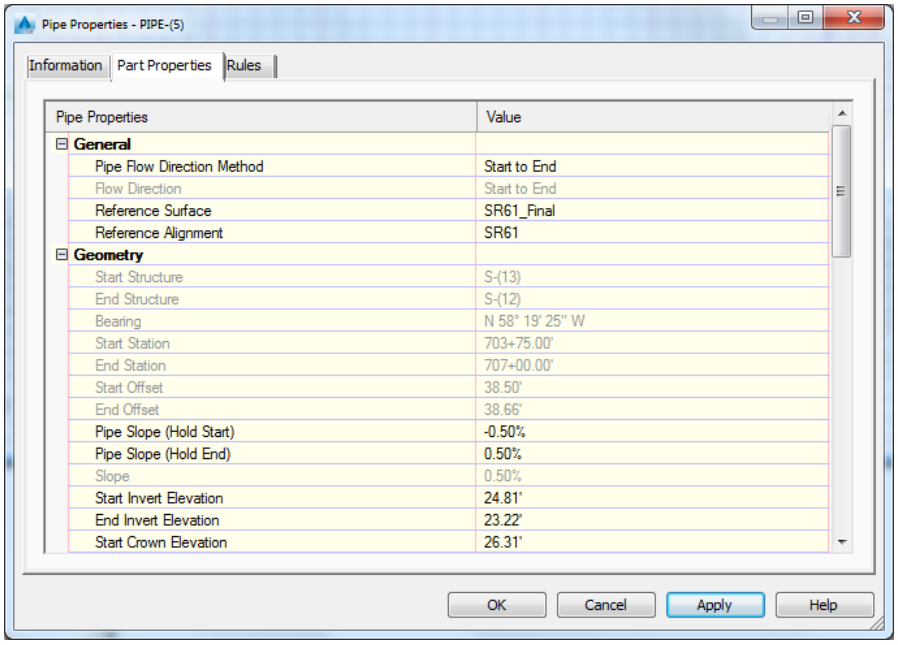
HINT Notice the Ribbon changes to a context sensitive state displaying the commands relevant to the selected object.



3. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Pipe Properties**.



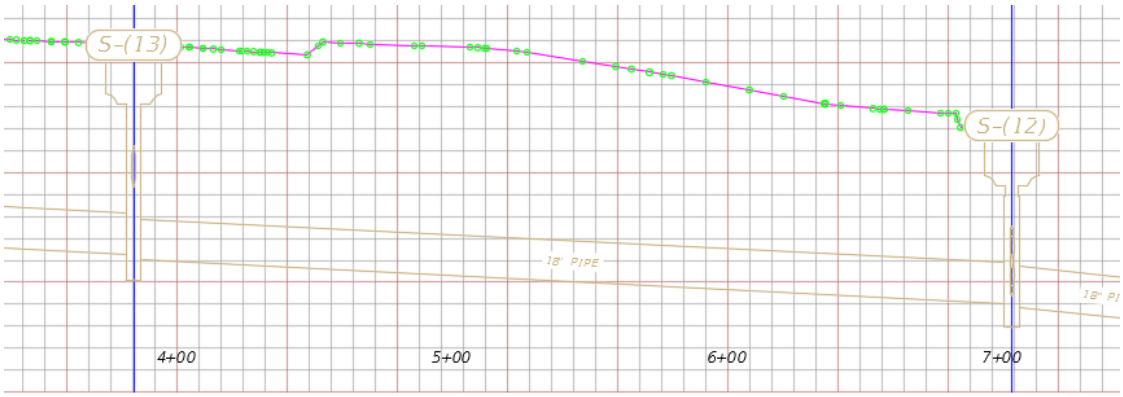
4. From the Pipe Properties - PIPE-(5) dialog box, select the **Part Properties** tab.



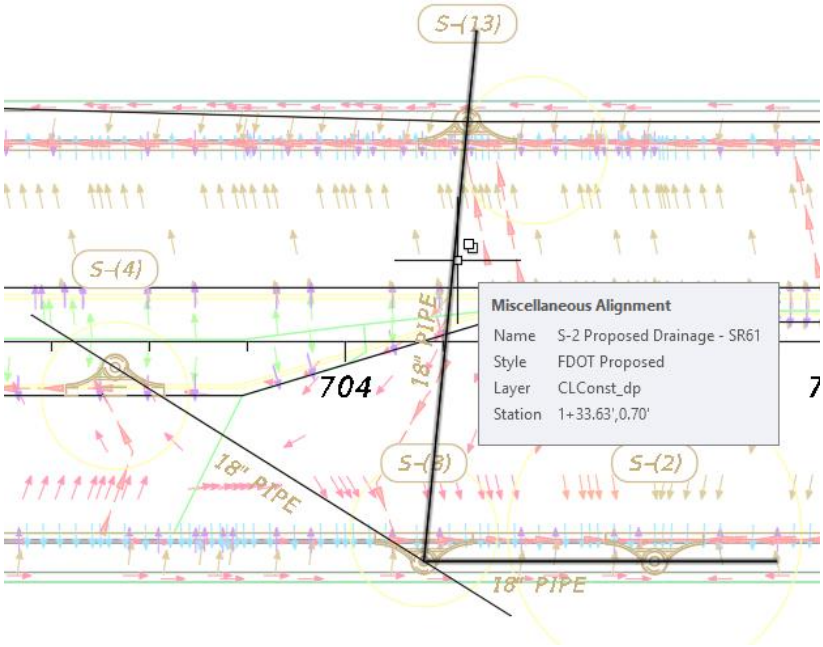
5. Adjust the *Pipe Slope (Hold End) value* to **0.5%**. By adjusting the Pipe Slope (Hold End) value you are modifying the elevation of the Start Invert. A positive slope value indicates the direction is uphill.

6. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start are recalculated and displayed.

7. Click **OK** to close the Pipe Properties - PIPE-(5) dialog box. The PIPE-(5) adjusted slope now displays.



8. The S-2 Proposed Drainage - SR61 Alignment intersects with the S-1 Proposed Drainage - SR61 Alignment S-1 at structure S-(13). You will review this in the next exercise.

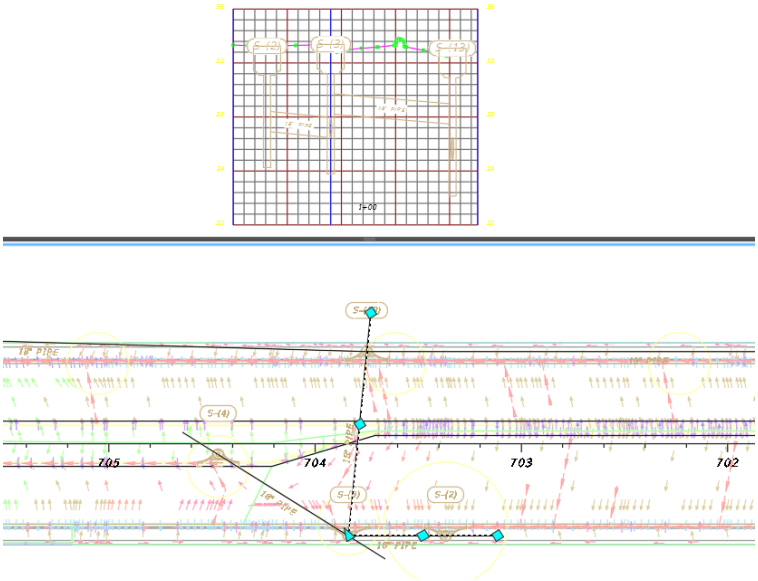


9. **Save** the *DRPRRD03.dwg* before continuing.

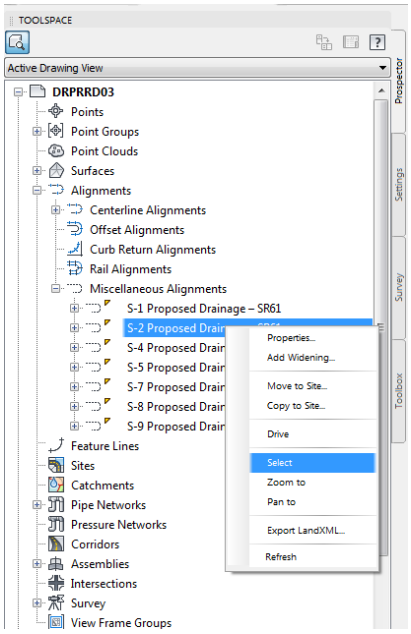
Exercise 12.2 Adjust Pipe Inverts & Slopes of Upstream/Downstream Pipes Connected to Structures

The next steps will show you how to adjust pipe inverts and slopes of the upstream and downstream pipes connected to structures displayed in the S-2 Proposed Drainage - SR61 Profile View.

S-2 Proposed Drainage – SR61
0+00.00–1+80.74

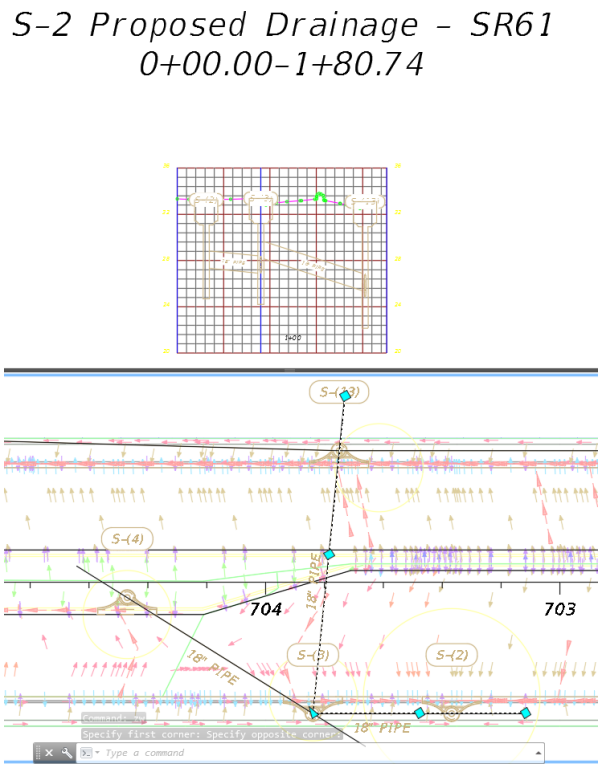


1. Select the **bottom Viewport** to make it the active Viewport.



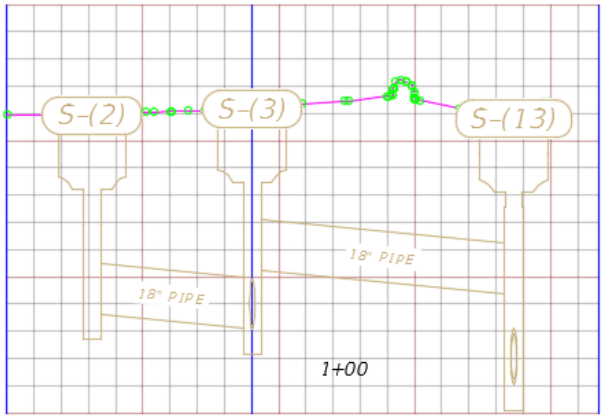
2. From the *TOOLSPACE > Prospector tab*, expand **Alignments,** expand **Miscellaneous Alignments**, right-click on **S-2 Proposed Drainage - SR61** and click **Select.**

3. **Zoom** and **Pan** to display the **S-2 Proposed Drainage - SR61 Alignment.**



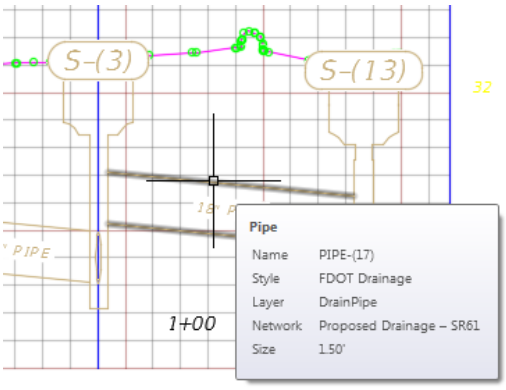
4. Select the **top Viewport** to make it the active Viewport. **Pan** to display the **S-2 Proposed Drainage - SR61 Profile View**. Press **ESC** to clear the grips.

5. Do you see any **Adverse Slopes** in the S-2 Proposed Drainage - SR61 Profile View? No adverse slopes displayed, you can continue to the next step.



6. **Zoom in** closer to display the **Pipes** connected to the structures displayed the S-2 Proposed Drainage - SR61 Profile View.

7. Do you see any **Outgoing Pipes** that may be equal to or higher than the *Incoming Pipes*? Yes, so you need to make a **list of Structures** to investigate.

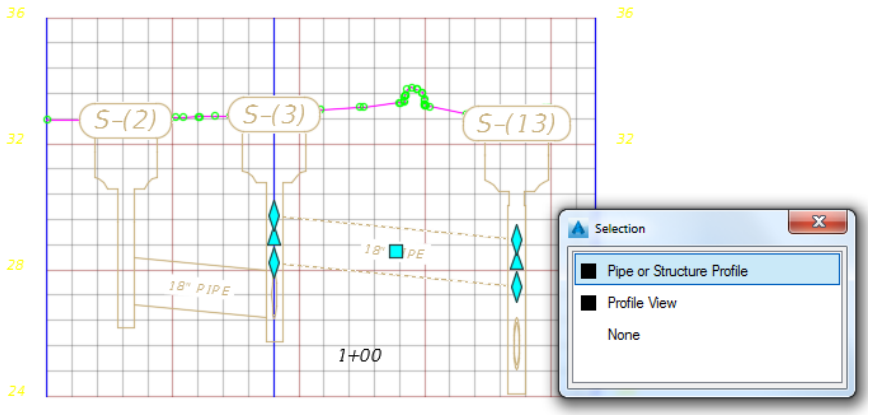


8. Hover over the Pipe that is between structure S-(3) and S-(13) to display a tooltip listing the Pipe as **PIPE-(17).**

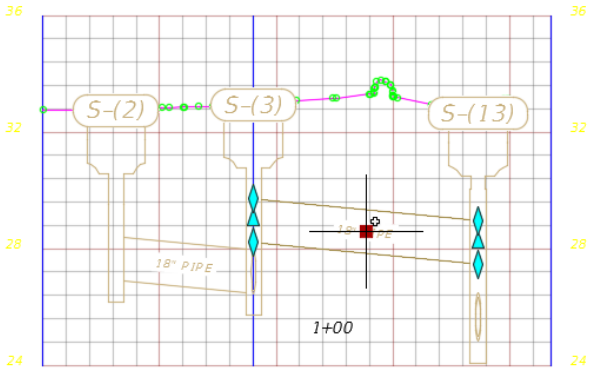
9. PIPE-(17) needs to be **lowered** to meet the *Incoming Pipe* requirements for structure S-(13) and the *Outgoing Pipe* requirements for structure S-(3). After PIPE-(17) has been adjusted investigate the structure S-(3) properties.

➢ *Adjust PIPE-(17)*

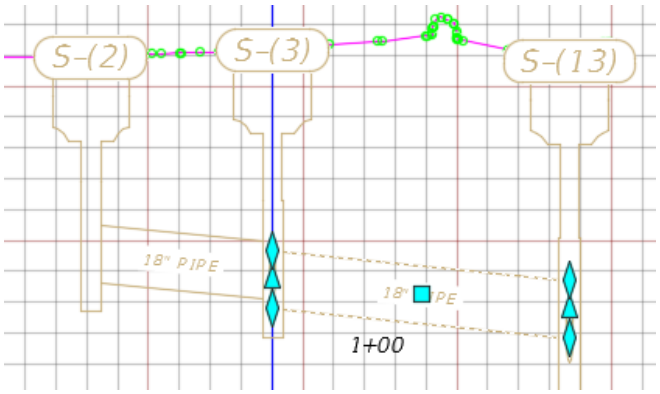
The next steps will show you how to adjust PIPE-(17) by using grips to move PIPE-(17) to lower location.



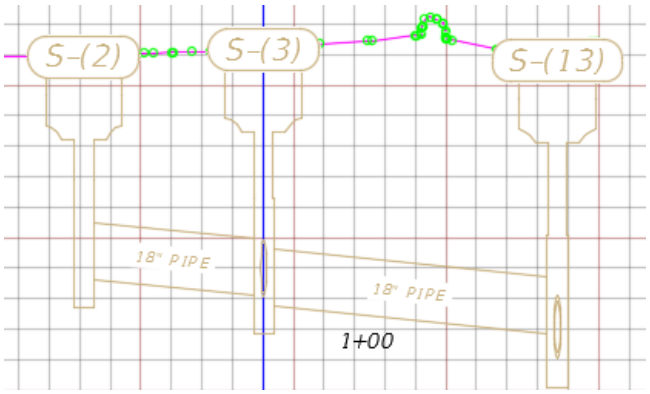
1. Select **PIPE-(17).** With *selection cycling* toggled On, a Selection dialog box displays. In the Selection dialog box select **Pipe or Structure Profile**.



2. Select the middle **square grip** of PIPE-(17) to maintain the slope while moving the pipe vertically downward.



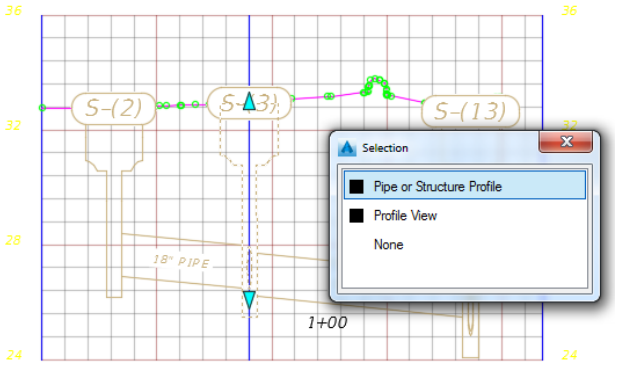
3. **Zoom in** closer as you *grip edit* to confirm placement at the upstream end of the pipe just below the incoming pipe at structure S-(3) and above the outgoing pipe at structure S-(13).



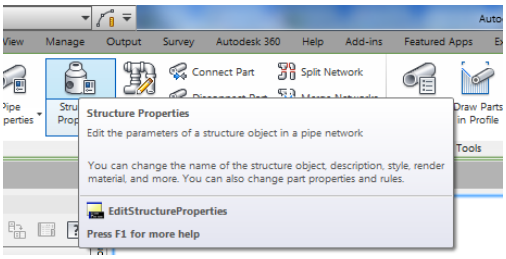
4. Move the grip downward, at the *command prompt* Type **20** and then press **ENTER** to move the PIPE-(17) downward 20'. Press **ESC** to clear grips

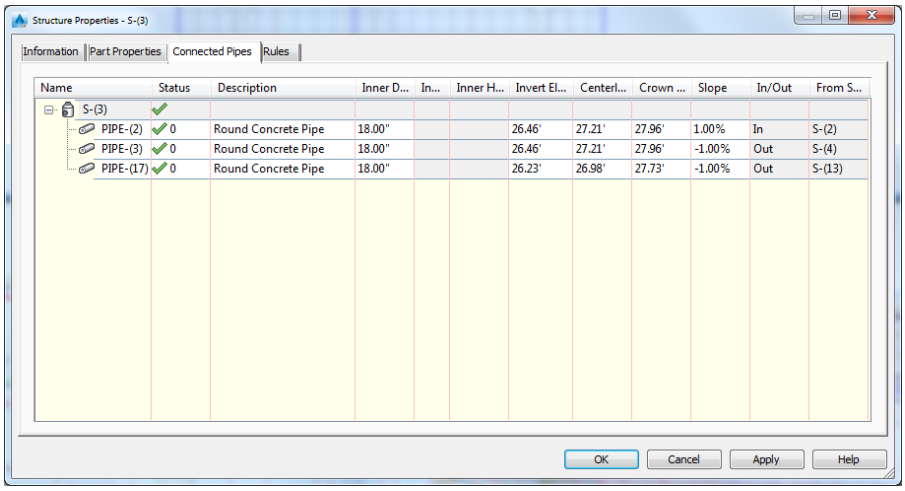
Exercise 12.3 Edit the Structure Properties

At this position, the upstream end of pipe PIPE-(17) is below the incoming pipe at structure S-(3). The next steps will show you how to Edit the Structure Properties of structure S-(3) to see if the invert elevations meet our requirements.



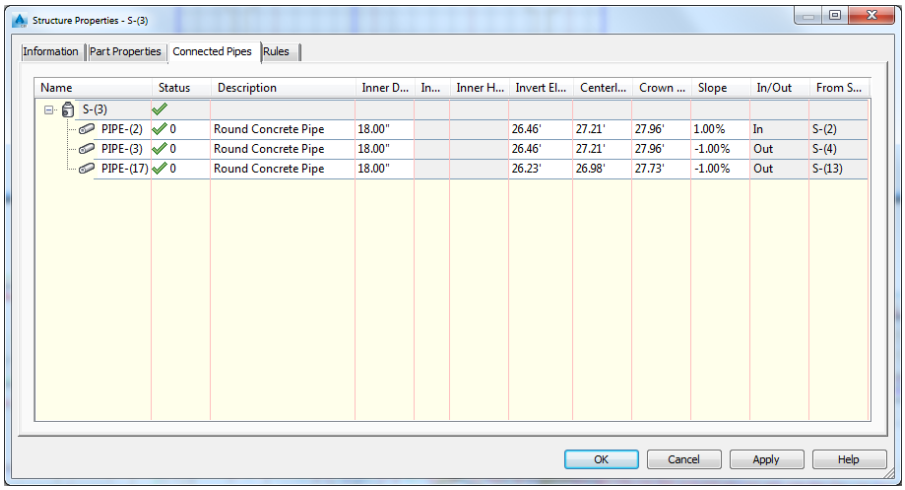
1. Select **structure S-(3)**. With *selection cycling* toggled On, a Selection dialog box displays. In the Selection dialog box select **Pipe or Structure Profile**.
2. From the *Pipe Networks Proposed Drainage - SR61 tab >Modify panel*, select **Structure Properties.**





3. From the Structure Properties - S-(3) dialog box, select the **Connected Pipes** tab. This tab displays the pipes connected to the structure S-(3).

4. Review the Structure S-(3) **connected Pipes data** and make a list of required adjustments.



5. Review the PIPE-(17) Outgoing Pipe Invert value and hold Invert elevation 26.23 for the Outgoing Pipe.
6. There are 2 pipes designated as an Outgoing Pipe. PIPE-(3) is NOT an Outgoing Pipe. You must change the flow direction of PIPE-(3) to correct this problem.

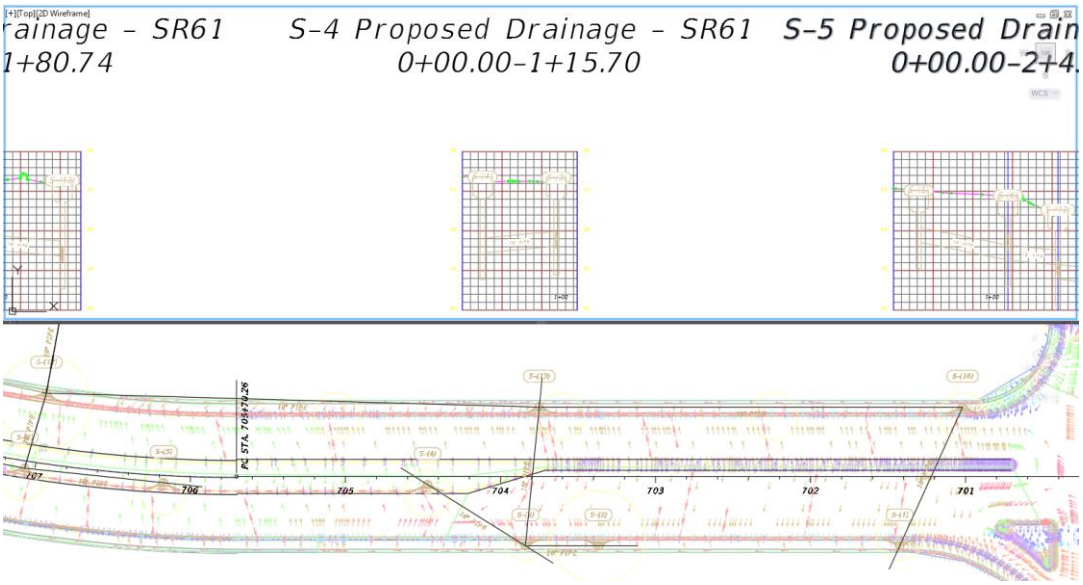
Note Changing the flow direction of PIPE-(3) will be performed in the next exercise, when editing the S-4 Proposed Drainage - SR61 Profile View.

7. All other Incoming Pipes have elevations greater than 0.1' above the Outgoing Pipe. No edits are required.
8. Review Slope for Values that have odd values. No edits are required.
9. Click **Apply** then **OK** to close the Structure Properties - S-(3) dialog box
10. **Save** the *DRPRRD03.dwg* file.

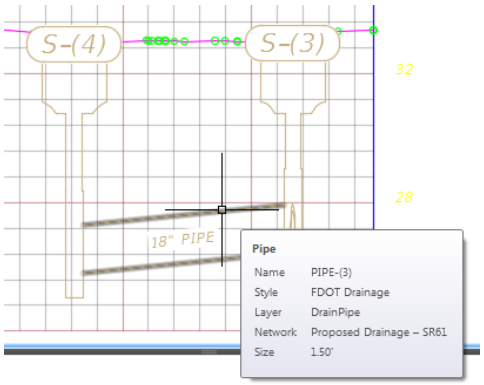
Exercise 12.4 Change Flow Direction for a Pipe

The next steps will show you how to change the flow direction for a pipe connecting structures displayed in the S-4 Proposed Drainage - SR61 Profile View

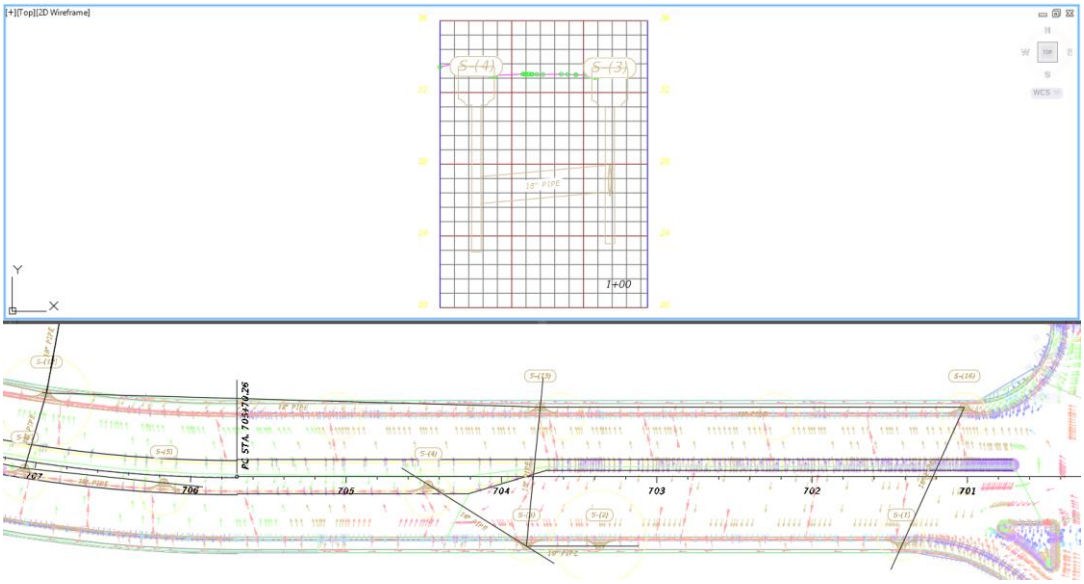
1. **Zoom** and **Pan** to display the **S-4 Proposed Drainage - SR61 Profile View**.



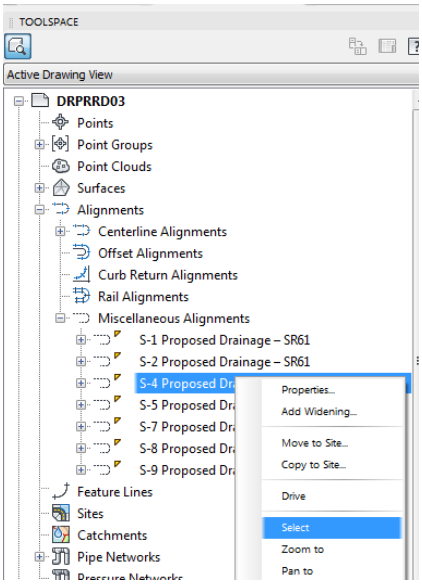
2. **Zoom in** closer to display **structures S-(4) and S-(3)**. Hover over the **Pipe** that is between structure S-(4) and S-(3) to display a tooltip listing the Pipe as **PIPE-(3).**

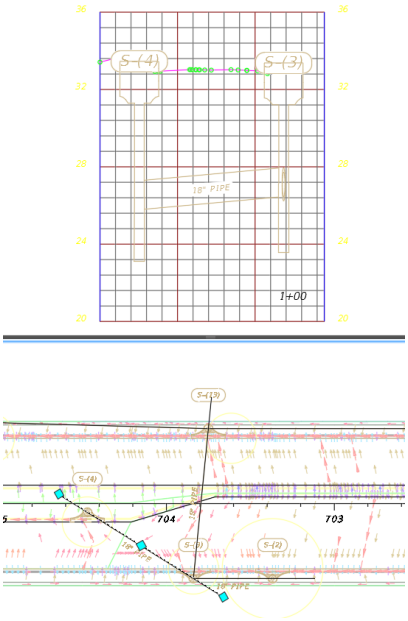


3. Select the **bottom Viewport** to make it the active Viewport.

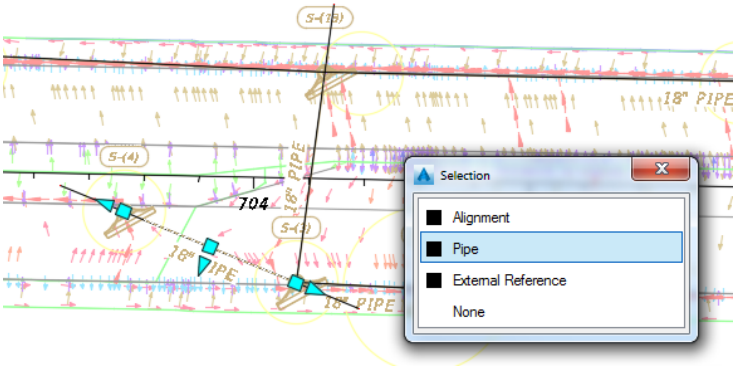


4. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-4 Proposed Drainage - SR61** and click **Select.**

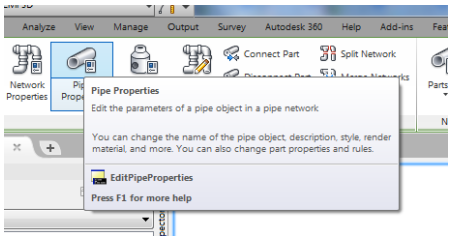




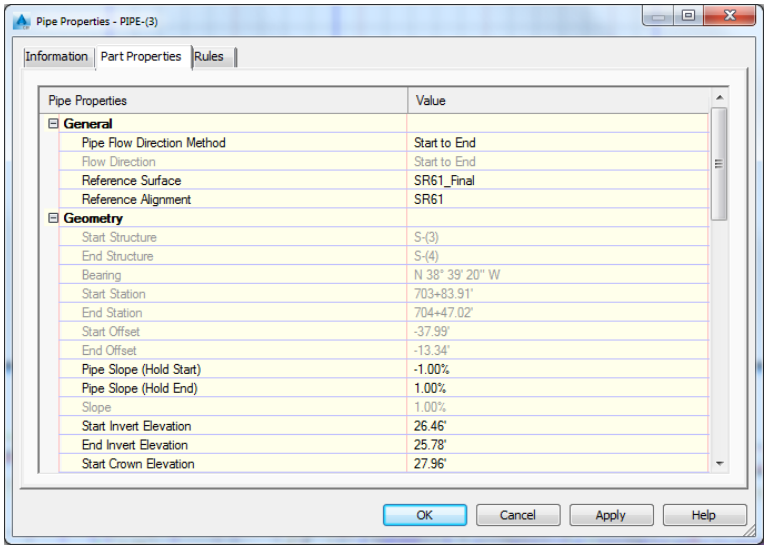
5. **Zoom** and **Pan** to display the **S-4 Proposed Drainage - SR61 Alignment**. Press **ESC** to clear grips.



6. Select the **downstream pipe** from structure S-(4). With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe**.

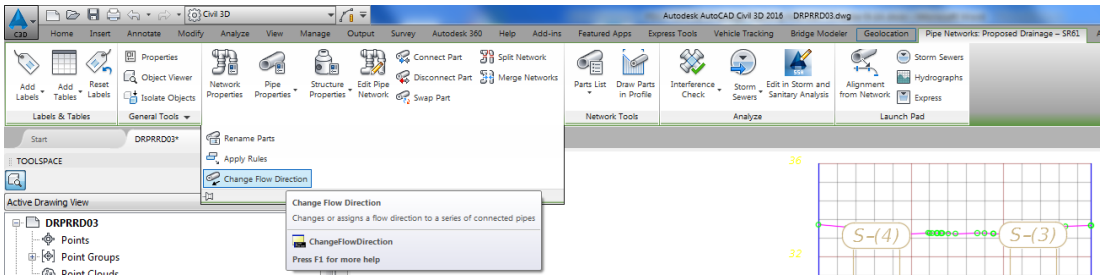


7. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Pipe Properties** button.

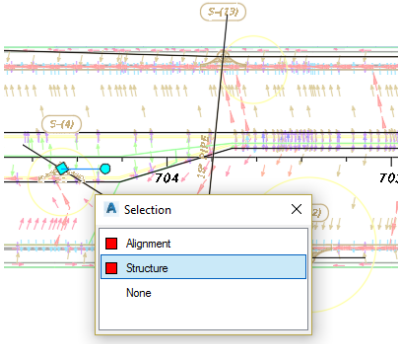


8. From the Pipe Properties - PIPE-(3) dialog box, select the **Part Properties** tab.

9. The flow direction is not correct, notice the **Start Structure is S-(3)** and the **End Structure is S-(4)**. The Pipe Flow Direction Method is Start to End. Press **Cancel** to close the Pipe Properties - PIPE-(3) dialog box.

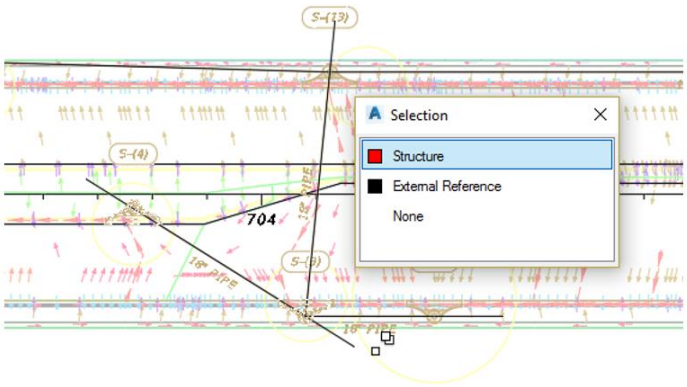


10. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, click the **Modify** panel to reveal the *hidden commands*. Select the **Change Flow Direction** command. The *command line* displays the prompt: *Select the intended **UPSTREAM** starting point in plan*.



11. Select **structure S-(4)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Structure.**

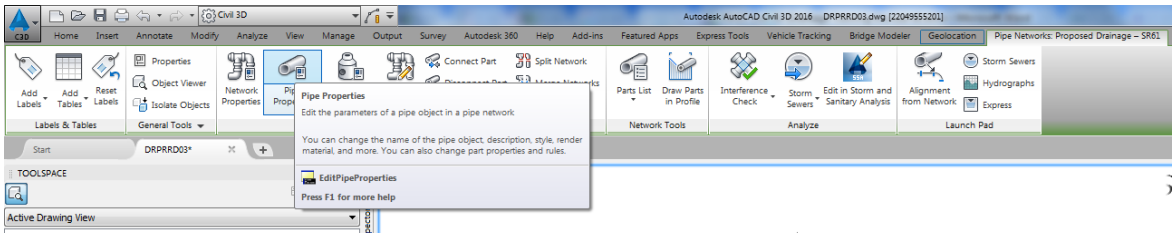
12. The *command line* displays the prompt: *Select the intended DOWNSTREAM ending point in plan*.



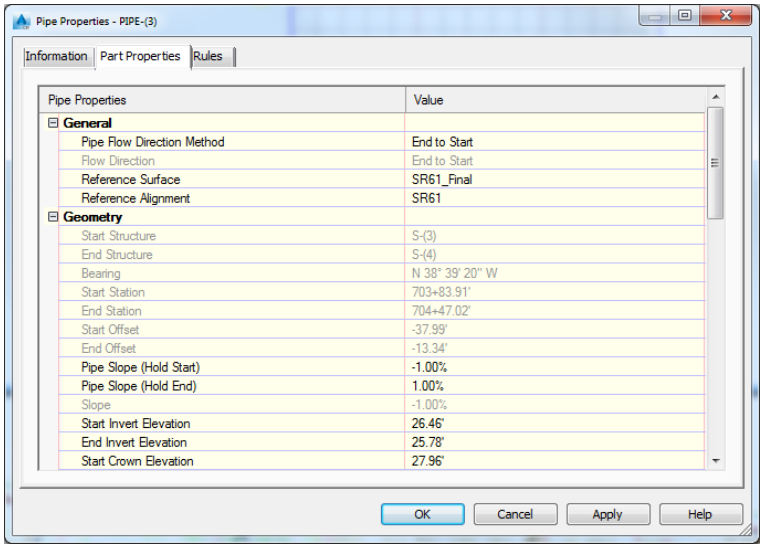
13. Select **structure S-(3)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Structure.** Press **ENTER**.

```
Flow direction successfully applied to 1 pipes.
```

14. The *command line history* indicates the change in flow direction was successful.



15. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Pipe Properties**.

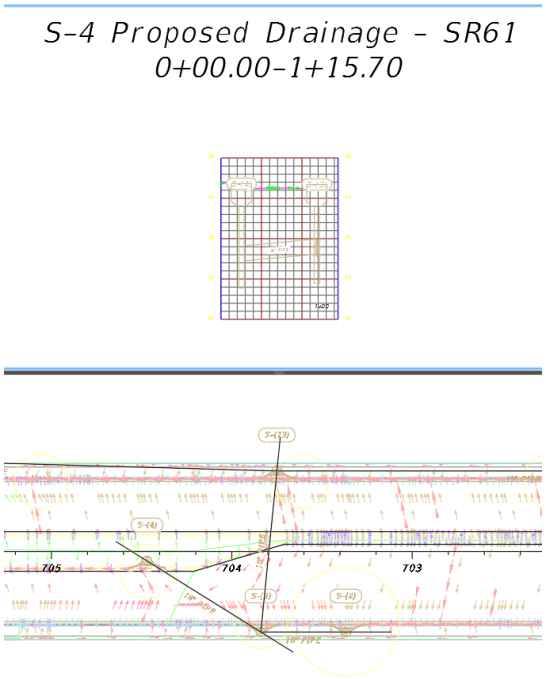


16. From the Pipe Properties - PIPE-(3) dialog box, select the **Part Properties** tab. The *Flow Direction* is now correct, notice the Start Structure is S-(3) and the End Structure is S-(4), but the *Pipe Flow Direction Method* is now End to Start.

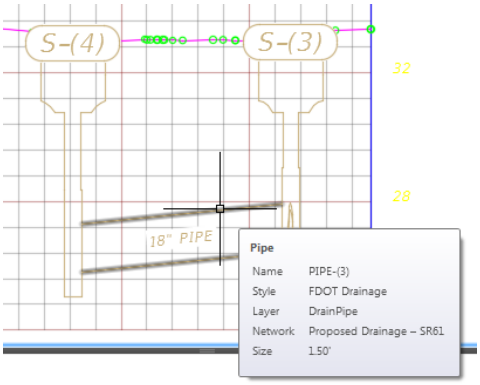
17. Press **Apply** then **OK** to close the Pipe Properties - PIPE-(3) dialog. **Save** the *DRPRRD03.dwg*.

Exercise 12.5 Review Structures in the S-4 Proposed Drainage - SR61 Profile View

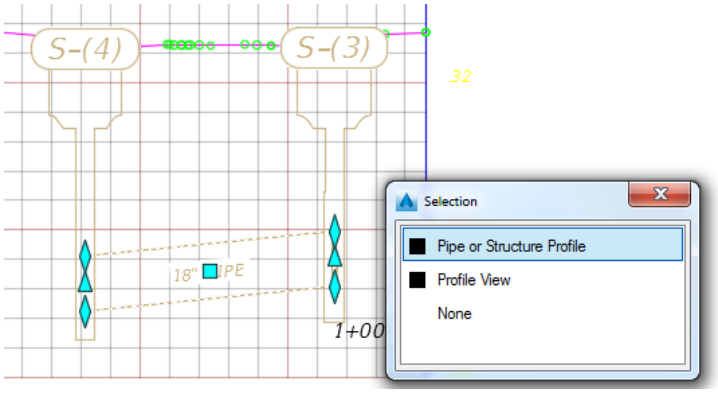
The next steps will show you how to review the S-4 Proposed Drainage - SR61 Profile View to verify flow direction and edit slope if necessary.



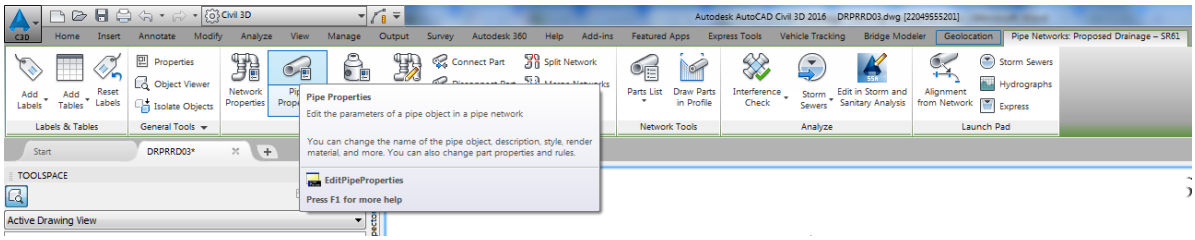
1. **Zoom** and **Pan** to display the **S-4 Proposed Drainage - SR61 Alignment**.
2. Select the **top Viewport** to make it the active Viewport. Zoom and Pan to visually inspect the Profile View and make a **list of required edits**. Do you see any adverse slopes? Yes. **Edits are required**.



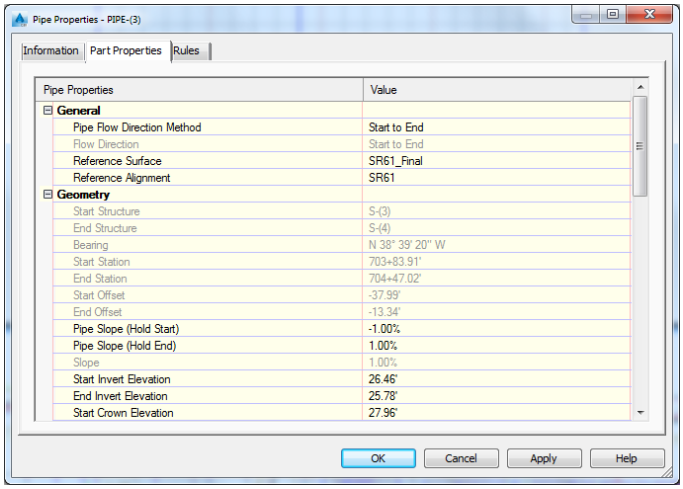
3. Hover over the **Pipe** that is between structure S-(4) and S-(3) to display a tooltip listing the Pipe as **PIPE-(3).** You need to **edit PIPE-(3) properties** to correct the *adverse slope*.



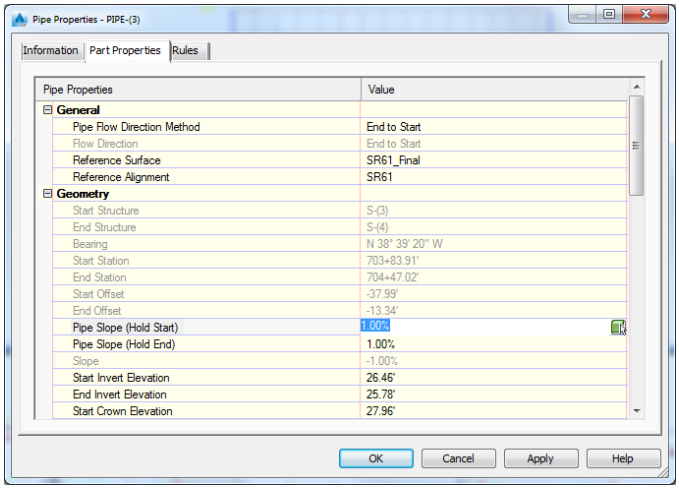
4. Select the **downstream Pipe** from structure S-(4). With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile.**



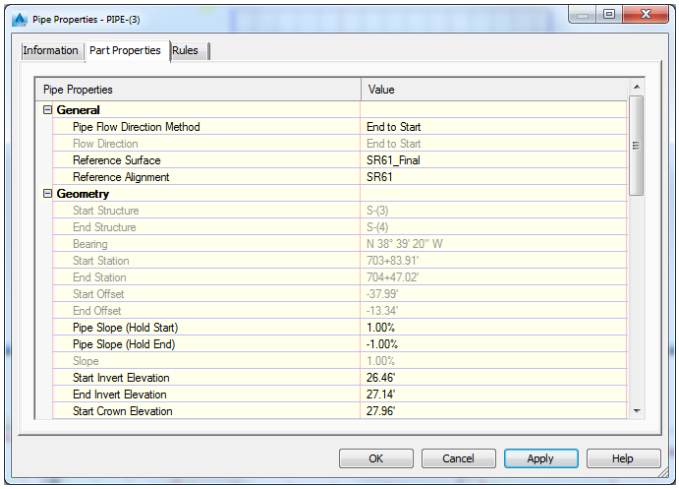
5. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Pipe Properties** and select the **Pipe** between S-(4) and S-(3).



6. From the Pipe Properties - PIPE-(3) dialog box, select the **Part Properties** tab.

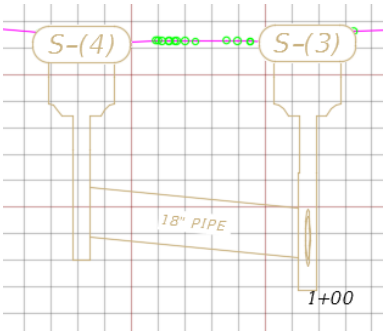


7. Adjust the *Pipe Slope (Hold End) value* to **1.0%.** By adjusting the Pipe Slope (Hold Start) value you are modifying the elevation of the Start Invert. A positive slope value indicates the direction is uphill.



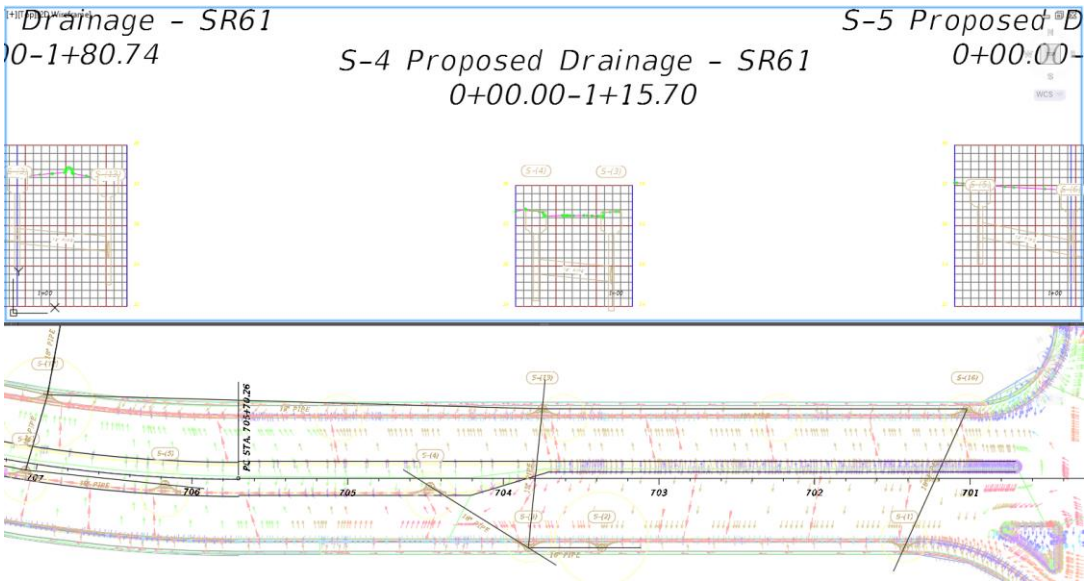
8. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start are recalculated and displayed.

9. Click **OK** to close the Pipe Properties - PIPE-(3) dialog box.



10. Review each Structure in the S-4 Proposed Drainage - SR61 Profile View. Do you see any **Downstream Pipes** that may be equal to or higher than the *Upstream Pipes*? **No**.

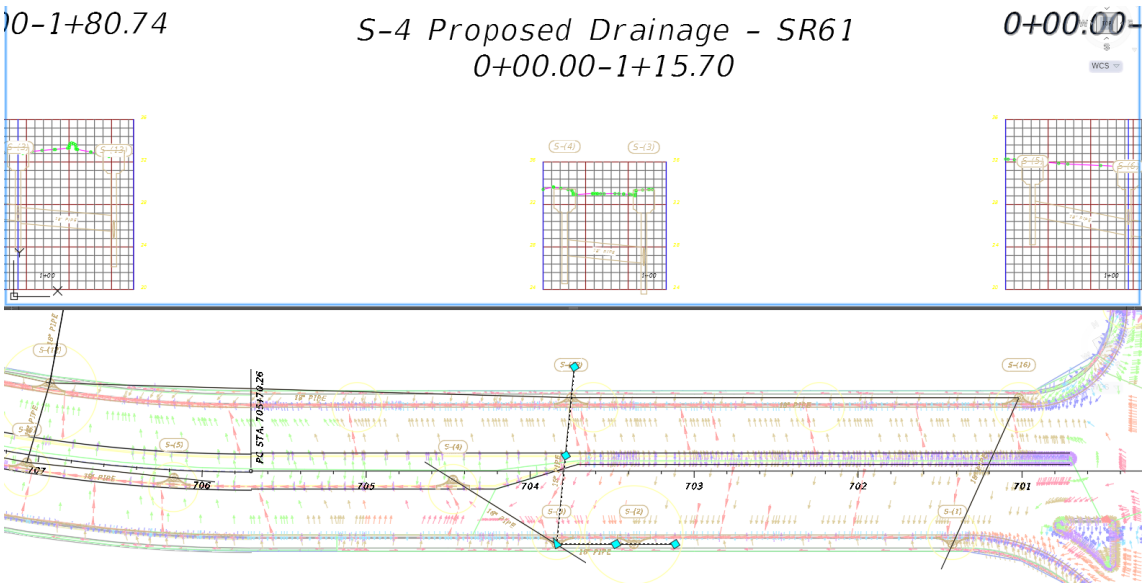
11. Notice that the adjusted PIPE-(3) slope now displays in the S-4 Proposed Drainage Profile View. This completes the edits required for the S-4 Profile View.



12. **Zoom** and **Pan** to display the **S-4 Proposed Drainage Profile View.**
13. **Save** the *DRPRRD03.dwg* file.

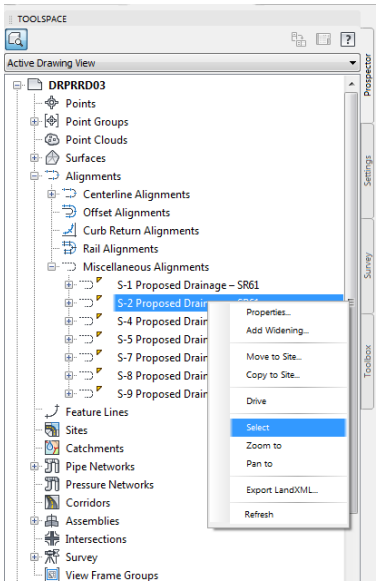
Exercise 12.6 Review Upstream and Downstream Pipes and Structures

The next steps will show you will review upstream and downstream pipes and structures displayed in the S-2 Proposed Drainage - SR61 Profile View.

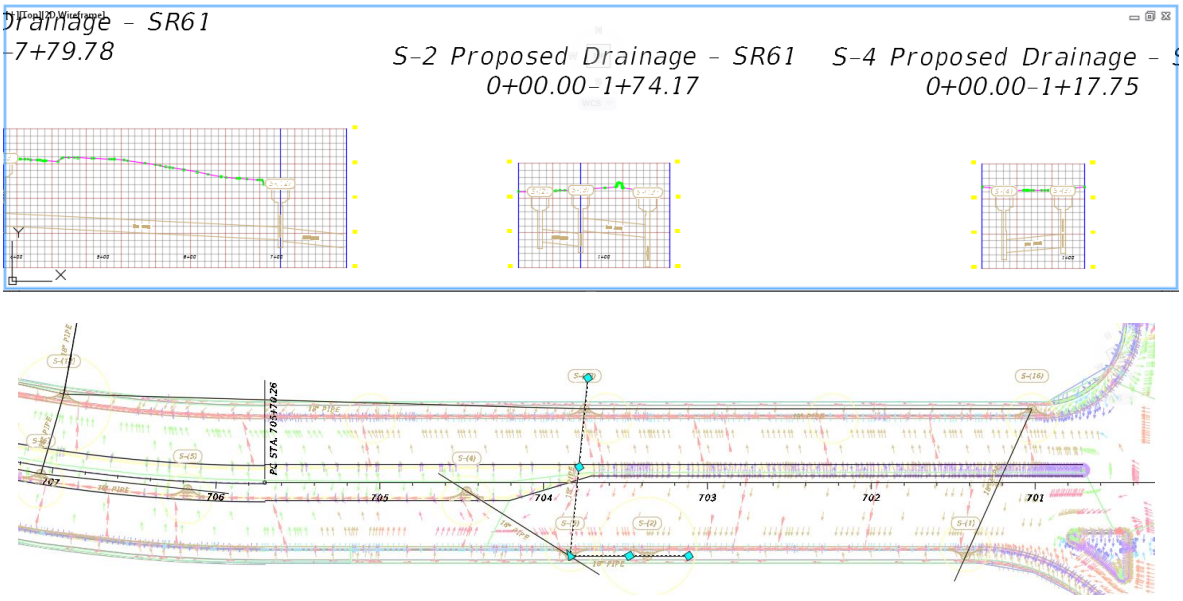


1. Select the **bottom Viewport** to make it the active Viewport.

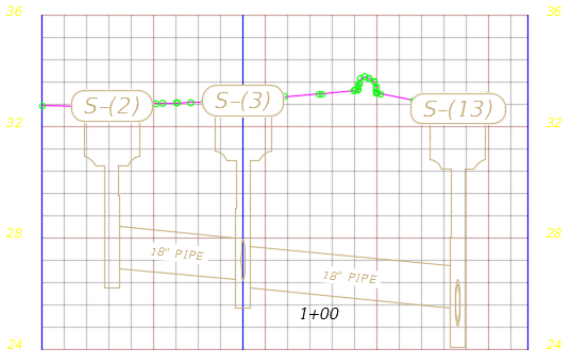
2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-2 Proposed Drainage - SR61** and click **Select.**



3. **Zoom** and **Pan** to display the **S-2 Proposed Drainage - SR61 Alignment.**
4. Select the **top Viewport** to make it the active Viewport.

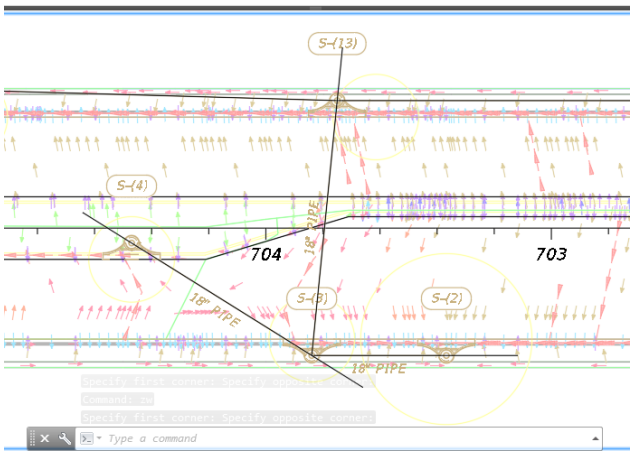


5. **Pan** to display the **S-2 Proposed Drainage - SR61 Profile View**. Press **ESC** to clear the grips.



6. **Zoom in** closer to display the **Pipes** connected to the structures and review each.
   a. Do you see any **Downstream Pipes** that may be equal to or higher than the *Upstream Pipes*? No, then no edits are required.
   b. Do you see any **Adverse Slopes** in the S-2 Proposed Drainage - SR61 Profile View? No, then no edits are required.

S-2 Proposed Drainage – SR61
0+00.00-1+80.74



7. **Zoom** and **Pan** to display the **S-2 Proposed Drainage - SR61 Profile View.**
8. **Save** the *DRPRRD03.dwg* file.

➢ *Review and Build a List of Actions*

Review what has been completed so far and build a list of actions still needed to be completed:

S-1 Proposed Drainage - SR61 Profile View edits completed

S-2 Proposed Drainage - SR61 Profile View edits completed

S-4 Proposed Drainage - SR61 Profile View edits completed

S-5 Proposed Drainage - SR61 Profile View edits need review

S-7 Proposed Drainage - SR61 Profile View edits need review

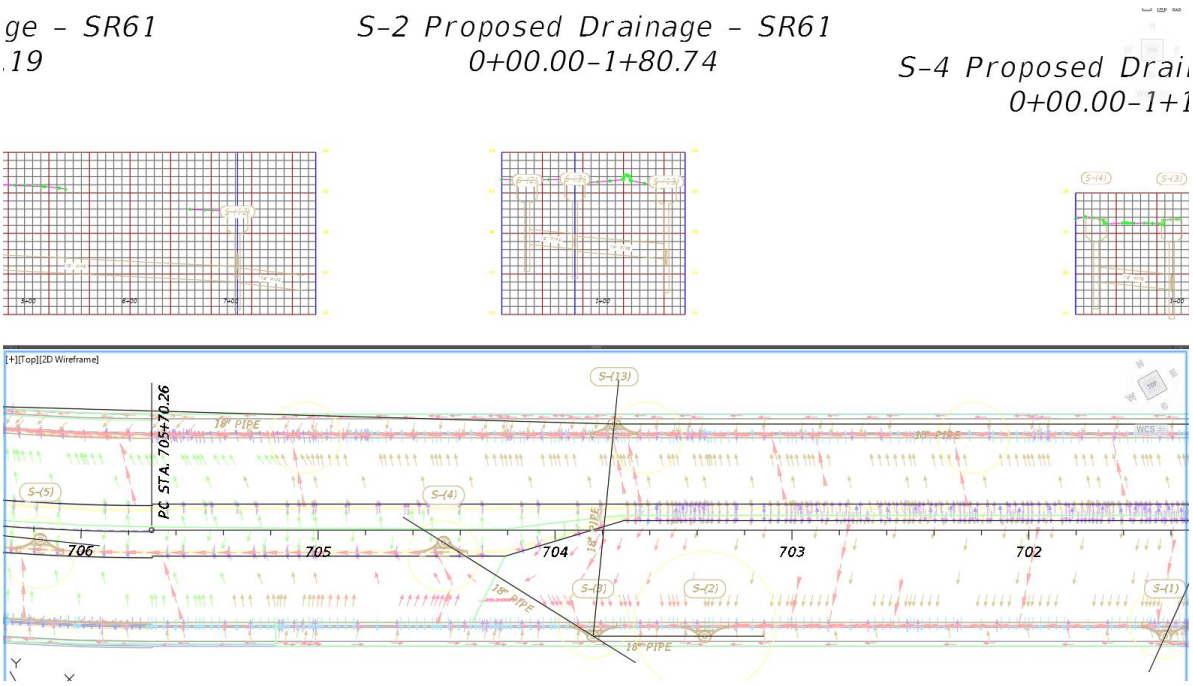
S-8 Proposed Drainage - SR61 Profile View edits need review

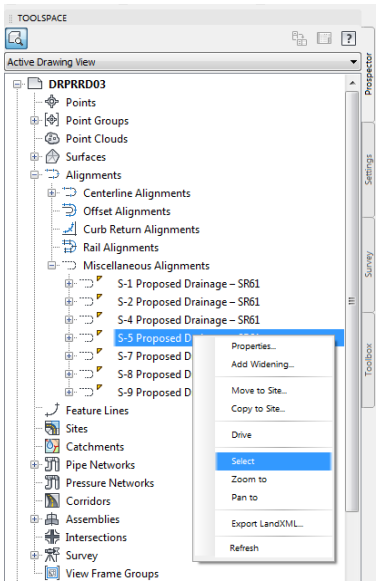
S-9 Proposed Drainage - SR61 Profile View edits need review

Exercise 12.7 *Review Structures in the S-5 Proposed Drainage - SR61 Profile View*

The next steps will show you will review upstream and downstream pipes and structures displayed in the S-5 Proposed Drainage - SR61 Profile View

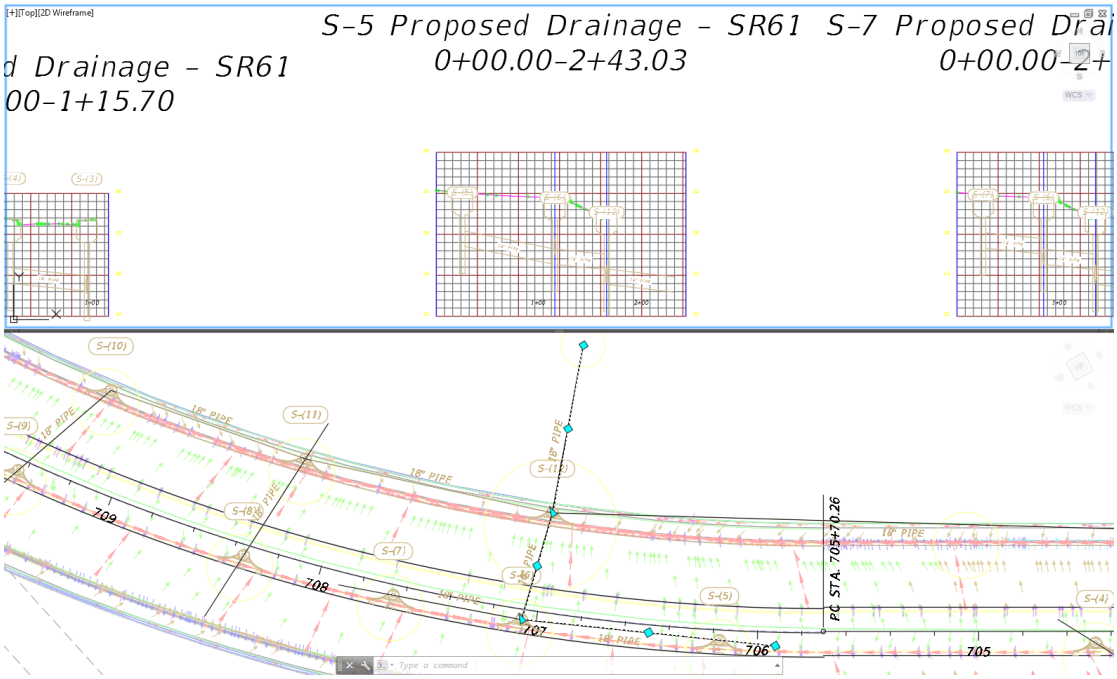
1. Select the **bottom Viewport** to make it the active Viewport.





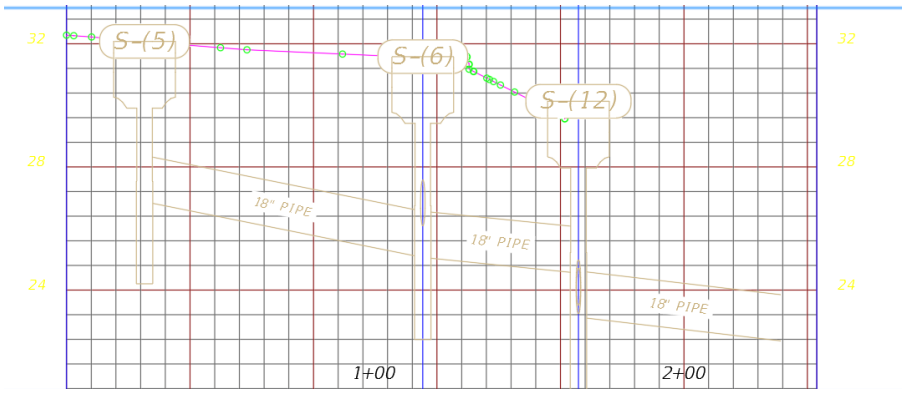
2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-5 Proposed Drainage - SR61** and click **Select.**

3. **Zoom** and **Pan** to display the **S-5 Proposed Drainage - SR61 alignment.**



4. Select the **top Viewport** to make it the active Viewport.

5. **Pan** to display the **S-5 Proposed Drainage - SR61 Profile View**. Press **ESC** to clear the grips.

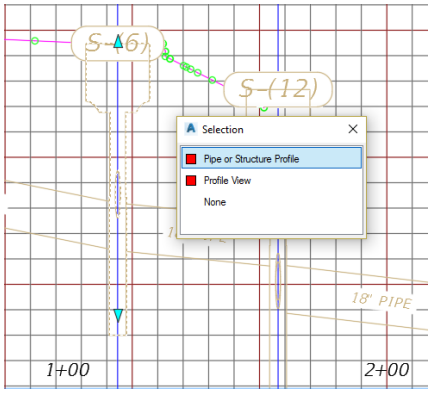


6. **Zoom in** closer to display the **Pipes** connected to the structures and review each **Structure**.

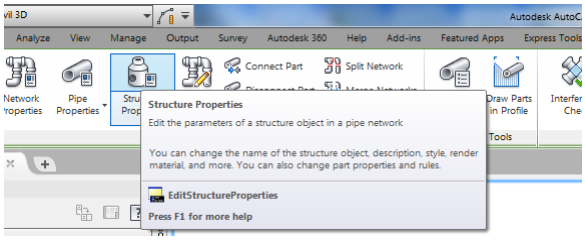
   a. Do you see any **Adverse Slopes** in the S-5 Proposed Drainage - SR61 Profile View? No, then no edits are required.

   b. Do you see any **Downstream Pipes** that may be equal to or higher than any *Upstream Pipes*? Yes, then **edits are required**. The downstream pipe from structure S-(6) needs closer inspection.

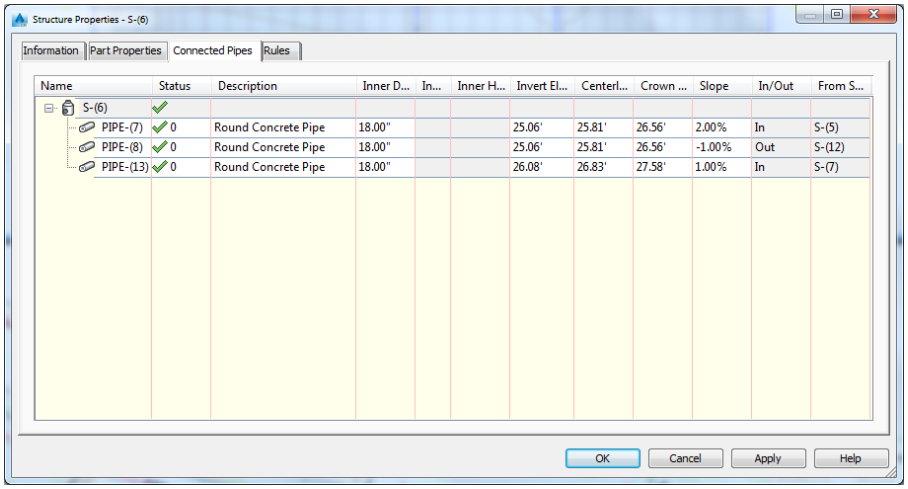
7. Hover over the **Pipe** that is between structure S-(6) and S-(12) to display a tooltip listing the Pipe as **PIPE-(8).**



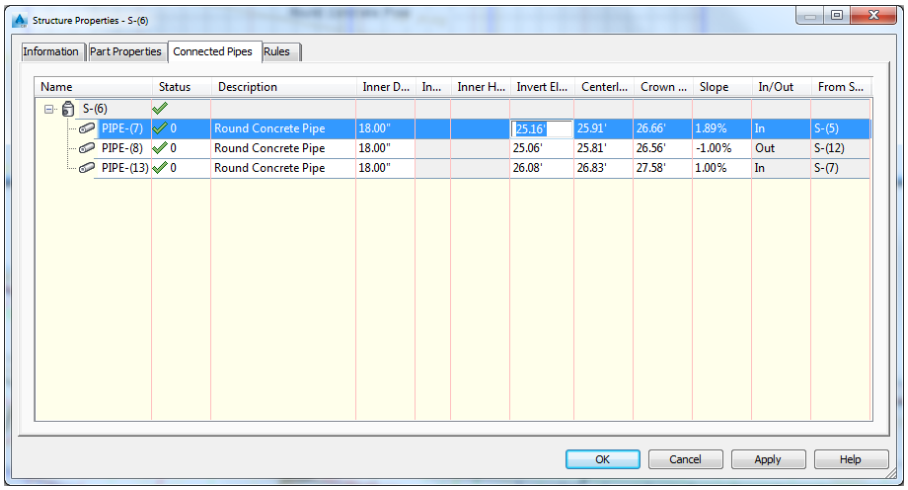
8. Select **structure S-(6)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



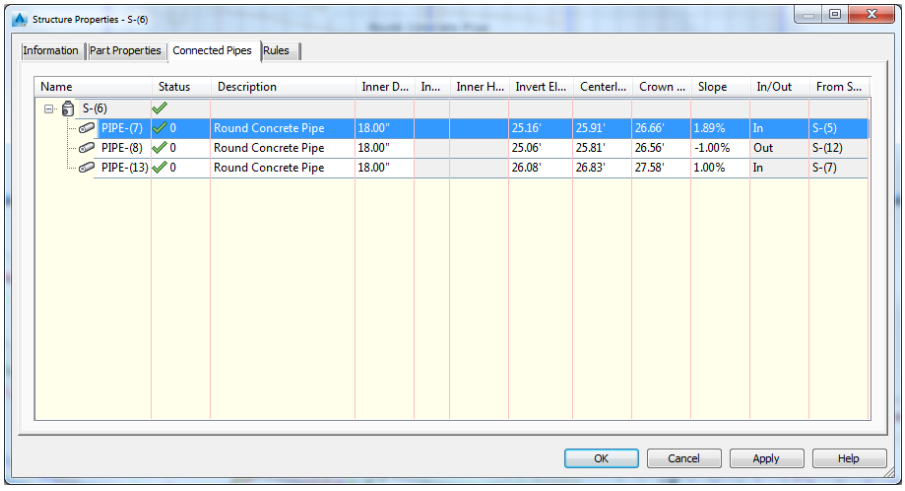
9. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Structure Properties** command.



10. From the Structure Properties - S-(6) dialog box, select the **Connected Pipes** tab. This tab displays the pipes connected to the structure S-(6). Review the Structure S-(6) **connected Pipes data** and make a **list of required adjustments**. Hold elevation 25.06 for Outgoing PIPE-(8).



11. Change the *PIPE-(7) Invert Elevation* to **25.16'** making it 0.1' above the Outgoing pipe, PIPE-(8). Click **Apply** to update the values in Structure Properties - S-(6) dialog box.

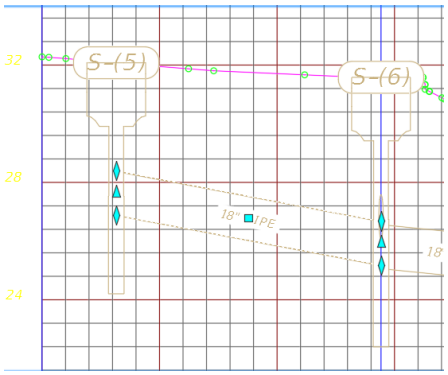


12. Review the **Slope Column** for values that are **odd** values.

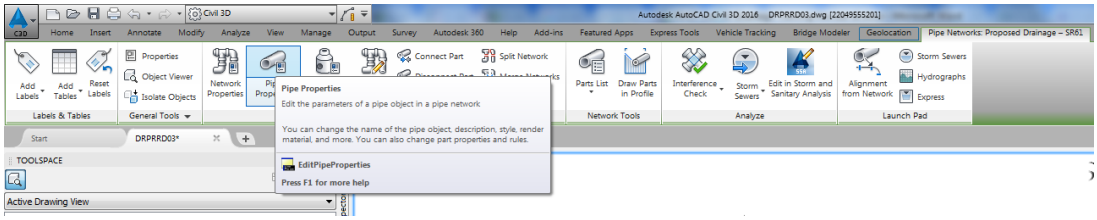
Note Based upon the Rules of Thumb being followed, the PIPE-(7) slope needs adjusting from 1.89%% to 1.5%. This adjustment cannot be done from the Structure Properties - S-(6) dialog box, but must be edited in the PIPE-(7) Properties.

13. Click **Apply** then **OK** to close the Structure Properties - S-(6) dialog box

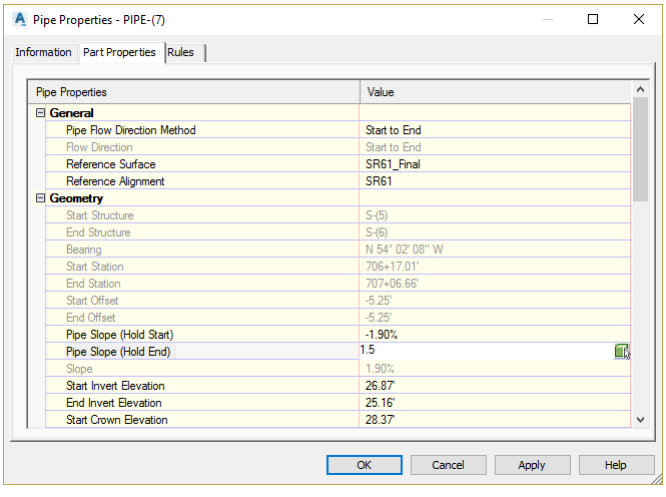
14. Hover over the **Pipe** that is between structure S-(5) and S-(6) to display a tooltip listing the pipe as **PIPE-(7)**.



15. Select **PIPE-(7)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



16. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Pipe Properties**.

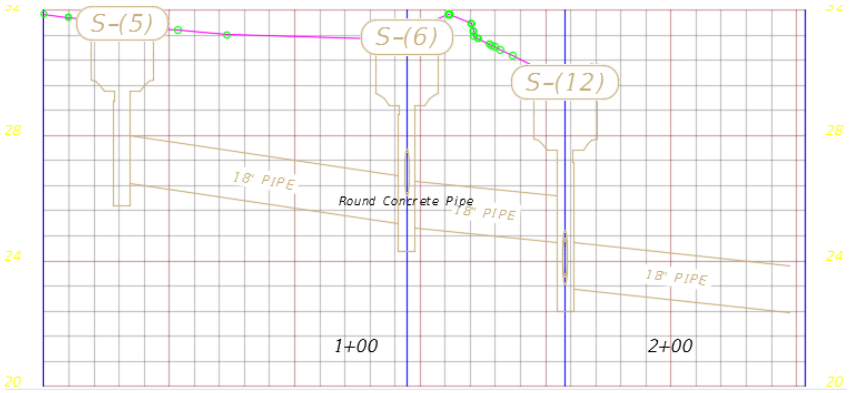


17. From the Pipe Properties - PIPE-(7) dialog box, select the **Part Properties** tab.

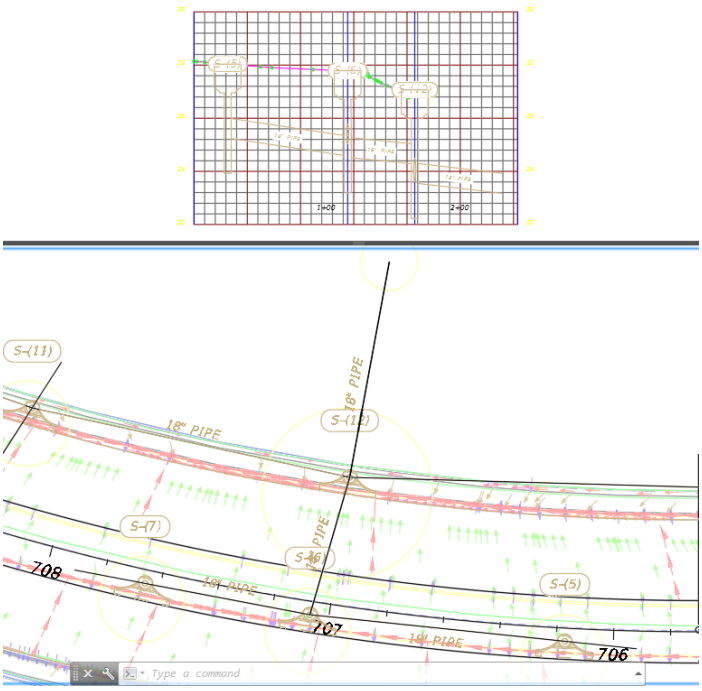
18. Adjust the *Pipe Slope (Hold End) value* from 1.89% to **1.5%.**

19. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start recalculate and display.

20. Click **OK** to close the Pipe Properties - PIPE-(7) dialog box.



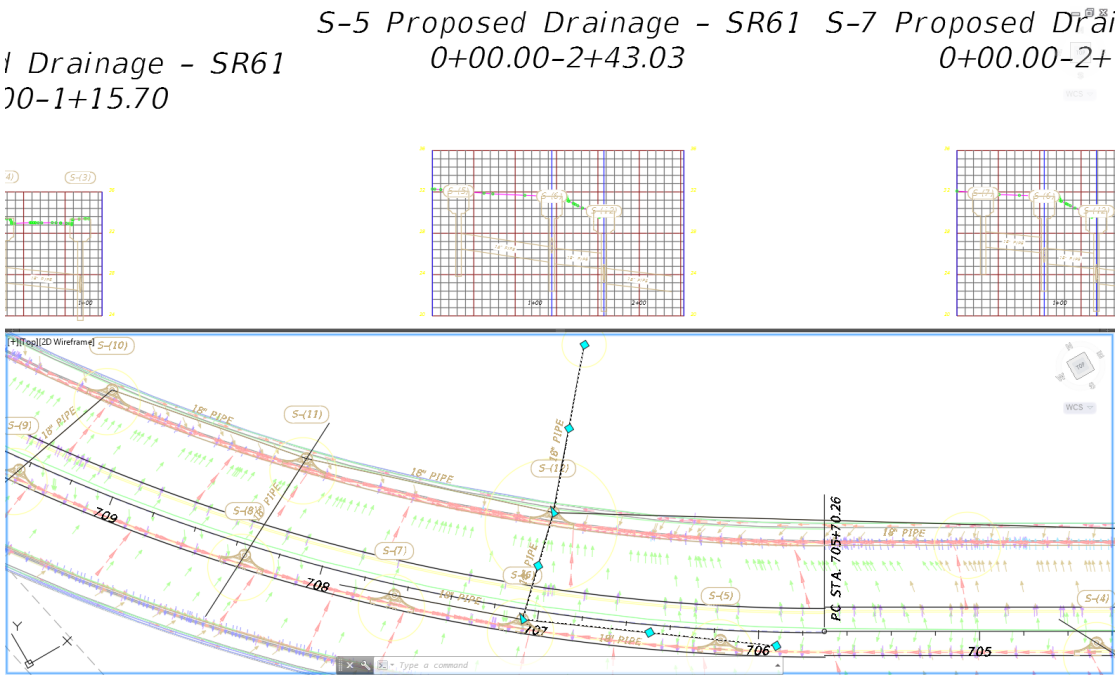
21. The S-5 Proposed Drainage - SR61 Profile View shows pipe PIPE-(7) sloped correctly.



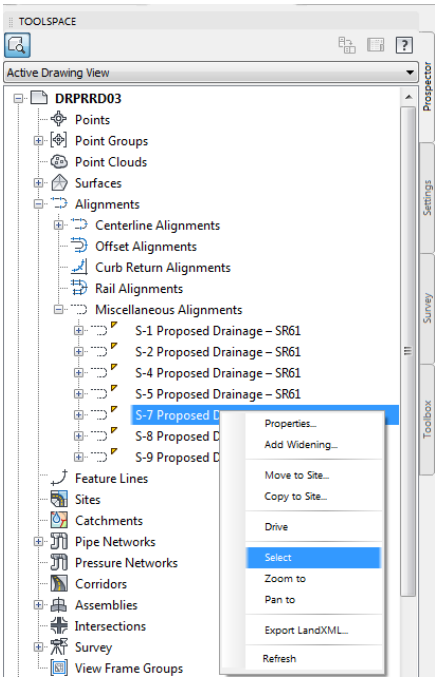
22. **Zoom** and **Pan** to display the **S-5 Proposed Drainage - SR61 Profile View.**
23. **Save** the *DRPRRD03.dwg* file.

Exercise 12.8 *Review Structures in the S-7 Proposed Drainage - SR61 Profile View*

The next steps will show you will review upstream and downstream pipes and structures displayed in the S-7 Proposed Drainage - SR61 Profile View.

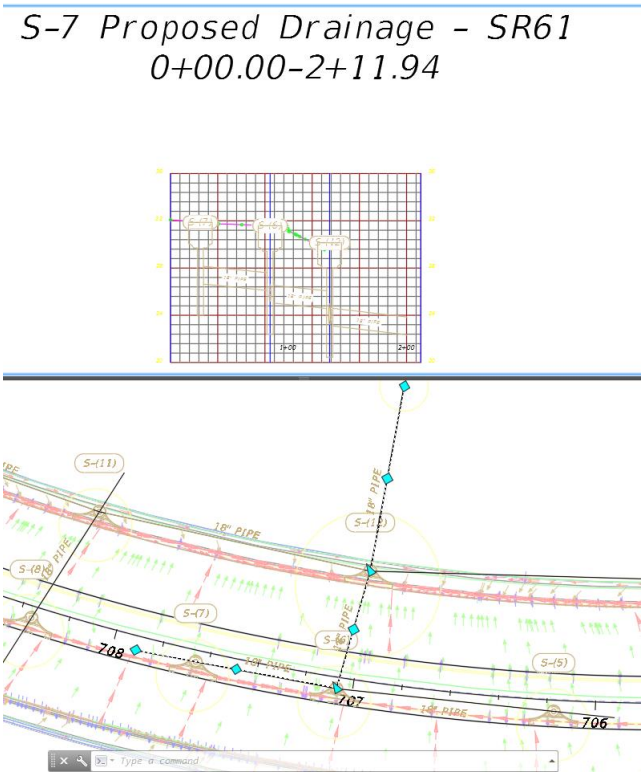


1. Select the **bottom Viewport** to make it the active Viewport.

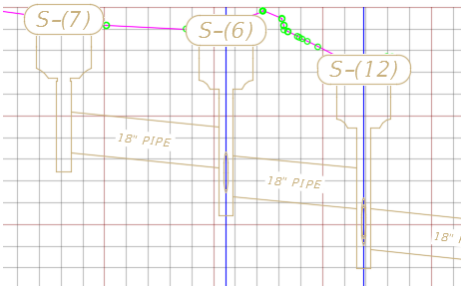


2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-7 Proposed Drainage - SR61** and click **Select.**

3. **Zoom** and **Pan** to display the **S-7 Proposed Drainage - SR61 Alignment.**



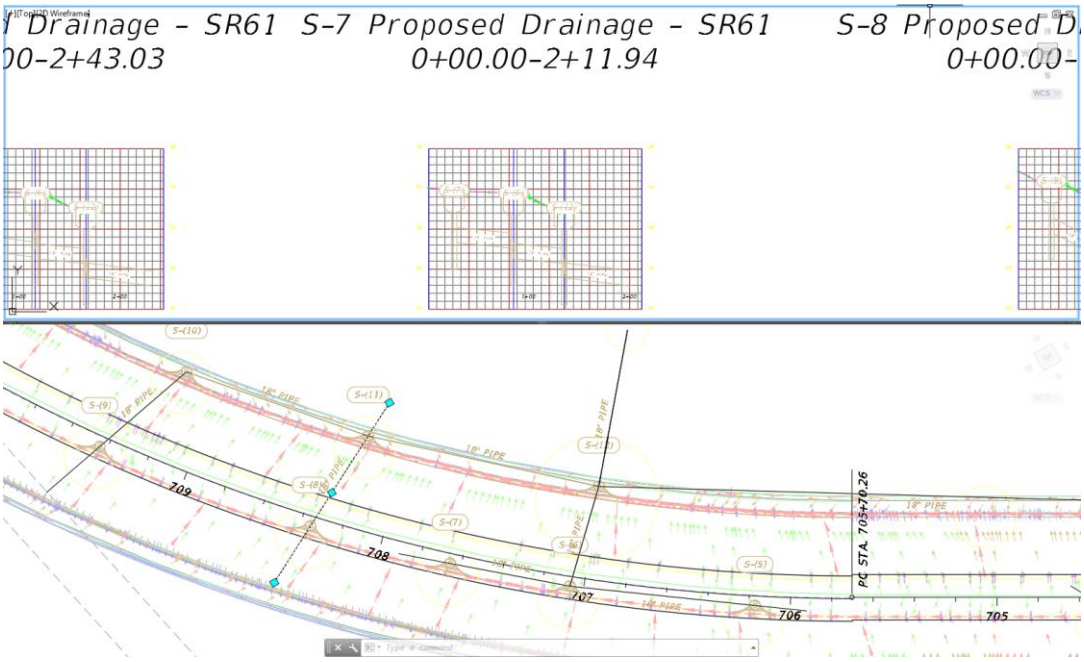
4. Select the **top Viewport** to make it the active Viewport. **Zoom** and **Pan** to display the **S-7 Proposed Drainage - SR61 Profile View**. Press **ESC** to clear the grips.



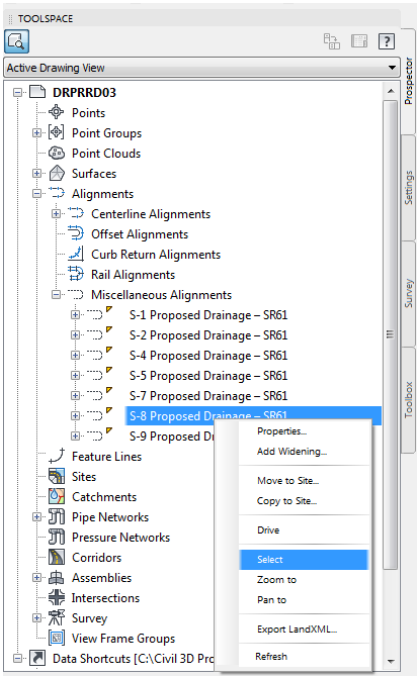
5. **Zoom in** closer to display the **Pipes** connected to the structures and review each.
   a. Do you see any **Downstream Pipes** that may be equal to or higher than the Upstream Pipes? No, then no edits are required.
   b. Do you see any **Adverse Slopes** in the S-7 Proposed Drainage - SR61 Profile View? No, then no edits are required.
6. **Save** the *DRPRRD03.dwg* file.

Exercise 12.9 *Review Structures in the S-8 Proposed Drainage - SR61 Profile View*

The next steps will show you will review upstream and downstream pipes and structures displayed in the S-8 Proposed Drainage - SR61 Profile View.

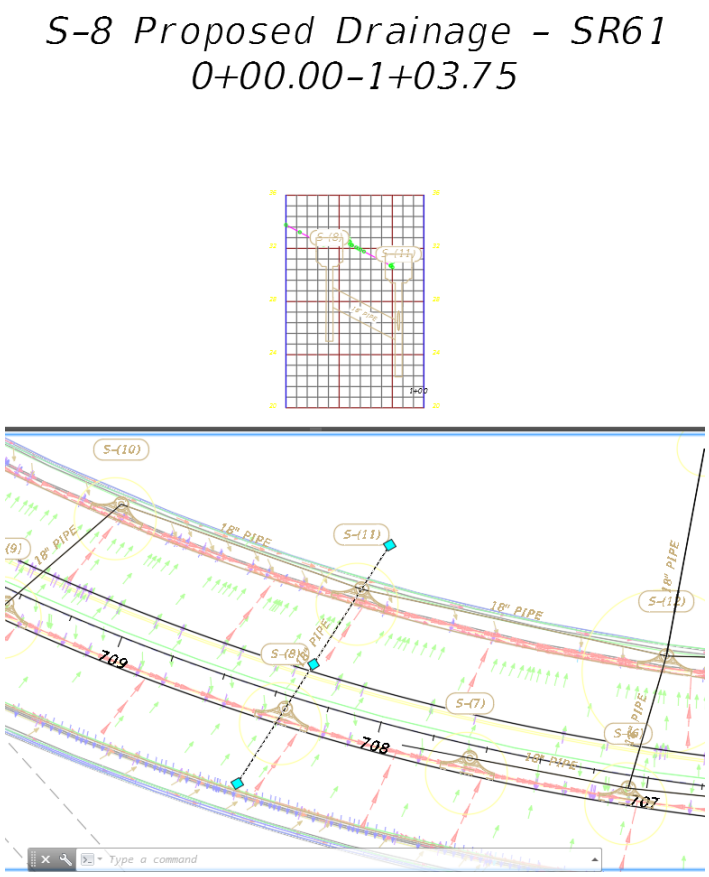


1. Select the **bottom Viewport** to make it the active Viewport.

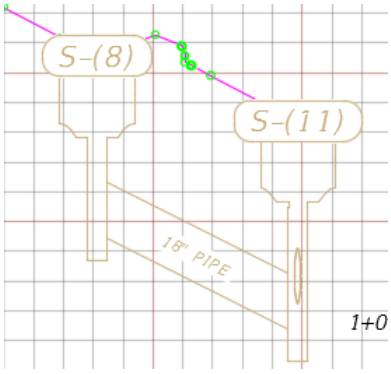


2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-8 Proposed Drainage - SR61** and click **Select.**

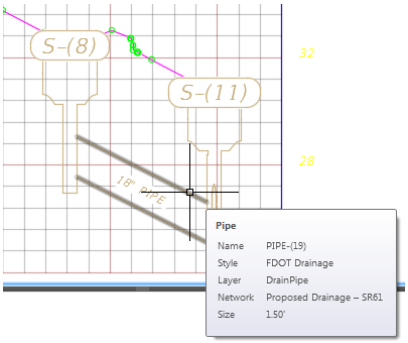
3. **Zoom** and **Pan** to display the **S-8 Proposed Drainage - SR61 Alignment.**



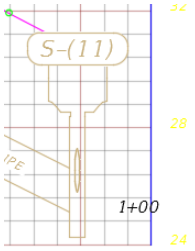
4. Select the **top Viewport** to make it the active Viewport.
5. **Zoom** and **Pan** to display **S-7 Proposed Drainage - SR61 Profile View**. Press **ESC** to clear grips.



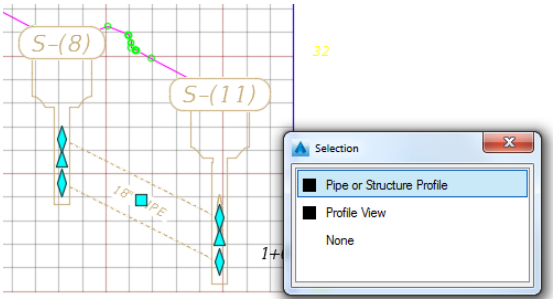
6. **Zoom in** closer to display the **Pipes** connected to the structures and review each Structure.
   a. Do you see any **Adverse Slopes** in the S-8 Proposed Drainage - SR61 Profile View? No, then no adjustments are required.
   b. Do you see any **Downstream Pipes** that may be equal to or higher than the Upstream Pipes? Yes, so you need to make a **list of Structures** to investigate.



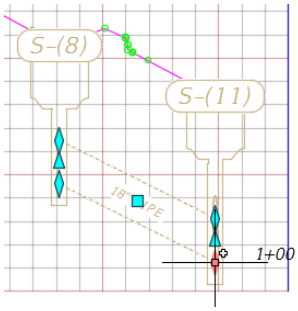
7. Hover over the Pipe that is between structure S-(8) and S-(11) to display a tooltip listing the pipe as **PIPE-(19).**



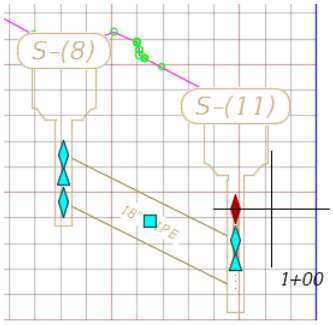
8. Notice that **Structure S-(11)** appears to have a higher Outgoing Pipe than the upstream PIPE-(19).



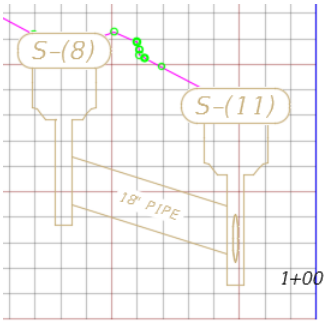
9. Select **PIPE-(19)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



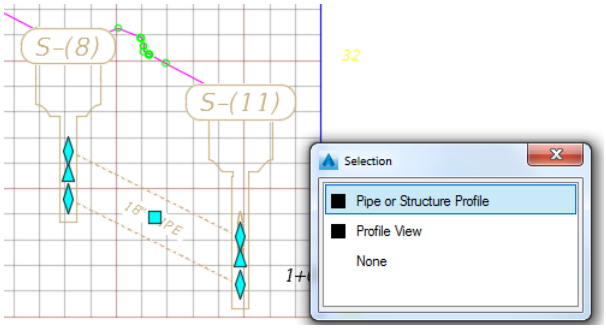
10. Select the **downstream invert diamond grip** of pipe PIPE-(19).



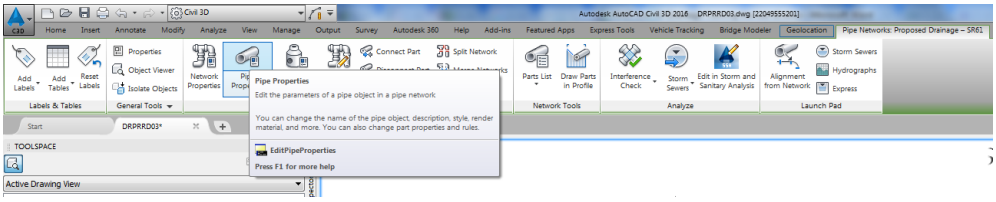
11. **Zoom in** closer as you **grip edit** to confirm placement of the downstream invert of the pipe just above the Outgoing Pipe at structure S-(11).
12. Move the **invert grip** upward, at the *command prompt* Type **10** and press **ENTER** to move the PIPE-(19) upward **10'**. Press **ESC** to clear grips.



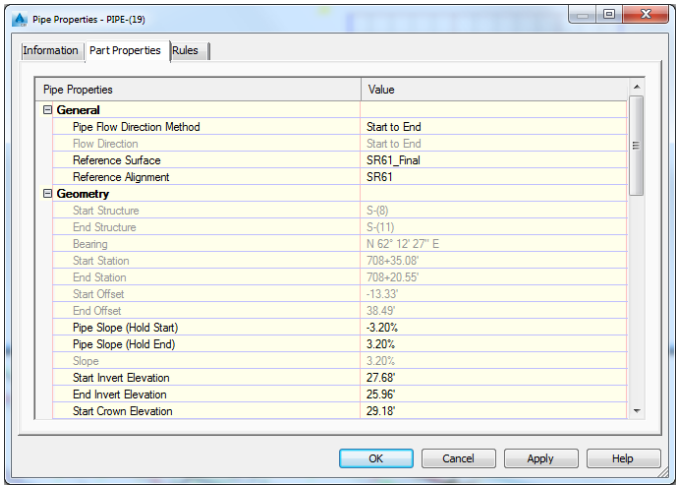
13. Notice that Structure S-(11) now displays lower with the Outgoing Pipe lower than the Upstream PIPE-(19).
14. From the *Pipe Properties* of PIPE-(19) change the *Pipe Slope* to a nominal value of **3.0%.**



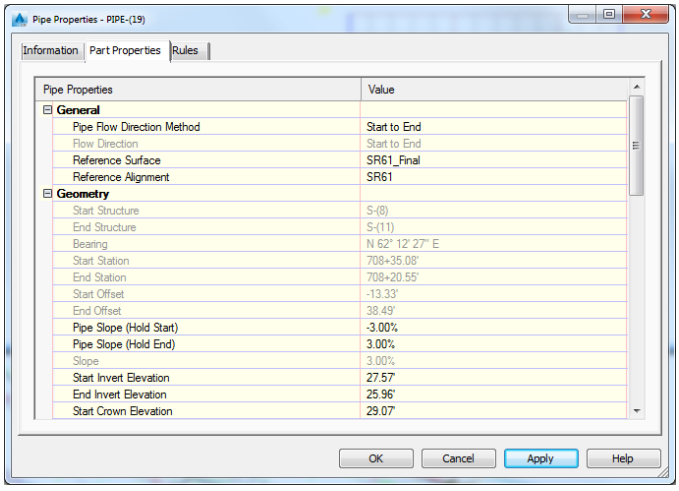
15. Select **PIPE-(19).** With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



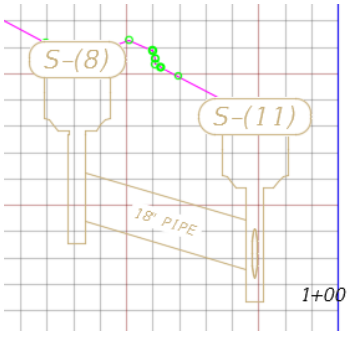
16. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select **Pipe Properties**.



17. From the Pipe Properties - PIPE-(19) dialog box, select the **Part Properties** tab.
18. Adjust the *Pipe Slope (Hold End) value* to **3.0%**. By adjusting the Pipe Slope (Hold End) value you are modifying the elevation of the Start Invert. A positive slope value indicates the direction is uphill.

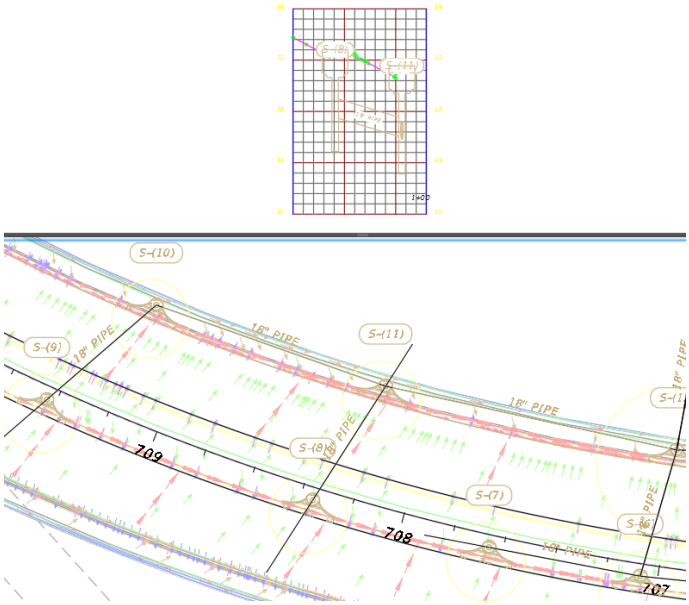


19. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start recalculate and display.
20. Click **OK** to close the Pipe Properties - PIPE-(19) dialog box.



21. Notice that the S-8 Proposed Profile View now displays PIPE-(19) sloped correctly.

S-8 Proposed Drainage - SR61
0+00.00-1+03.75



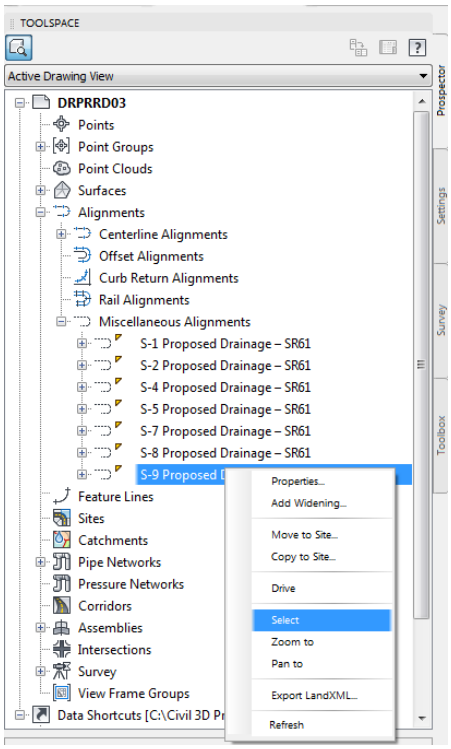
22. **Zoom** and **Pan** to display the **S-8 Proposed Drainage - SR61 Profile View**.
23. **Save** the *DRPRRD03.dwg* file.

Exercise 12.10 *Review Structures in the S-9 Proposed Drainage - SR61 Profile View*

The next steps will show you will review upstream and downstream pipes and structures displayed in the S-9 Proposed Drainage - SR61 Profile View.

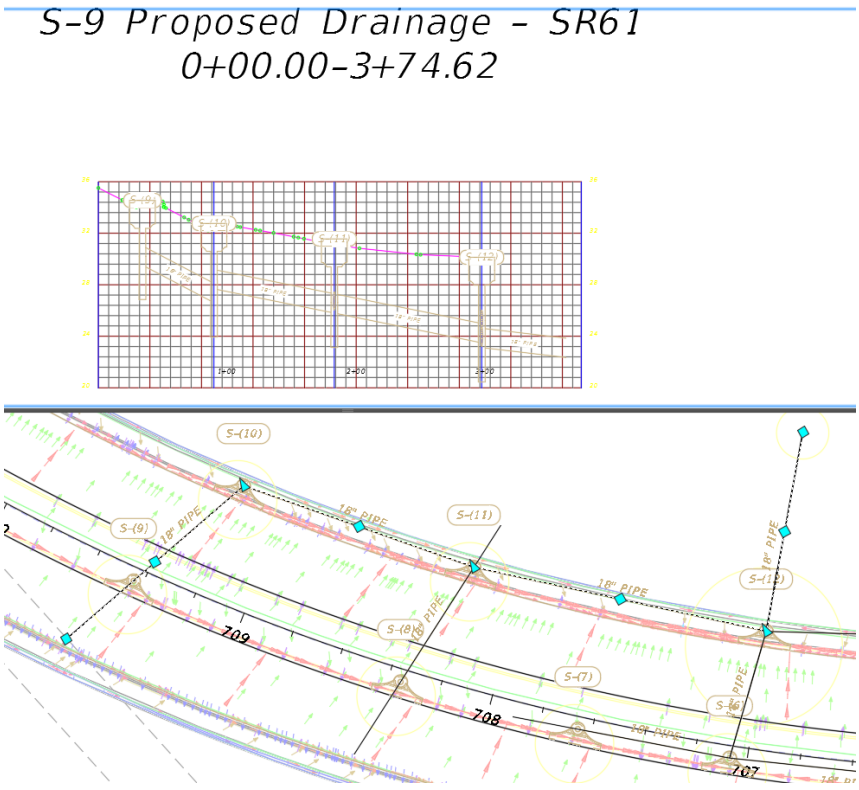
rainage - SR61 *S-8 Proposed Drainage - SR61* *S-9 Proposed Dra*
2+11.94 *0+00.00-1+03.75* *0+00.00-3*

1. Select the **bottom Viewport** to make it the active Viewport.



2. From the *TOOLSPACE > Prospector tab*, expand **Alignments**, expand **Miscellaneous Alignments**, right-click on **S-9 Proposed Drainage - SR61** and click **Select.**

3. **Zoom** and **Pan** to display the **S-9 Proposed Drainage - SR61 Alignment.**

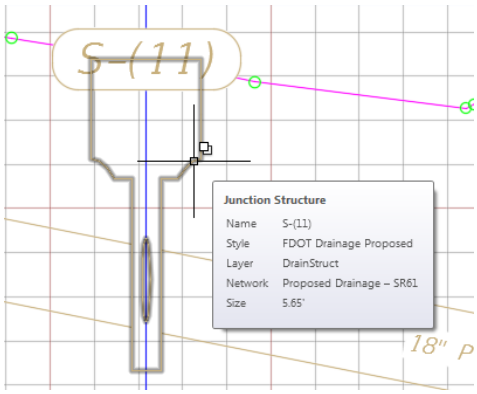


4. Select the **top Viewport** to make it the active Viewport. **Pan** to display the **S-9 Proposed Drainage - SR61 Profile View.** Press **ESC** to clear the grips.

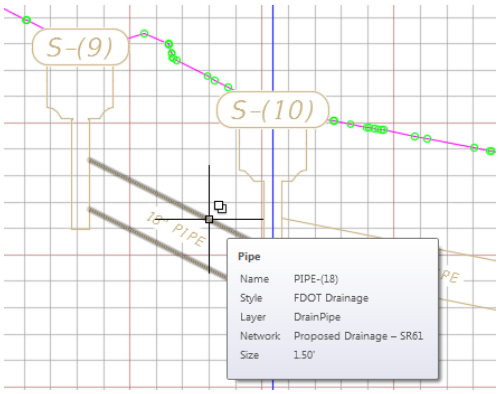
5. **Zoom in** closer to display the **Pipes** connected to the structures and review each Structure.

   a. Do you see any **Adverse Slopes** in the S-9 Proposed Drainage - SR61 Profile View? **No**, then no adjustments are required.

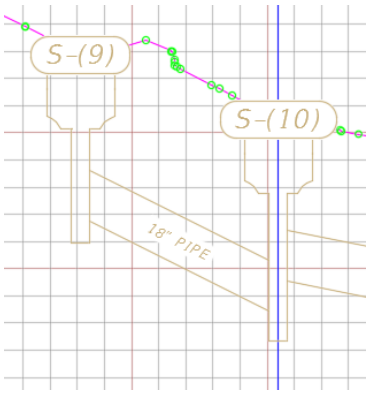
   b. Do you see any **Downstream Pipes** that may be equal to or higher than the *Upstream Pipes*? **Yes**, so you need to make a **list of Structures to investigate**.



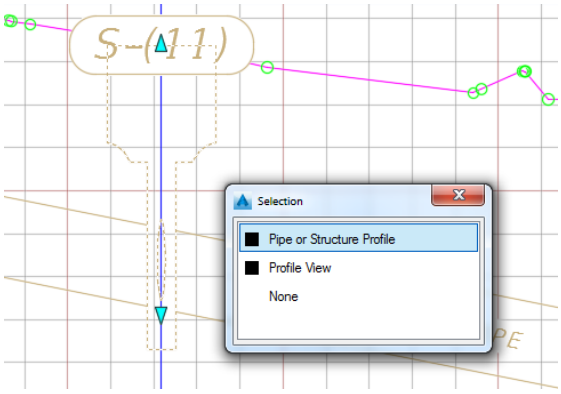
6. **Zoom** and **Pan** to display **structure S-(11)**, as it may have inverts to adjust.



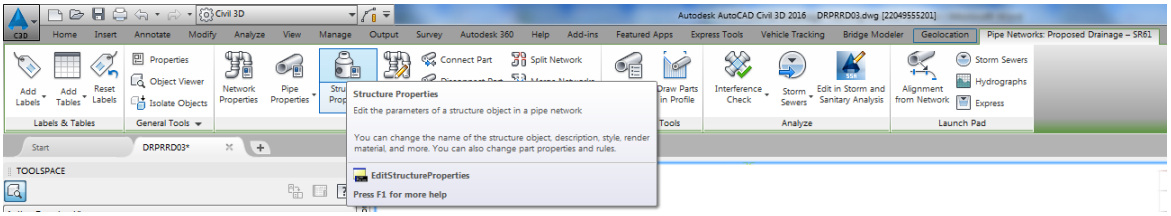
7. **Zoom** and **Pan** to display **structures S-(9)** and **S-(10).** Hover over the **Pipe** that is between structure S-(9) and S-(10) to display a tooltip listing the pipe as PIPE-(18).



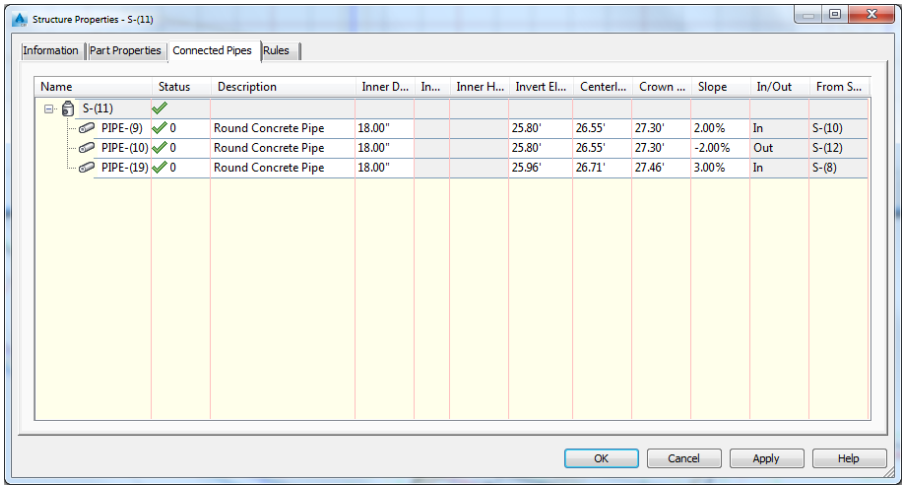
8. Structure S-(10) has an Upstream PIPE-(18) which is lower than the Downstream Pipe. Perform the **required adjustments** in the order of Downstream to Upstream. Edit **Structure S-(11) Properties**.



9. **Zoom** and **Pan** to display **structure S-(11)**. Select **structure S-(11)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile.**



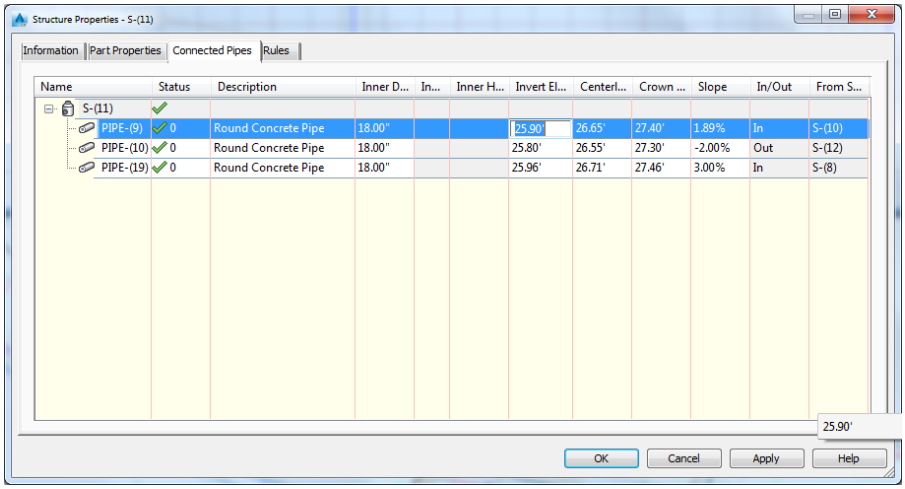
10. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Structure Properties** command.



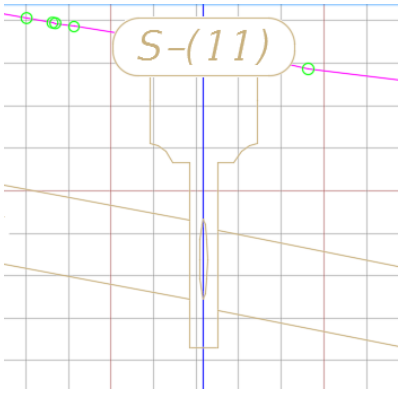
Name	Status	Description	Inner D...	In...	Inner H...	Invert El...	Centerl...	Crown ...	Slope	In/Out	From S...
S-(11)											
PIPE-(9)	0	Round Concrete Pipe	18.00"			25.80'	26.55'	27.30'	2.00%	In	S-(10)
PIPE-(10)	0	Round Concrete Pipe	18.00"			25.80'	26.55'	27.30'	-2.00%	Out	S-(12)
PIPE-(19)	0	Round Concrete Pipe	18.00"			25.96'	26.71'	27.46'	3.00%	In	S-(8)

11. From the Structure Properties - S-(11) dialog box, select the **Connected Pipes** tab. This tab displays the pipes connected to the structure S-(11). Review the **Structure S-(11) Connected Pipes data** and make a **list of required adjustments**. Look for *Outgoing Pipe Invert*.

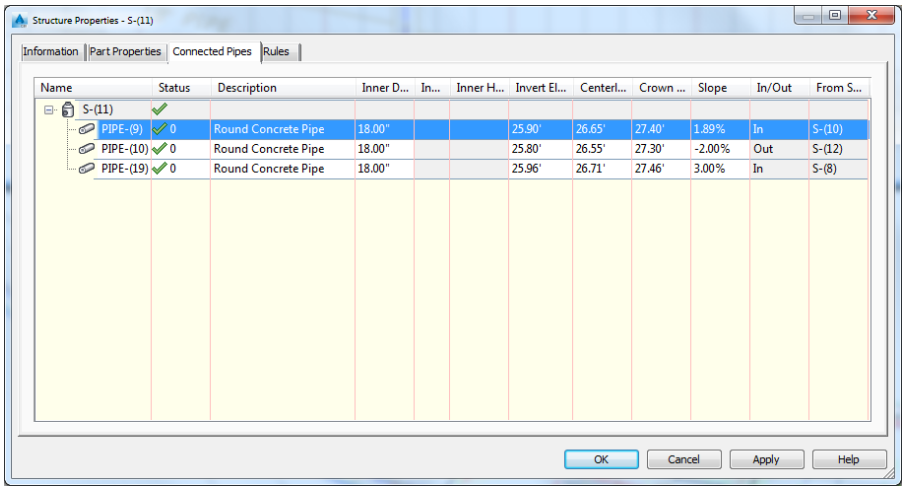
12. Hold elevation 25.80 for Outgoing PIPE 10.



13. Change the *PIPE-9 Invert Elevation* to **25.90'** making it 0.1' above the Outgoing pipe PIPE-10.

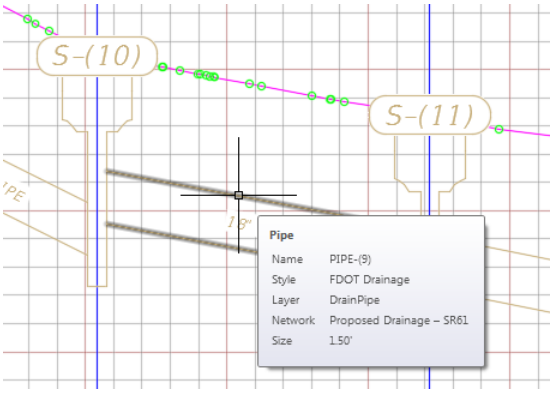


14. Click **Apply** to update the value in the dialog and in the S-9 Proposed Drainage - SR61 Profile View.
15. Review for *Slope Values* that have **odd** values.

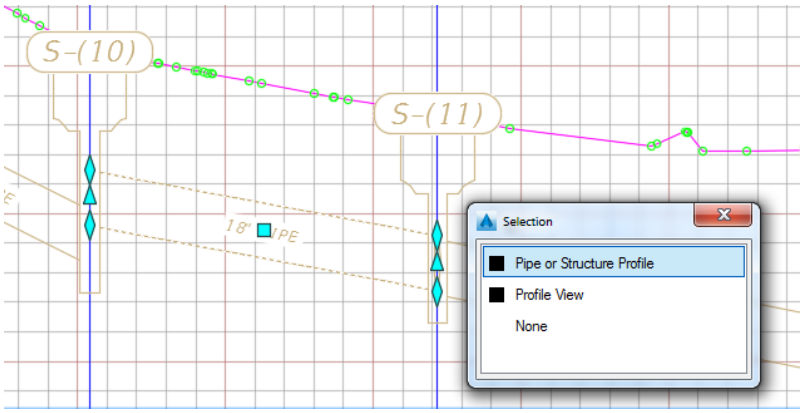


Note Based upon the Rules of Thumb being followed, the PIPE-(9) *slope* needs adjustment from 1.89% to **1.5%**, but this adjustment cannot be done from the Structure Properties - S-(11) dialog box, it has to be done by editing the PIPE-(9) properties.

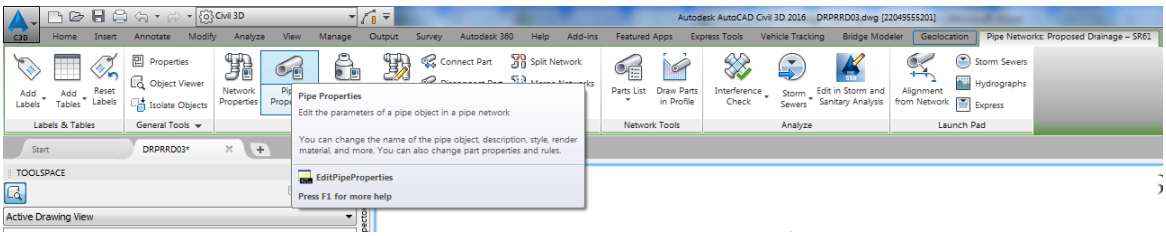
16. Click **Apply** then **OK** to close the Structure Properties - S-(11) dialog box



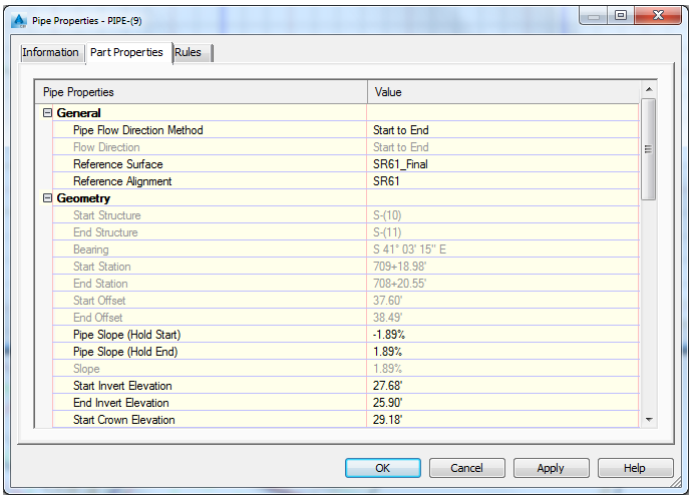
17. **Zoom** and **Pan** to display **structures S-(10)** and **S-(11).** Hover over the **Pipe** that is between structure S-(10) and S-(11) to display a tooltip listing the pipe as **PIPE-(9)**.



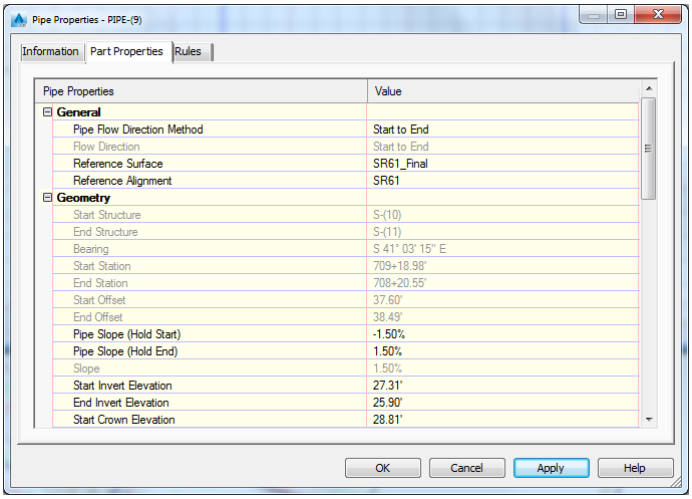
18. Select **PIPE-(9)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



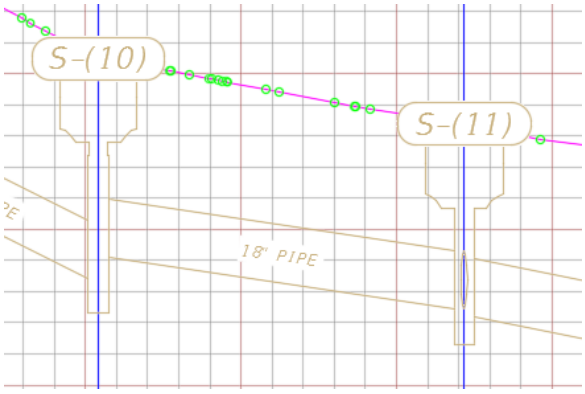
19. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Pipe Properties** button.



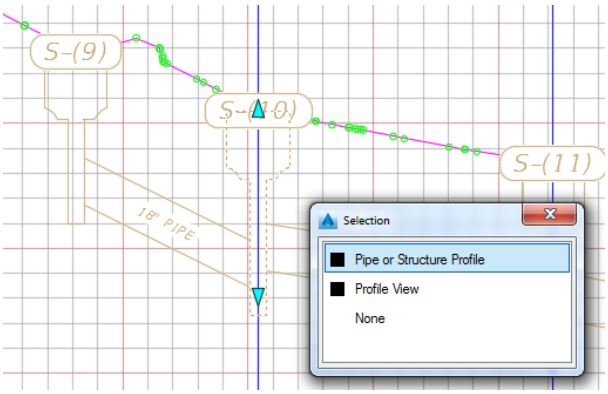
20. From the Pipe Properties - PIPE-(9) dialog box, select the **Part Properties** tab.
21. Adjust the *Pipe Slope (Hold End) value* to **1.5%.** By adjusting the Pipe Slope (Hold End) value you are modifying the elevation of the Start Invert. A positive slope value indicates the direction is uphill.



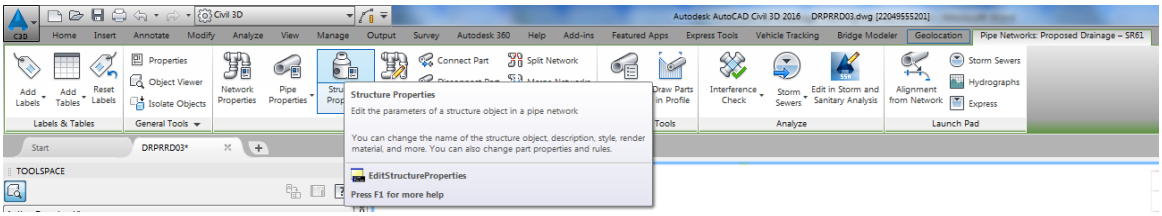
22. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start re-calculate and display.
23. Click **OK** to close the Pipe Properties - PIPE-(9) dialog box.



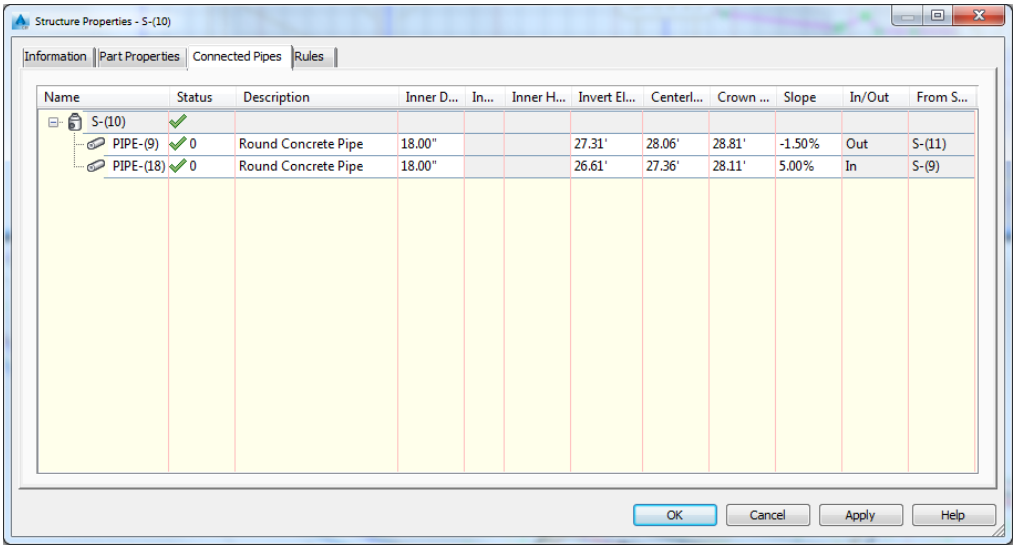
24. The S-9 Proposed Drainage - SR61 Profile View now displays PIPE-(9) sloped correctly. Continue by editing structure S-(10) structure properties.



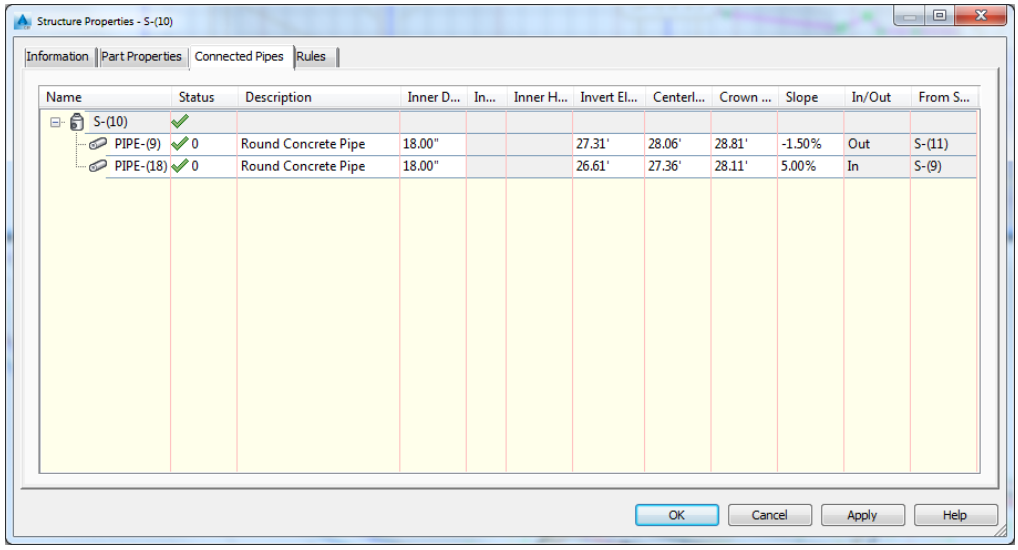
25. Select **structure S-(10)**. With *selection cycling* toggled On, a Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



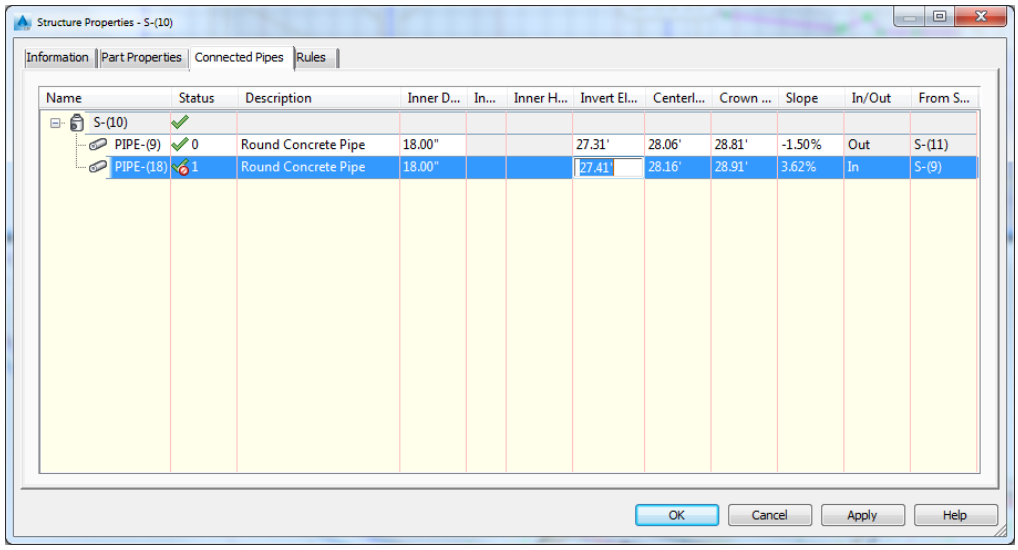
26. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Structure Properties** command.



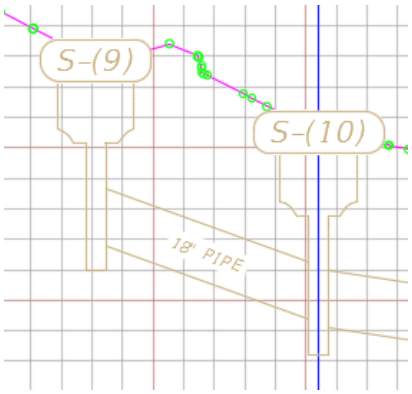
27. From the Structure Properties - S-(10) dialog box, select the **Connected Pipes** tab. This tab displays the pipes connected to the structure S-(10). Review the Structure S-(10) **connected Pipes data** and make a **list of required adjustments**. Look for Outgoing Pipe Invert.



28. Hold elevation 27.31 for Outgoing PIPE-9. Edit **PIPE-(18) Pipe Properties**.

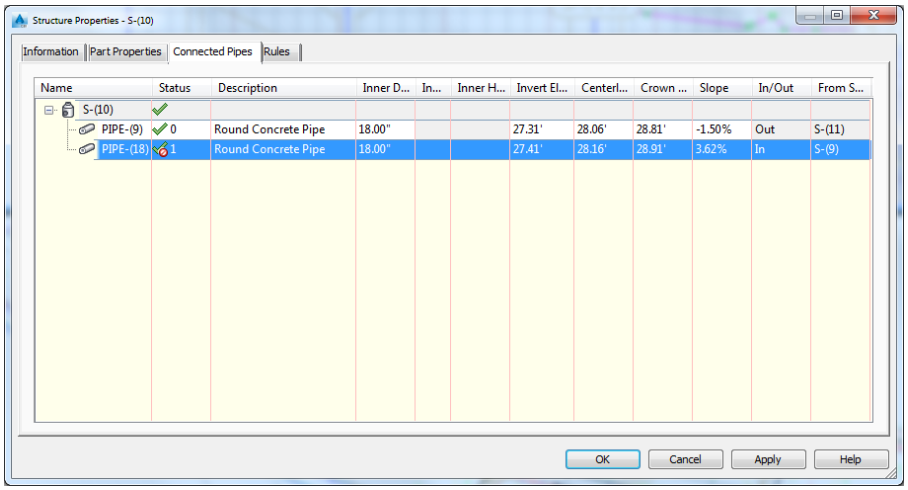


29. Change the *PIPE-(18) Invert Elevation* to **27.41'** making it 0.1' above the Outgoing PIPE-9.



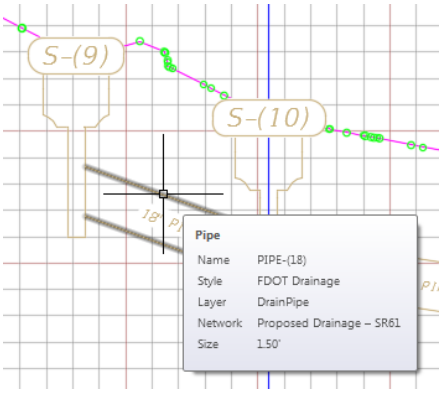
30. Click **Apply** to update values in the dialog and in the S-9 Proposed Drainage - SR61 Profile View.

31. Review *Slope Values* for **odd** values.

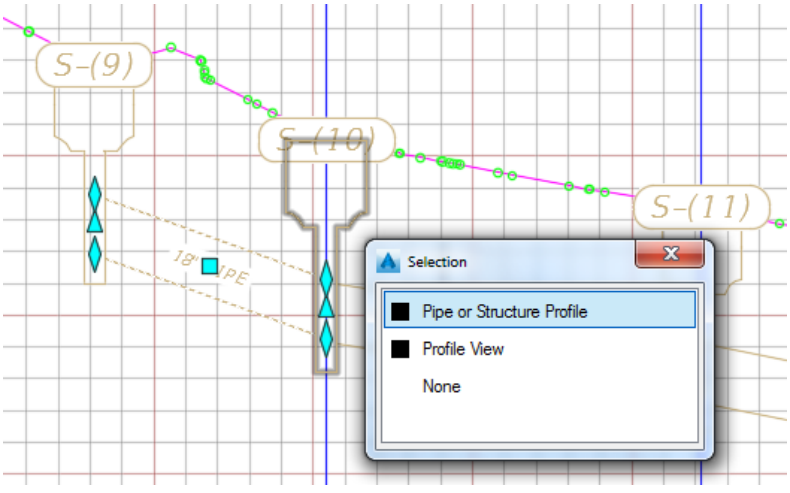


Note Based upon the Rules of Thumb being followed, the slope on PIPE-(18) needs adjustment from 3.62% to 3.0%, but this adjustment cannot be done from the Structure Properties - S-(10) dialog box, it has to be done by editing the PIPE-(18) properties

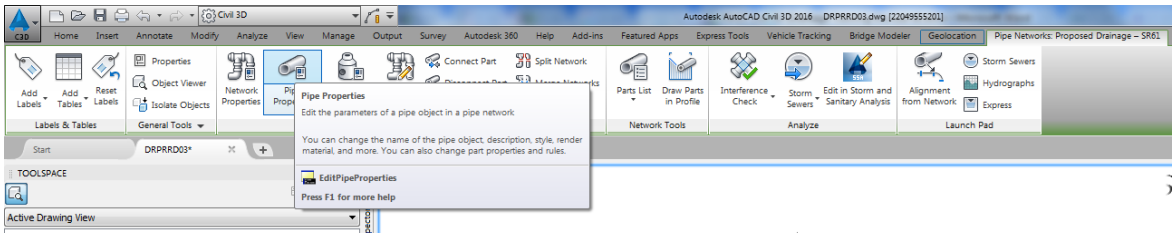
32. Click **Apply** then **OK** to close the Structure Properties - S-(10) dialog box



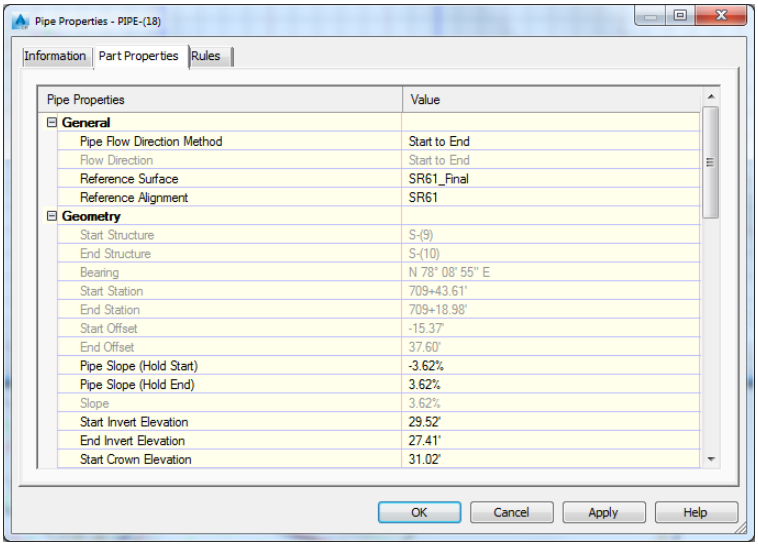
33. **Zoom** and **Pan** to display **structures S-(9)** and **S-(10)**. Hover over the **Pipe** that is between structure S-(9) and S-(10) to display a tooltip listing the pipe as **PIPE-(18).**



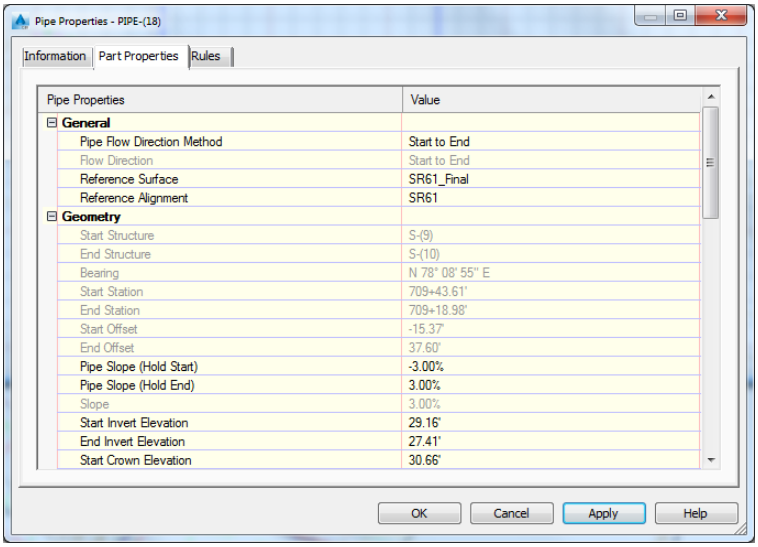
34. Select **PIPE-(18).** With *selection cycling* toggled On. A Selection dialog box displays. From the Selection dialog box select **Pipe or Structure Profile**.



35. From the *Pipe Networks Proposed Drainage - SR61 tab > Modify panel*, select the **Pipe Properties** button.

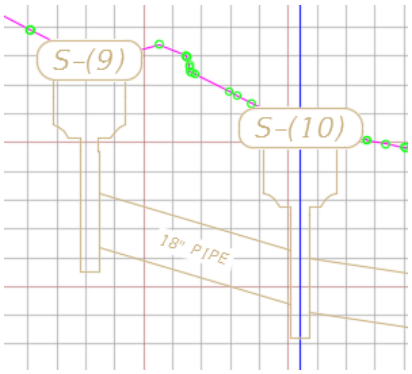


36. From the Pipe Properties - PIPE-(18) dialog box, select the **Part Properties** tab.

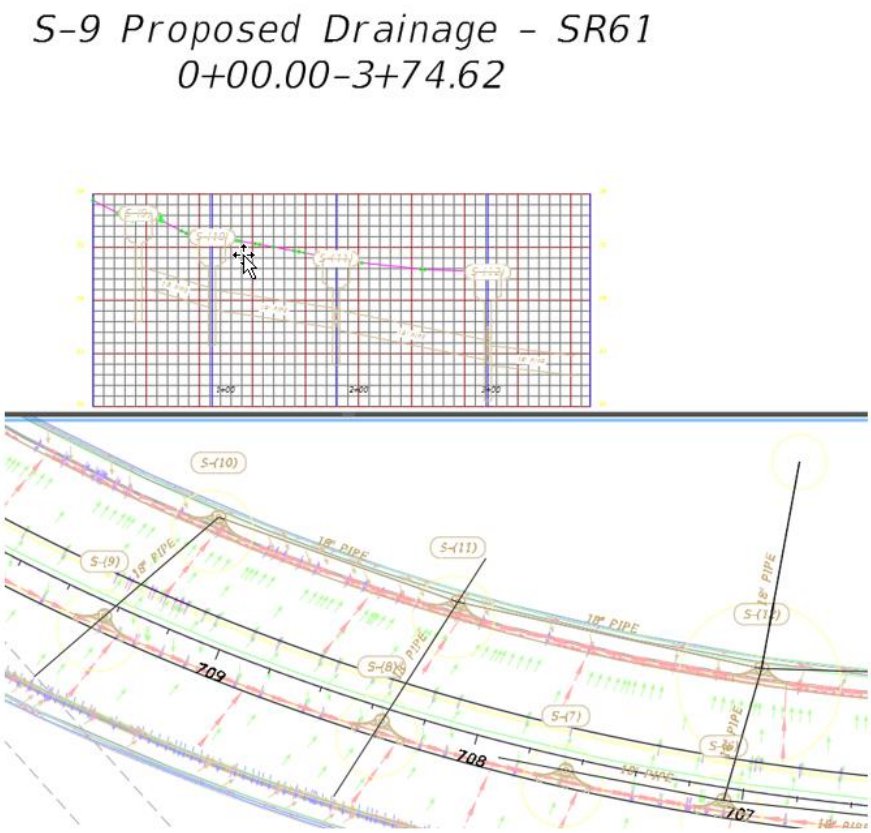


37. Adjust the *Pipe Slope (Hold End) value* to from 3.80% to **3.0%.** By adjusting the Pipe Slope (Hold End) value you are modifying the elevation of the Start Invert.

38. Press **ENTER** to complete the adjustment, then click **Apply**. The values for both Hold End and Hold Start recalculate and display.
39. Click **OK** to close the Pipe Properties - PIPE-(18) dialog box.



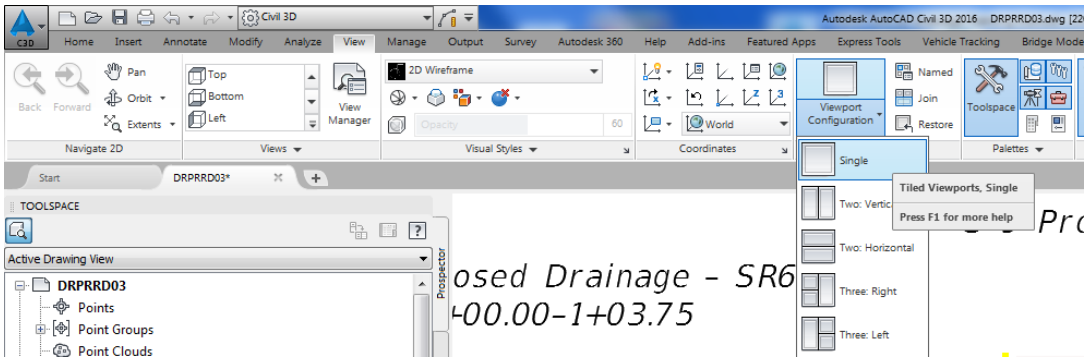
40. Notice that the S-9 Proposed Drainage - SR61 Profile View now displays PIPE-(18) sloped correctly.



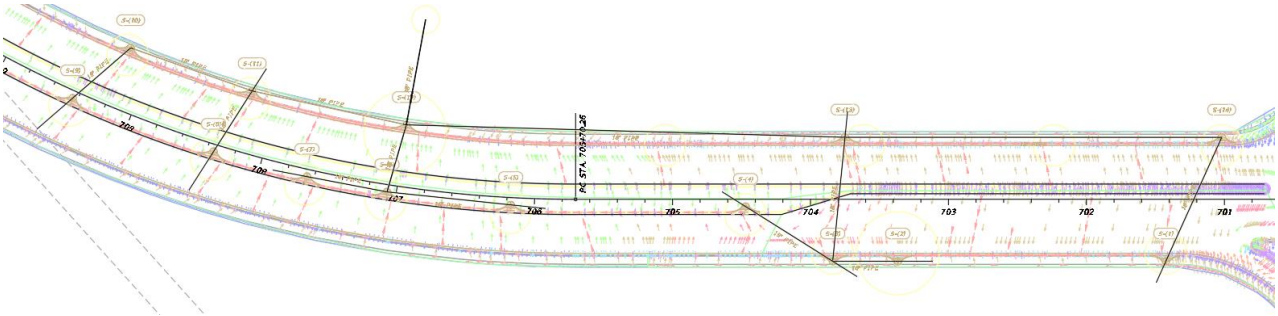
41. **Zoom out** to display the entire **S-9 Proposed Drainage - SR61 Profile View**.
42. **Save** the *DRPRRD03.dwg* file. Adjusting the Pipe Inverts and Slopes for all the Proposed Drainage - SR61 Profile Views is complete

Exercise 12.11 Change the Viewport Configuration to Single & Untwist View

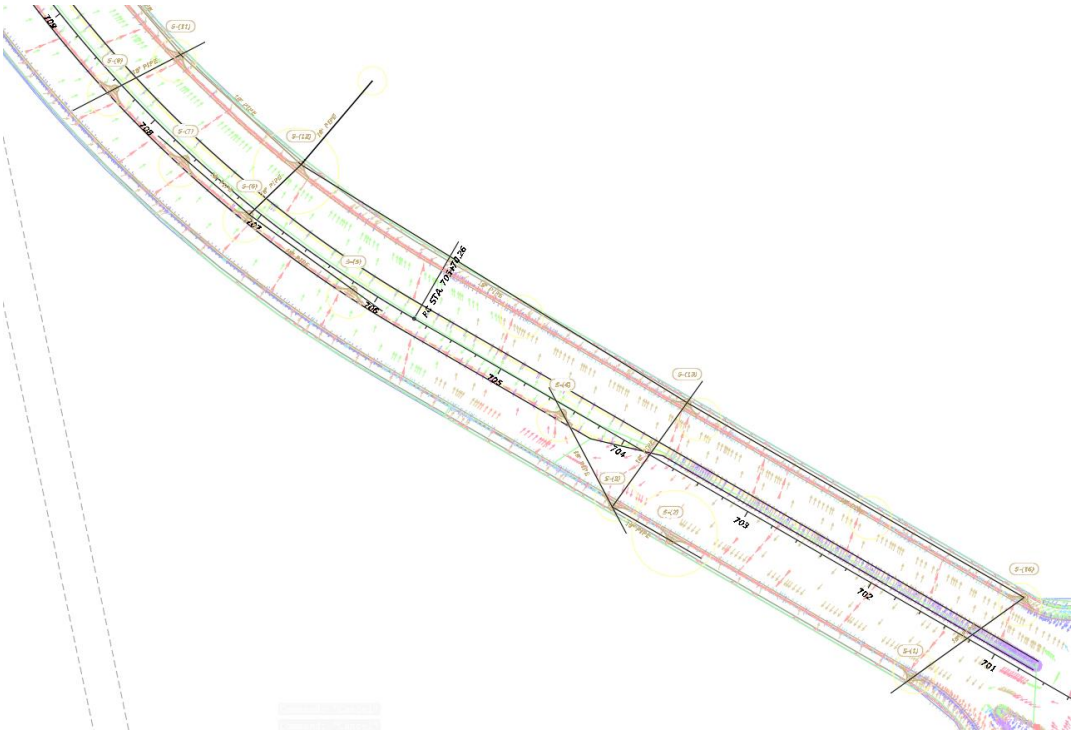
1. Select the **bottom Viewport** to make it the active Viewport.



2. From the *View tab > Model Viewports panel > Viewport Configuration drop down list*, select **Single**.



3. A single viewport now displays, notice that it is still rotated as shown by the UCS icon displayed above.
4. From the *FDOT tab > Tools panel*, click on the **Untwist View** button.



5. The Viewport is **rotated** back to the correct rotation as shown by the UCS icon displayed above.
6. **Save** and **Close** the *DRPRRD03.dwg* file.

13 CATCHMENT AREAS

DESCRIPTION

In this chapter, you will review the definition and purpose of Catchment Areas and perform a Watershed Analysis of a surface.

OBJECTIVES

In this chapter, you will learn about:

- Catchment Areas Definition and Purpose
- Performing Watersheds Analysis on a Surface

CHAPTER SETUP

Run the Chapter 13 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

CATCHMENT AREAS

Catchment areas are used to delineate a drainage boundary that drains to a structure or pipe. Catchment areas can have additional hydrological data attached for further analysis.

CATCHMENTS

In the next few steps you will review the processes of creating Catchments.

You can model drainage areas by using existing surface data or polyline data to create catchments.

A catchment object is comprised of a boundary and a flow path. The boundary represents the watershed area that produces the runoff. The flow path represents the Time of Concentration data for the runoff flow from the catchment area. This Time of Concentration data can be defined by using the TR-55 method or it may be user-defined.

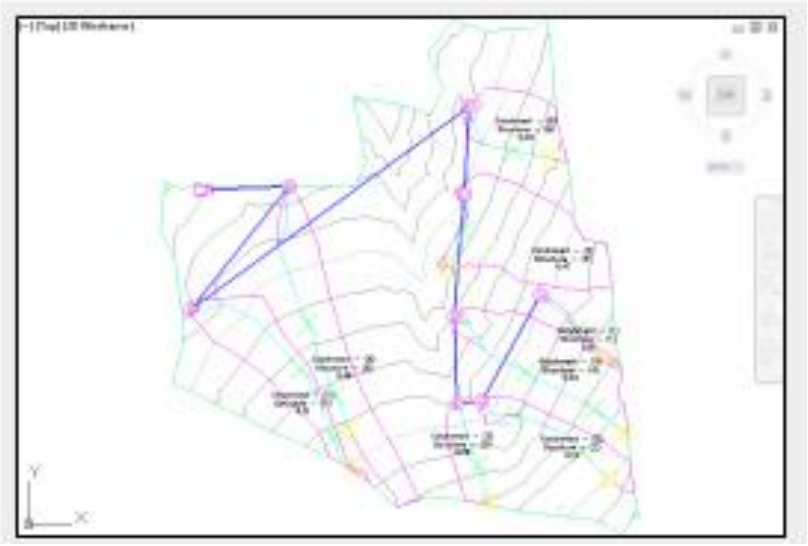
When a catchment is associated with a pipe network structure, the catchment data can be exported to Autodesk Storm and Sanitary Analysis for further analysis and development of the model.

CREATE CATCHMENT OBJECTS TO MODEL DRAINAGE AREAS ON A SURFACE

Catchments can be accessed from the TOOLSPACE Prospector tab, and associated catchment styles and settings are accessed from the TOOLSPACE Settings tab. When you select a catchment in the drawing, the Catchment contextual ribbon is displayed where you can access catchment-related commands.

CATCHMENT WORKFLOW

A catchment object is comprised of a boundary and a flow path. The boundary represents the watershed area that produces the runoff. The flow path represents the Time of Concentration data for the runoff flow from the catchment area. This Time of Concentration data can be defined by using the NRCS (SCS) TR-55 method or it may be user-defined.



CREATING CATCHMENTS FROM SURFACES

If existing surface data is available, you can define a catchment and flow path from this surface data.

You may optionally use the Water Drop command to check how Civil 3D would calculate the flow path from the surface. If this command does not produce the desired results, due to surface irregularities such as localized depressions or erratic triangulation issues, you may opt to use the Create Catchment from Object command and select a manually drawn flow path.

CREATING CATCHMENTS FROM OBJECTS

If existing surface data is not available, you can define a catchment and flow path from polylines. If the polylines have elevation data, you can use that data for the flow path slope, or you can edit the slopes of the flow path segments later by using the Flow Segments vista.

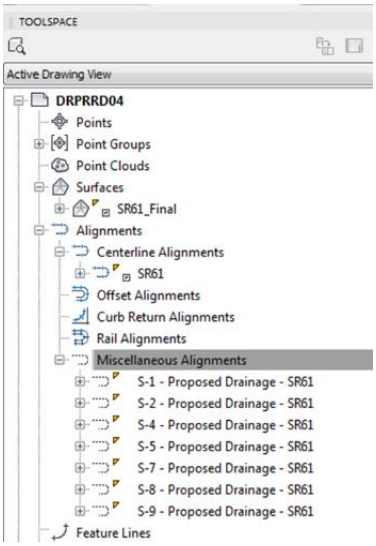
In this drawing we will be creating Catchment objects from polylines. The process starts by displaying the watershed boundaries analysis from the road design surface. The Watershed Analysis displays the same boundaries you make with the Define Catchments from Surface command. It is a good starting point for delineating sub basins which you will define later by subdividing the watershed into smaller areas each draining to a single inlet.

Exercise 13.1 Watersheds Analysis

1. Start the FDOT Civil 3D State Kit and open the **DRPRRD03.dwg** located in the Chapter 13 dataset drainage folder.
2. **Save** file as *DRPRRD04.dwg* in the same folder location.
3. As shown in previous steps, associate the drawing file to the 22049555201 Project by right clicking on the *data shortcut working* folder and selecting **Associate Project to Current Drawing.**

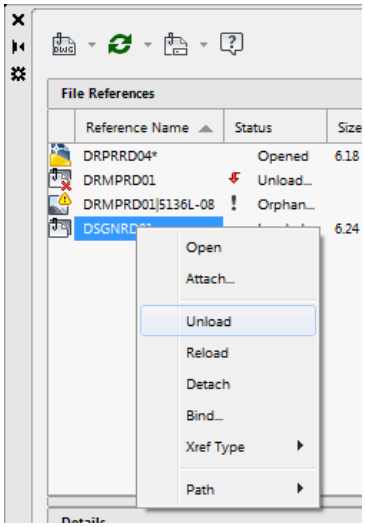
➢ ***Review the Surface SR61_Final.***

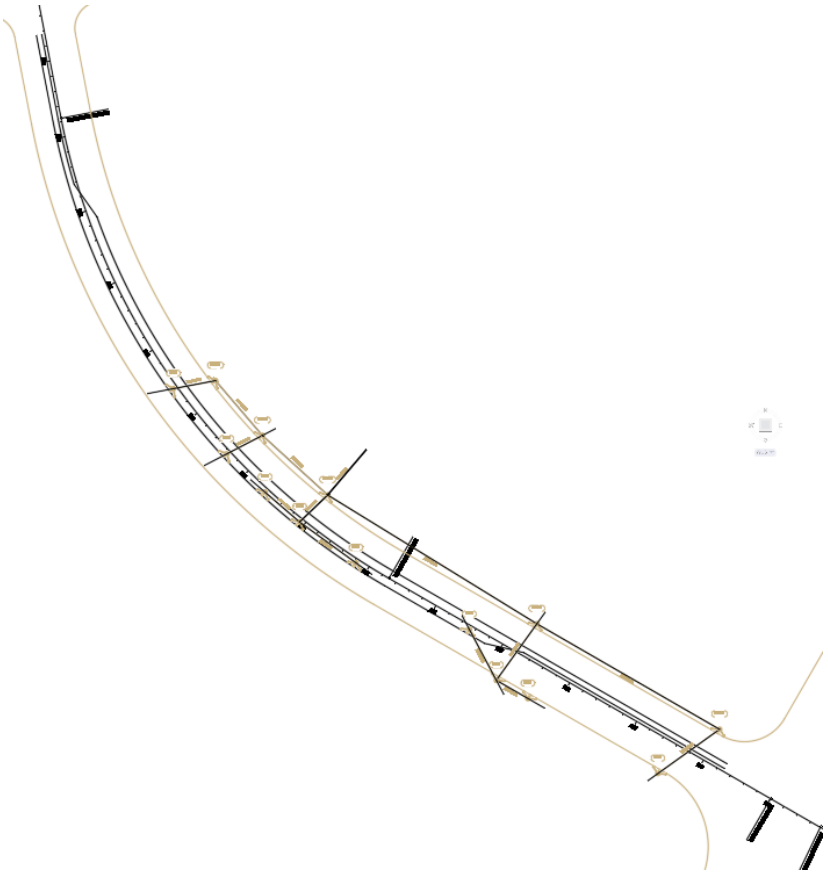
In the next few steps you will review the Surface SR61_Final that will be used to delineate watershed areas.



4. In the *TOOLSPACE > Prospector* tab notice SR61_Final is the name of the surface we will use to delineate watershed areas. The *Pipe Network Proposed Drainage – SR61* is where we will find the inlets to be connected to Catchment objects.

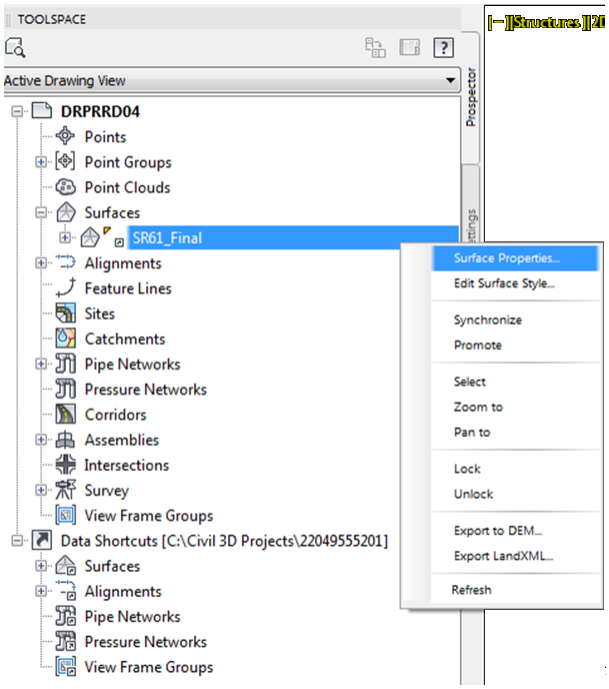
5. On the *command line* Type: **Xref** to open the Xref Manager.
6. In the list right click on *DRMPRD01* and select **Unload**.
7. Repeating the above step to **Unload** the *DSGNRD01* file.



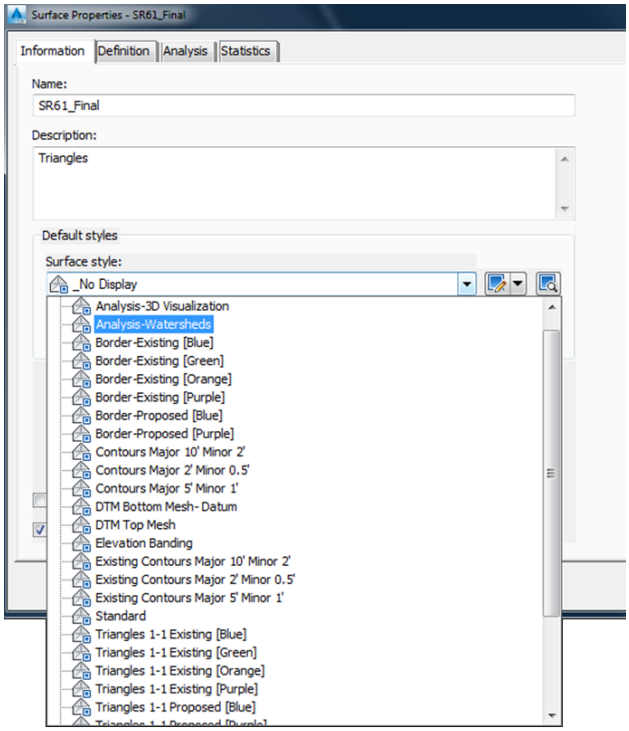


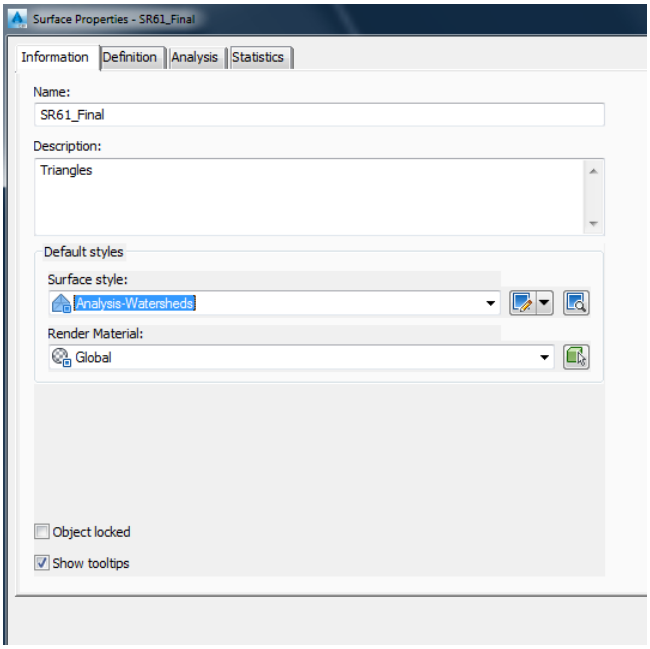
➢ *Watersheds Analysis of SR61_Final Surface*

The contents of the current drawing is all that displays. In the next few steps you will perform **Watersheds Analysis** on the SR61_Final surface.

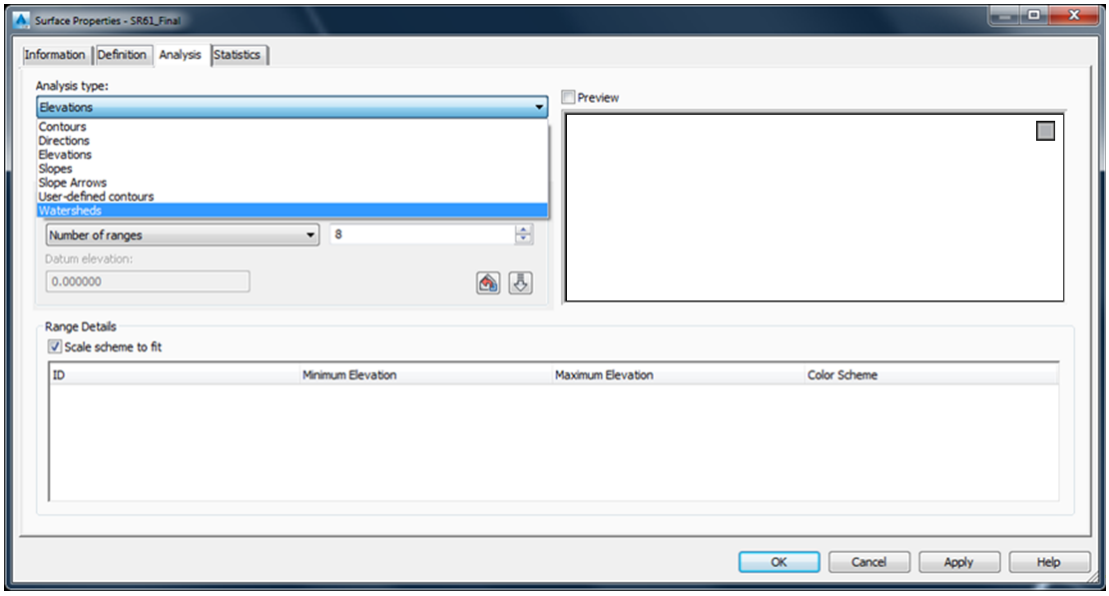


1. In the *TOOLSPACE > Prospector tab*, expand **Surfaces**, right click on **SR61_Final** surface and select **Surface Properties**.

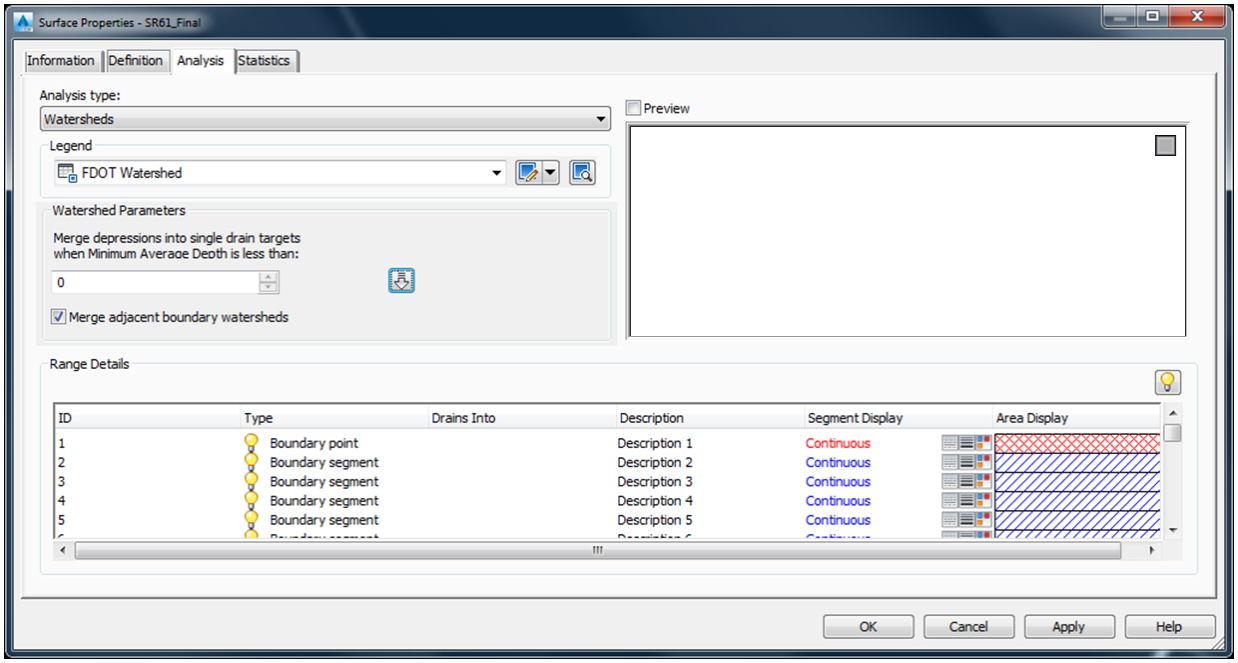




2. From the Surface Properties - SR61_Final dialog box, select the **Information** tab. From the *Surface style: drop down list*, select **Analysis-Watersheds**.

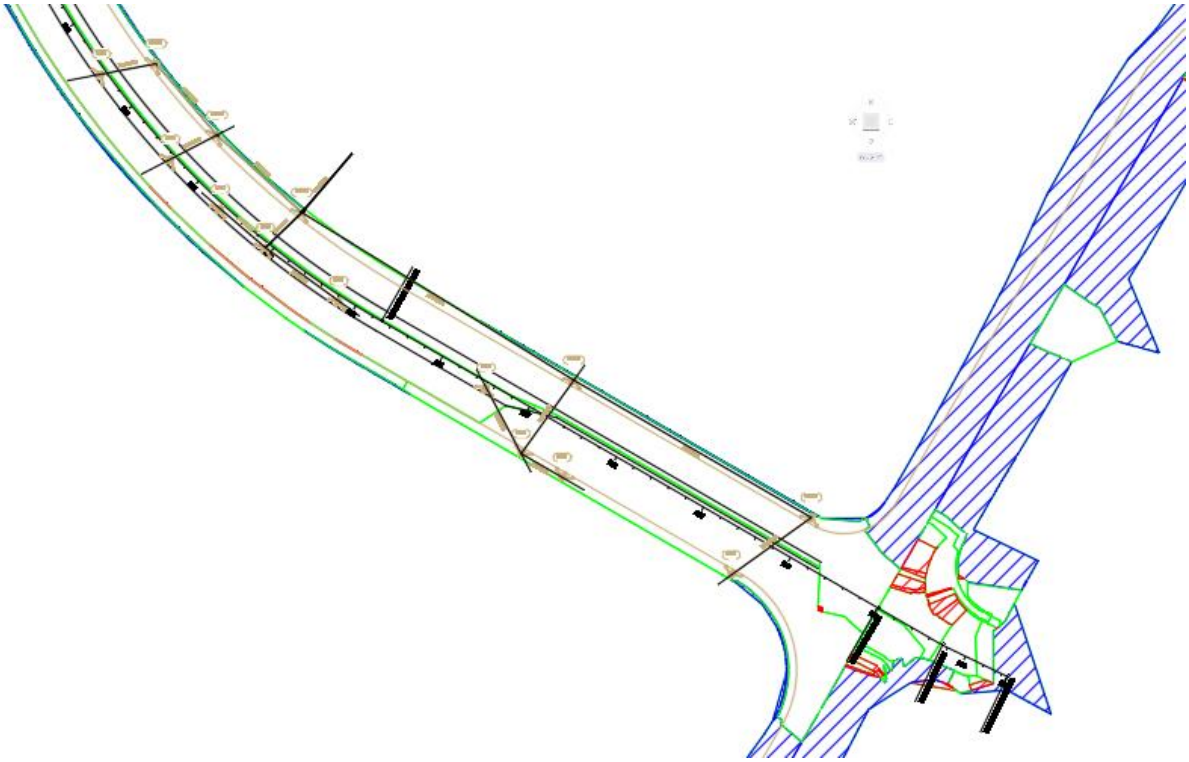


3. From the Surface Properties - SR61_Final dialog box, select the **Analysis** tab. From the *Analysis type: drop down list*, select **Watersheds.**



4. Check the **Merge adjacent boundary watersheds** box and click the **down arrow** to populate the *Range Details* with the calculated Watershed areas.

5. Click **Apply** then **OK** to close the Surface Properties - SR61_Final dialog box.



6. **Zoom** and **Pan** to display the **Proposed Drainage – SR61 Pipe Network**. Each inlet is located inside a Watershed Area. In the next chapter you will isolate the Watershed Areas relevant to the design and convert them into polylines.
7. **Save** and **Close** *DRPRRD04.dwg.*

14 POLYLINES FROM WATERSHED ANALYSIS

DESCRIPTION

In this chapter, you will create Polylines from a Watershed Analysis.

OBJECTIVES

In this chapter, you will learn about:

- Creating Polylines from a Watershed Analysis of the FG Road Surface

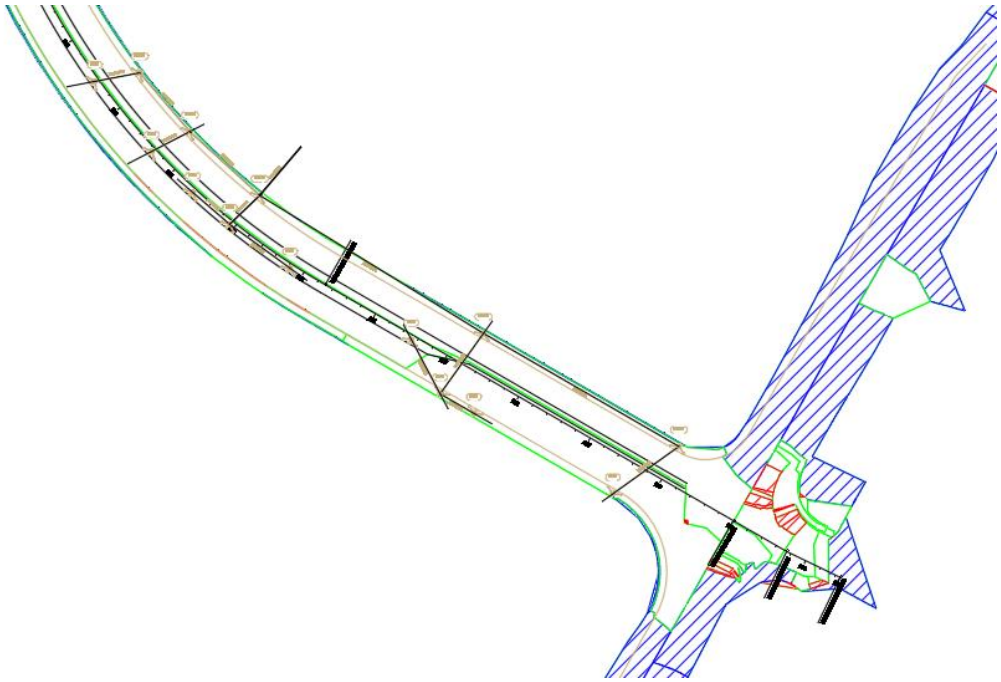
CHAPTER SETUP

Run the Chapter 14 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

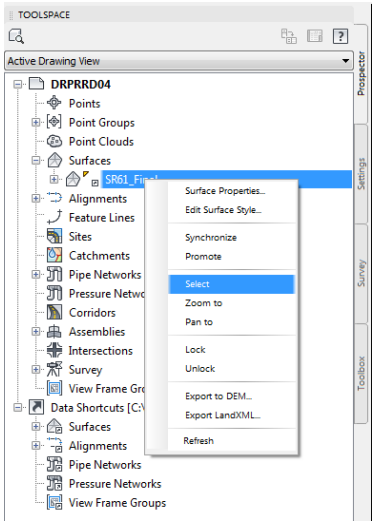
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 14.1 Creating Polylines from a Watershed Analysis

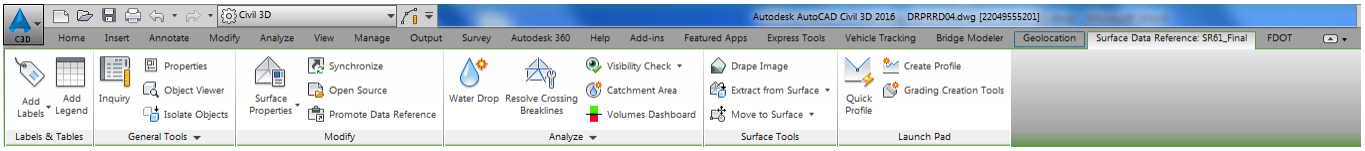
1. Start the FDOT Civil 3D State Kit and open the **DRPRRD04.dwg** located in the Chapter 14 dataset drainage folder.
2. As shown in previous steps, associate the drawing file to the 22049555201 Project by right clicking on the *data shortcut working* folder and selecting **Associate Project to Current Drawing.**



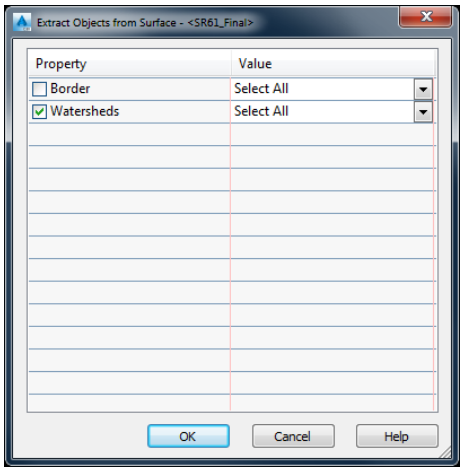
3. The drawing containing the drainage pipe network opens. In the next few steps you will Extract Objects from the SR61_Final surface.



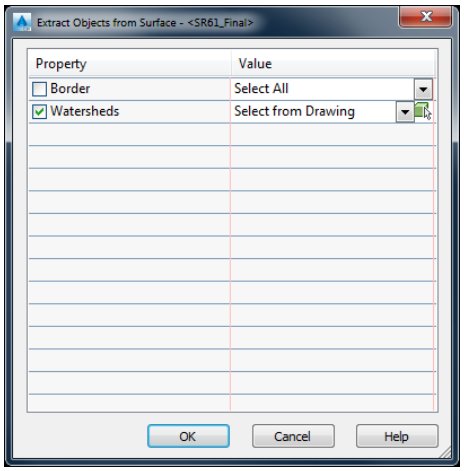
4. From the *TOOLSPACE > Prospector tab*, expand **Surfaces**, right-click on **SR61_Final** surface and click **Select.**



5. In the *Surface Data Reference SR61_Final > Surface Tools panel > Extract from Surface drop down list,* select **Extract Objects**.



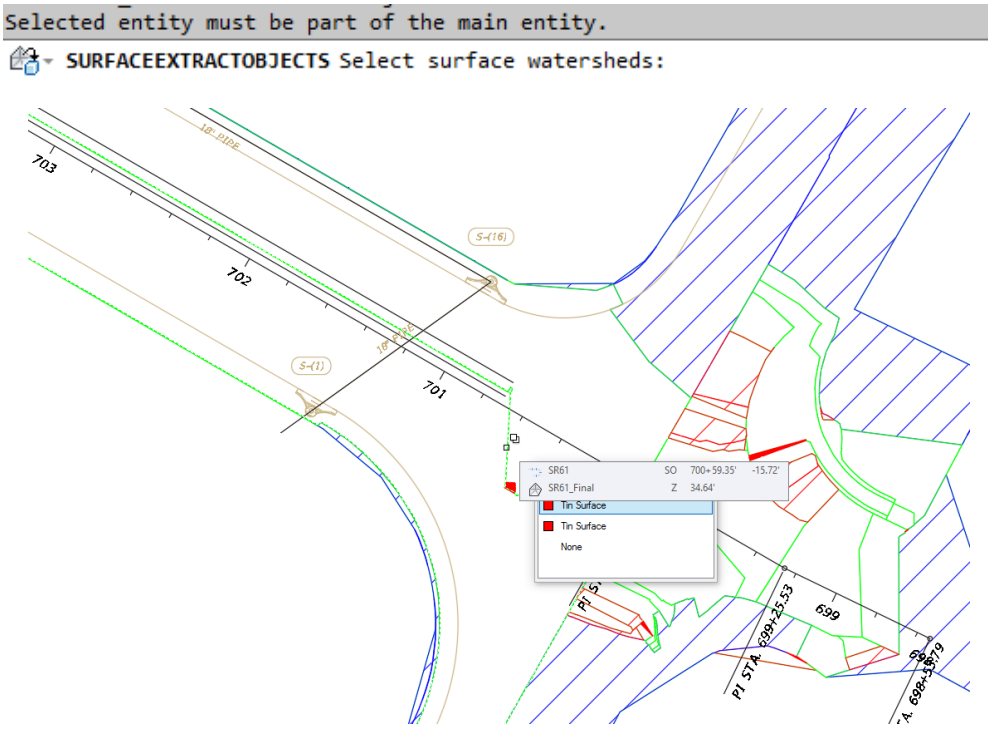
6. From the Extract Objects from Surface - <SR61_Final> dialog box, clear the check next to **Border**.



7. From the *Watersheds Value drop down list*, choose **Select from Drawing**.

8. Click the **Select from Drawing** icon. The Extract Objects from Surface - <SR61_Final> dialog box closes while you make your selection.

9. From the *command line* you are prompted to: *Select surface watersheds:*



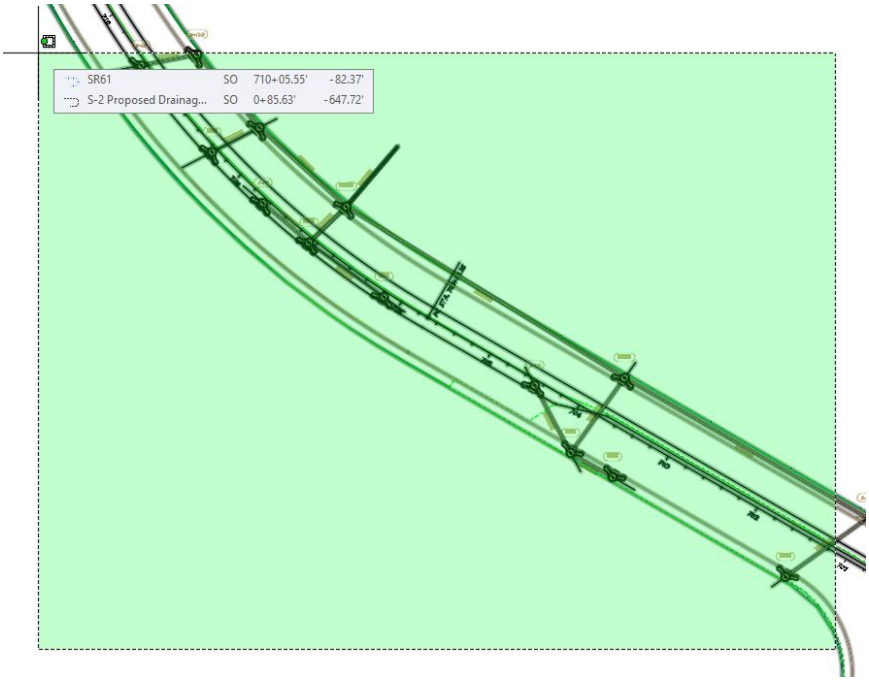
10. Select a green **Watershed Boundary** as shown above.

11. From the Selection dialog box, select **Tin Surface**.

Note Selection cycling helps you click the correct Watershed since adjacent areas share a common boundary.

```
Command: _AeccSurfaceExtractObjects 1 found
Selected entity must be part of the main entity.
Select surface watersheds: 1 found
SURFACEEXTRACTOBJECTS Select surface watersheds:
```

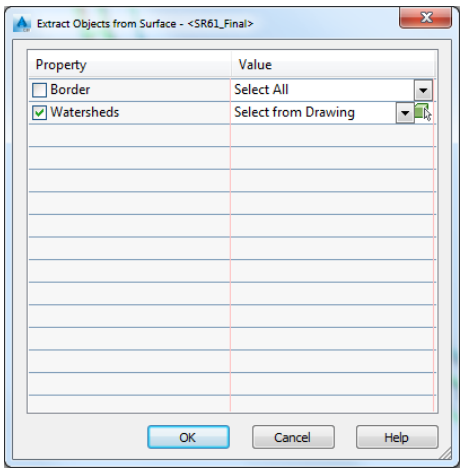
12. Notice the *command line* displays a history of objects selected.



13. **Zoom out** and use a *Crossing Window* as shown above to select other green **Watershed Boundaries**. Start a crossing window at the red circle displayed in the lower right location then end at the red circle displayed in the upper left location to complete the crossing window selection.

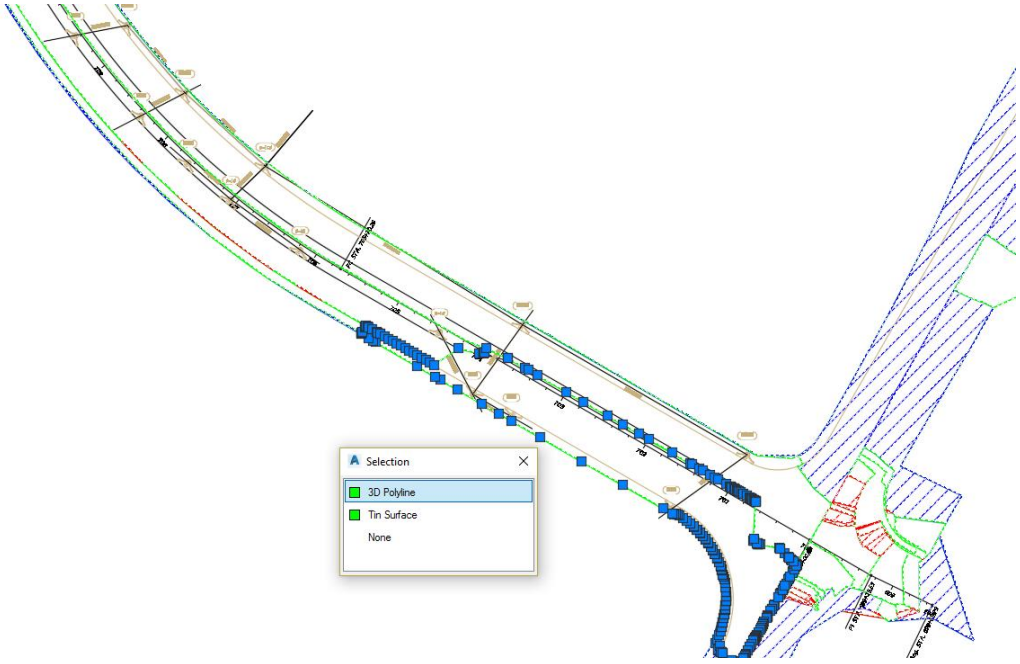
```
Select surface watersheds: Specify opposite corner: 121 found
119 were filtered out, 23 total
SURFACEEXTRACTOBJECTS Select surface watersheds:
```

14. Notice the *command line* displays a history of objects selected.
15. Press **ENTER** to return to the Extract Objects from Surface - <SR61_Final> dialog box.

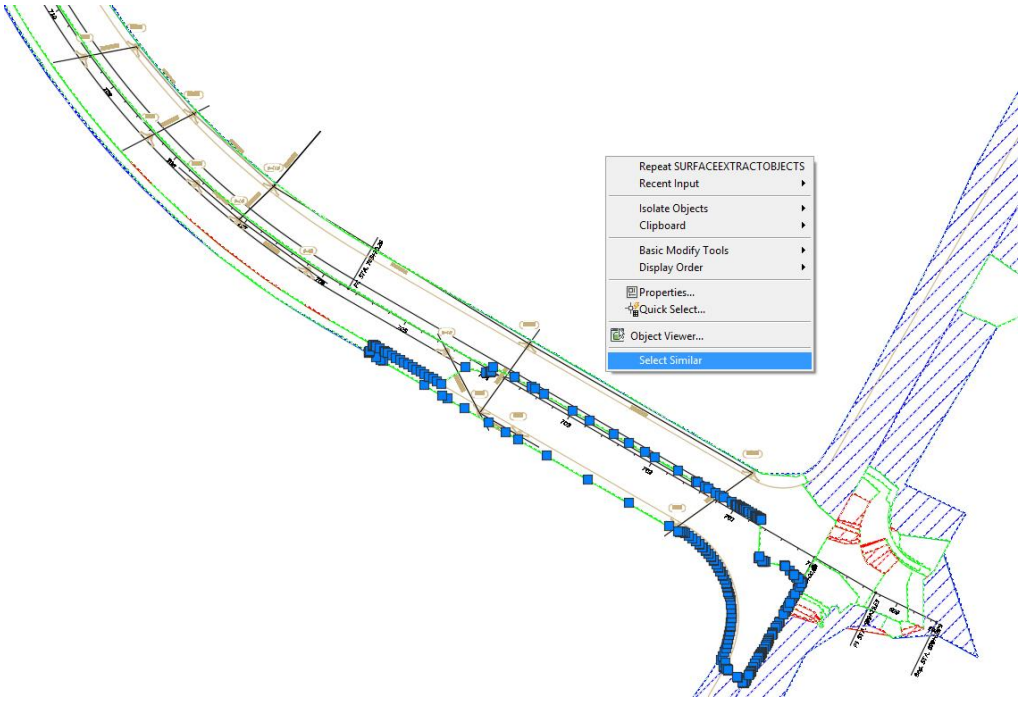


16. Click **OK** to close the Extract Objects from Surface - <SR61_Final> dialog box.

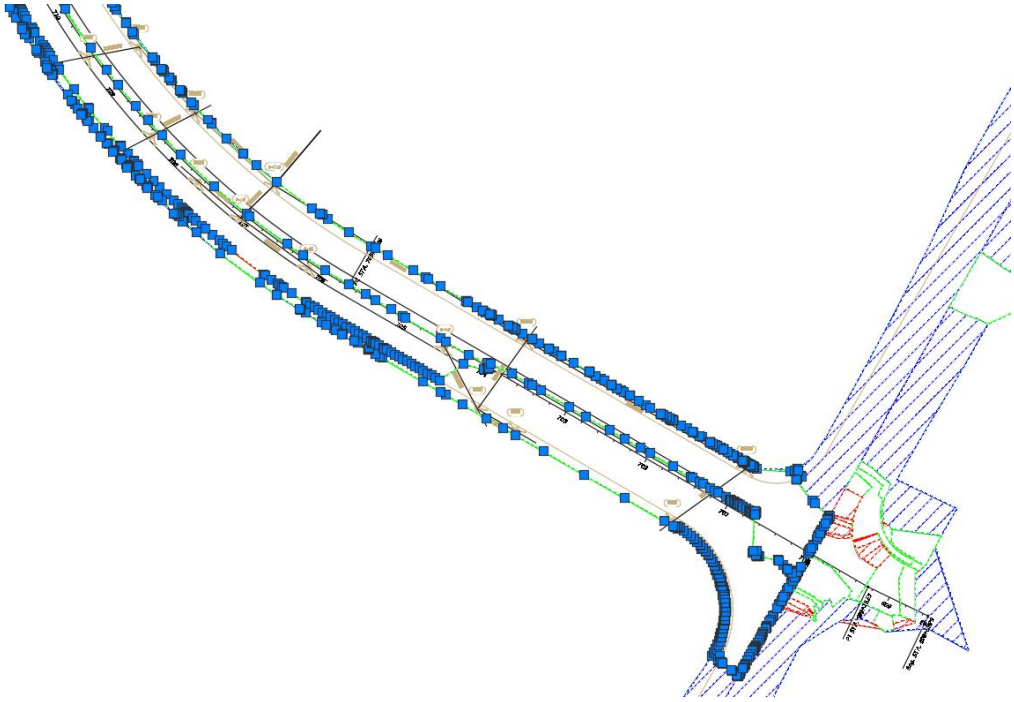
17. **Zoom** and **Pan** in a little closer and hover over the Watershed Boundary to display the tooltip revealing the extracted object is a **3D Polyline**.



18. Select the **3D Polyline.** With selection cycling toggled on, a Selection dialog box displays. From the Selection dialog box select **3D Polyline.**



19. Right-click and choose **Select Similar** from the shortcut menu.



20. The display of grips confirms that other 3D Polyline objects were extracted. Press **ESC** to clear grips.
21. **Save** and **Close** the *DRPRRD04.dwg* file.

15 BOUNDARY LINES DOWNSTREAM OF STRUCTURES

DESCRIPTION

In this chapter, you will do some basic setup of your design file and then you create boundary lines downstream of structures.

OBJECTIVES

In this chapter, you will learn about creating Boundary Lines Downstream of Structures.

CHAPTER SETUP

Run the Chapter 16 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

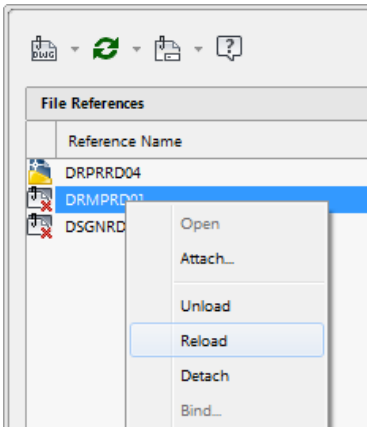
Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

Exercise 15.1 Create Boundary Lines Downstream of Structures

➢ *Drawing Catchment Boundary Lines*

1. Start the FDOT Civil 3D State Kit and open the **DRPRRD04.dwg** located in the Chapter 15 dataset drainage folder.
2. As shown in previous steps, associate the drawing file to the 22049555201 Project by right clicking on the *data shortcut working* folder and selecting **Associate Project to Current Drawing.**

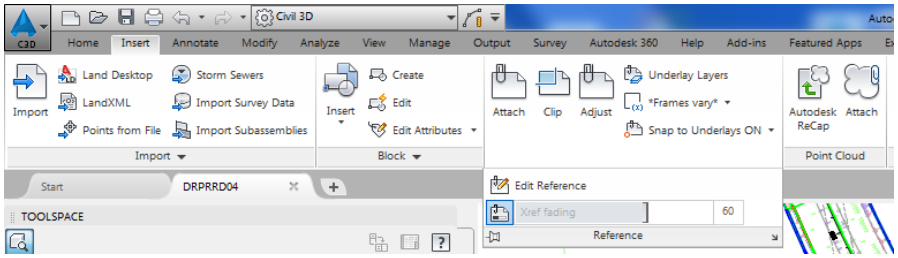
3. The drawing containing the Drainage Pipe Network opens.
4. On the *command line* Type: **Xref**. Reload *Reference Drawings* back into your current drawing file.



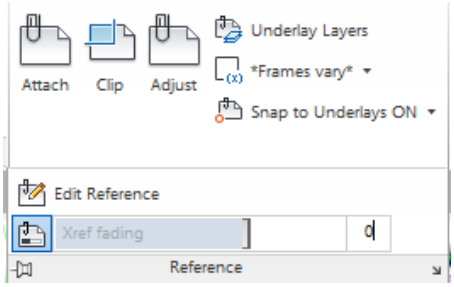
5. On the *File Reference list* right click on **DRMPRD01** and select **Reload.** The drawing is reloaded and now visible.
6. Right click on **DSGNRD01** and select **Reload**.
7. **Close** the External References tool palette.
8. **Save** the *DRPRRD04.dwg* file.

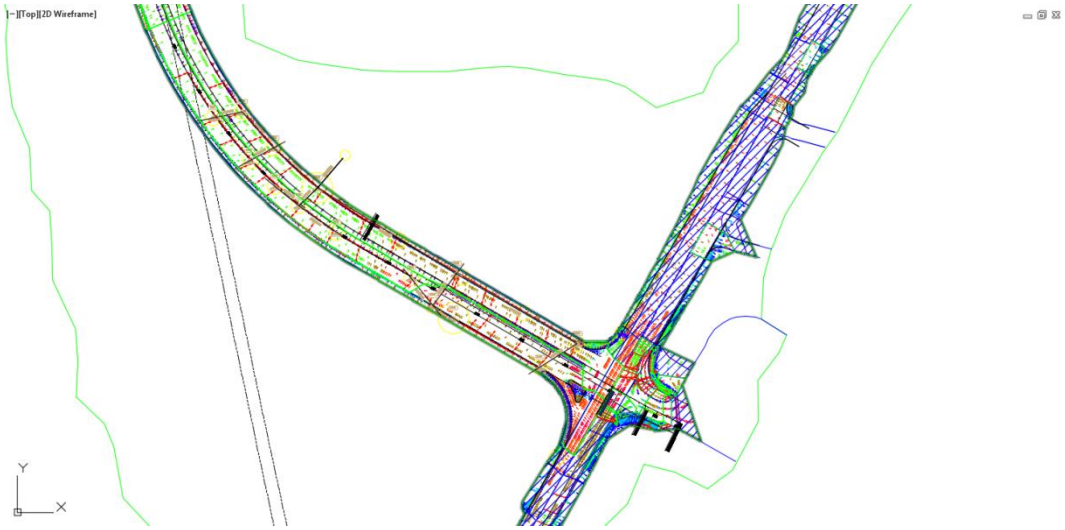
➢ *Set Xref Fading for Attached Xrefs*

The next steps will show you how to set Xref fading for all attached Xrefs. Xref fading controls how visible your referenced files are in your source drawing. The higher the number the more screened objects are.

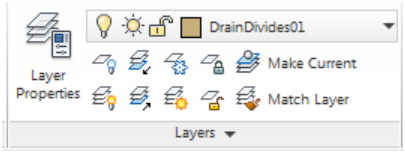


1. From the *Insert tab > Reference panel*, click on the panel title to display the hidden commands.
2. Set the *Xref fading value* to **zero.**





3. Notice in the drawing editor the Xrefs appear brighter. The alignment's display remains at full intensity.
4. From the *Home tab > Layers panel > Layer drop down list*, and set the current Layer to **DrainDivides01**.



HINT You can also type in the layer name on the command line to change it.

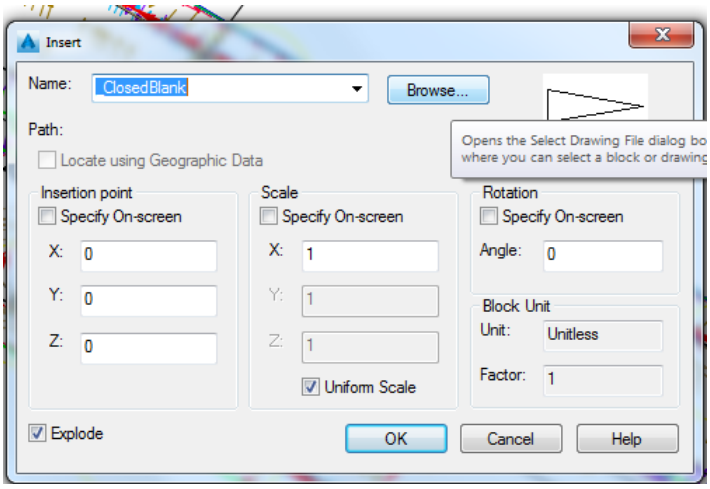
➢ *Define Temporary Drainage Divide Lines*

The next steps will show you how to define temporay Drainage Divide lines to be used as boundaries when creating polylines for each subbasin

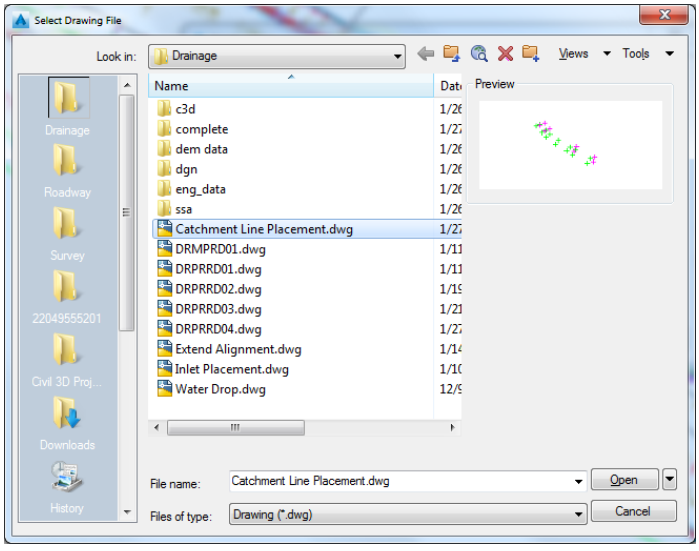
You need to define temporay Drainage Divide lines to be used as boundaries when creating polylines for each subbasin. These lines will form the downstream limits of the subbasin at each inlet. Beyond these downstream limits the water will be flowing toward another downstream inlet (as bypass flow).

A file named Catchment Line *Placement.dwg* has been created for you. The Catchment Line *Placement.dwg* contains AutoCAD points to be inserted into the *DRPRRD04.dwg* . These AutoCAD points will used as aids in the later process of defining temporay Drainage Divide lines to be used as boundaries when creating polylines for each subbasin

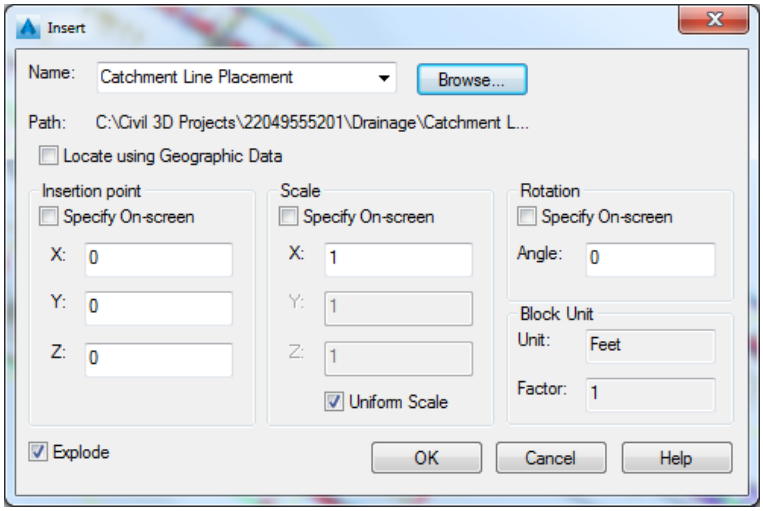
1. On the *Command Line* Type **Insert** <OR> **I** to open the Insert dialog.



2. From the Insert dialog box click on **Browse**.



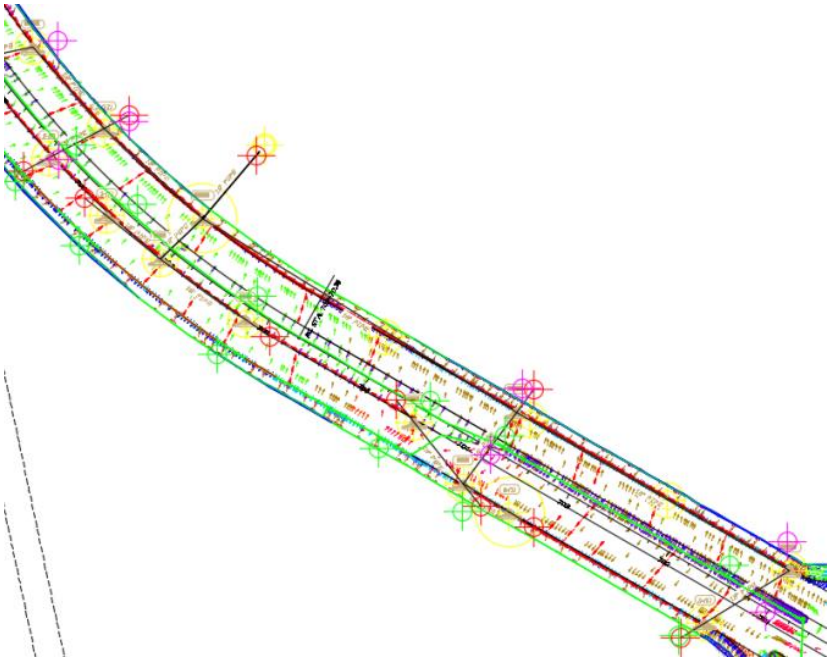
3. From the Select Drawing File dialog box, navigate to: C:\Civil 3D Projects\22049555201\Drainage.
4. Select **Catchment Line Placement.dwg**, then click **Open** to close Select Drawing File dialog box.



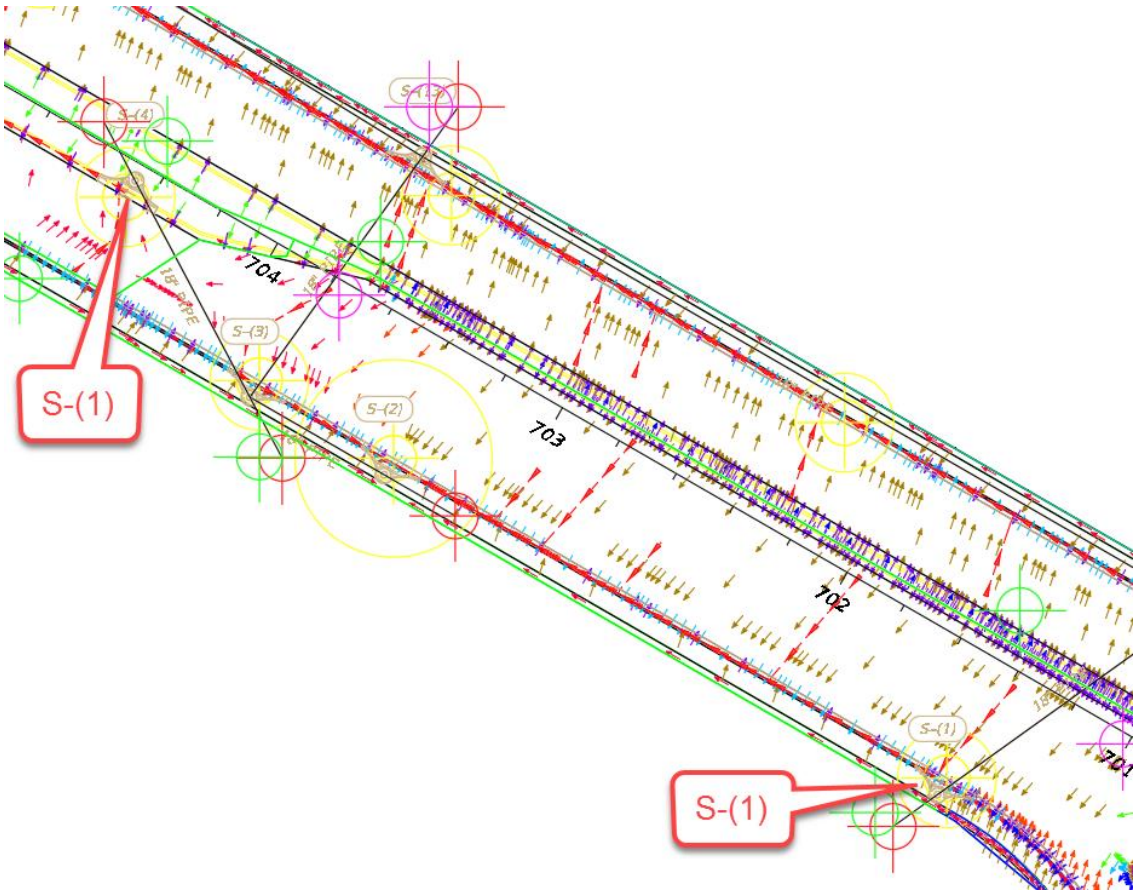
5. From the Insert dialog box, **Uncheck** *Insertion Point*, *Scale*, and *Rotation* boxes, then **Check** *Explode* box.
6. Click **OK** to close the Insert dialog box.
7. To view the AutoCAD Points to be used in the next process of defining temporay Drainage Dividing lines the Point Display Mode PDMODE must be set. From the *command line* Type: **PDMODE**, then press **ENTER.**

```
PDMODE Enter new value for PDMODE <0>: 34
```

8. On the *command line* Type: **34**, then Press ENTER again. The drawing should display as shown below.



9. **Zoom** and **Pan** to display **structures S-(1)** and **S-(4).**



10. AutoCAD Points from the inserted *Catchment Line Placement.dwg* display in the following ways:
    - AutoCAD Points that are south of the SR61 median display using the color Green.
    - AutoCAD Points that are north of the SR61 median display using the color Magenta.
    - AutoCAD Points that display using the color Red were used in the process of extending the Proposed Drainage - SR61 Alignments and are not used in this example.

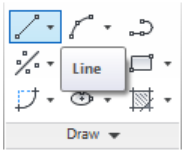
HINT If the AutoCAD Points are displayed to large execute a REGEN command from the command line. The REGEN command will resize the AutoCAD Points based on the current zoom display scale

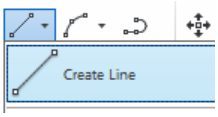
11. **Save** the *DRPRRD04.dwg* file.

Exercise 15.2 Draw Boundary Lines Downstream of Structures

➢ *Draw Lines Downstream of Structure S-(1)*

The next steps will show you how to draw lines that will represent the downstream boundary of the catchment areas.

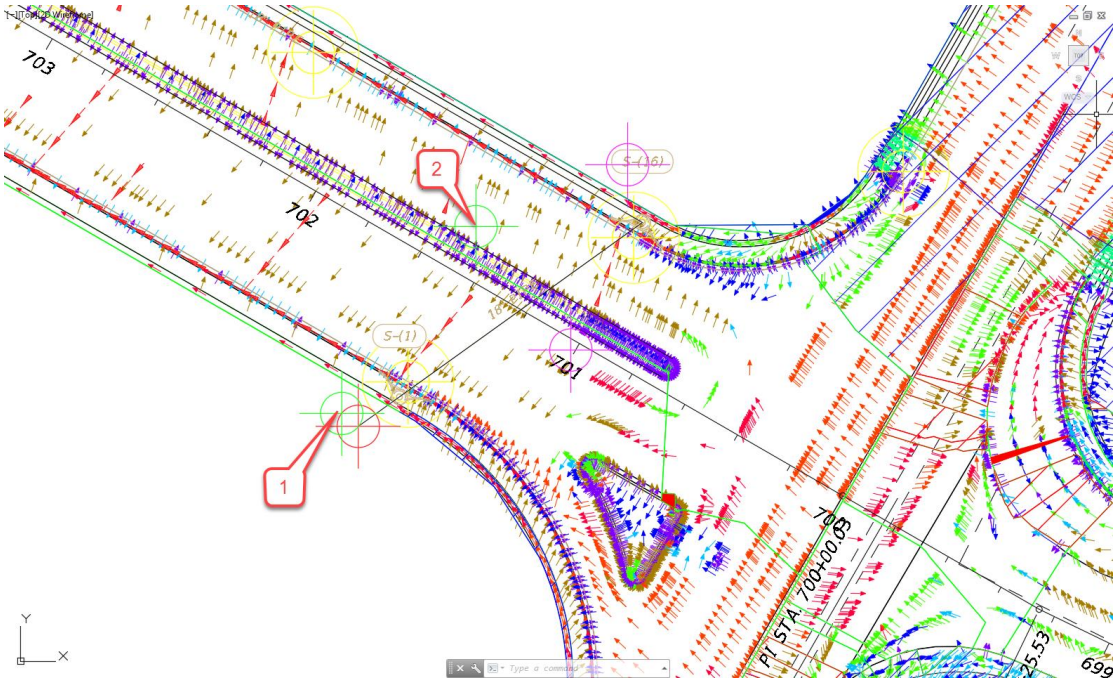




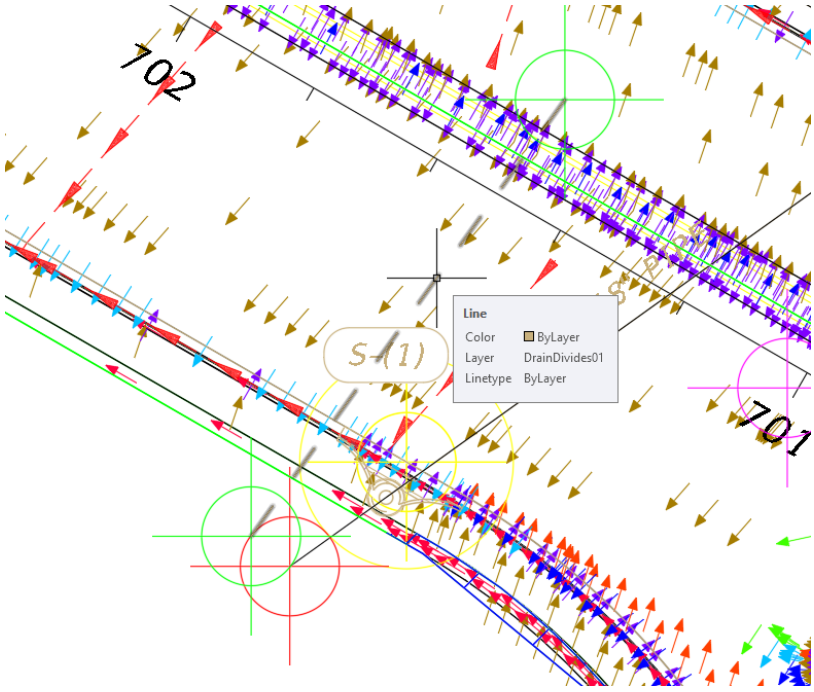
1. From the *Home tab > Draw panel drop down list*, select the **Create Line** command. The *command line* prompts you for the *starting point*.

```
LINE Specify first point:
```

2. **Zoom** and **Pan** to display **structure S-(1).**



3. Using a **Node Object Snap** select the green AutoCAD **Point (1)** as displayed above on the downstream side of structure S-(1). The *command line* prompts you for the *second point*.
4. Using a **Node Object Snap** select the green AutoCAD **Point (2)** as displayed above the SR61 Median.
5. Press **ENTER** to end the **Line** command.



6. Hover over the **Line** just created representing the *Downstream Boundary*. This line is parallel to the flow direction arrows and represents a Subbasin Boundary on the immediate downstream side of the structure S-(1).
7. **Save** the *DRPRRD04.dwg* file.

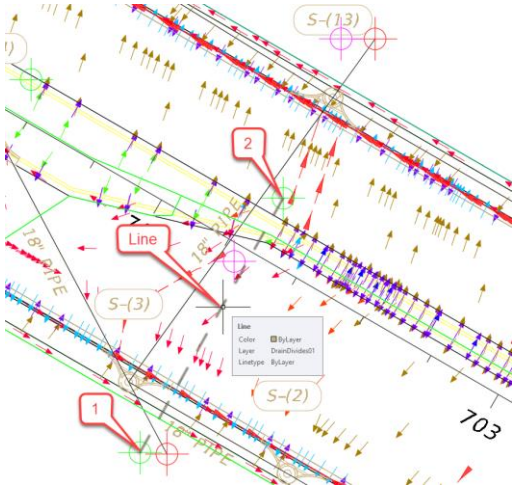
➢ *Draw Lines Downstream of Structures S-(2)*

Using Steps from the previous exercise draw a line downstream from the following structures. The Lines will be parallel to the Flow direction arrows.

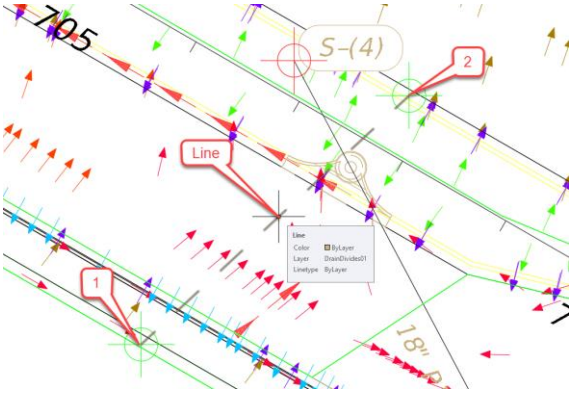
1. Structure List to use in this exercise:

S-(2)	**S-(4)**	**S-(5)**	**S-(7)**	**S-(8)**
S-(9)	**S-(10)**	**S-(11)**	**S-(13)**	**S-(16)**

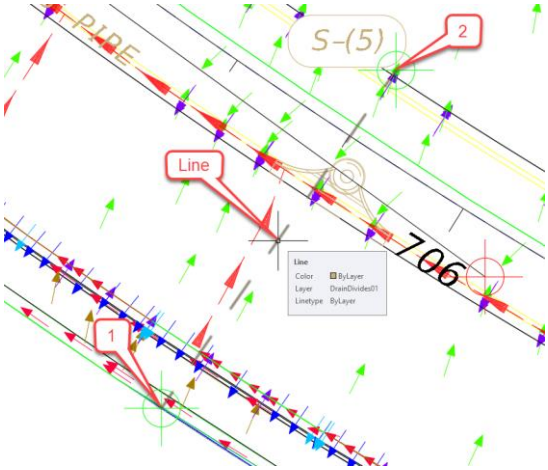
2. Use the following diagrams to assist.



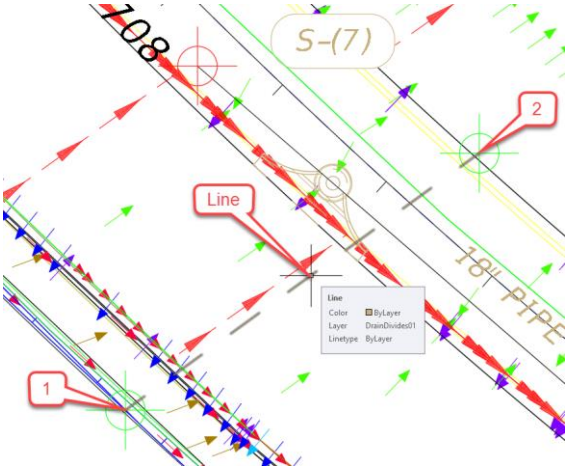
Structure S-(2)



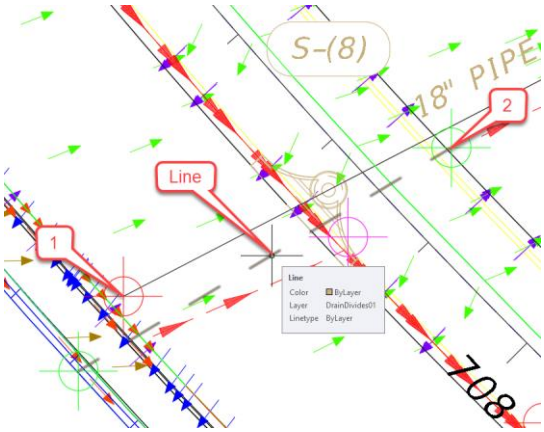
Structure S-(4)



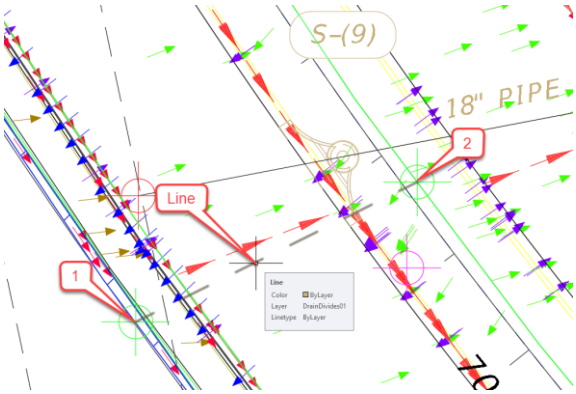
Structure S-(5)



Structure S-(7)



Structure S-(8)

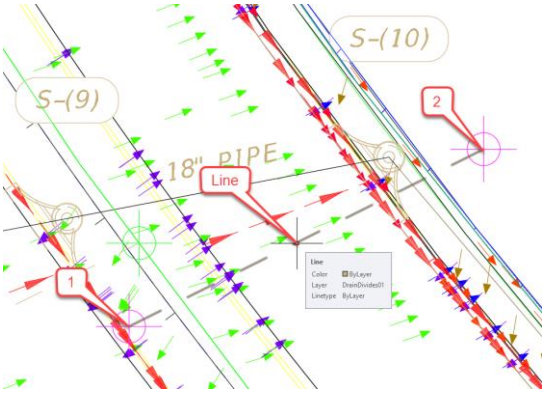


Structure S-(9)

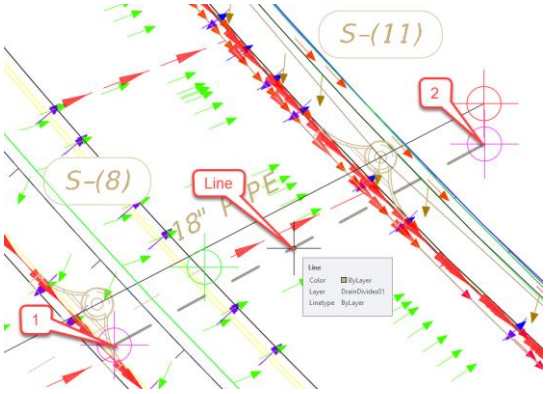
3. **Save** the *DRPRRD04.dwg* file:

➢ ***Next you will use the Magenta AutoCAD Points to draw the lines.***

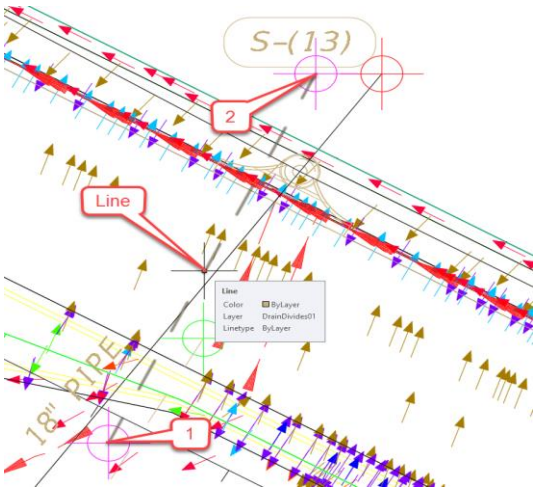
1. Use the following diagrams to assist.



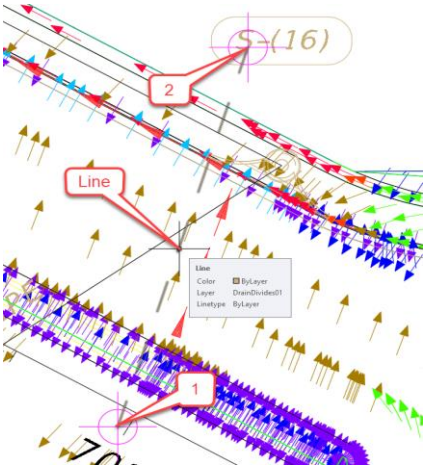
Structure S-10)



Structure S-(11)



Structure S-(13)



Structure S-(16)

2. **Save** and **Close** the *DRPRRD04.dwg* file:

Note	The geometry for the sub-basins has been determined. In the next chapter you will create closed polylines for each sub-basin. Afterward the polylines will be converted to Catchments and assigned to inlets.

16 DEFINING CATCHMENT AREAS

DESCRIPTION

In this chapter, you will create catchment areas for the inlets in the closed drainage system for the pavement.

OBJECTIVES

In this chapter, you will learn about:

- Creating Closed Polylines to Represent Catchment Area Geometry for Each Inlet
- Defining Catchment Areas from Polylines
- Assigning Inlets to Catchment Areas
- Labeling Catchment Areas

CHAPTER SETUP

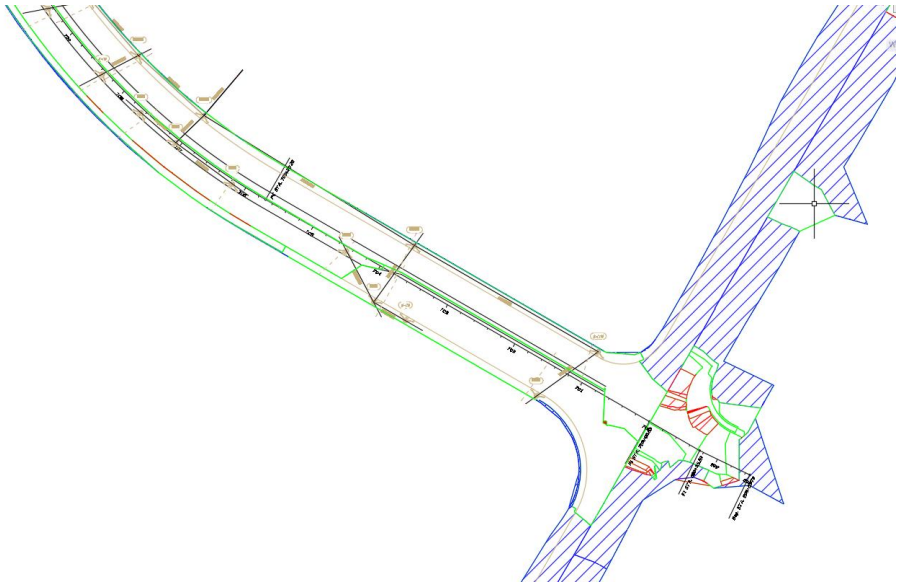
Run the Chapter 16 - 22049555201.exe file and restore all files to the C:\Civil 3D Projects folder.

Do not change the location in which the Practice Files are installed. Doing so can cause errors when completing the exercises in this training manual.

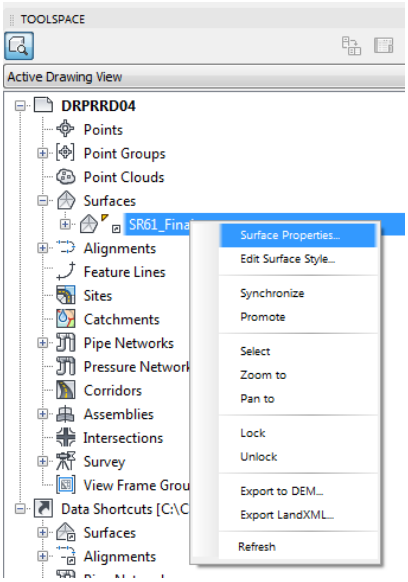
Exercise 16.1 Boundary Line Creation for Catchments

1. Start the FDOT Civil 3D State Kit and open the **DRPRRD04.dwg** located in the Chapter 16 dataset drainage folder.
2. As shown in previous steps, associate the drawing file to the 22049555201 Project by right clicking on the *data shortcut working* folder and selecting **Associate Project to Current Drawing.**
3. As show in previous chapters, **Unload** some *Xreferences* from the current file. On the *command line* Type **Xref** to open the Xref Manager.
4. **Unload** the following files: *DRMPRD01.dwg* and *DSGNRD01.dwg*. Hovering over the Filename right click to open the Shortcut Menu.

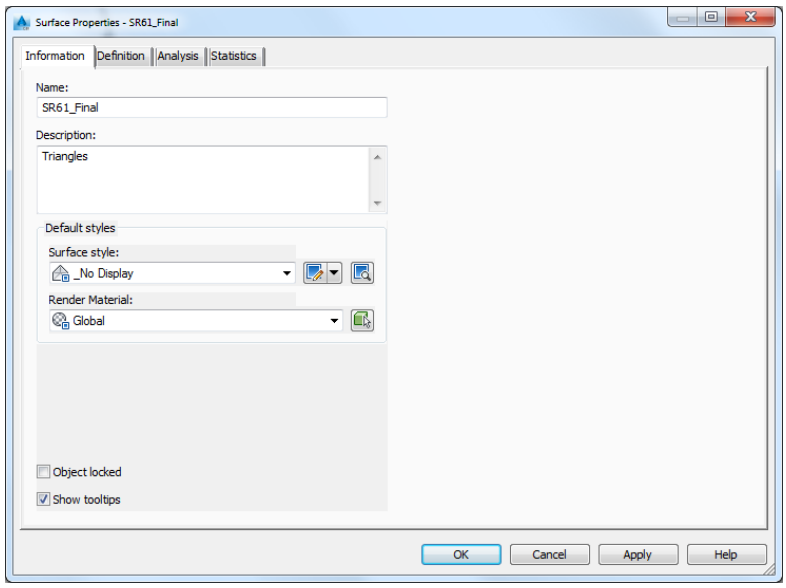
5. **Reset** *PDMODE* to **0**. On the *command line* Type **PDMODE** and change the setting to **0**. Press **ENTER** to exit the command. The drawing should look like image below.



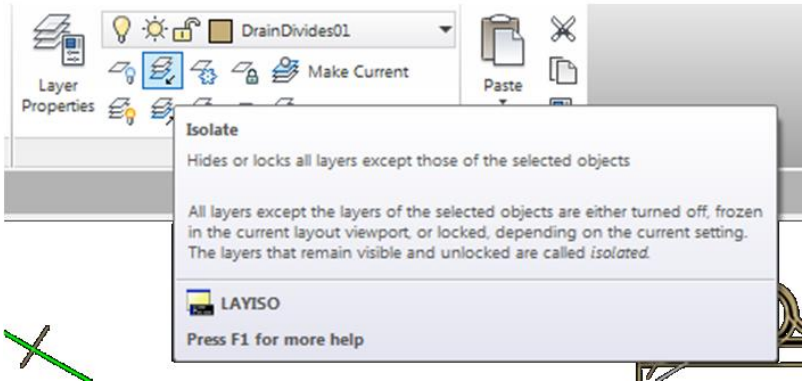
➢ ***Next you will change the final surface style to no display.***



1. From the *TOOLSPACE* > *Prospector tab*, expand **Surfaces**, right click on **SR61_Final** and select **Surface Properties.**



2. From the Surface Properties – SR61_Final dialog, select the **Information** tab. From the *Surface style: drop down list*, select **_No Display**. Click **Apply** the click **OK**.



3. From the *Home tab in the Ribbon > Layer panel*, select the **Isolate** to flatten catchment polylines to an elevation of 0.

```
LAYISO Select objects on the layer(s) to be isolated or [Settings]:
```

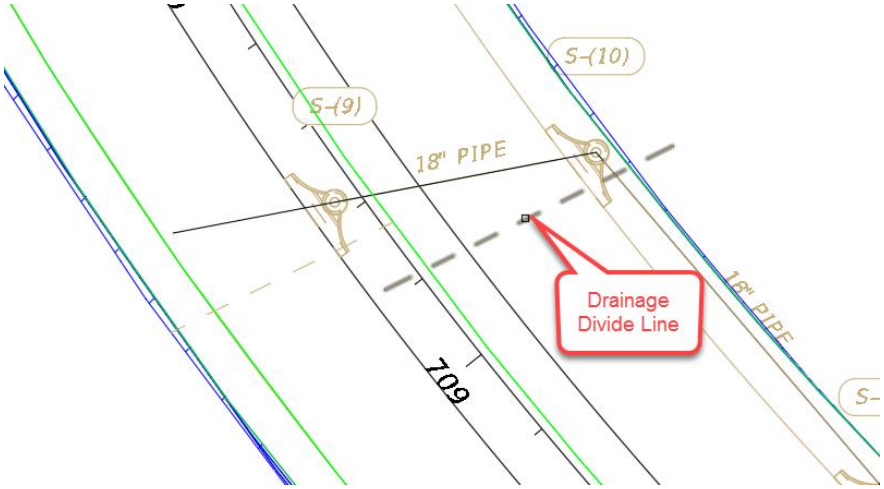
4. On the *command line* you are prompted to: *Select objects on the layer(s) to be isolated or [Settings]*. Select the **Settings** option.

```
LAYISO Enter setting for layers not isolated [Off Lock and fade] <Off>:
```

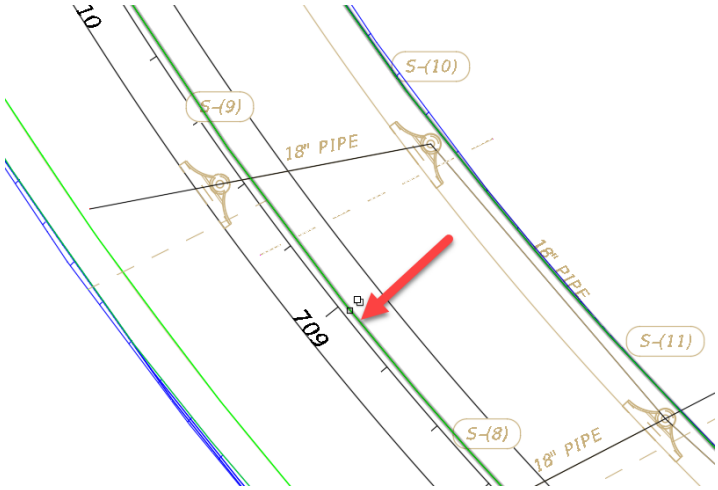
5. On the *command line* you are prompted to: *Enter setting for layers not isolated [Off Lock and fade] <off>*. Select **Off** to set the behavior of the command to turn off the unselected Layers when completed.

```
LAYISO In paper space viewport use [Vpfreeze Off] <Vpfreeze>:
```

6. On the *command line* you are prompted to: *In paper space viewport use [Vpfreeze Off] <Vpfreeze>*. Select the *Viewport* setting **Vpfreeze** as the next option.



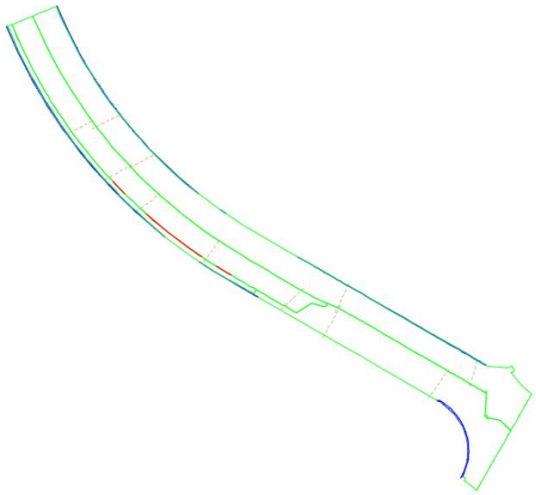
7. On the *command line* you are prompted to: *Select objects on the layer(s) to be isolated*. Select a line on the **drainage divide01** *layer*.



8. Select one of the green **3D Polylines**.

```
Select objects on the layer(s) to be isolated or [Settings]: 1 found
Select objects on the layer(s) to be isolated or [Settings]: 1 found, 2 total
LAYISO Select objects on the layer(s) to be isolated or [Settings]:
```

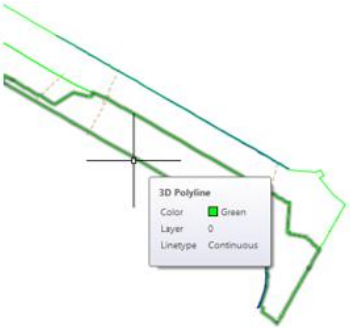
9. The *command line history* logs each selection made. Press **ENTER** to complete the command. The results are all layers are turned off except the selected layers as shown below.



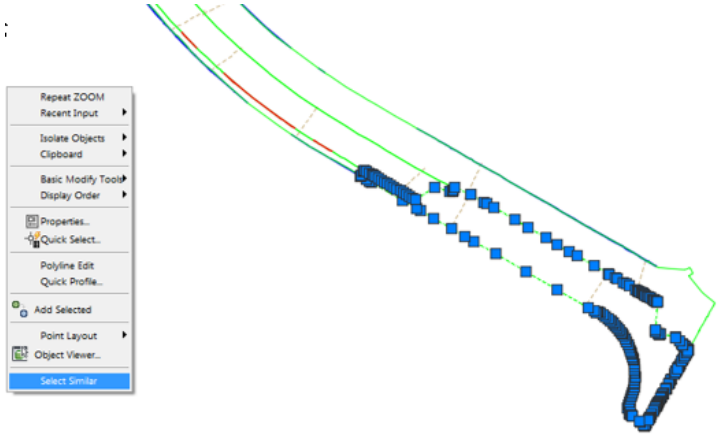
10. Hover over the **3D Polyline** to confirm you have the correct objects displayed. The 3D Polylines are at the terrain model elevations.

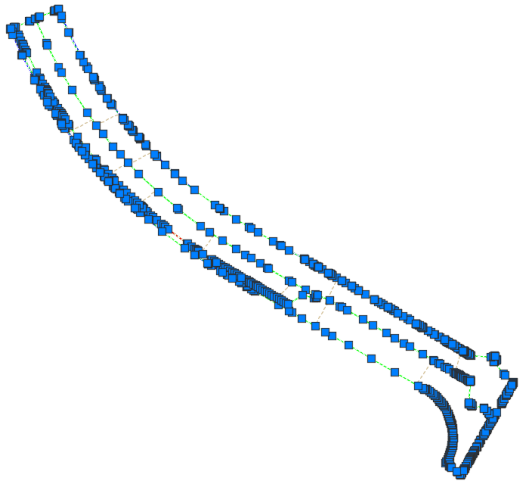
➢ *Create 2D Closed Polylines Using the BOUNDARY Command*

We want to create 2D closed polylines using the BOUNDARY command. The BOUNDARY command requires all objects to be at the same elevation. To do this we need change all the 3D polyline vertices to elevation zero (Z=0 at each vertex). The lines on layer DrainDivide01 are at elevation zero.



1. Flatten all objects before moving to Boundary Creation. Select a **3D Polyline**, right click and select choose **Similar**.

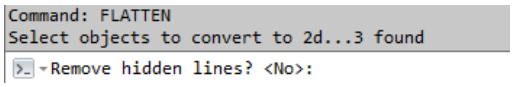




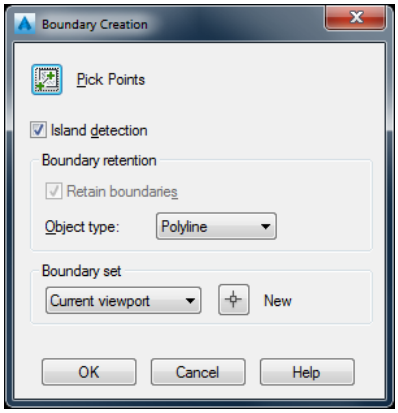
2. Notice that all **3D Polylines** are now selected.

➢ *Use the FLATTEN Command to Set All Vertices*

The BOUNDARY command used to create closed Polylines requires 2D Polylines. We will use the **FLATTEN** command to set all vertices of the selected 3D Polylines to elevation 0.



1. On the *command line* Type **FLATTEN**. The *command line* asks if you would like to: *Remove hidden lines?* Select **NO** and press **ENTER.**
2. Select a **3D Polyline**, right click and select **Properties**. The Properties palette displays. Notice the *Vertex Z value* is **0**. **Close** the Properties palette.
3. Press **ESC** to clear the grips.
4. **Zoom** to display all the **Watershed Geometry** on the screen. The **BOUNDARY** command requires all enclosed areas to be fully visible.
5. With all geometry now at *elevation* **0**, on the *command line* type **BOUNDARY**. Press **ENTER**. The Boundary Creation dialog displays. Click the **Pick Points** button.



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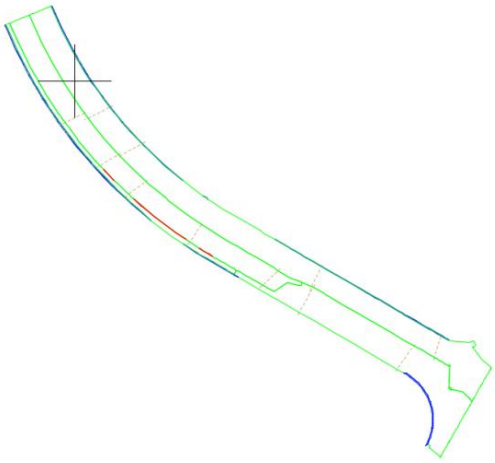
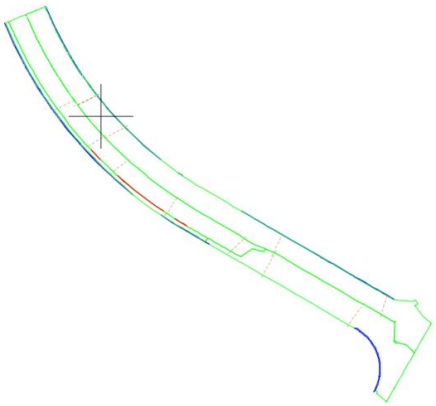
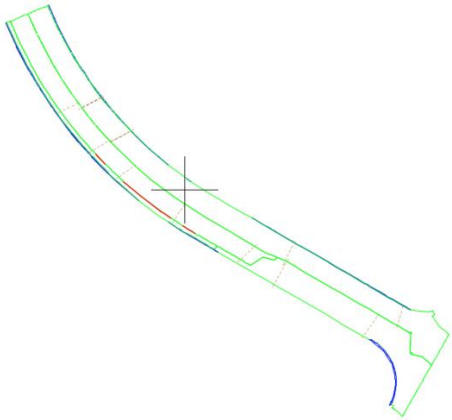
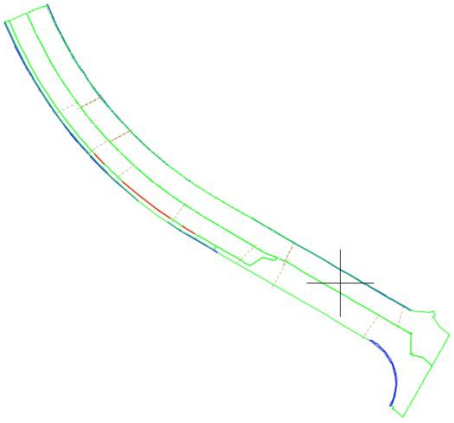
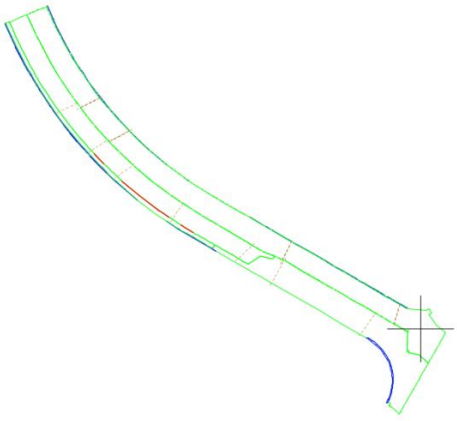


6. Start on **North Side** of *SR61 Alignment*. An *enclosed area* is visible and formed by the *3D Polyline* and a line on the *DrainDivide00* Layer. Click *inside* the **enclosed area** as shown above. The perimeter of the area selected will highlight.
7. Move your cursor over the next **enclosed area** and click.
8. Repeat the process for the remaining **enclosed areas** as displayed the following images. Notice the cursor placement in each one.

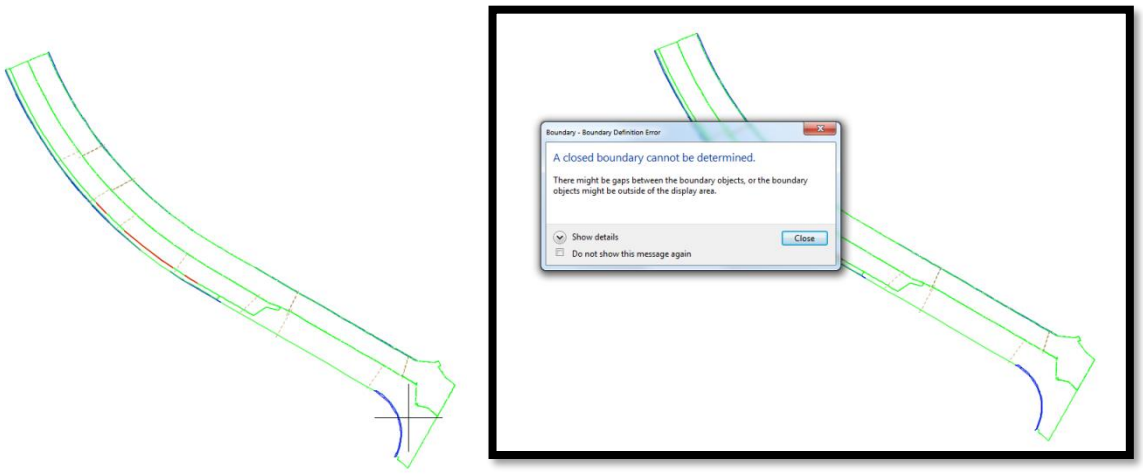




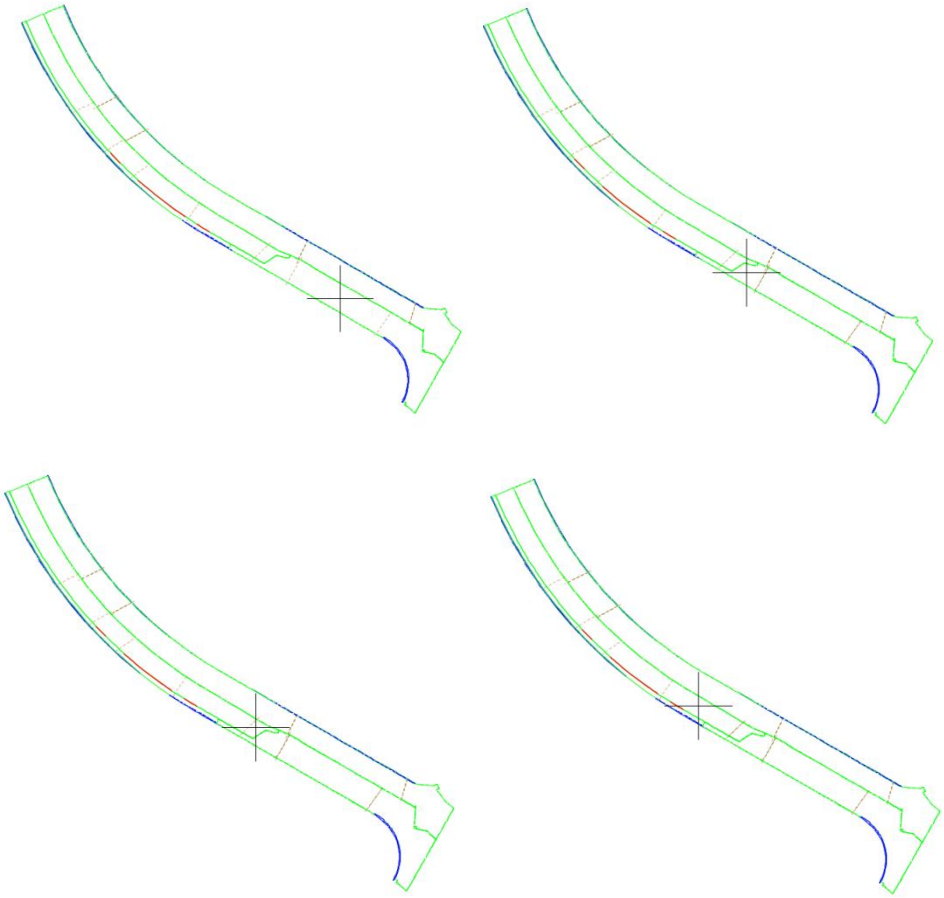


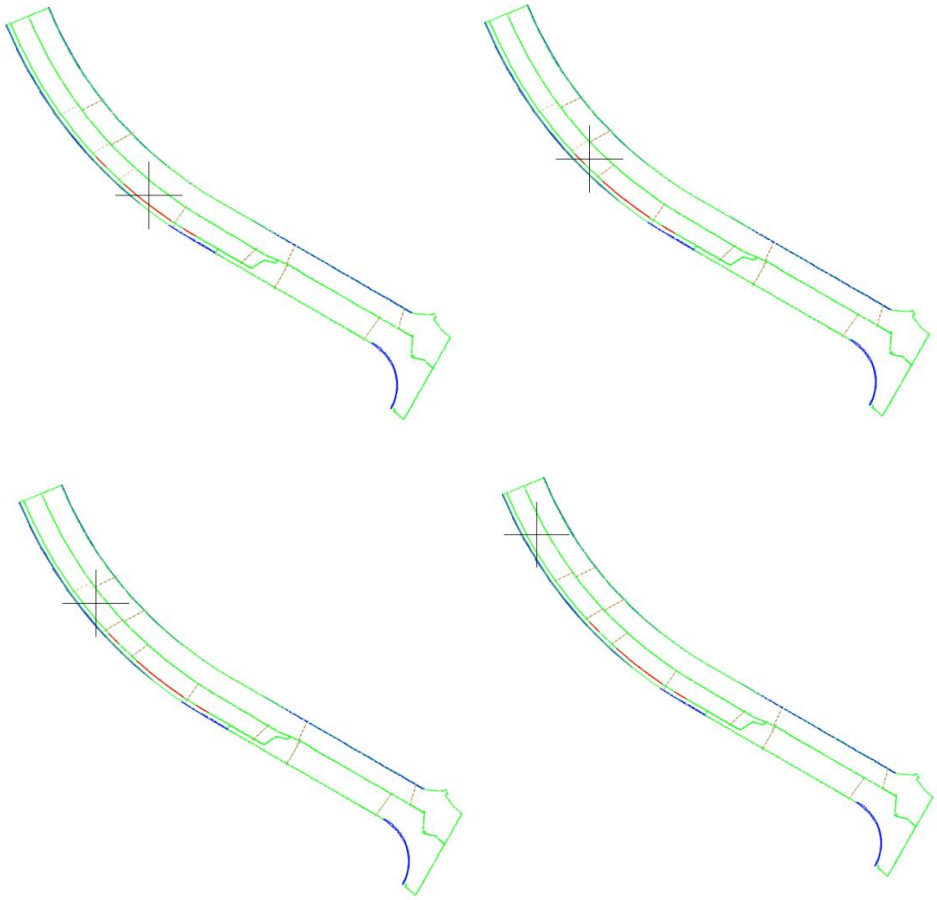


Note One image displays an error when selecting the boundary. This will be fixed in later steps.

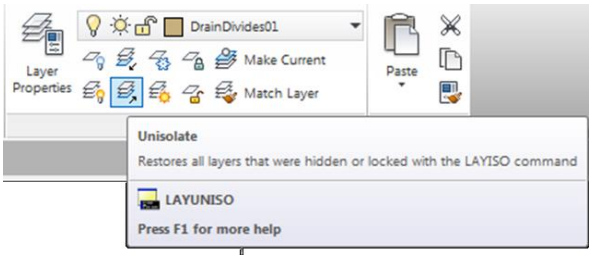


9. Click **Close** to close the Boundary - Boundary Definition Error dialog box. Continue creating Boundaries. We will correct this error later.



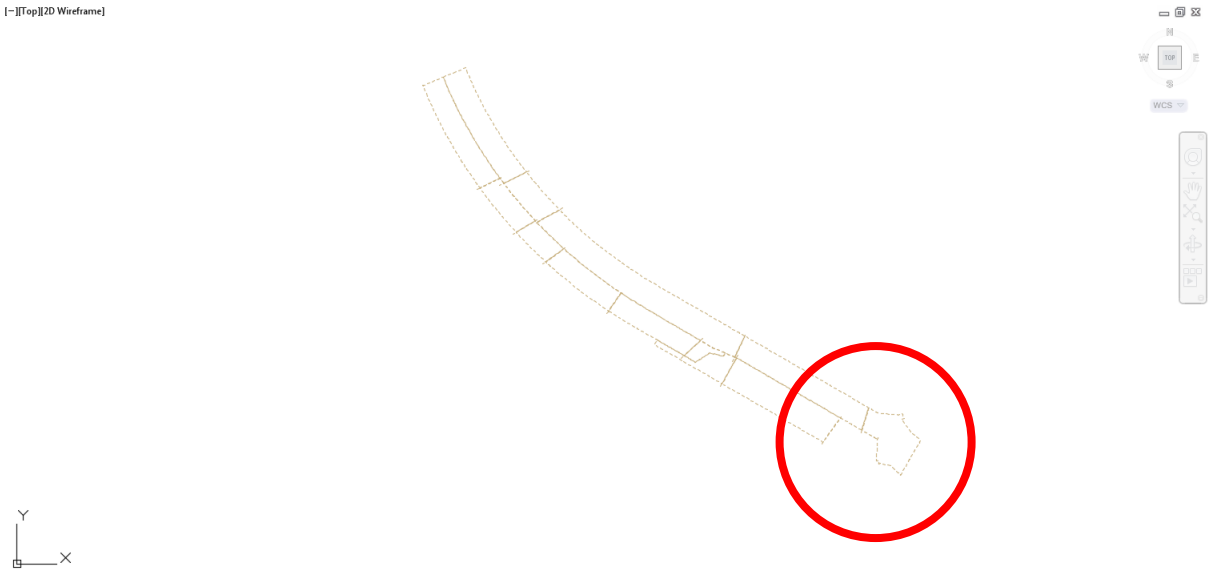


10. Press **ENTER** after clicking in the last **enclosed area**.



11. From the *Home tab of the Ribbon > Layer Properties panel*, select the **Unisolate** command.

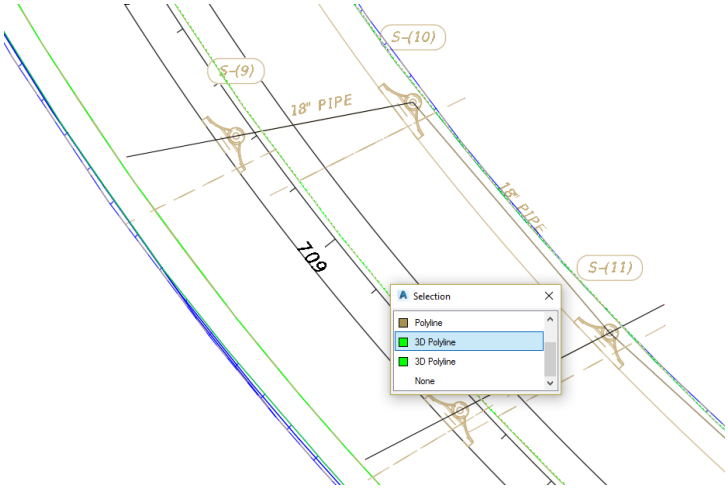
12. Isolate **DrainDivide01** *layer* so it is the only visible collection on the screen. Refer to steps above if you need a refresher. Your drawing should look like image below.



➢ *Try the Boundary Command Again for Errors*

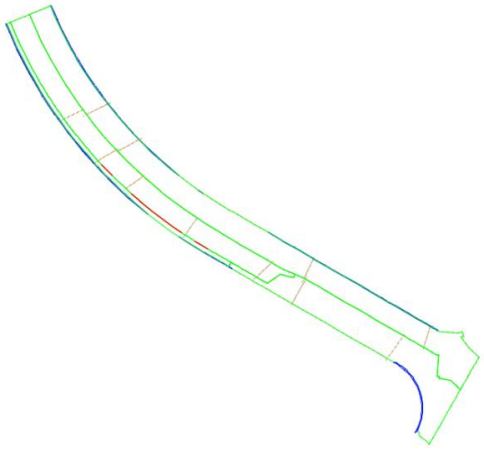
The objects on other visible layers are now off leaving only the 2D Polylines on layer DrainDivide01 visible. The area inside the red circle was where we received the error message when attempting to create a Boundary. Because we now have the surrounding boundaries created which may provide closed geometry, let's try the Boundary command again.

1. **Unisolate** the Drainage Layers.
2. **Isolate** *DrainDivide01* and *0* Layers to display geometry for remaining *Catchment Area*. For object select a line on the **drainagedivide01** *Layer*.

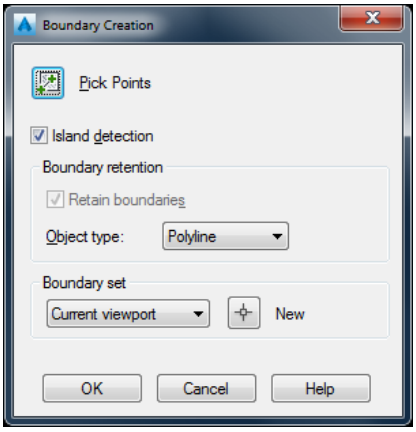


3. Select a green **3D Polylines** on the **0** layer.

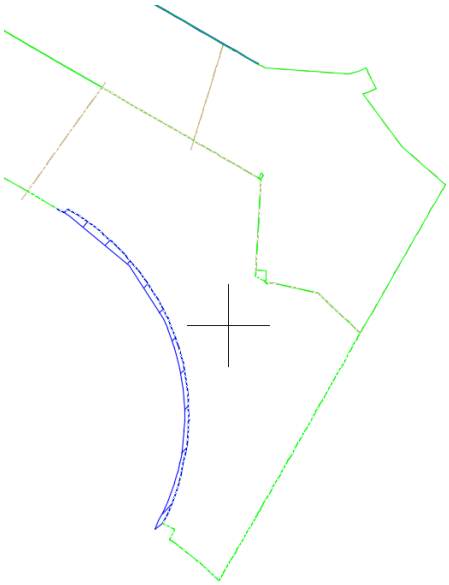
4. Press **ENTER** to complete the command. Your drawing should look like image below.

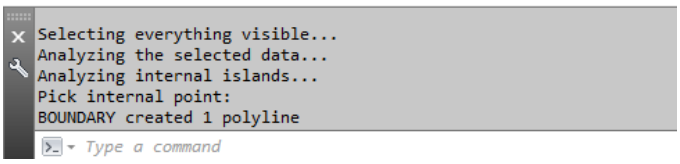


5. On the *command line* Type **BOUNDARY**. Press **ENTER**.

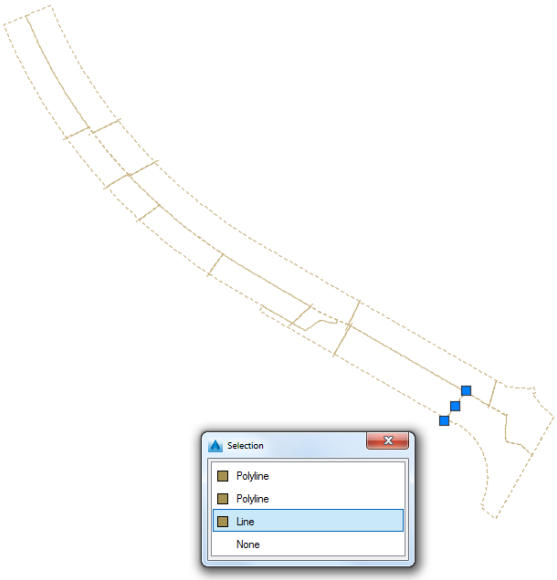


6. From the Boundary Creation dialog box, click the **Pick Points** button.

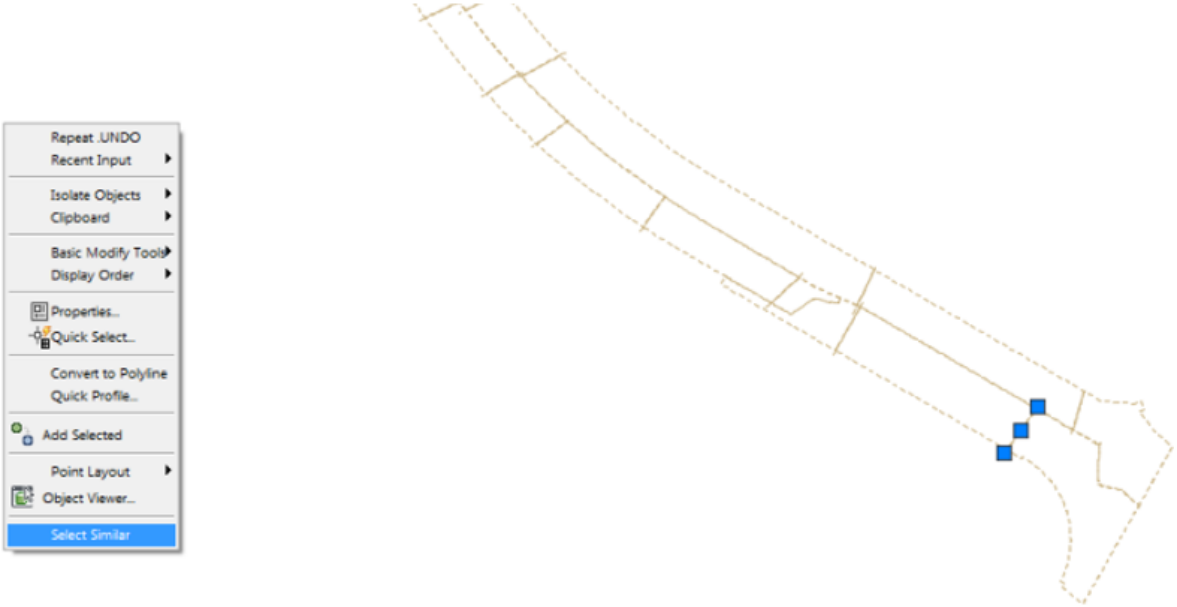




7. The *command line history* logs each selection made.
8. On the *Home tab of the Ribbon > Layers panel*, select the **Un-isolate** command. You can isolate just the DrainDivides01 Layer to verify the boundary is now created.

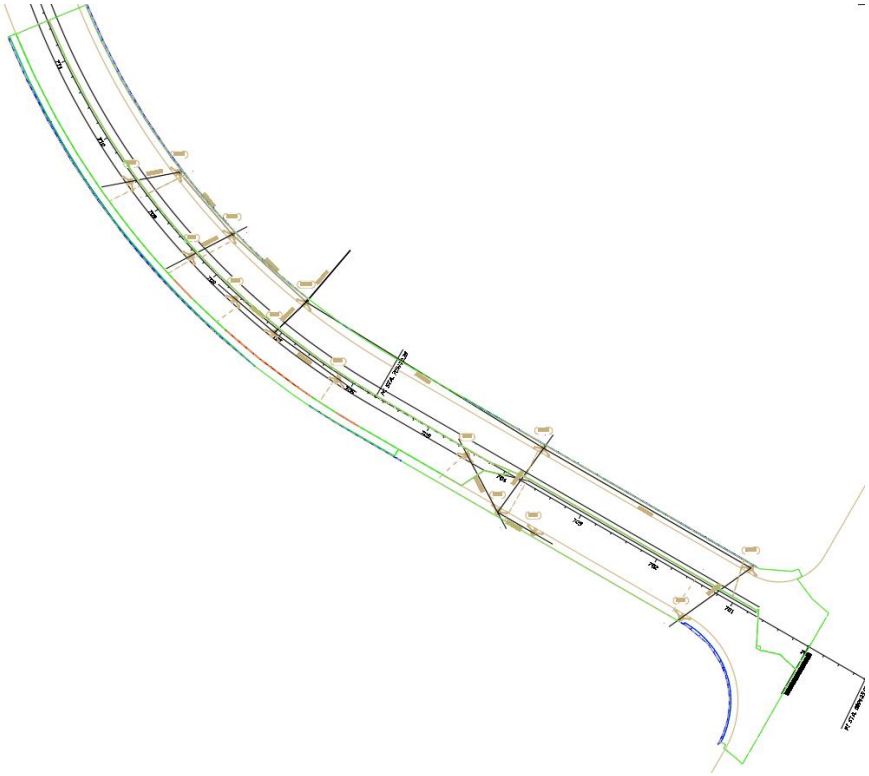


9. Erase the Lines drawn in the previous chapter that helped divide the Catchment Areas. As displayed in the image above, select one of the **lines**. With *selection cycling* On, a Selection dialog displays. Select **Line**.



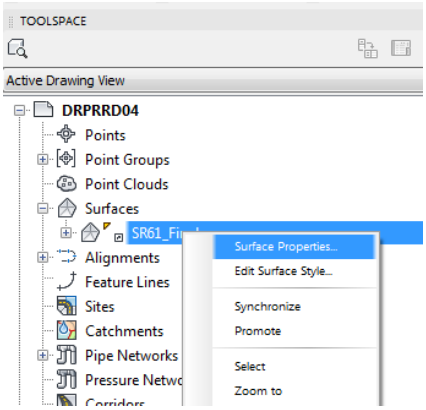
10. Right click to display the Shortcut Menu and choose **Select Similar** to select the other Lines.

11. With all of the Lines highlighted with grips, Press **Delete**.
12. Run the **Unisolate** command again to turn **ON** all of the Layers.

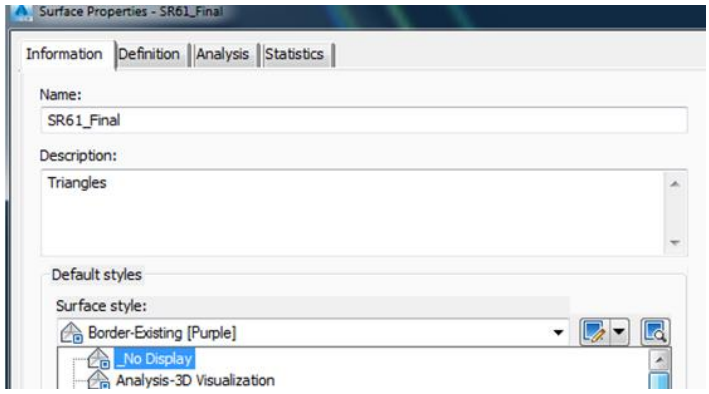


➢ *Verify the Surface Style Set to _No Display*

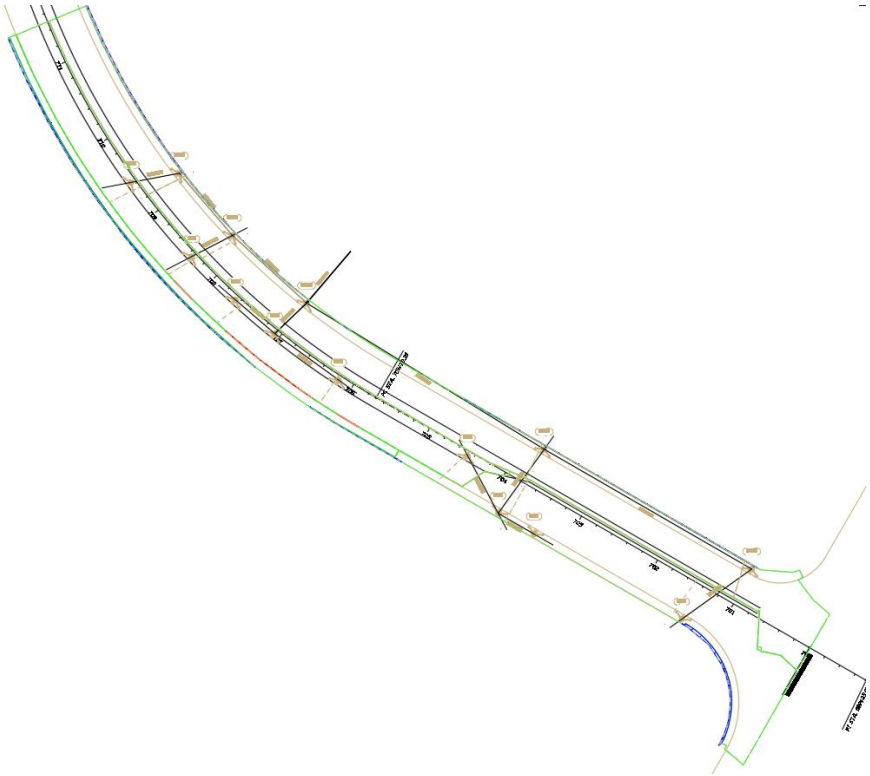
Prepare the display for selecting polylines and inlets by verifying the surface style is set to _No Display.



1. On the *TOOLSPACE > Prospector tab* expand **Surfaces, r**ight click on **SR61_Final** and select **Surface Properties**.



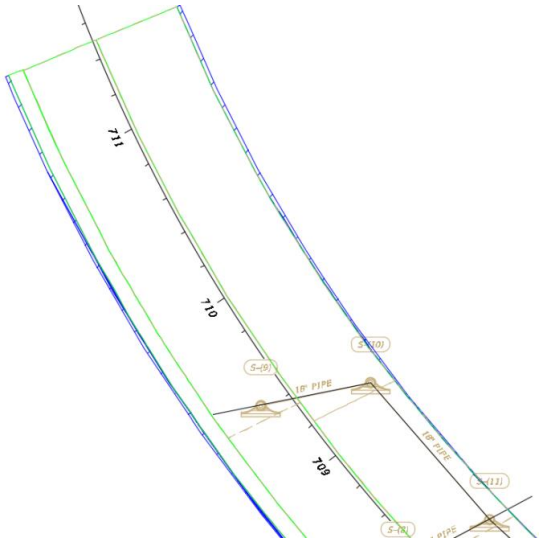
2. From the Surface Properties – SR61dialog box, select the **Information** tab. Make sure the *Surface Style* is set to **_No Display.** Click **Apply** then **OK** to close the dialog box.



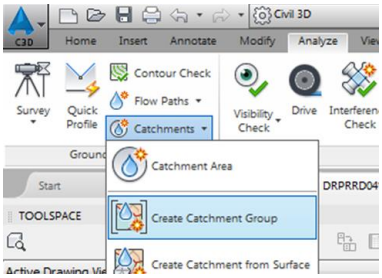
3. By setting the *Surface Style* to **_No Display** the *Watershed Boundaries* will not get in the way of our selecting the polylines on the DrainDivide01 layer.

Exercise 16.2 Create Catchment Groups and Individual Catchments

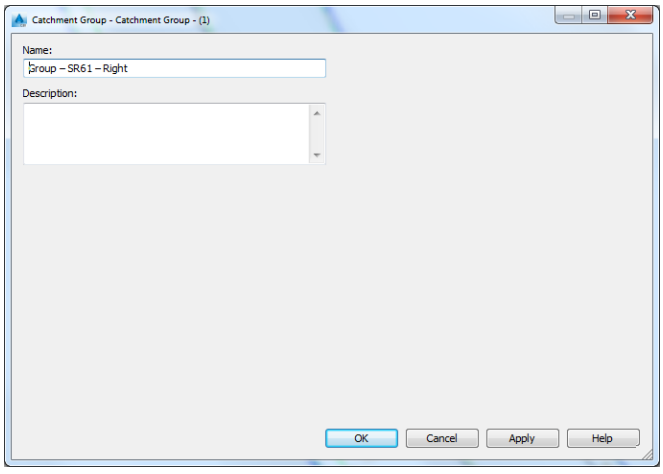
Now you will Create Catchment Groups and populate them with the individual Catchments.



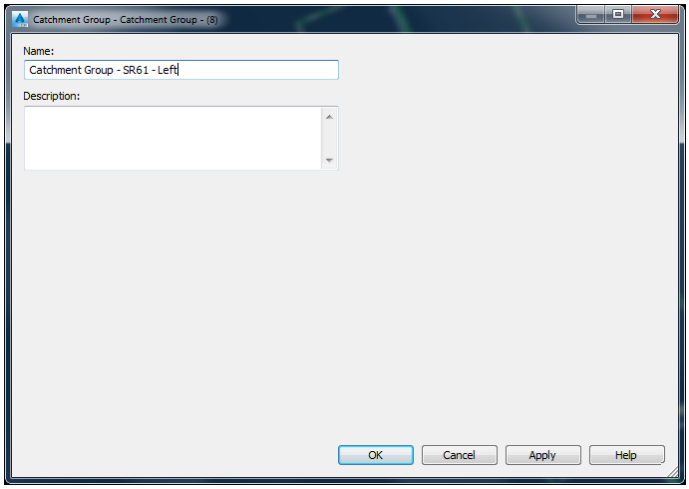
1. **Zoom** to the Northern end of our *area of interest* and begin creating *Catchment Areas*.



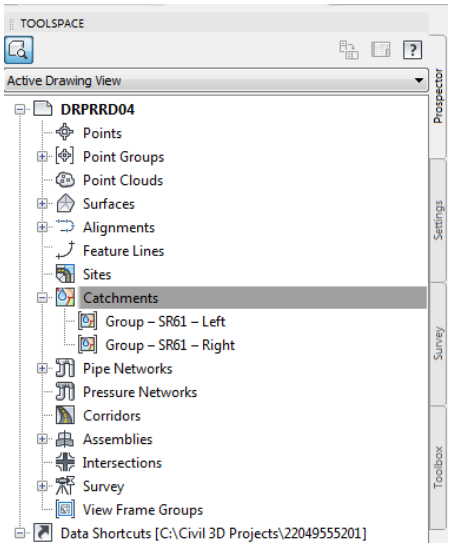
2. From the *Analyze tab on the ribbon > Catchments pull down list*, select **Create Catchment Group**.



3. From the Catchment Group dialog box, Type **Catchment Group – SR61 – Right** in the *Name* field. Click **Apply** then **OK** to close the dialog box.



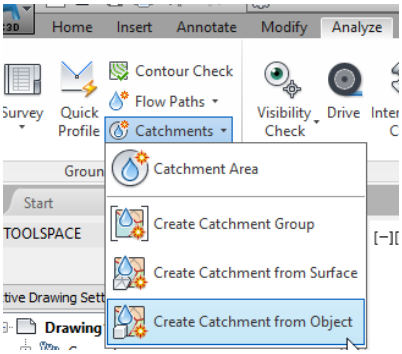
4. Repeat the command to create **Catchment Group – SR61 – Left.**



5. Review the newly created *Catchments*.

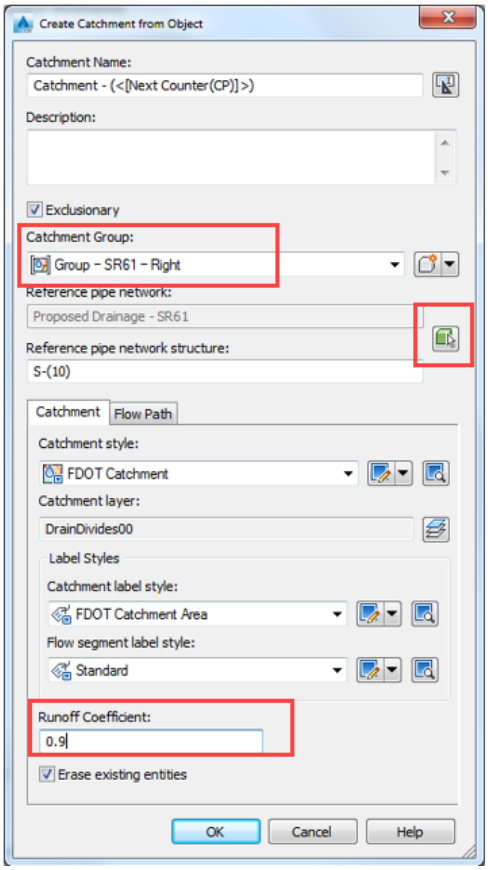
➢ *Create Catchments for Each Structure*

Now you will create catchments for each Structure within the appropriate Catchment Group.

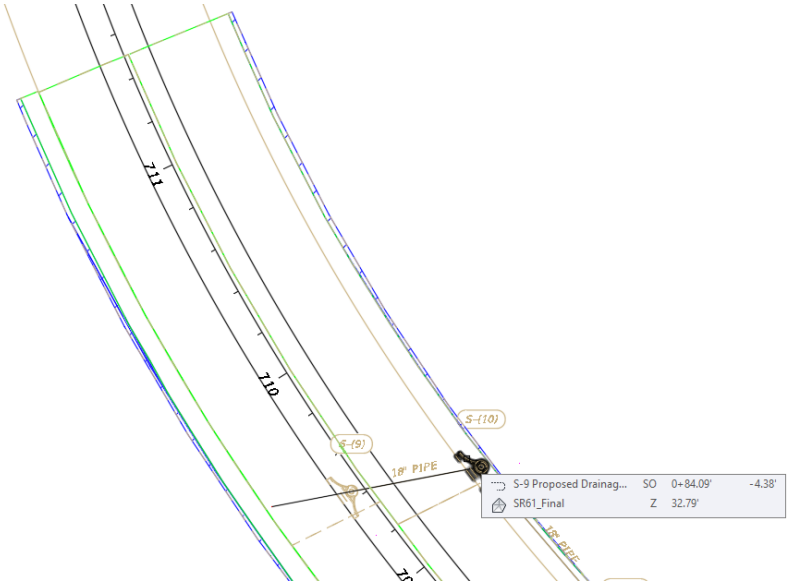


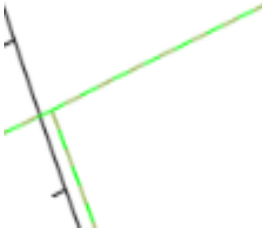
1. From the *Analyze tab on the Ribbon* > *Catchments drop down list*, select **Create Catchment from Object.**

2. On the *command line* you are prompted to: *Select polyline for catchment area boundary*. With the *selection cycling* On, select the **Polyline Boundary** enclosing S-(10). Press **ESC** to skip selecting the Flow Path Polyline.



3. The Create Catchment from Object dialog box displays. Make the following changes:
   a. Set the *Catchment Group* to **Catchment Group – SR61 – Right**
   b. Change the *Runoff Coefficient* to **0.90**
4. Click the **Select Reference Structure** button next to the *Reference pipe network structure:* option. The *command line* prompts you to: *Select Pipe Network Structure.* Select **Structure S-(10).**
5. Click **OK** to close the dialog.





6. Notice the **Area Label** is centered in the *Catchment Area*.
7. On the *command line* you are still in the **Create Catchment** command. Repeat steps above for the following structures:

S-(11) S-(12) S-(13) S-(16)

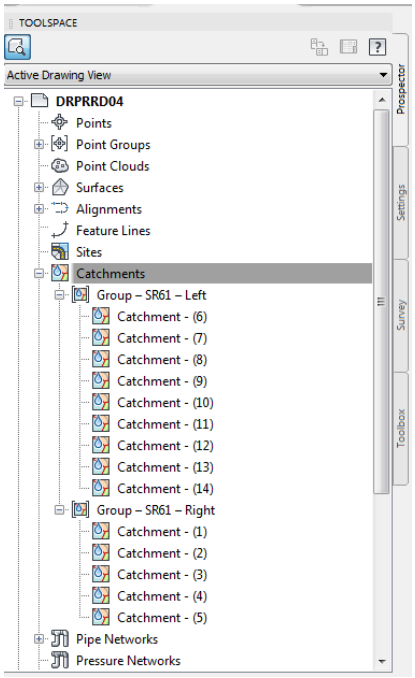
8. Change the *Catchment Group* to **Group–SR 61–Left** and repeat steps above for the following structures:

S-(1) S-(2) S-(3) S-(4) S-(5)

S-(6) S-(7) S-(8) S-(9)

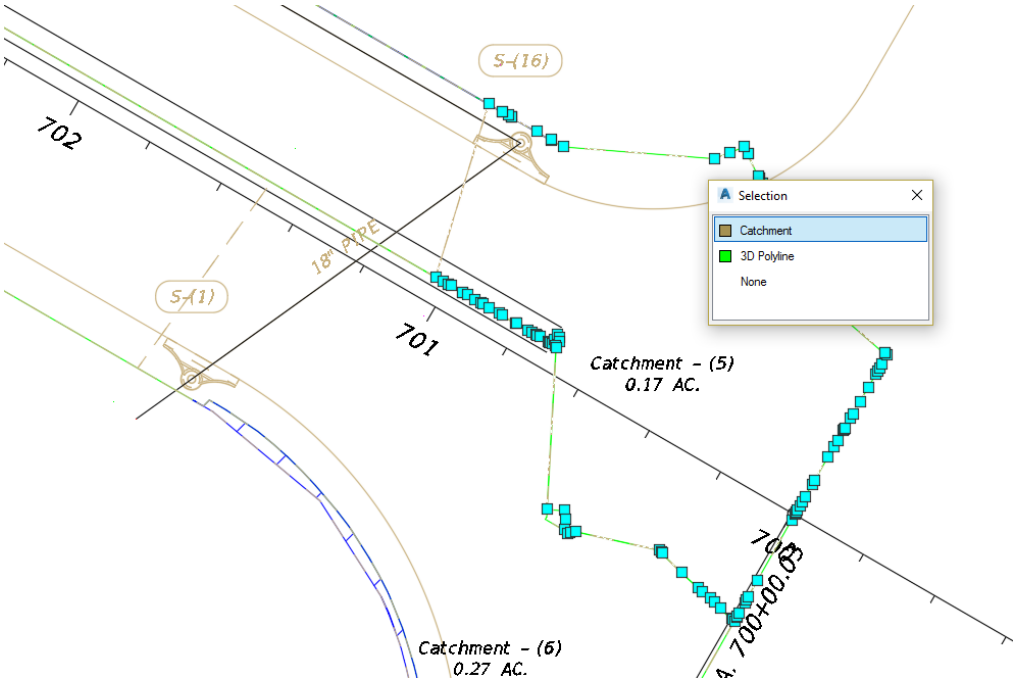
➢ *Review Catchments*

Expand the Catchments collection in the Prospector to view the Catchment Groups and individual Catchment Areas. The name of the Catchments will renamed in the next exercise.

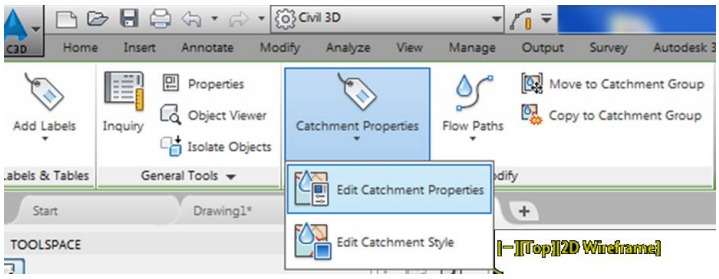


Exercise 16.3 Rename Catchments

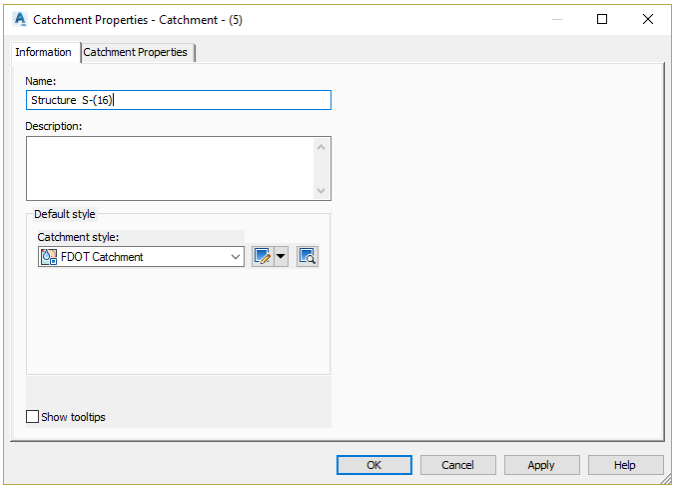
Rename the Catchments to match the corresponding structure numbers.



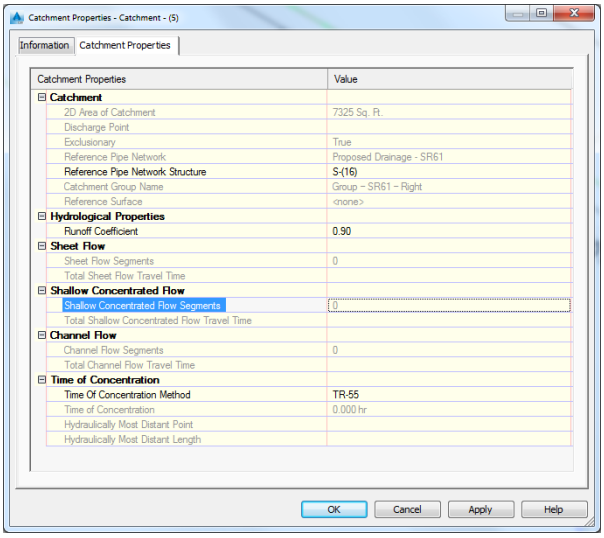
1. Select the **Catchment Boundary** to activate the *Blue Grips* for **structure S-(16)** as shown above. From the Selection dialog select **Catchment**.



2. From the *Context Sensitive Menu > Catchment Properties drop down list*, select **Edit Catchment Properties**.



3. From the Catchment Properties dialog box, select the **Information** tab. The tab displays the *Name* of the Catchment and the *Catchment Style* used. Change *Name:* to **Structure S-(16).**



4. From the Catchment Properties dialog box, select the **Catchment Properties** tab.

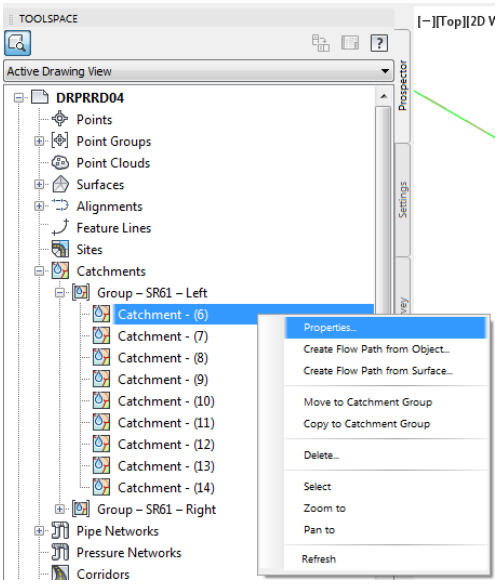
   a. Notice the name of the *Reference Pipe Network Structure* is **S-(16).**

Note The Reference Pipe Network Structure should always be the name of the catchment. If you try to use a duplicate name you will get an error message. All Catchments must have unique names. Using the Structure name in the Catchment name will avoid this conflict.

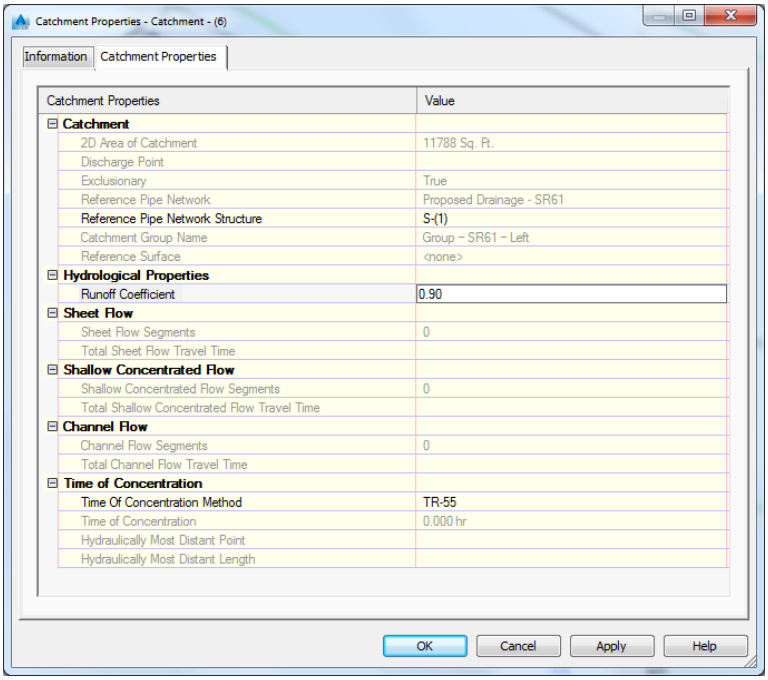
   b. Verify that *Runoff Coefficient* is set to **0.90**.

5. Click **Apply**, then **Ok** to close the dialog box.

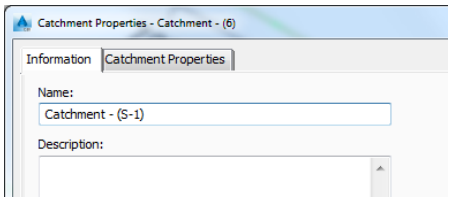
➢ *Edit Name Using a Different (Quicker) Method*



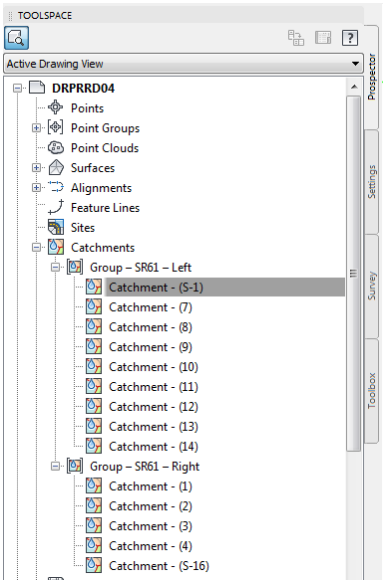
1. Working from the *TOOLSPACE > Prospector tab*, expand **Catchments**, expand **Catchment Group - SR61 –Left**, right-click on **Catchment - (6),** then select **Properties.**



2. From the Catchment Properties dialog box, select the **Catchment Properties** tab.
   a. Review the *Reference Pipe Network Structure*.
   b. Verify the *Runoff Coefficient* is set to **0.90**.

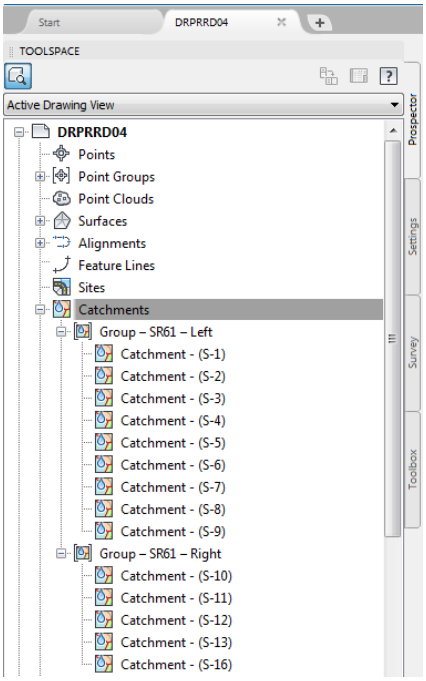


3. From the Catchment Properties dialog box, select the **Information** tab. Change *Name:* to **Catchment – (S-1).** Click **Apply** then **OK** to close dialog box.

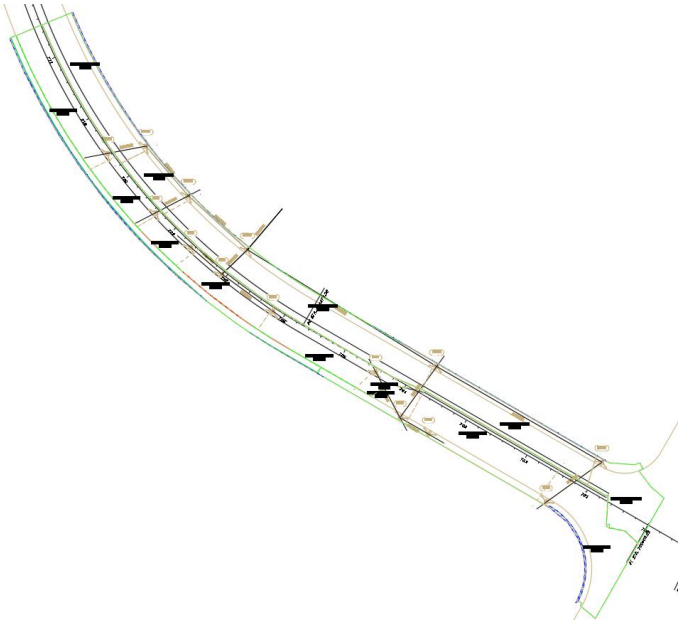


4. Using the method above, **Re-Name** all of the *Catchments* to the appropriate structure number. Use the Re-Naming table below for reference:

Catchment Group	Structure	Catchment Original Names	Final Catchment Names
Left	S-1	Catchment - (6)	Catchment - (S-1)
Left	S-2	Catchment - (7)	Catchment - (S-2)
Left	S-3	Catchment - (8)	Catchment - (S-3)
Left	S-4	Catchment - (9)	Catchment - (S-4)
Left	S-5	Catchment - (10)	Catchment - (S-5)
Left	S-6	Catchment - (11)	Catchment - (S-6)
Left	S-7	Catchment - (12)	Catchment - (S-7)
Left	S-8	Catchment - (13)	Catchment - (S-8)
Left	S-9	Catchment - (14)	Catchment - (S-9)
Right	S-10	Catchment - (1)	Catchment - (S-10)
Right	S-11	Catchment - (2)	Catchment - (S-11)
Right	S-12	Catchment - (3)	Catchment - (S-12)
Right	S-13	Catchment - (4)	Catchment - (S-13)
Right	S-16	Catchment - (5)	Catchment - (S-16)



5. Review the end resulting list of *Catchments* which should display as above.



6. Notice when the task is complete *Area Labels* display in each *Catchment*. *Catchment Names* match the *Inlet Structure Name* so there is no need to label the names of the *Catchment Areas*.
7. **Save** and **Close** *DRPRRD04.dwg* file.