



FDOTConnect for OpenRoads Designer



Drainage Design & 3-D Modeling **COURSE GUIDE**

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State of Florida

Department of Transportation

FDOTConnect

for

**OpenRoads Designer
Drainage Design & 3D
Modeling with Plans
Development**

Course Guide

2024

PRODUCTION SUPPORT / CADD OFFICE

TALLAHASSEE, FLORIDA

<http://www.fdot.gov/cadd>

FDOTConnect for ***OpenRoads Designer***

Drainage Design & 3D Modeling Workflow

Description

This course was developed to introduce The Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition tools for drainage design and modeling on Florida Department of Transportation (FDOT) projects. The curriculum was developed within the FDOTConnect Workspace to provide sample exercises for many of the Drainage Tools on a sample project data set. Participants of this course will be introduced to the newest OpenRoads environment and a Workflow for designing two dimensional (2D) Plans, Profiles, and three dimensional (3D) Models for drainage related Construction Deliverables.

Objectives

- Finding additional learning resources and training materials for OpenRoads Designer CONNECT Edition and the general process using Drainage and Utilities Workflow to design storm drain systems
- Various file types used within The Drainage and Utilities Workflow
- How to create and prepare a drainage file for design
- Navigating the interface for basic drainage tools and FDOT drainage components
- Delivered features and components within the FDOTConnect Drainage DGN library
- Laying out a simple network of inlets, pipes, and an outfall
- Tools to evaluate and edit drainage properties
- Creating a custom drainage feature
- Creating and assigning catchments to inlets
- Tools to define drainage design priorities and constraints
- Tools to review and evaluate hydraulic performance
- Producing a NexGen drainage structures sheet
- Producing a NexGen Summary of Drainage report (drainage quantities)
- Editing and exporting flex tables for drainage documentation

Audience

FDOT Drainage Designers and Engineers

Prerequisites

Participants need to have a basic understanding of Computer Aided Drafting and Design (CADD) using MicroStation, a basic understanding of OpenRoads Designer CONNECT Edition - OpenRoads Technology tools and a solid understanding of the engineering necessary to design drainage improvements on a Roadway.

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FDOT CONNECT WORKSPACE OVERVIEW

This course was developed to introduce The Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition tools for drainage design and modeling on Florida Department of Transportation (FDOT) projects. The curriculum was developed within the FDOTConnect Workspace to provide sample exercises for many of the Drainage Tools on a sample project data set.

INTRODUCTION

OpenRoads Designer CONNECT Edition -Drainage and Utilities Workflow is a comprehensive application for designing and analyzing storm drain systems, which can leverage many roadway design features to create a seamless information exchange to the drainage design process. A Drainage model may contain multiple drainage network and scenarios; each comprised of any number of topologically connected drainage areas, inlets, pipes and ditches. The Drainage and Utilities workflow closely mirrors conventional design processes allowing for the design of the surface collection system (i.e. drainage areas, inlets) and then the design of the subsequent conveyance system (i.e. pipes, ditches).

OpenRoads Drainage & Utilities is extremely flexible, in that the hydraulics designer can create and manipulate elements of the system, while simultaneously seeing the effects. Interactive dialogs and design visualization make the process easy to learn and efficiently produce results. Manipulations and redesign are accomplished quickly and easily, whether it's moving a single inlet or developing an entire network. At any time during the process, customized flex table reports can be generated to provide hard copy outputs.

Roadway alignments and digital terrain models created as part of the design process may be used throughout Drainage & Utilities to provide pertinent information to the drainage design. All drainage components feature interactive graphical placement tools for easy spatial definition of the drainage system. Visualization tools in OpenRoads Drainage & Utilities for networks, drainage components, and computations allow for immediate evaluation of the drainage system.

OpenRoads Drainage & Utilities hydrologic and hydraulic capabilities include runoff computations, inlet design and analysis, and pipe and ditch design and analysis. All computations follow recommended methodologies in the Federal Highway Administration (FHWA) publication "Drainage of Highway Pavements" as well as the procedures in the American Association of State Highway and Transportation Officials (AASHTO) Model Drainage Manual.

Runoff computations are performed using either the Rational or SCS method (not set up in FDOT Connect) where rainfall parameters may be specified with common intensity equations, hydrographs, or by tabular intensity-duration data. Drainage area delineation tools allow easy creation of contributing areas and the graphical assignment of these to drainage features.

Inlet design and analysis capabilities include Curb, Slotted Drain, and Grate inlets both on grade and in a sump. The Department's common inlets are included in the Department's DGNLib discussed later in this manual. Inlets may also be designed or analyzed with gutter bypass flows from one inlet to another, including gutter bypass flows between inlets of different networks.

Most standard pipe configurations may be designed and analyzed including box, circular, elliptical and pipe arches. The Department's most common pipe and box culvert shapes and materials are included in the DGNLib, discussed later in this manual. Pipe design selections may be optimized to meet a number of definable constraints. Trapezoidal ditches may also be designed or analyzed anywhere within a storm drain network. The pipe and ditch hydraulics include backwater curve computations and junction loss options.

Participants of this course will be introduced to the newest OpenRoads environment and a Workflow for designing two dimensional (2D) Plans, Profiles, and three dimensional (3D) Models for drainage related Construction Deliverables. At successful completion they will have learned about:

- Finding additional learning resources and training materials for OpenRoads Designer CONNECT Edition and the general process using Drainage and Utilities Workflow to design storm drain systems
- Various file types used within The Drainage and Utilities Workflow
- How to create and prepare a drainage file for design
- Navigating the interface for basic drainage tools and FDOT drainage components
- Delivered features and components within the FDOTConnect Drainage DGN library
- Laying out a simple network of inlets, pipes, and an outfall
- Tools to evaluate and edit drainage properties
- Creating a custom drainage feature
- Creating and assigning catchments to inlets
- Tools to define drainage design priorities and constraints
- Tools to review and evaluate hydraulic performance
- Producing a NexGen drainage structures sheet
- Producing a NexGen Summary of Drainage report (drainage quantities)
- Editing and exporting flex tables for drainage documentation

This training guide was developed with FDOTConnect10.12. Any reference to FDOTConnect within this document should indicate either FDOTConnect10.12 or the currently supported FDOTConnect version.

EXPECTATIONS - WHAT THIS COURSE PROVIDES

This course serves three primary functions. It is a training manual for instructor lead training, a user's manual for designers and technicians, and a technical reference.

The Florida Department of Transportation (FDOT) standards for drainage design are provided in the Drainage Manual. Guidelines for drainage design are provided in the Drainage Design Guide. The FDOT Design Manual and CADD Manual provide the standards for preparing the construction plan sets. Suggestions or preferred approaches for how to best use The Drainage and Utilities Workflow tools to comply with the Department's CADD standards and guidelines are included in this document, where appropriate. Although this course references key tools in the drainage design and plans preparation process for FDOT projects, it does not replace the need for professional engineering judgement or prelude the use of other information.

This course provides a standard workflow for drainage design with Bentley Systems OpenRoads Designer CONNECT Edition –Drainage and Utilities Workflow within the FDOTConnect Workspace. While many tools are used throughout, this course does not provide a description of every Bentley Systems OpenRoads Designer CONNECT Edition Drainage and Utilities tool. Where applicable, this guide documents supplemental descriptions of FDOT-specific content, tools, and methodology.

DOCUMENT STYLE

Style conventions used throughout the course guide are shown in the following table.

Item	Convention	Example
Menu names and commands	Bold (Names separated with > symbol)	<ul style="list-style-type: none">• General form is Workflow (when applicable) > Tab > Group > Tool• File > Open• File > Settings > User > Preferences• OpenBridge Modeler (Workflow) > FDOT > Actions > Create File
Window actions	Bold	<ul style="list-style-type: none">• Click the Apply button.• Click the Graphic Select button to the right of the Horizontal Alignment Include box.• In the Segment Type list, click Lines.
Window field names	<i>Italic</i>	<ul style="list-style-type: none">• Key in Hemfield Road in the Alignment Name field.• Click the Graphic Select button to the right of the Horizontal Alignment Include field.• In the Segment Type list, click Lines.
Key-ins	Bold	<ul style="list-style-type: none">• Key in Hemfield Road in the Alignment Name field.
File names	<i>Italic</i>	<ul style="list-style-type: none">• <i>Open the file Working Graphics.dgn in the C:\Bentley Training\GEOPAK 101\Project Setup\Practice\ folder.</i>
File paths	<u>Underline</u>	<ul style="list-style-type: none">• Open the file Working Graphics.dgn in the <u>C:\Bentley Training\GEOPAK 101\Project Setup\Practice\ folder.</u>
New terms or emphasis	<i>Italic</i> or Bold	<ul style="list-style-type: none">• The Template Library contains templates, which represent typical sections of the proposed roadway.• The user is not to utilize this tool.

FILE TYPES

The Bentley Systems OpenRoads drainage design process now uses a single source file type, the MicroStation Design *DGN* file. All pertinent design data is stored in the design file. This information can be viewed through the Project Explorer and reported on through flex tables and other report tools.

The FDOT Connect Workspace is delivered with supporting library files containing the Department's CADD standards and hydraulic seed data: the DGN Library (*.dgnlib), and the MicroStation Cell Library (*.cel). Below are brief descriptions of these file types.

File Type Description:

MicroStation Design File (*.dgn) - This file is utilized for the visualization of the drainage project and definition of certain drainage features using MicroStation graphic elements. When the designer initiates the Drainage & Utilities tools, the DGN Library hydraulic seed data will be referenced by the design file. Subsequently, as drainage components are placed, the DGN model automatically populates hydraulic properties from the DGN Library and drainage structure geometry from the Cell Library into the design file. All the design data is stored within the design dgn file and database attributes are attached to the 2D graphics. As the designer places components in the 2D model, Drainage & Utilities creates the 3D model elements in the dgn simultaneously.

DGN Library (*.dgnlib) - The feature definitions, symbology, and hydraulic seed data for drainage design and modeling are stored in DGN libraries. The DGN Library is utilized for numerous projects, as it contains the standards for an entire organization. The DGN Library contains the storm data, hydraulic settings, standard inlet types, standard pipes configurations, spread sections, and land cover tables. These items are used by each project to accommodate standardization and information sharing among projects. The Department provides a DGN Library with the CADD deliverables.

Drainage Cell Library (*.cel) - Drainage cells are the 2D and 3D views of the Department's drainage structures such as inlets and manholes. The Cell Library contains the commonly used structures. The Nodes used in the DGN Library refer to appropriate cells in the Cell Library. The Department provides a Cell Library with the CADD deliverables.

Currently, there is not a tool to import legacy Select Series GEOPAK Drainage files directly into an OpenRoads drainage model, DGN file from Bentley and FDOT is not developing a utility.

LEARNING RESOURCES

For optimized use of this manual, it is recommended that new OpenRoads users engage with the Bentley LEARNserver and Online Help as needed to become familiar with the OpenRoads environment and tools.

There are several resources available for learning about the various Bentley Systems OpenRoads Designer CONNECT edition Drainage and Utilities tools. Among them are:

- Bentley Learn:

Bentley Institute site is for registered user and may require a Select Server site license to participate:
<https://learn.bentley.com>

Bentley Product Line: OpenRoads Designer:

09 – OpenRoads Designer – Drainage & Utilities – Fundamentals

10 – OpenRoads Designer – Drainage – Intermediate

- Bentley Product Documentation: Drainage and Utilities CONNECT Edition Help:

<https://docs.bentley.com/LiveContent/web/Drainage%20and%20Utilities%20CONNECT%20Edition%20Help-v3/en/GUID-288FAFD8-1107-4FCB-9843-8BECC9099A06.html>

- Bentley Communities:

https://communities.bentley.com/products/road_site_design/w/road_and_site_design_wiki/38322/drain_age-and-utilities

- YouTube Search - Google:

Bentley OpenRoads Drainage returns several sites with videos for learning how to apply the technology on project specific situations.

- Production Support Office | CADD (CADD) Website: <http://www.fdot.gov/cadd/>

Webinar training recordings are available on many of the subjects covered in this manual:

<https://www.fdot.gov/cadd/main/webinars/fdotcaddwebinars>

COURSE SUPPORTING FILES

The exercises for each chapter are independent of one another and can be used without having to complete the exercises in previous modules. The exercise files are organized into separate completed Selected zip files for each chapter. All files used in this course are located also at this link:

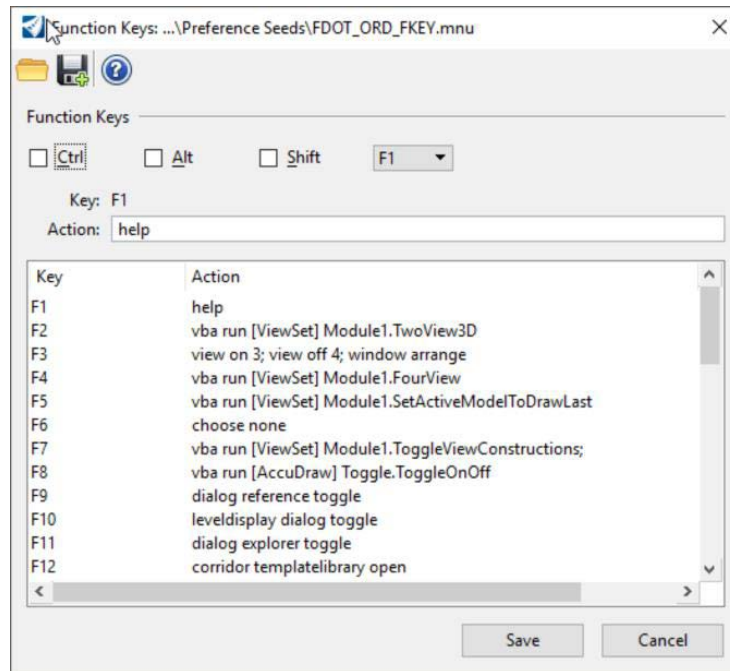
<https://www.fdot.gov/cadd/main/fdotcaddtraining.shtm>

INTRODUCING A NEW WORKSPACE

The following are some of the FDOTConnect workspace settings that will be used during this course. Additional information can be found within the FDOTConnect for OpenRoads Designer 2D Design & 3D Modeling with Plans Development Training Guide

FDOTConnect FUNCTION KEYS

FDOTConnect Function Key Assignments	
F1	Opens the OpenRoads Designer On-line Help. Ctrl+F1 Closes all Views except View 1
F2	Open View 1 (2D Plan) and View 2 (3D Isometric) and fits both views.
F3	Opens View 3 (2D Plan), closes all View 4, and arranges all Views.
F4	Open View 1 (2D Plan) , View 2 (3D Isometric), View 1 (2D Plan), View 1 (2D Plan) & Fits All views
F5	Toggles Dim References ON/OFF
F6	Resets out of any ongoing commands.
F7	Toggles the Construction view attribute ON/OFF.
F8	Toggles between MicroStation AccuDraw and Civil AccuDraw.
F9	Toggles (opens or closes) the Reference dialog.
F10	Toggles (opens or closes) the Level Display dialog.
F11	Toggles (opens or closes) the Project Explorer dialog.
F12	Opens the Create Template dialog.



FDOTConnect DRAINAGE DESIGN AND 3D MODELING OVERVIEW

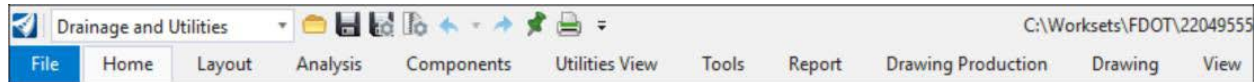
GENERAL WORKFLOW

The design of a storm drain system is usually an iterative process. Inlets locations and pipe sizes are selected. The designer checks if the system meets the Department's criteria and changes pipe sizes and other items as needed. The need to check if the system meets criteria is not avoided by using OpenRoads Drainage & Utilities. This document describes several ways that designers can use Drainage & Utilities to check and identify where the system needs to be changed. The following is a general outline for creating storm drain systems in Drainage & Utilities, detailed in other chapters.

1. Start New Project file (.dgn) by using the FDOT Create file tool.
2. Select Inlet Locations and Types from Feature Definitions.
3. Define Area to each Node.
4. Link Inlets Together with Pipe (Conduit) Segments.
5. Identify Hydraulic Run of Pipes and Inlets.
6. Use Drainage & Utilities to Design System.
7. Check Design to meet Criteria.
8. Edit System, Re-compute Hydraulics and Check if Criteria are met.
9. Add J-structure Bottoms (if appropriate) for Large or Skewed Pipes
10. Print Storm Drain Tabulation Form.
11. Prepare Construction Deliverables.

NAVIGATING THE DRAINAGE AND UTILITIES WORKFLOW RIBBON

When the Drainage and Utilities workflow is activated, there are ten tabs that populate the ribbon. The tabs are organized to help you find the tools you need to complete a task. Upcoming chapters will further describe these tabs and included tools that are commonly used for FDOT drainage design.



The Home tab has six groups. One of the most useful tools for managing the drainage model is Explorer, located in the Primary Group. The Project Explorer is docked on the left side or use the F11 function key to toggle ON/OFF the dialog.



NAVIGATING PROJECT EXPLORER FOR DRAINAGE

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

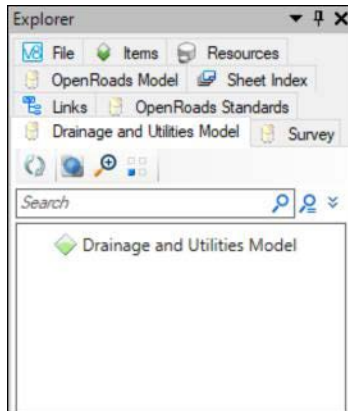
“The Explorer dialog allows you to manage and control project content. It is a single interface that provides browsing function for files, links, items, resources, and sheet indexes.

- *File - used to browse and manage the file content such as models, references, saved views, levels, styles, templates, and so on.*
- *Items - displays non-graphical business data in a DGN file in hierarchical order.*
- *Resources - displays resources used in a DGN file in hierarchical order.*
- *OpenRoads Model – displays content in categories such as alignments, terrain models, etc.*
- *Sheet Index - allows you to manage sheet indexing. A sheet index is an organizes and named collection of sheet models from one or more design files.*
- *Links tab - used to create or view the linked data.*
- *OpenRoads Standards - used to create, edit or review horizontal and vertical geometry design standards, feature information, civil cells, annotation, and graphical filters.”*

The Drainage and Utilities section of Project Explorer is used to manage conduits, drainage areas, nodes and profile runs in the model.

NOTE *It is a recommended practice to check the Explorer when first opening a drainage DGN file to understand the contents of the file.*

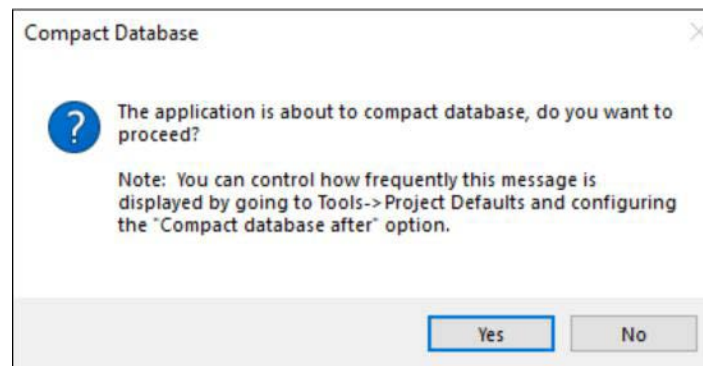
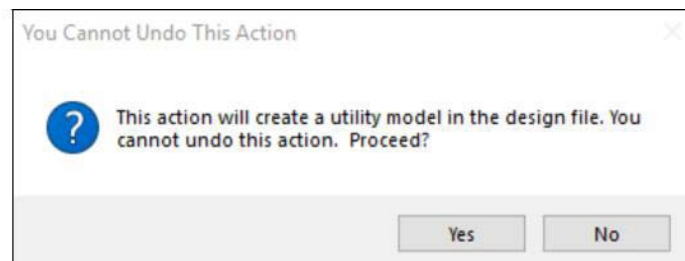
A DGN file without an active or referenced drainage model will appear blank:



However, once a utility model is created, the Drainage and Utilities section of Project Explorer is organized into collapsible lists of elements: nodes, conduits, drainage areas, and profile runs.

CREATE A NEW UTILITY MODEL

1. In the *DRPRRD01.dgn*, click on **Drainage and Utilities > Layout > Layout > Place Node**.
2. Since this file does not yet contain a utility model, the Place Node tool will not activate. However, the following message will pop up, asking if you wish to proceed creating a utility model. Click **Yes** to this prompt and the next.



3. Now, this file is ready to place drainage features in the DGN and/or reference drainage models from other DGNs.

1 DRAINAGE LIBRARY

INTRODUCTION

The main focus in this chapter will be on: Reviewing the Drainage Library.

This chapter will introduce several important components of the Drainage Library in FDOTConnect. They are:

- Feature Definitions
 - Symbology
 - Levels, cells, materials
 - Element templates
 - Feature Symbology
- Hydraulic Seed Data
 - Catalog
 - Prototypes
 - Storm Data

FEATURE DEFINITIONS

As defined in the Bentley Drainage and Utilities CONNECT Edition help files:

“Feature Definitions are used to control symbology and define properties of utility elements. There are three types of Feature Definition for support of utility workflow:

- *Node Feature Definitions – A variation on civil Point type. It defines information for Utility Nodes, such as catch basins, manholes, valves and etc.*
- *Conduit Feature Definitions – A variation on the civil Linear type. It defines information for Utility conduits of all types, including drainage pipes, pressure lines, cables and ducts.*
- *Polygon Feature Definitions – Used to denote area features such as catchments (drainage areas).”*

Feature Definitions developed for the most widely used standard FDOT drainage structures, gutters, and pipes have been included within the *FDOT_Drainage_And_Uilities.dgnlib* for the FDOTConnect Workspace to be used for most FDOT projects. They can be viewed in the **Project Explorer > OpenRoads Standards tab: Drainage and Utilities > Home > Primary > Explorer > OpenRoads Standards > Standards > Libraries > Feature Definitions**. An inventory of available FDOT features is included with the Technical References section of this manual. The Workflow to Create a New Feature Definition will be discussed later in this manual.

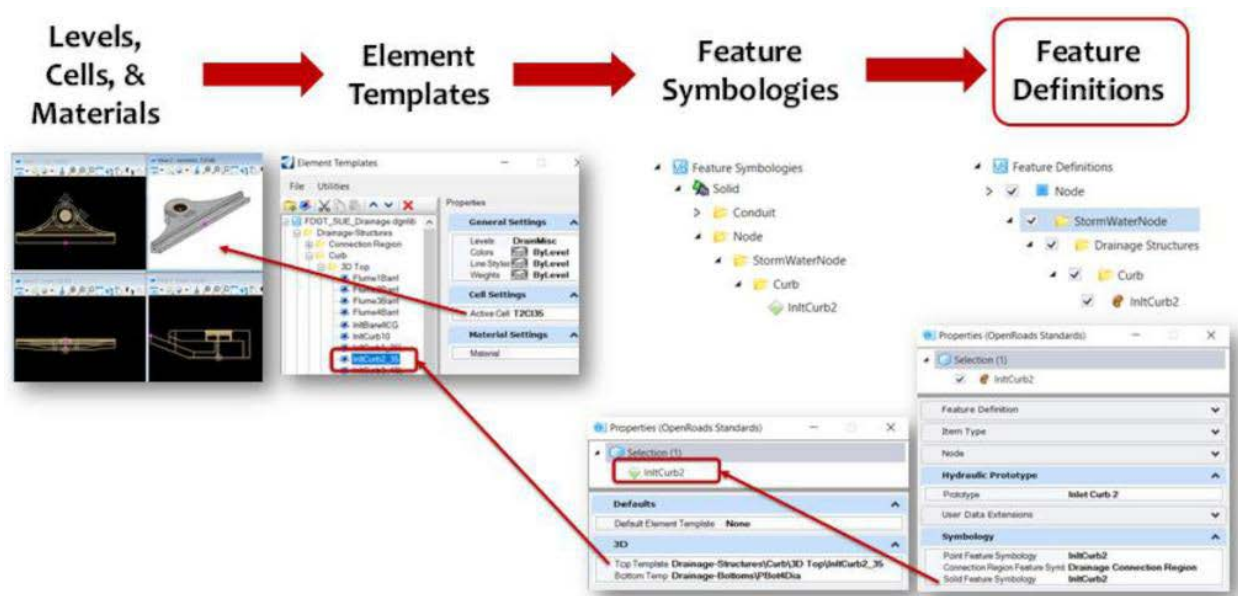
As discussed in the File Types section, all project design and modeling data is stored within the design DGN file. When users choose a drainage feature to place for the first time, the software loads the DGN Library and copies the feature definition and associated properties into the DGN file, both onto the individual drainage feature placed and the design file's OpenRoads Standards.

For purposes of this course guide, components of feature definitions will be separated into two categories: symbology and hydraulic seed data. In the FDOTConnect Workspace, both components are stored in the same DGN Library file: *FDOT_Drainage_And_Uilities.dgnlib*.

SYMBOLOLOGY

The 2D and 3D graphical presentations of drainage features in the design file are built from a series of elements defined in the DGN library. A description of this series of elements as defined in the Bentley Drainage and Utilities CONNECT Edition help files for utility nodes is below:

- “Feature definitions for all node types will link to a series of Feature Symbology’s.
- Feature symbologist will link to a series of MicroStation Element Templates for symbology and presentation.
- The plan space template will include a 2D cell of user’s design. This cell is placed in plan space for all plans production activities.
- The 3D presentation normally points to two templates. The first defines a 3D cell that models the physical nature of the top of the node. The second defines a 3D cell that models the physical nature of the bottom of the node. The two cells are joined by extruding a slice of the bottom cell upwards to meet the top cell. If the top cell is blank, then no extrusion is done and only the bottom cell is placed.
- The plan, top, and bottom cells will contain various attributed elements to define key points and regions necessary for the creation of the node 3D structure, alignment of the 3 cells, defining connection of conduits, and defining hydraulic key points.”



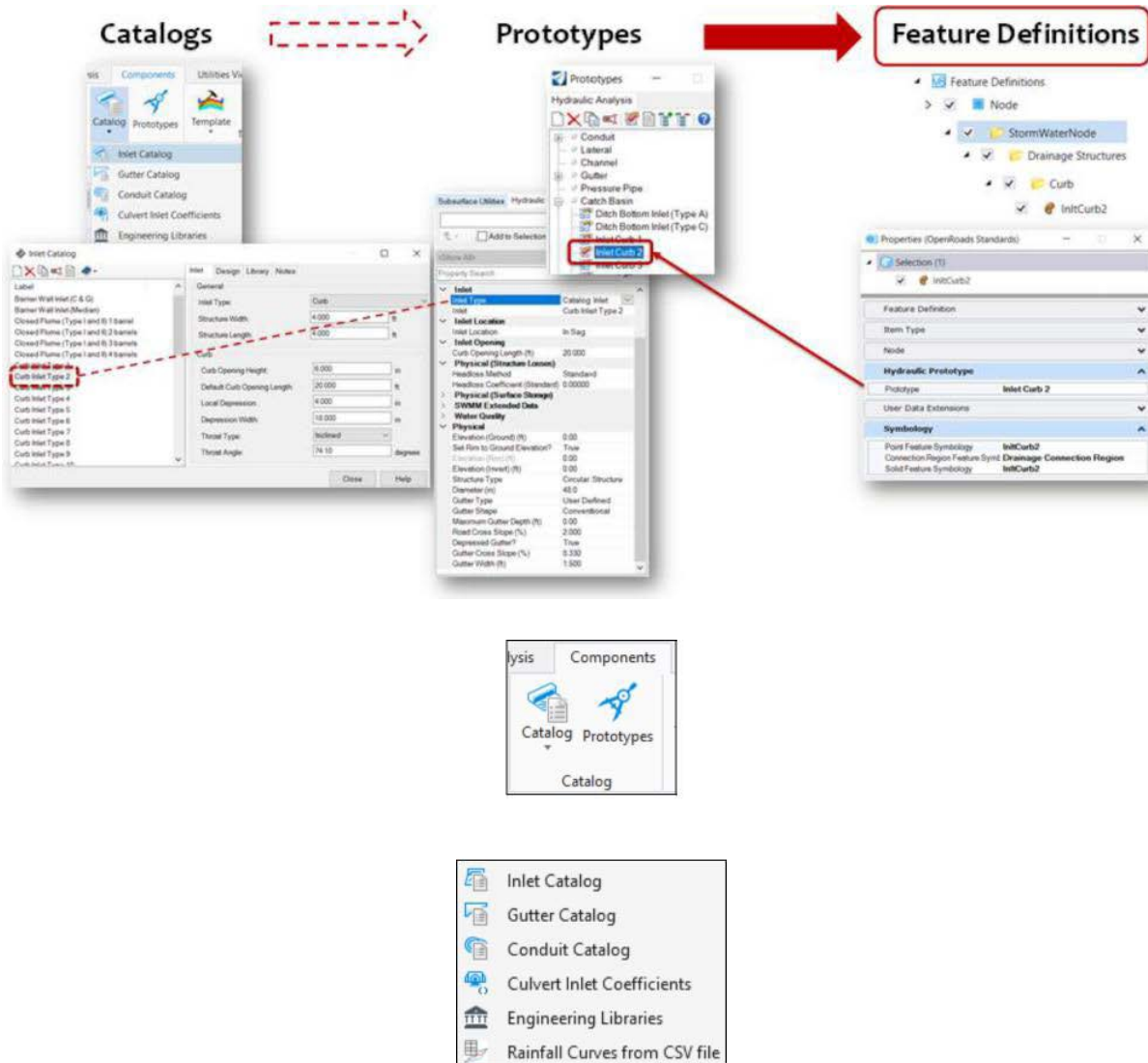
HYDRAULIC SEED DATA

In addition to housing drainage symbology information, the *FDOT_Drainage_And_Uilities.dgnlib* is also the repository for the default information and properties necessary for hydraulic modeling. This includes properties assigned to individual drainage features as well as global definitions (e.g. storm data). This information is accessed in various ways within the OpenRoads Designer environment and is described further in the sections below.

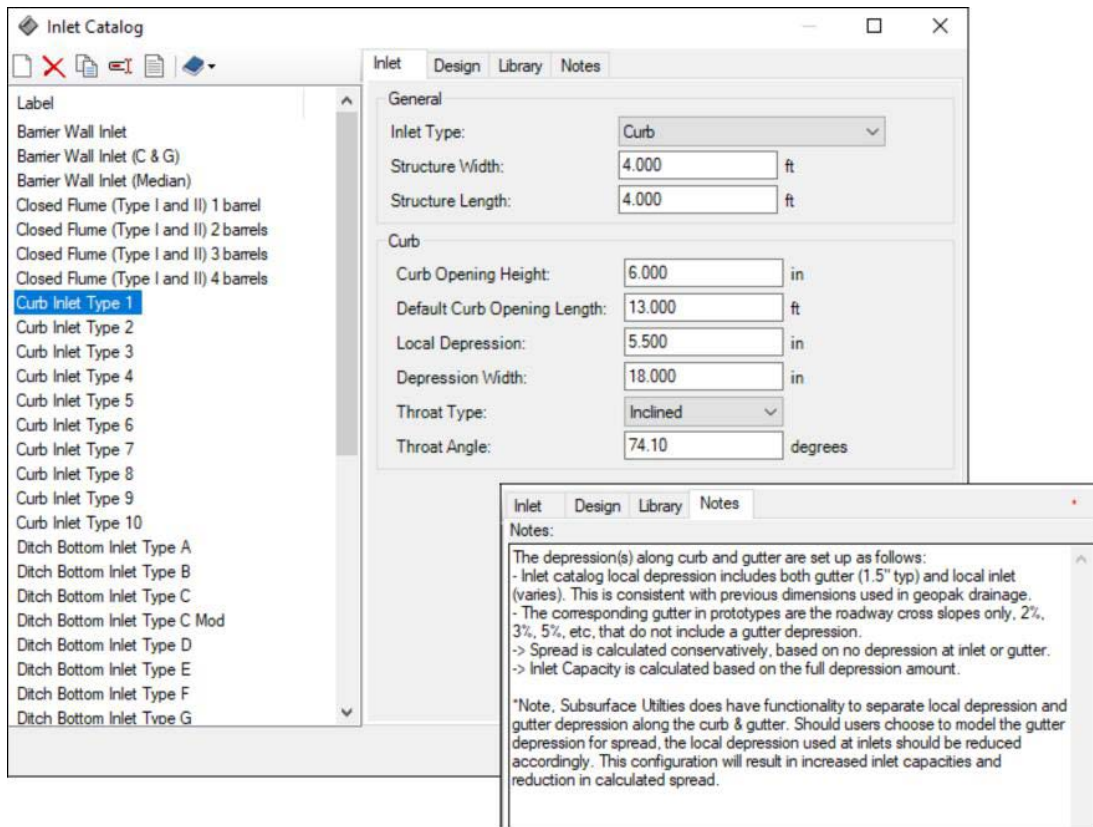
CATALOGS

In OpenRoads, Catalogs are an efficient way to reuse common physical definitions for inlets, conduits, and gutters. Catalog items can be imported from and exported to engineering libraries. Similar to the symbology series of elements that build feature definitions, there are a series of hydraulic components that ultimately assign the hydraulic properties to the feature definitions for drainage elements in the FDOTConnect Workspace. Catalogs are loaded by Prototypes, which are loaded by feature definitions. The FDOTConnect Workspace has Catalog items defined locally (not synchronized to a library) for inlets, gutters, and conduits. These can be accessed from the path:

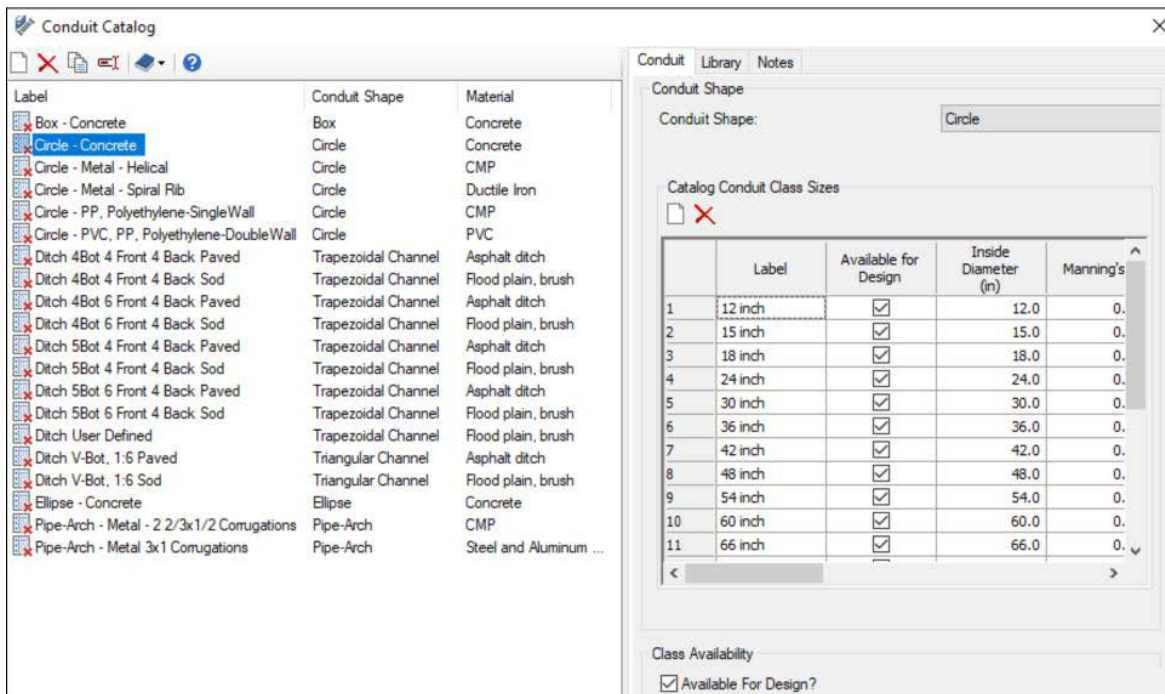
Drainage and Utilities > Components > Catalog > Catalog



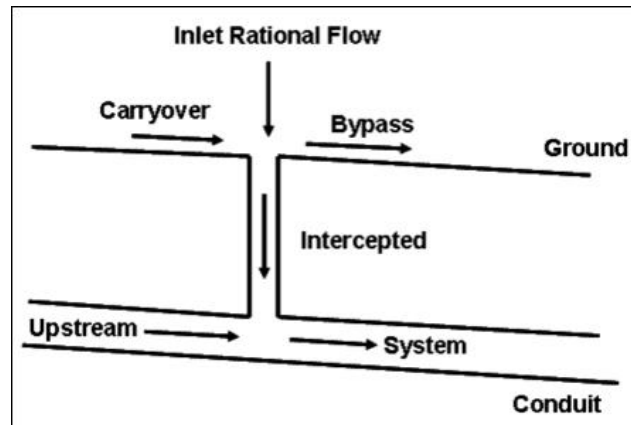
The catalog windows contain several tabs to define input, design parameters, engineering library connections, and notes. Where applicable, notes have been included to clarify input. Though FDOT inlets do not have variable opening lengths subject to design, the conduit catalog is built so that automated design selects from available standard pipe sizes



NOTE These parameters are needed for typical FHWA HEC-12 or HEC-22 calculations. The values provided were determined by the Department's staff and are felt to be conservative. Users should verify values prior to performing inlet and spread calculations with Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition.

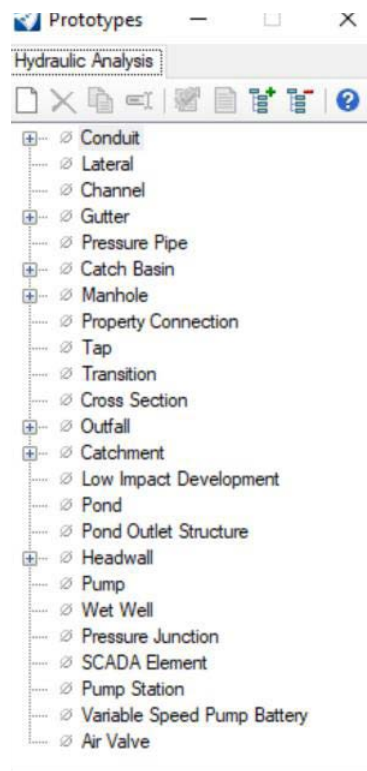


NOTE *Conduit vs. Gutter: Conduits model system flow that is intercepted by and passed through nodes. Gutters model bypass flow along the ground surface between nodes. Open channel ditch shapes are included in each catalog with the FDOTConnect Workspace.*



PROTOTYPES

In OpenRoads, Prototypes are similar to Catalogs, but contain additional parameters used for design & analysis and are loaded directly by feature definitions. Prototypes are not able to be imported or exported. Where possible, the FDOTConnect Workspace Prototypes load the respective Catalog. FDOTConnect Prototype items include inlets, manholes, outfalls, headwalls, gutters, conduits, and catchments (drainage areas). These can be accessed from the path: **Drainage and Utilities > Components > Catalog > Prototypes.**

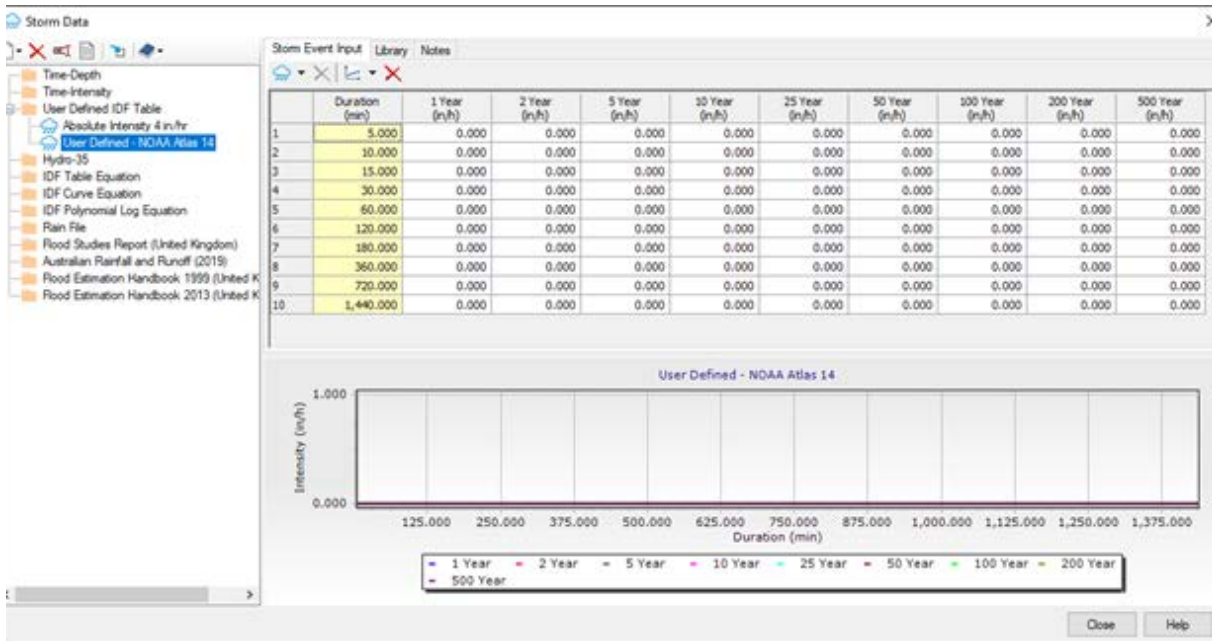


NOTE *Changes to the prototypes are not retroactive and will not affect any elements created prior to the change. This also applies to changes in feature definitions; though symbology will change if a feature definition is switched after placement, hydraulic properties are applied automatically only once, during initial placement.*

STORM DATA

The OpenRoads environment has a variety of options available for assigning wet weather flows to drainage models. Storm data can be accessed from the path: **Drainage and Utilities > Components > Common > Storm Data > Storm Data.**

For typical rational method calculations on the Department's projects, the Drainage Manual requires use of National Oceanic and Atmospheric (NOAA) Atlas 14 Rainfall Data. In the FDOTConnect Workspace, User Defined IDF Tables are set up with a blank IDF table intended for user input from project-specific NOAA Atlas 14 data.



The Absolute Intensity IDF Table includes a constant 4 in/hr intensity for spread analyses.

There are, for special occasions, several other Storm Types supported in OpenRoads.

NOTE *Not all the forms of storm data are compatible with all of the hydrology methods in the model. Refer to Bentley Product Documentation for further information.*

EXERCISE OVERVIEW

Exercise 1.1	Getting Started.....	26
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Exercise 1.3	Review and Create a New Catchment Prototype.....	37
Exercise 1.4	Populate the IDF Table with NOAA Atlas 14 Data and Set the Global Storm Event.....	41

GETTING STARTED

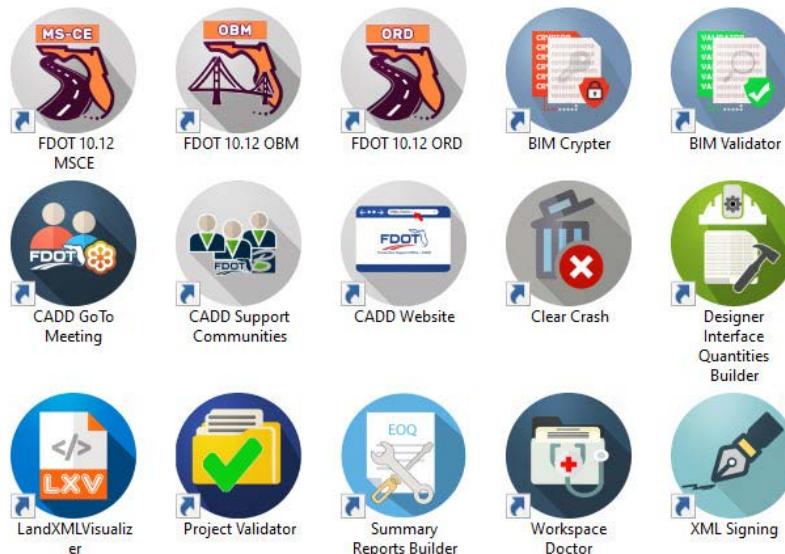
Exercise 1.1 Launching FDOTConnect For OpenRoads Designer

FDOTConnect can be launched from the FDOT – Roadway and FDOT – ROW icons located in the FDOTConnect folder on your desktop. The first time it is launched, it is important to select the FDOT workspace from the workspace dropdown.

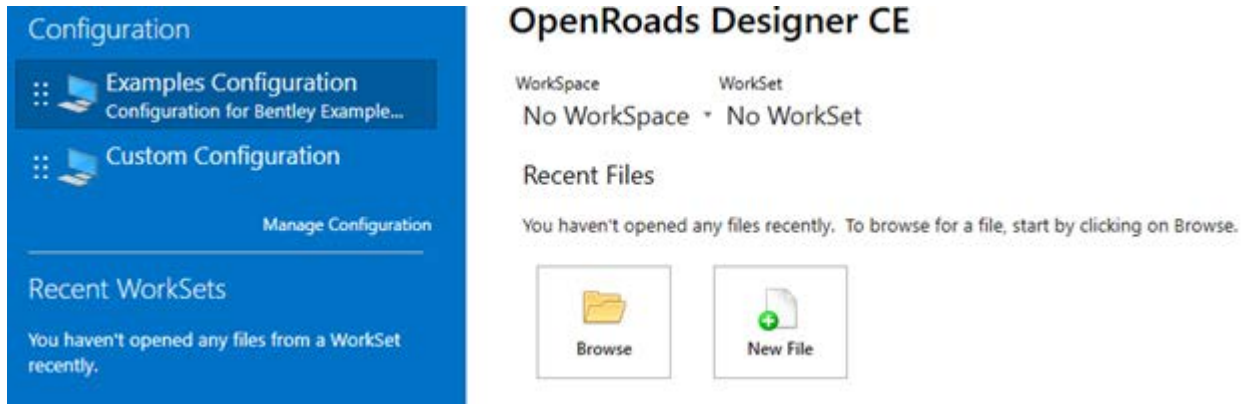
1. Find the FDOT Connect launch icons on your desktop or locate the “FDOTConnect” folder on your desktop.



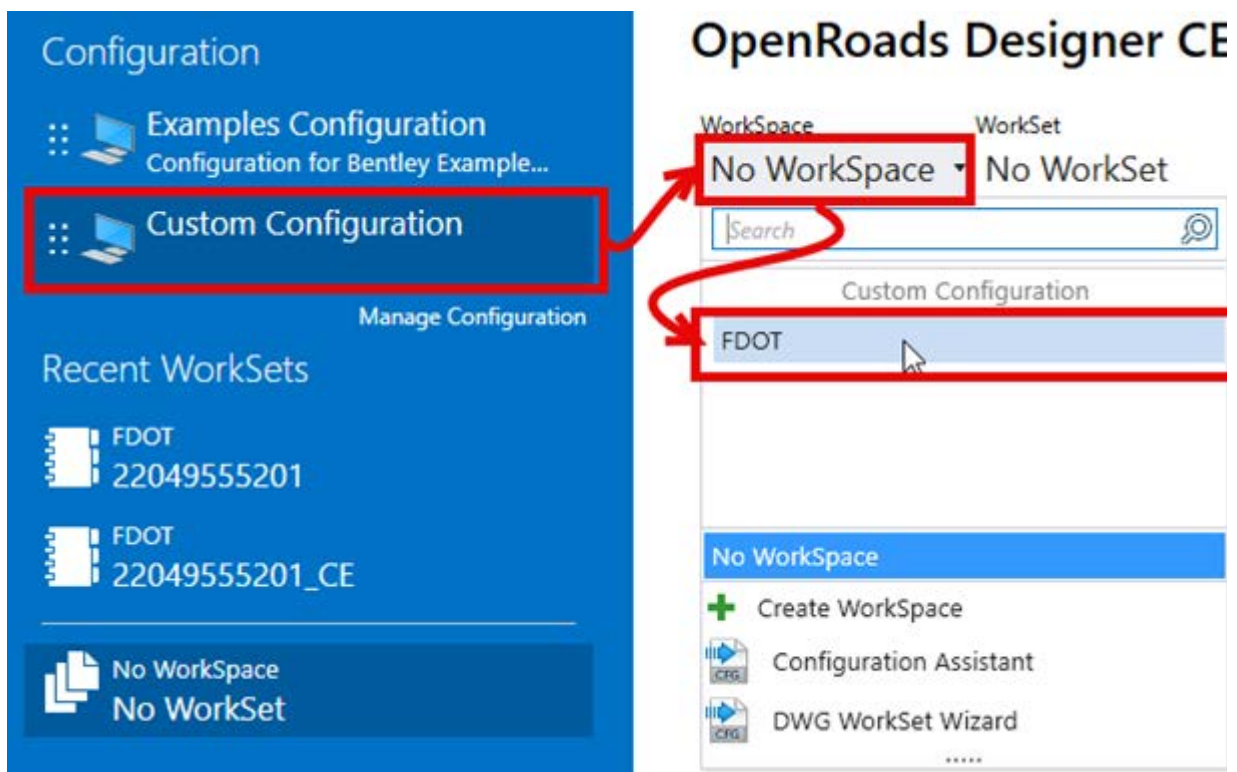
2. Launch FDOTConnect for OpenRoads Designer by double-clicking one of the FDOT icons. Note that your FDOTConnect launch icons will vary depending on which Bentley Connect Edition platforms you have installed. FDOTConnect will create an icon for OpenRoads Designer, an icon for MicroStation Connect Edition (MSCE), and an icon for OpenBridge Modeler (OBM) depending on which of these applications is present on your machine during installation of the Workstation or Client.



3. In the Workspace/Workset select screen of OpenRoads Designer, select the Workspace selection drop-down menu by clicking on **No Workspace**.



4. Select **FDOT** from the drop-down menu to select the FDOTConnect workspace.



5. From here, you can now create a new WorkSet. This is done by selecting the drop-down menu, being sure to select the FDOT's "0_WORKSET_TEMPLATE" as the workset template.
6. Click **OK** after filling in the Create Workset dialog.
7. After creating a new project using the FDOT Workset Template, you can create new files using the FDOT Create File tool. This tool is launched from within the FDOTConnect workspace, so you must first open a file. The FDOT Workset template includes a blank starting file from which to launch the Create File tool.

- From the OpenRoads Designer file open dialog, select **Browse** to browse the contents of your new workset.

OpenRoads Designer CE

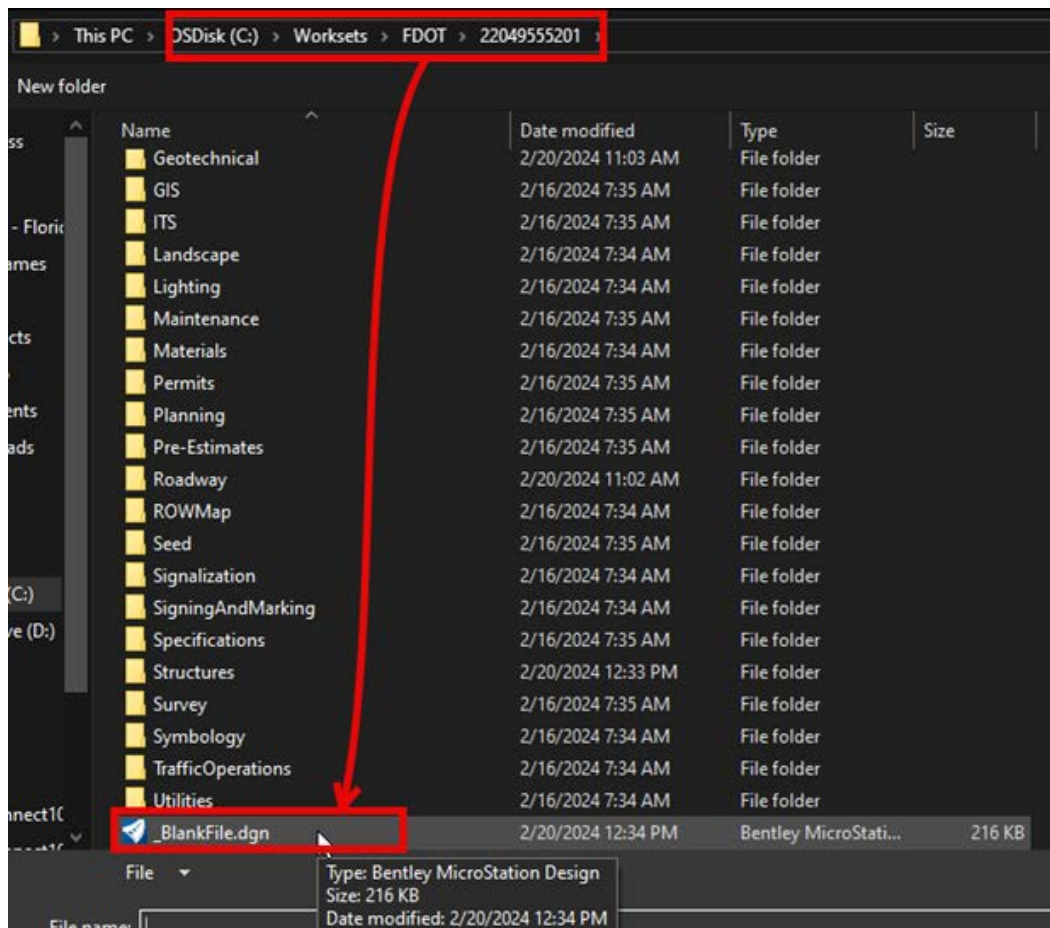
WorkSpace WorkSet
FDOT ▾ 22049555201 ▾

Recent Files

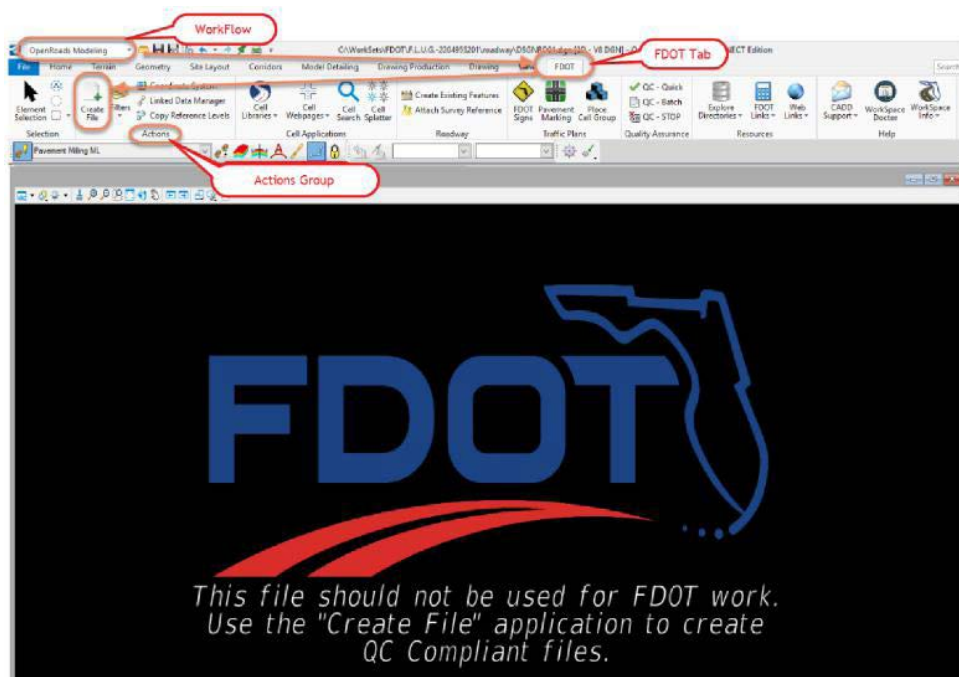
You haven't opened any files recently. To browse



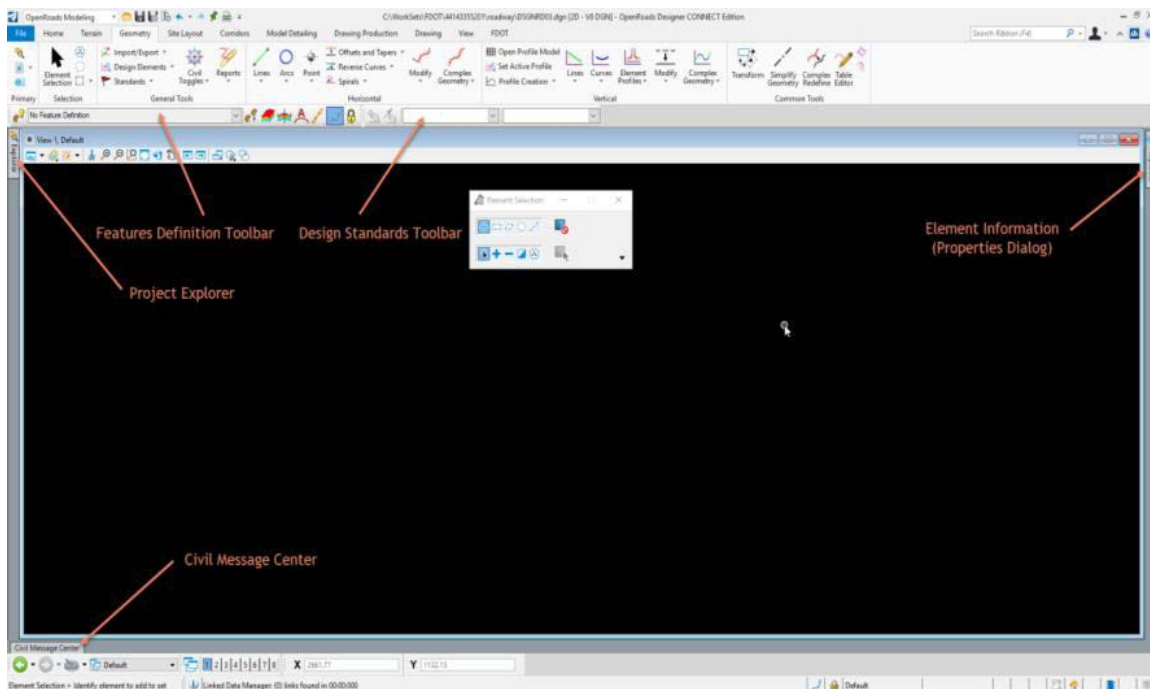
- Locate *_Blankfile.dgn* at the root of your workset folder structure. Select this file and then select **OPEN** to open it.



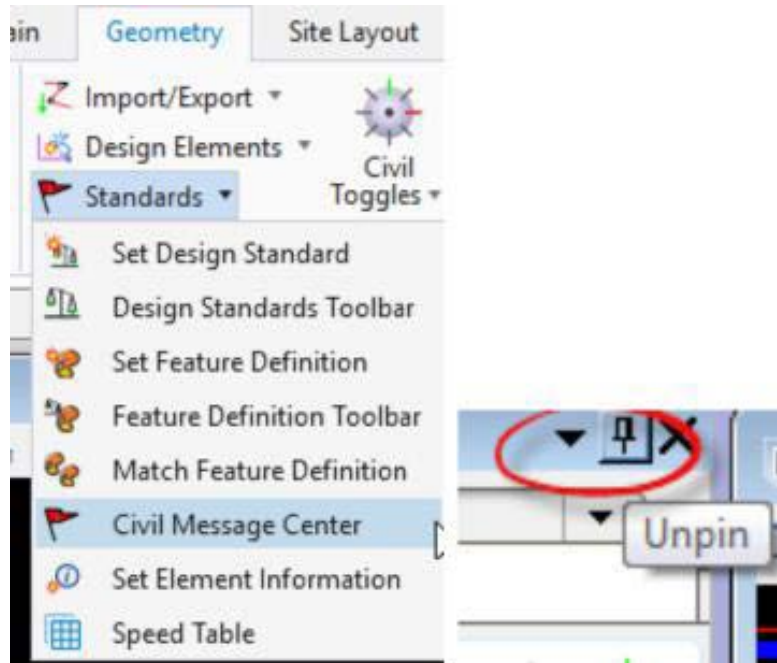
- When the FDOTConnect Workspace opens, you can locate the FDOT ribbon by selecting the **OpenRoads Modeling** workflow from the menu at the top left of the screen. The FDOT tab is located at the far right of this ribbon. Select **Create File** to launch the Create File tool for creating FDOT project files.



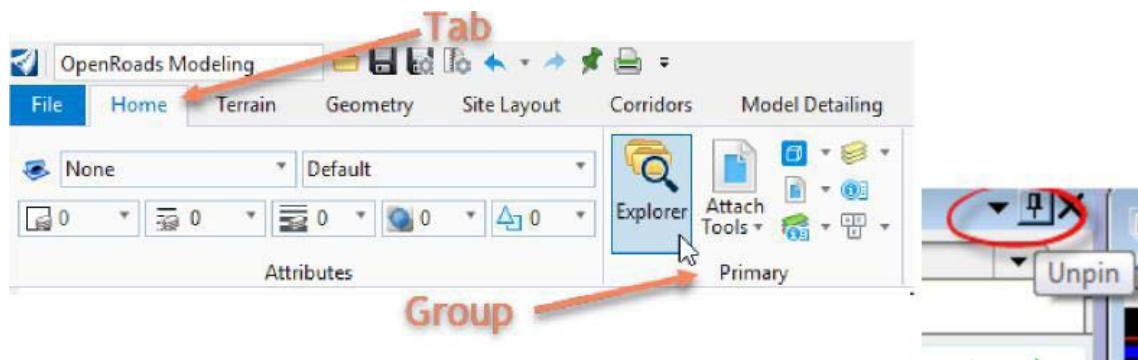
MENU DOCKING



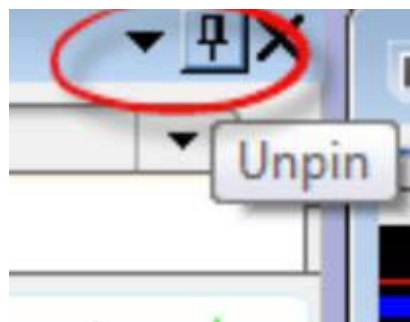
1. Verify that the Civil Message Center tool is already docked on the bottom; if not, select it from the General Geometry Task group, dock and unpin.



2. Verify that the Project Explorer is docked on the left side; if not, from the Ribbon select the Home tab then in the group named primary click on the explorer icon...Or use the F11 function key to toggle ON/OFF the dialog.



3. Verify that the Level Display is docked on the right side; if not, from the FDOT-Function Keys press F10, dock and unpin.



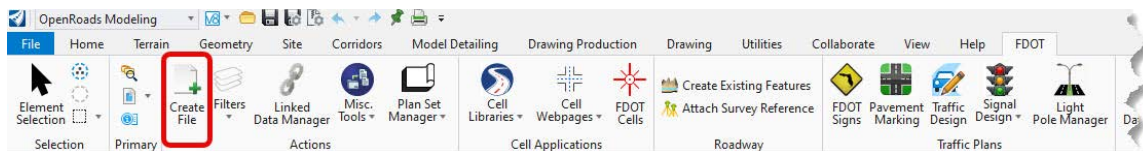
4. Verify that the Element Information is docked on the right side; if not, this can be brought up by selecting Ctrl+I , dock and unpin.



HINT Many of the dialog settings are stored in user preferences defined in xml data files located in the users data folders, i.e. C:\Users\rd964vd\AppData\Local\Bentley\OpenRoadsDesigner\10.0.0\prefs.

CREATE A NEW DGN FILE

1. Open FDOTConnect, set the Workspace to “FDOT” and select the Workset – 22049555201.
2. Browse to the *_BlankFile.dgn* and open.
3. On the FDOT Ribbon Tab in the Actions Group, select “Create File.”
 - Discipline = “DRAINAGE”
 - File Group = “Drainage Design Files”
 - File Type = “DRPRRD”
 - File Sequence # = “01”
 - County = “Wakulla” (State Plane Coordinate System = FL83-NF)
4. Click on the “Create – Open File” button. Close the Create File Dialogue box.



The 'CreateFile (v2023.5.12.1)' dialog box is shown with the following fields and values:

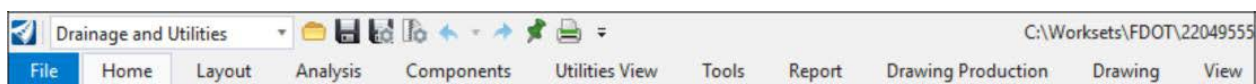
- Workset: C:\Worksets\FDOT\22049555201
- Discipline: DRAINAGE
- File Group: Drainage Design Files
- File Type: DRPRRD (selected in a table)
- Output File: Base Filename: DRPRRD, Modifier (Optional): , File Sequence #: 01, Extension: .dgn
- Output Folder: drainage
- Seed File: c:\fdotconnect10.12\organization-civil\fdot\seed\FDOT-ORD-Seed
- County: Wakulla
- Coordinate System: FL83/2011-NF

A red arrow points to the 'Create - Open File' button at the bottom of the dialog.

	Base Filename	Description
	DRFLRD	Flood Data Form
	DROMRD	Optional Materials Tabulation
▶	DRPRRD	Drainage Structures - Proposed
	PDPLRD	Pond Design
	TEXTDR	Text
	WETLRD	Wetlands Delineation

NAVIGATING THE DRAINAGE AND UTILITIES WORKFLOW RIBBON

When The Drainage and Utilities workflow is activated, there are ten tabs that populate the ribbon. The tabs are organized to help you find the tools you need to complete a task. Upcoming chapters will further describe these tabs and included tools that are commonly used for FDOT drainage design.



The Home tab has six groups. One of the most useful tools for managing the drainage model is Explorer, located in the Primary Group. The Project Explorer is docked on the left side or use the F11 function key to toggle ON/OFF the dialog.



NAVIGATING PROJECT EXPLORER FOR DRAINAGE

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

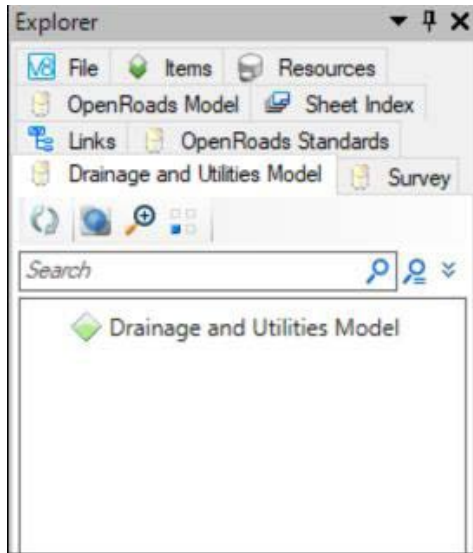
“The Explorer dialog allows you to manage and control project content. It is a single interface that provides browsing function for files, links, items, resources, and sheet indexes.

- *File - used to browse and manage the file content such as models, references, saved views, levels, styles, templates, and so on.*
- *Items - displays non-graphical business data in a DGN file in hierarchical order.*
- *Resources - displays resources used in a DGN file in hierarchical order.*
- *OpenRoads Model – displays content in categories such as alignments, terrain models, etc.*
- *Sheet Index - allows you to manage sheet indexing. A sheet index is an organizes and named collection of sheet models from one or more design files.*
- *Links tab - used to create or view the linked data.*
- *OpenRoads Standards - used to create, edit or review horizontal and vertical geometry design standards, feature information, civil cells, annotation, and graphical filters.*

The Drainage and Utilities section of Project Explorer is used to manage conduits, drainage areas, nodes and profile runs in the model.”

NOTE *It is a recommended practice to check the Explorer when first opening a drainage DGN file to understand the contents of the file.*

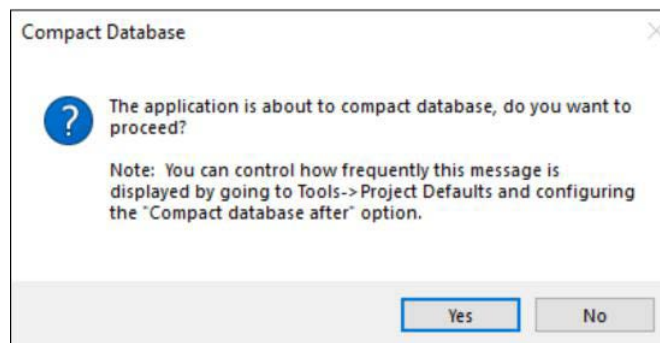
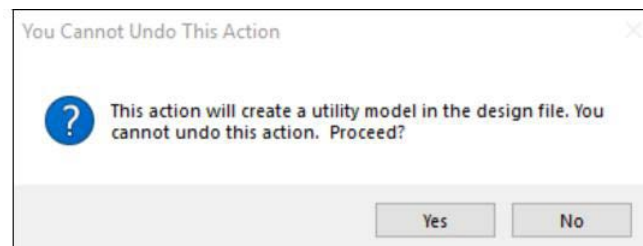
A DGN file without an active or referenced drainage model will appear blank:



However, once a utility model is created, the Drainage and Utilities section of Project Explorer is organized into collapsible lists of elements: nodes, conduits, drainage areas, and profile runs.

CREATE A NEW UTILITY MODEL

1. In the *DRPRRD01.dgn*, click on **Drainage and Utilities > Layout > Layout > Place Node**.
2. Since this file does not yet contain a utility model, the **Place Node** tool will not activate. However, the following message will pop up, asking if you wish to proceed creating a utility model. Click **Yes** to this prompt and the next.

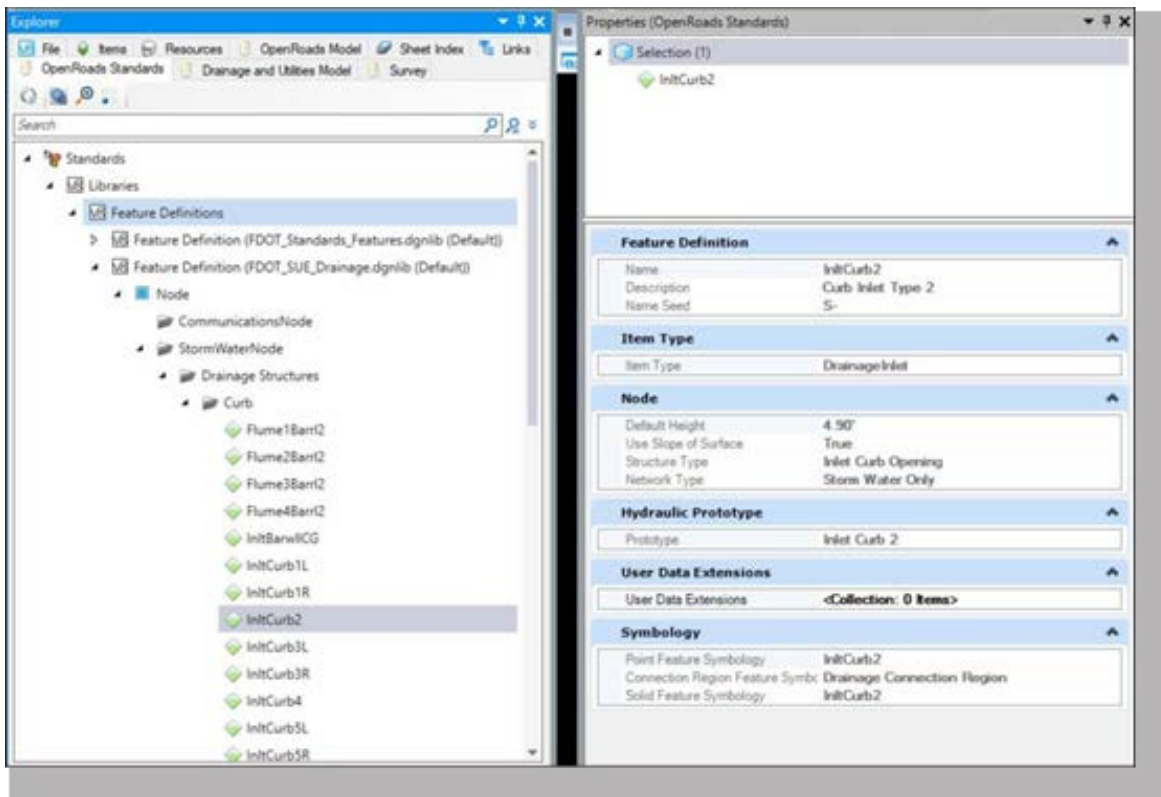


3. Now, this file is ready to place drainage features in the DGN and/or reference drainage models from other DGNs.

Exercise 1.2 Explore Properties in Feature Definitions

In this exercise, the user will open the Properties dialog of a drainage feature definition from the DGN Library and identify the associated symbology and hydraulic properties.

1. Open FDOTConnect, set the Workspace to “FDOT” and select the Workset – 22049555201.
2. Browse to the drainage folder and open “DRPRRD01.dgn”.
3. Use the *Explorer* Dialog (Function Key F11) if you do not have it docked. Navigate to the **OpenRoads Standards** Tab then click on Standards to expand list. The list contains loaded DGN Libraries and the current file you are in.
4. Navigate through the following path and right-click to open the properties of the feature definition for a Type 2 Curb Inlet: **Libraries > Feature Definitions > Feature Definition (FDOT_Drainage_And_Utilities.dgnlib) (Default) > Node > StormWaterNode > Drainage Structures > Curb > InltCurb2**.



HINT Items in grey are read only.

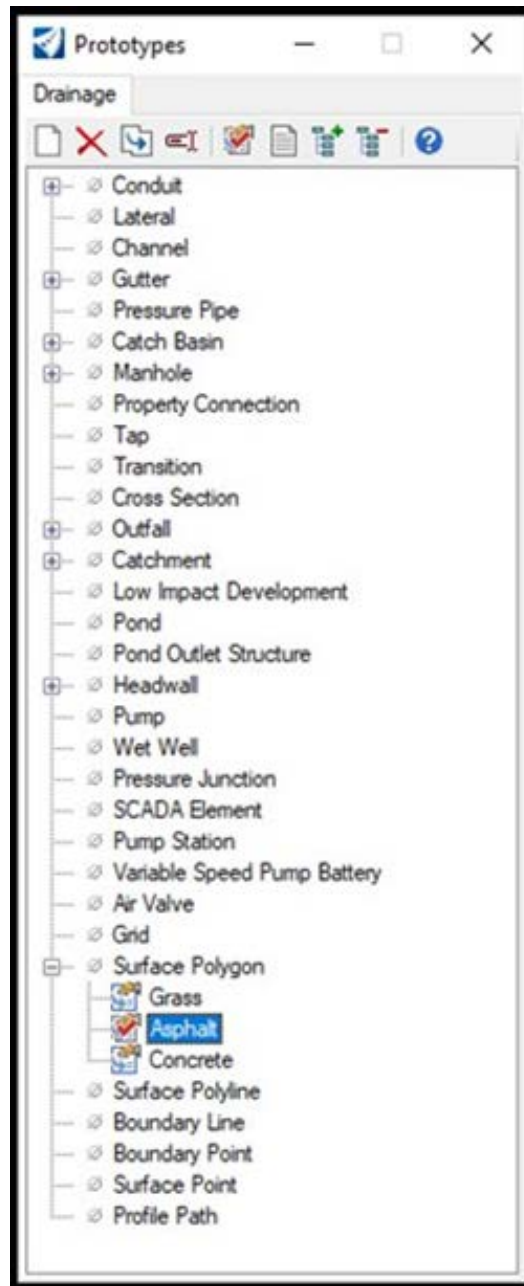
Reviewing the feature definition properties dialog from top to bottom:

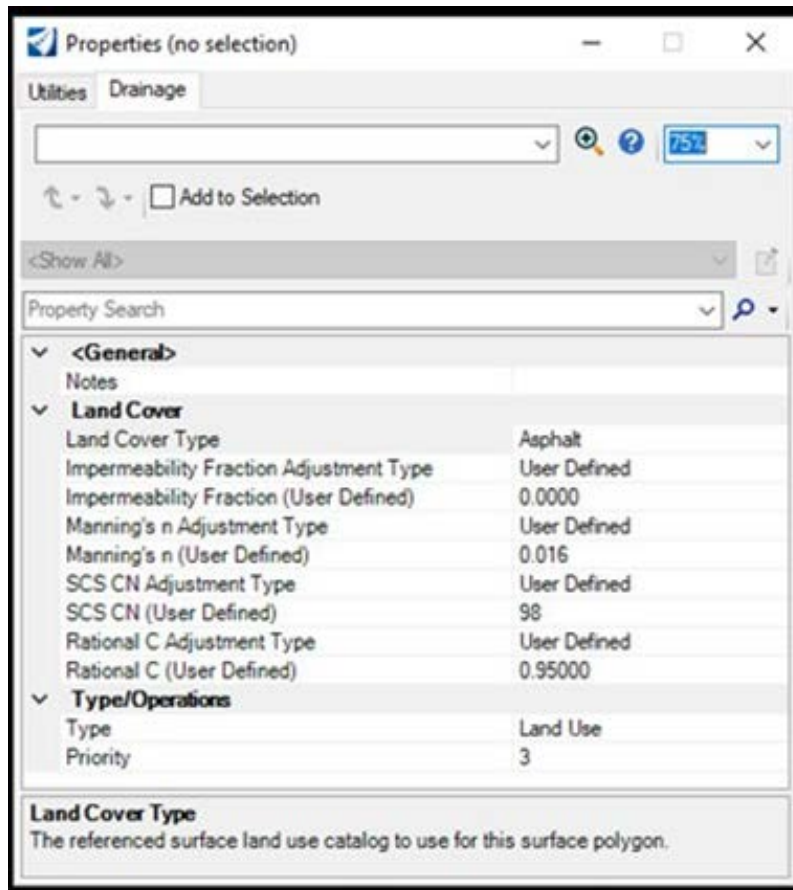
- a. **Feature Definition** category includes name, description, and the name seed. When this inlet is placed, the prompts will prefill the name input with 'S-'.
- b. **Item Type** assigned to this type of structure is 'DrainageInlet'. Item types are used for FDOT quantity reports and will be discussed in more detail later in this course guide.
- c. **Node** definitions include default height, use slope of surface, structure type, and network type. The default height value controls the minimum distance allowed between the top and structure invert elevations.
- d. The **Hydraulic Prototype** input indicates that when a Type 2 Curb Inlet is placed, the hydraulic properties will be assigned from the 'Inlet Curb 2' prototype.
- e. **User Data Extensions** are defined for some FDOTConnect drainage features. These are flex tables used in plans and drainage design documentation. Flex Tables and User Data Extensions will be discussed in more detail later in this course guide.
- f. **Symbology** for nodes include point, connection region, and solid. The point feature symbology controls presentation of the node in plan view and the solid feature symbology controls 3D presentation.

Exercise 1.3 Review and Create a New Land Use Area Prototype

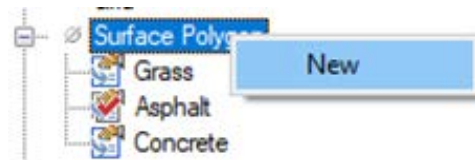
In this exercise, the user will review available land cover definitions provided with the FDOTConnect Workspace and learn how to create a new land use area (surface polygon) prototype for project-specific use. Custom prototypes may be useful if project drainage areas have a consistent C value that are not reflected in the predefined land covers.

1. Navigate through the following path to open the list of land use prototypes (surface polygons) and open properties for **Asphalt Pavement: Drainage and Utilities > Components > Catalog > Prototypes > Drainage > Surface Polygons > Asphalt**

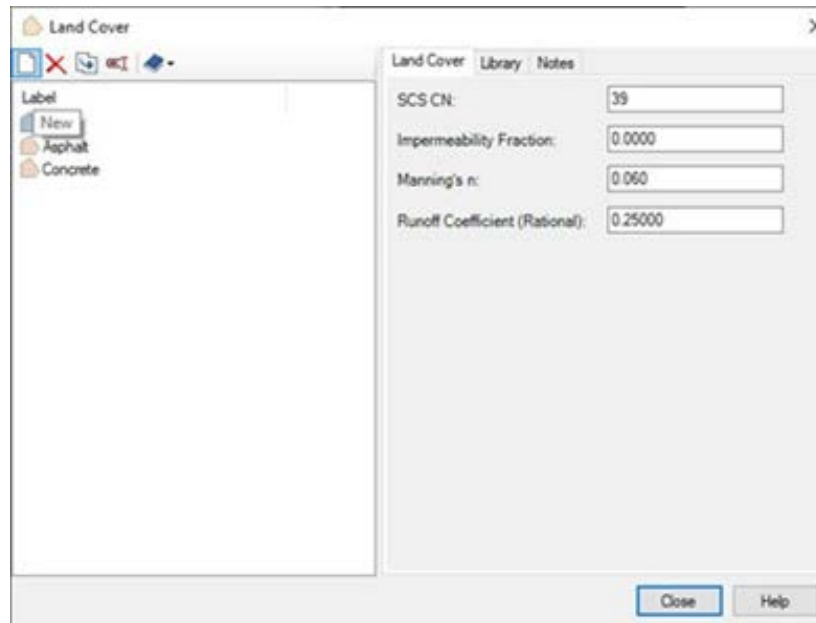




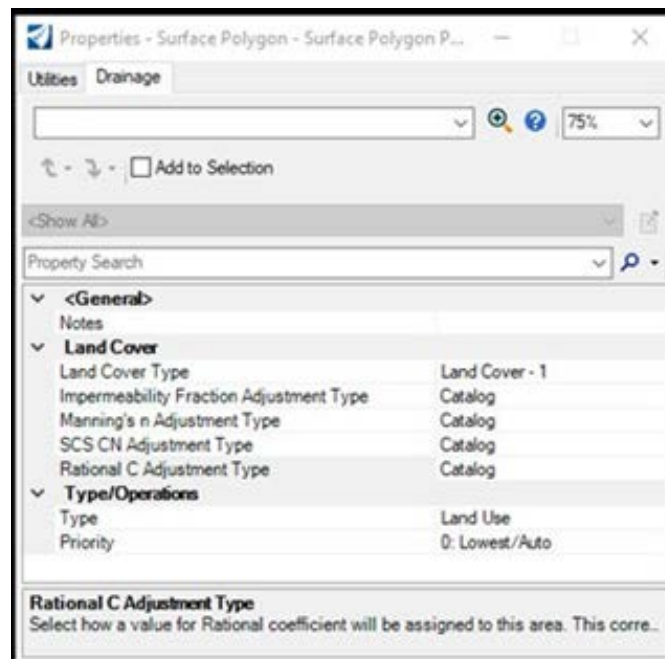
2. Since this is a prototype, settings shown in this *Properties* dialog are applied by default to new land use areas with feature definition = Asphalt. For Asphalt, the assigned C value is 0.95, Manning's n value is 0.016, and CN value of 98. These values are used for various hydrologic and hydraulic analysis within ORD. Close the *Properties* dialog.
3. Right click **Surface Polygon** in the *Prototypes* dialog and select **New**. Double click to open the newly created **Surface Polygon Prototype – 1**



4. Reviewing from top to bottom, the following are sample settings for a project-specific mixed land cover:
 - a. Change *Type/Operations* to **Land Use**
 - b. Change *Land Cover Type* to '**<Edit Land Cover>**' and the *Land Cover Catalog* dialog box should appear. Alternatively, you can access the Catalog by going to **Drainage and Utilities > Components > Catalog > Catalog > Land Cover**. Then click on the top left button that looks like a blank page to create a new Land Cover type appropriate for your project-specific needs.



- a. Fill out the *Land Cover* catalog for the project-specific land use area. Then close the catalog box.
- b. Returning to the *Prototype Properties* dialog box, change *Land Cover Type* to the new project-specific land cover created within the catalog from the previous steps.
- c. Edit the associated *Impermeability Fraction Adjustment Type*, *Manning's n Adjustment Type*, *SCS CN Adjustment Type*, and *Rational C Adjustment Type* either to **Catalog** or **User Defined** as appropriate for the project. More information on these parameters are provided in Chapter 3.
 - i. Choosing **Catalog** will globally reference the catalog values for that land use area type.
 - ii. Choosing **User Defined** will default those values to the referenced catalog values, but allows for adjustments to unique sections to have their values changed if needed.



5. To sketch the newly created project-specific Land Use Area, Feature Symbologies and Feature Definition for the project-specific Surface Polygon must be created.
 - a. Create the Feature Symbology:
 - i. Navigate to: **Drainage and Utilities > Home > Primary > Explorer > OpenRoads Standards > (DGN file) > Feature Symbologies > Linear > Landuse**
 - ii. Right click on the Landuse folder to create **New Feature Symbology**
 - iii. Right click on the newly created feature symbology and go to its **Properties** which opens the *Properties (OpenRoads Standards)* dialog box.
 - iv. Change the *Properties Default Element Template* to **Manage Templates** which will open the *Element Templates* dialog box.
 - v. Under your DGN file, navigate to **Drainage-Areas > Plan** to right click on the **Plan** folder to create *New Template*
 - vi. Once you click on the newly created template, you can set general level symbology definitions as appropriate. Then close the *Template* dialog box.
 - vii. Going back to the *Properties*, set the *Default Element Template* to the newly created template.
 - b. Create the Feature Definition:
 - i. Navigate to: **Drainage and Utilities > Home > Primary > Explorer > OpenRoads Standards > (DGN file) > Feature Definitions > Drainage and Utilities > Drainage Area > Surface Polygon**
 - ii. Right click on *Surface Polygon* folder and select *New Feature Definition*
 - iii. Right click on the new feature definition and go to *Properties* which opens the *Properties (OpenRoads Standards)* dialog box.
 - iv. Set the *Hydraulic Prototype* to the project-specific surface polygon prototype created in this example.
 - v. Set the *Center Feature Symbology* to the newly created *Linear Landuse* feature created in previous step.
6. Now the new land use is available for analysis. To draw the land use area:
 - a. Navigate to: **Drainage and Utilities > Layout > Layout > Place Land Use Area**
 - b. In the *Place Land Use* tool, choose the *Feature Definition* created from this exercise.

NOTE *Future discussion on hydrology analysis using these land use areas is provided in Chapter 3.*

Exercise 1.4 *Populate the IDF Table with NOAA Atlas 14 Data and Set the Global Storm Event*

In this exercise, the user will review where to obtain and enter project-specific NOAA Atlas rainfall data and set the global storm event for the Base Rainfall Runoff alternative. Alternatives will be further discussed later in this manual.

1. Navigate through the following path to and select the User Defined – NOAA Atlas 14 IDF Table: **Drainage and Utilities > Components > Common > Storm Data > Storm Data > User Defined IDF Table > User Defined – NOAA Atlas 14.**

The screenshot shows the 'Storm Data' window in the software. The window title is 'Storm Data'. On the left, there is a tree view showing the project structure, with 'User Defined - NOAA Atlas 14' selected. The main area contains a 'Storm Event Input' table and a graph titled 'User Defined - NOAA Atlas 14'.

Duration (min)	1 Year (in/h)	2 Year (in/h)	5 Year (in/h)	10 Year (in/h)	25 Year (in/h)	50 Year (in/h)	100 Year (in/h)	200 Year (in/h)	500 Year (in/h)
5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
180.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
360.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
720.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1,440.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The graph below the table shows Intensity (in/h) on the y-axis (ranging from 0.000 to 1.000) and Duration (min) on the x-axis (ranging from 125.000 to 1,375.000). The graph is currently empty, with a legend at the bottom showing color-coded lines for return periods: 1 Year (blue), 2 Year (orange), 5 Year (green), 10 Year (red), 25 Year (purple), 50 Year (brown), 100 Year (pink), 200 Year (gray), and 500 Year (black).

2. By default, the table is empty and set up to receive intensity data for durations 5-min to 24-hr and 1 Year to 500 Year storms.
3. From the Department's Drainage Manual, Section 1.4, open the hyperlink to the [NOAA Atlas 14 Rainfall Data](#).
4. Enter project location information and make the following selections within the NOAA web page:
 - a. Data type = Precipitation intensity

- b. By location = Latitude 30.107805 and Longitude -84.379975 and Submit.

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: FL

Data description
 Data type: Units: Time series type:

Select location
 1) Manually:
 a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude:
 b) By station (list of FL stations):
 c) By address:

2) Use map (ESRI interactive map is not loading, try adding the host: https://s.arcgis.com/ to the firewall, or contact us at ndbc.questions@noaa.gov)

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
 WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
 NOAA Atlas 14, Volume 5, Version 2

5. At the bottom of the data table, select Submit to generate the CSV file.

60-day	0.013 (0.011-0.015)	0.014 (0.012-0.017)	0.017 (0.014-0.020)	0.019 (0.016-0.022)	0.021 (0.017-0.026)	0.023 (0.019-0.028)	0.025 (0.019-0.032)	0.027 (0.020-0.035)	0.029 (0.021-0.039)	0.030 (0.021-0.042)
--------	------------------------	------------------------	------------------------	------------------------	------------------------	------------------------	------------------------	------------------------	------------------------	------------------------

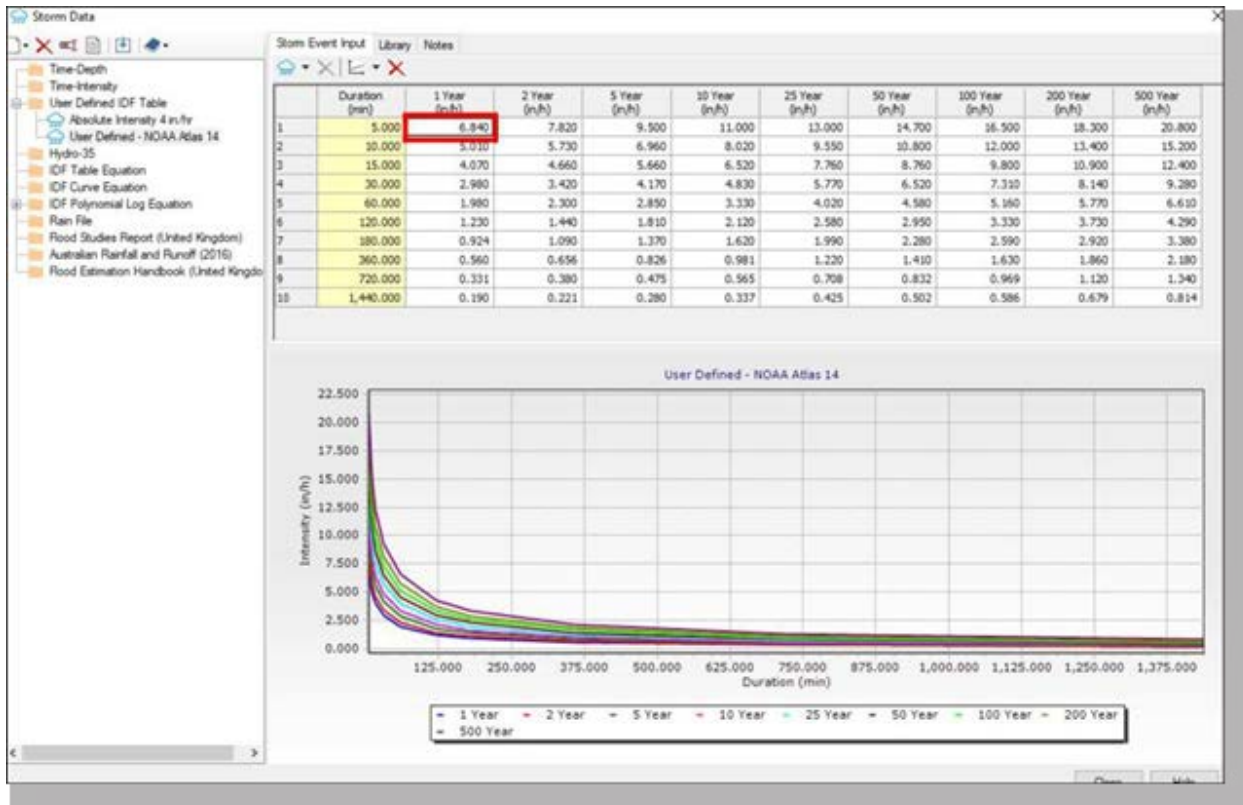
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format:

6. Open the CSV file and copy the following range of data: 5-min to 24-hr and 1 Year to 500 Year:

PRECIPITATION FREQUENCY ESTIMATES											
by duratic	1	2	5	10	25	50	100	200	500	1000	
5-min:	6.84	7.82	9.5	11	13	14.7	16.5	18.3	20.8	22.8	
10-min:	5.01	5.73	6.96	8.02	9.55	10.8	12	13.4	15.2	16.7	
15-min:	4.07	4.66	5.66	6.52	7.76	8.76	9.8	10.9	12.4	13.5	
30-min:	2.98	3.42	4.17	4.83	5.77	6.52	7.31	8.14	9.28	10.2	
60-min:	1.98	2.3	2.85	3.33	4.02	4.58	5.16	5.77	6.61	7.27	
2-hr:	1.23	1.44	1.81	2.12	2.58	2.95	3.33	3.73	4.29	4.72	
3-hr:	0.924	1.09	1.37	1.62	1.99	2.28	2.59	2.92	3.38	3.74	
6-hr:	0.56	0.656	0.826	0.981	1.22	1.41	1.63	1.86	2.18	2.45	
12-hr:	0.331	0.38	0.475	0.565	0.708	0.832	0.969	1.12	1.34	1.52	
24-hr:	0.19	0.221	0.28	0.337	0.425	0.502	0.586	0.679	0.814	0.924	
2-day:	0.106	0.128	0.167	0.203	0.257	0.302	0.35	0.402	0.476	0.536	

- Back in OpenRoads, click on the upper left of the table, the cell for 5-min, 1 Year, and Ctrl-V to paste the rainfall data. The completed table is shown below. Close the dialog when finished.



- Open *Global Storm Events*, from the path **Drainage and Utilities > Components > Common > Storm Data > Global Storm Events**.



- Click the down arrow in the white cell beneath *Global Storm Event* heading to expand the list of available FDOT storms. Select *User Defined – NOAA Atlas 14 – 10 Year*, near the bottom of the list, and close the dialog box.

Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration Modified (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate A (C)
as Rainfall Runoff	Orphan (local)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	None	

Dropdown menu options for Global Storm Event:

- Absolute Intensity 4 in/hr - 0 Year
- User Defined - NOAA Atlas 14 - 1 Year
- User Defined - NOAA Atlas 14 - 2 Year
- User Defined - NOAA Atlas 14 - 5 Year
- User Defined - NOAA Atlas 14 - 10 Year
- User Defined - NOAA Atlas 14 - 25 Year
- User Defined - NOAA Atlas 14 - 50 Year
- User Defined - NOAA Atlas 14 - 100 Year
- User Defined - NOAA Atlas 14 - 200 Year
- User Defined - NOAA Atlas 14 - 500 Year

2 POND DESIGN

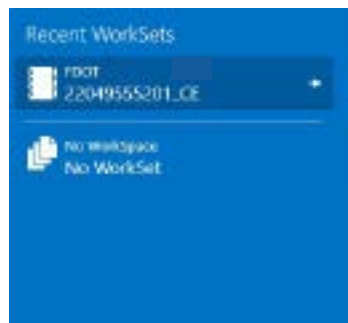
OBJECTIVES

EXERCISE OVERVIEW

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Exercise 2.1 Create The Pond Design File

1. From the desktop FDOTConnect folder double left click on the FDOTConnect for OpenRoads Designer icon. to set the Workspace to FDOT and the Workset to 22049555201. Open the *_BlankFile.dgn* or any dgn file within the 22049555201 Workset.



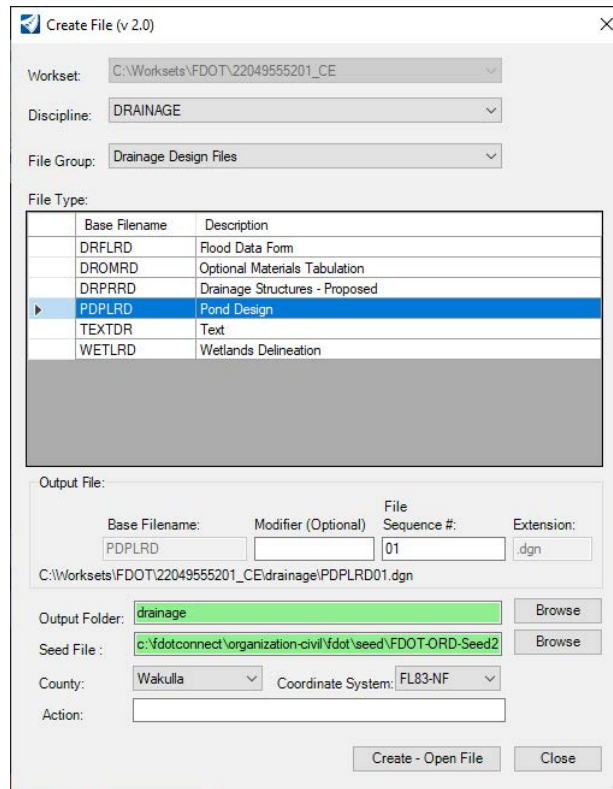
OpenRoads Designer CONNECT Edition



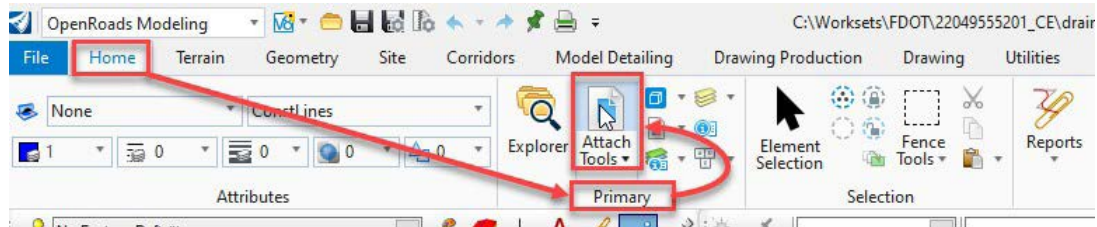
2. From the OpenRoads Modeling Workflow, navigate to the FDOT Tab of the Ribbon, then the Actions Group and left click on the Create File icon



- The **Create File** dialog displays. On the **Create File** dialog, set the *Discipline* to **Drainage** and the *File Group* to **Drainage Design Files**. From the **File Type** list, select **PDPLRD Pond Design**. On the **Output File** section of the dialog, be sure to set the *County* to **Wakulla** and the *Coordinate System* to **FL83-NF**. Once everything is set up to match the image below, left click the **Create – Open File** button to create and open the **Pond Design** file. Now left click on the **Close** button to close the dialog.

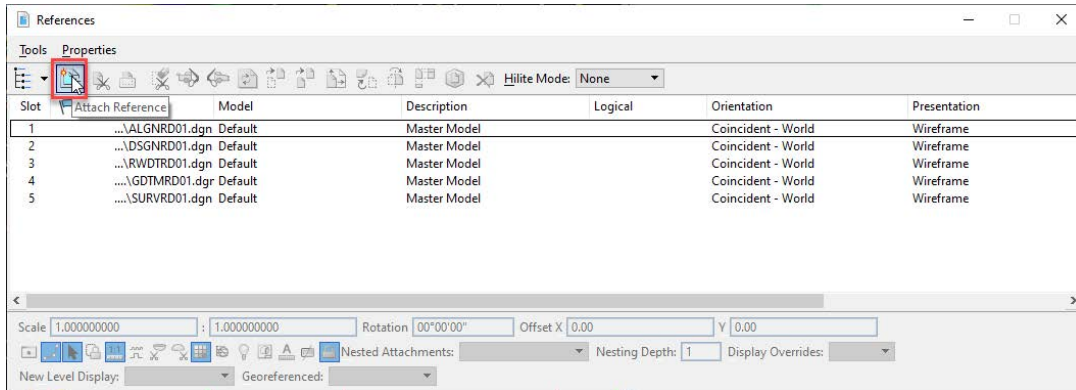


- Navigate to the **Home** tab and in the **Primary Group** left click on the **Attach Tools** icon to open the **References** dialog.

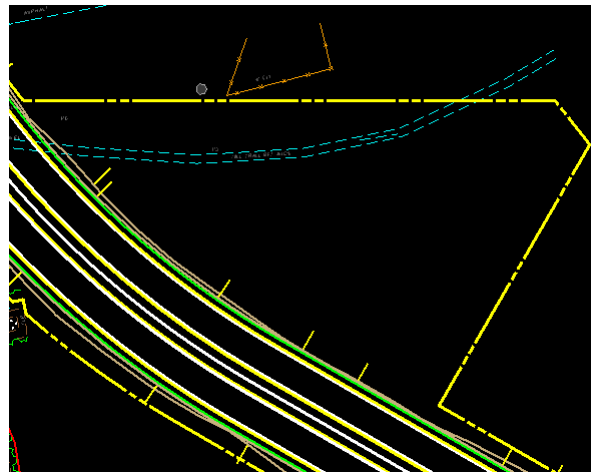


This will open the **References** dialog. Left click on the **Attach References** button in the upper left of the dialog. Navigate to and reference in the following design files:

- C:\worksets\FDOT\22049555201\roadway\ALGNRD01.dgn
- C:\worksets\FDOT\22049555201\roadway\DSGNRD01.dgn
- C:\worksets\FDOT\22049555201\roadway\RWDTRD01.dgn
- C:\worksets\FDOT\22049555201\survey\GDTMRD01.dgn
- C:\worksets\FDOT\22049555201\survey\ URVRD01.dgn



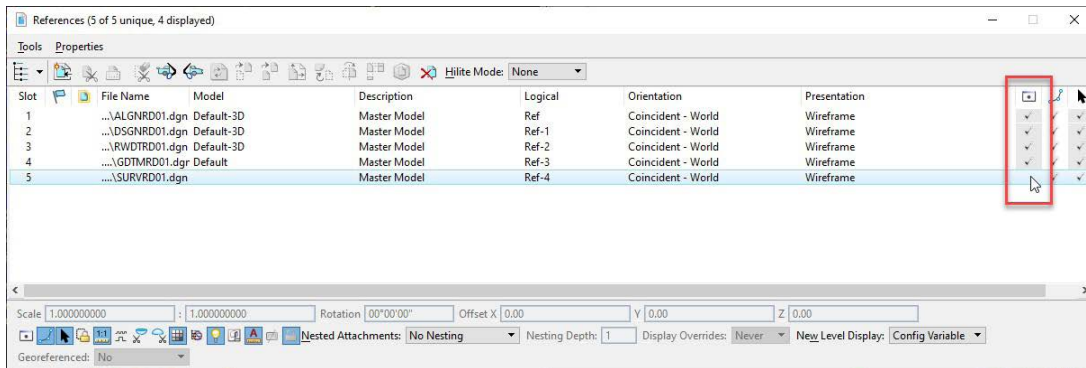
5. The pond will be constructed in the area of the proposed R/W to the right of SR61.



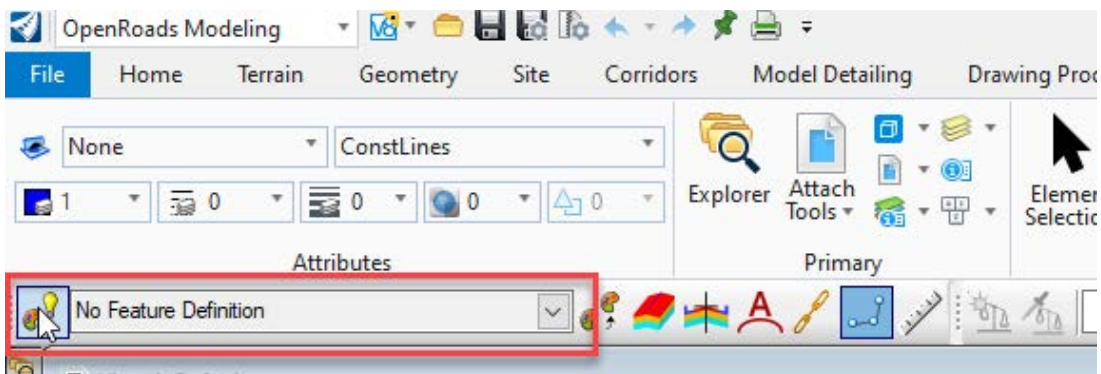
Exercise 2.2 Create The Pond Control Line

Use the Roadway and R/W Lines to Create a Pond Boundary.

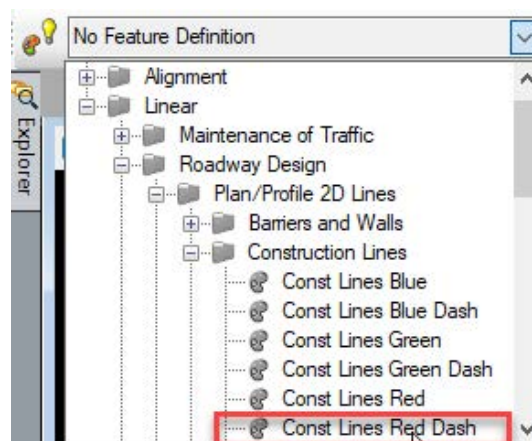
1. Verify that the workflow is set to the **OpenRoads Modeling Workflow** and on the **Home Tab** in the **Primary Group** click on the **Attach Tools** icon. This will open the **References** dialog box. In the **References** dialog box left click on the **SURVRD01.dgn** reference file in the list and un-check the **Display** option to turn this file off for now.



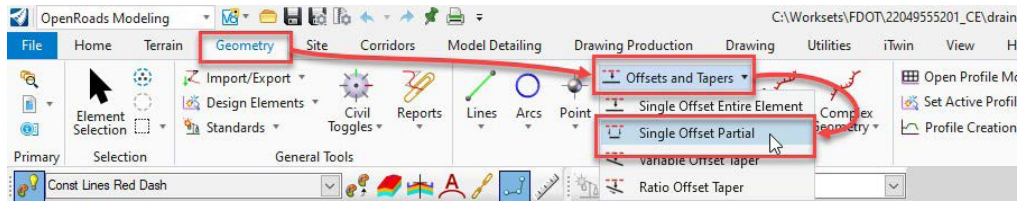
2. Construction lines will be used to create the **Pond Control** line. Setting **ORD** to use the **Active Feature Definition** will make things a little more streamlined. Left click on the **Use Active Feature** button.



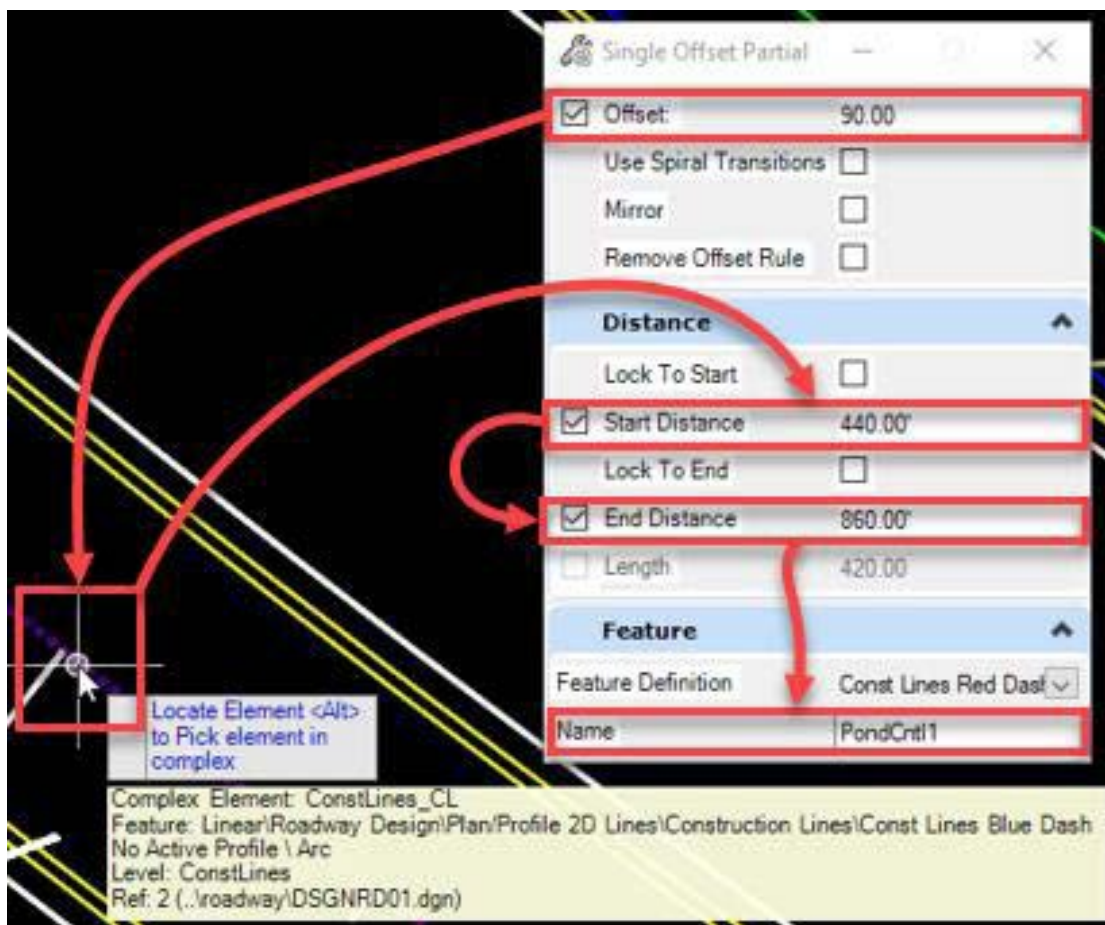
3. Now left click on the **Feature Definition** drop down. Expand the **Linear** folder then the **Roadway Design** folder followed by the **Plan/Profile 2D Lines** folder and the **Construction Lines** folder. Select **Const Lines Red Dash** feature definition from the list.



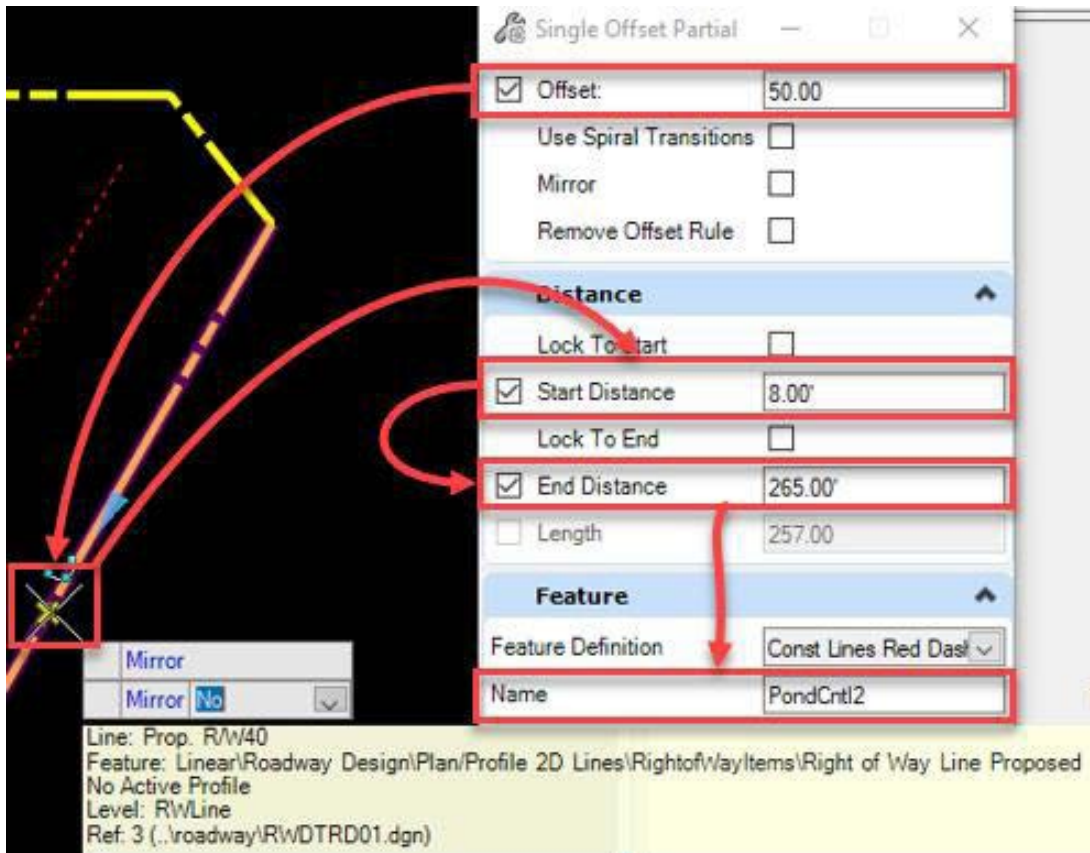
- Under the Geometry tab in the Horizontal group, left click on the Offsets and Tapers dropdown and select the **Single Offset Partial** tool.



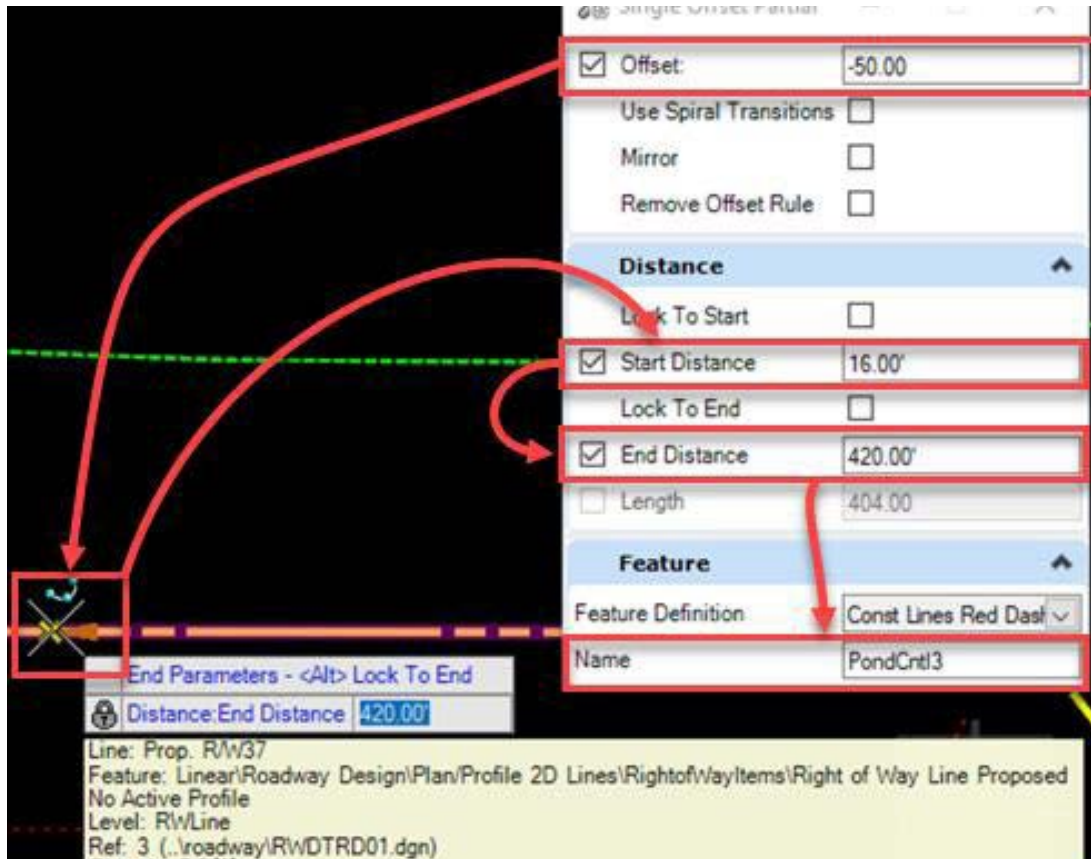
- This will open the **Single Offset Partial** dialog box. Check the box to lock the *Offset*. Type **90** in the *Offset* field and hit **Enter** on the keyboard. Now left click (Data Point) on the Centerline of the roadway. Check the box to lock the *Start Distance*. Type **70440** in the *Start Distance* field and hit **Enter** on the keyboard. Now check the box to lock the *End Distance*. Type **70860** in the *End Distance* field and hit **Enter** on the keyboard. Left click in the *Name* field and type **PondCntl1**. Hit **Enter** on the keyboard. Now left click (Data Point) in the open 3 times to create the first Pond Control construction line.



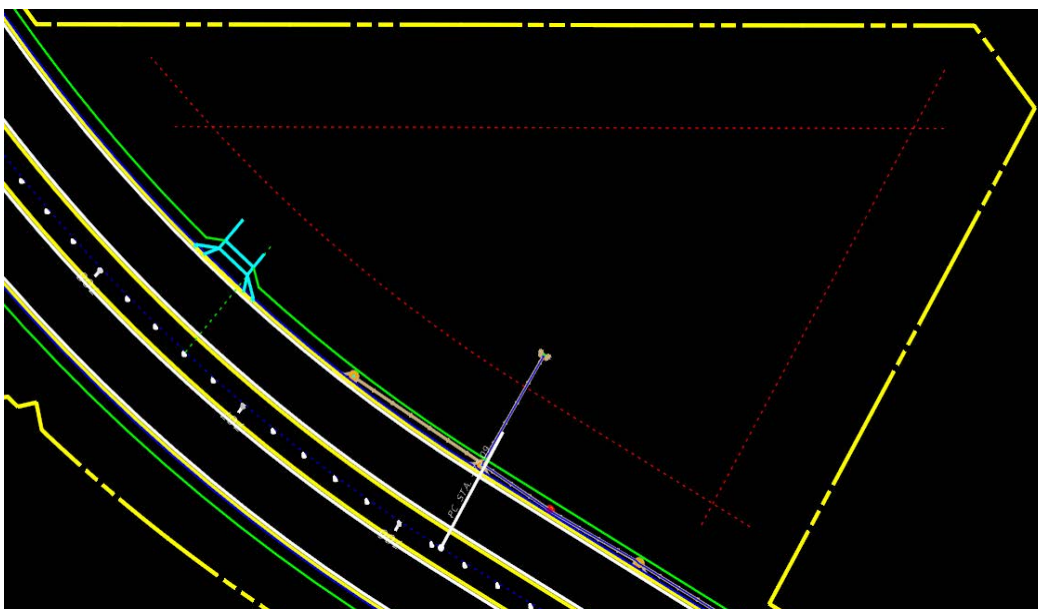
- Using the same tool, Change the *Offset* value to **-50** and hit **Enter** on the keyboard. Left click (Data Point) on the horizontal proposed right of way line. Type **16** in the *Start Distance* field and hit **Enter** on the keyboard. Type **420** in the *End Distance* field and hit **Enter** on the keyboard. Change the *Name* field to **PondCntl2** and hit **Enter** on the keyboard. Now left click (Data Point) in the open 3 times to create the second Pond Control construction line.



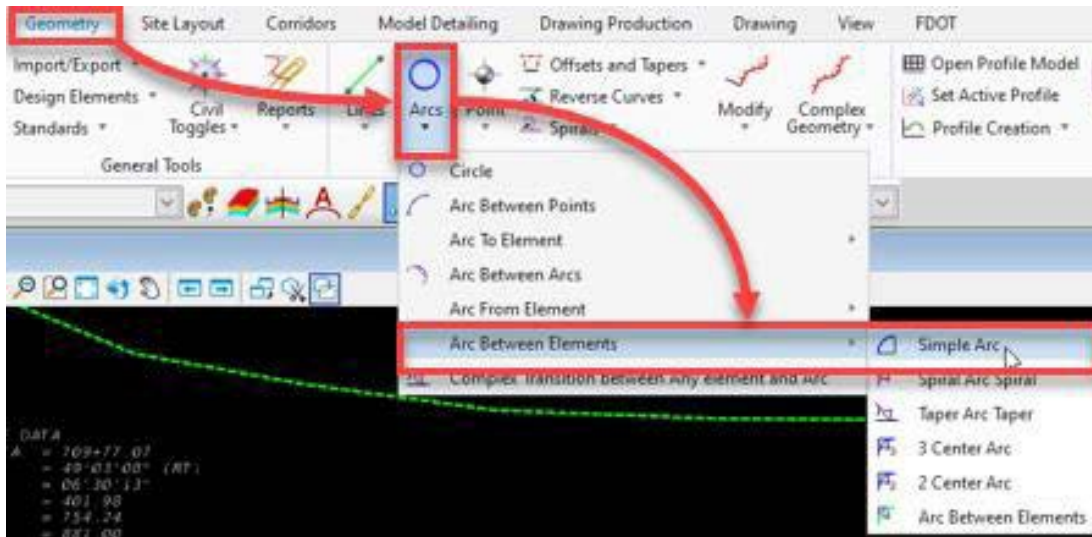
- Using the same tool, Change the *Offset* value to **50** and hit **Enter** on the keyboard. Left click (Data Point) on the diagonal proposed right of way line at the bottom of the two other Pond Control construction lines. Type **8** in the *Start Distance* field and hit **Enter** on the keyboard. Type **265** in the *End Distance* field and hit **Enter** on the keyboard. Change the *Name* field to **PondCntl3** and hit **Enter** on the keyboard. Now left click (Data Point) in the open 3 times to create the third Pond Control construction line.



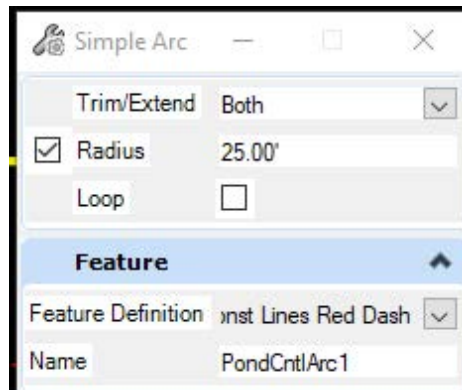
- There should be 3 red dashed lines placed inside the proposed R/W.



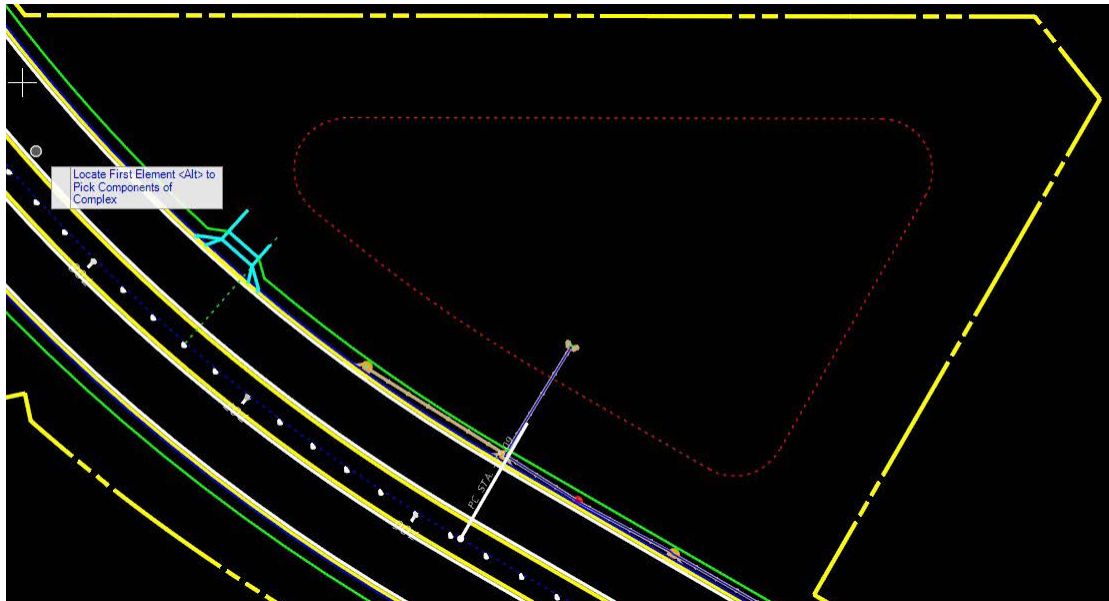
- Under the *Geometry* tab in the **Horizontal** group left click on the **Arcs** dropdown and while hovering on the *Arc Between Elements* flyout left click on the **Simple Arc** tool. This will open the *Simple Arc* dialog box.



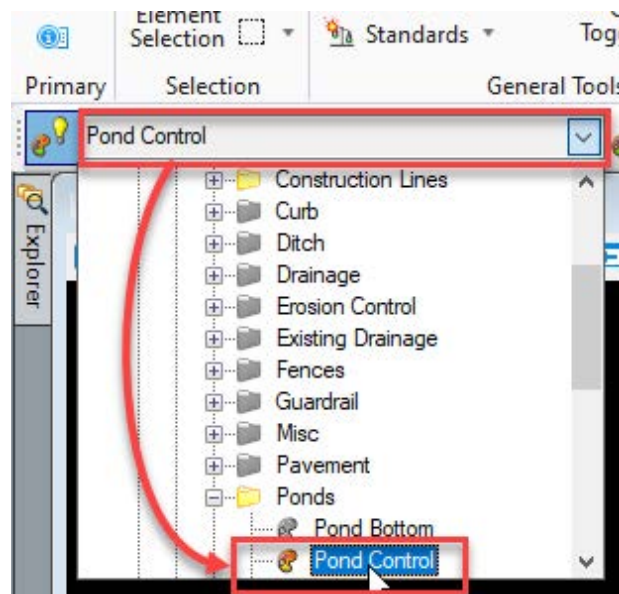
- Set the *Trim/Extend* dropdown to **Both**. Check the *Radius* check box to lock the radius and type **25** in the field and hit **Enter** on the keyboard. Leave the *Loop* check box un-checked. Change the *Name* field to **PondCntlArc1** and hit **Enter** on the keyboard. Left click (Data Point) on the PondCntl1 line and then left click (Data Point) on the PondCntl2 line. Left click (Data Point) 2 times in the middle of the proposed pond area to create the first arc.



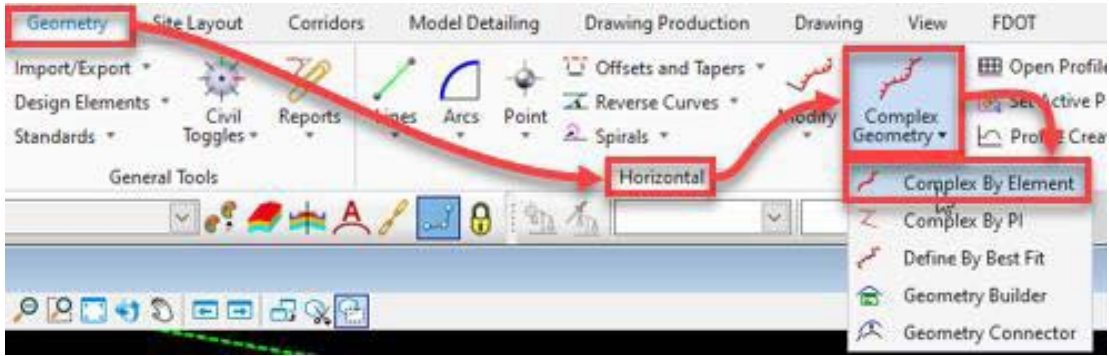
11. Change the *Name* field to **PondCntlArc2** and hit **Enter** on the keyboard. Left click (Data Point) on the PondCntl2 line and then left click (Data Point) on the PondCntl3 line. Left click (Data Point) 2 times in the middle of the proposed pond area to create the second arc. Now change the *Name* field to **PondCntlArc3** and hit **Enter** on the keyboard. Left click (Data Point) on the PondCntl3 line and then left click (Data Point) on the PondCntl1 line. Left click (Data Point) 2 times in the middle of the proposed pond area to create the third arc. There should now be an outline of the Pond Control shape.



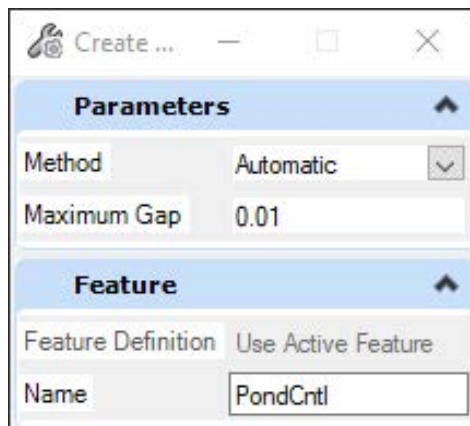
12. Left click on the *Feature Definition* dropdown. Collapse the *Construction Lines* folder and expand the *Ponds* folder. Select *Pond control* feature definition from the list.



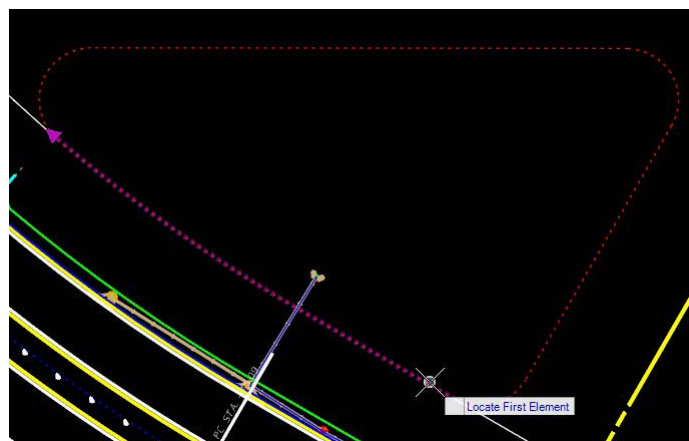
13. Under the **Geometry** tab in the **Horizontal** group left click on the *Complex Geometry* dropdown and left click on the *Complex By Element*. This will open the Create *Complex By Element* dialog box.



14. Set the Method to Automatic and the Maximum Gap to 0.01. Change the Name to PondCntl and hit Enter on the keyboard.



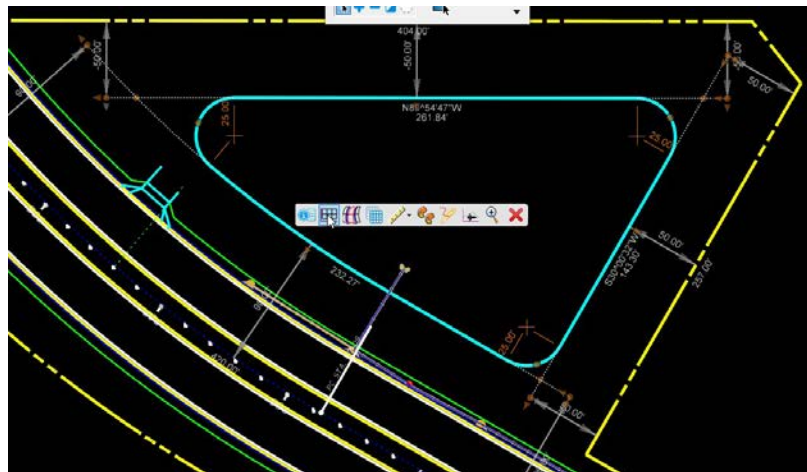
15. Left click (Data Point) on the PondCntl1 construction line and Left click (Data Point) in the open below the line to accept the new Pond Control complex element. Now hit the **ESC** key on the keyboard to terminate the command.



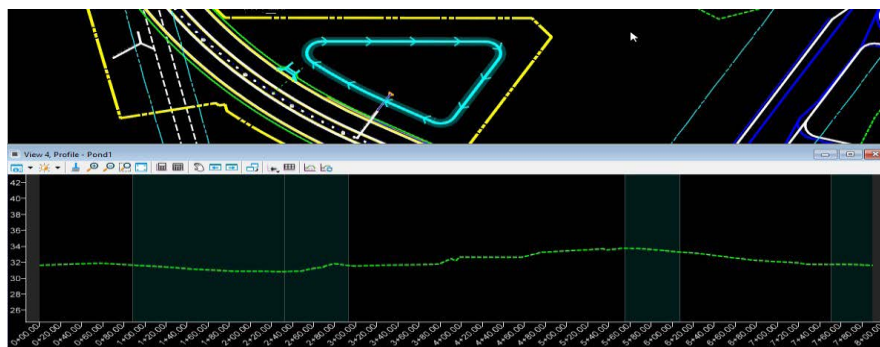
- Zoom out so the Existing Ground Boundary is visible. Using the element selector tool, left click (Data Point) on the green dashed Existing Ground Boundary Element. Hover over the line to cause the pop-up menu to appear. Select the middle icon to set this as the Active Terrain Model and left click (Data Point) in the open to clear the selection set.



- Using the element selector tool again, select the Pond Control shape. Hover over the selected shape and choose the second icon to Open a Profile Model of the existing ground along the Pond shape.



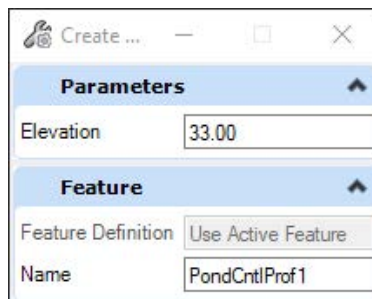
- Now left click on the Open or Close a View button for view 4 and left click (Data Point) inside the newly open view 4 window. This will create a Profile view of the Existing Ground surface along the Pond Control Shape.



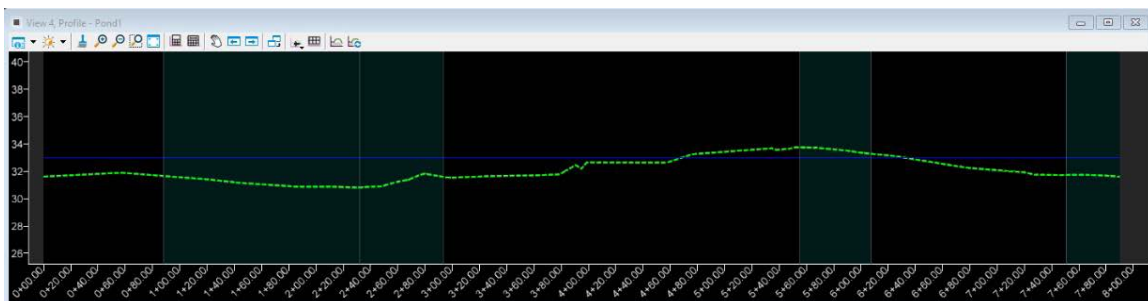
- Under the **Geometry** tab in the *Vertical* group left click on the *Element Profiles* dropdown and left click on the **Profile By Constant Elevation** tool. This will open the **Create Element By Elevation** dialog box.



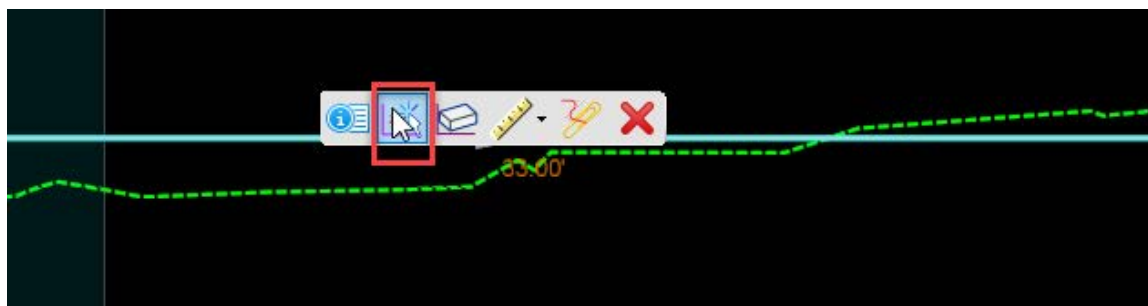
- Set the *Elevation* to **33** and the *Name* to **PondCntlProf1**. With view 1 active left click (Data Point) on the Pond Control shape to select it and right click in the open to accept it.



- Now left click (Data Point) one more time to create the new Pond Control Profile. It will appear in the view 4 Profile view as a flat line at an elevation of 33 feet. Hit the **Esc** key on the keyboard to exit this tool.

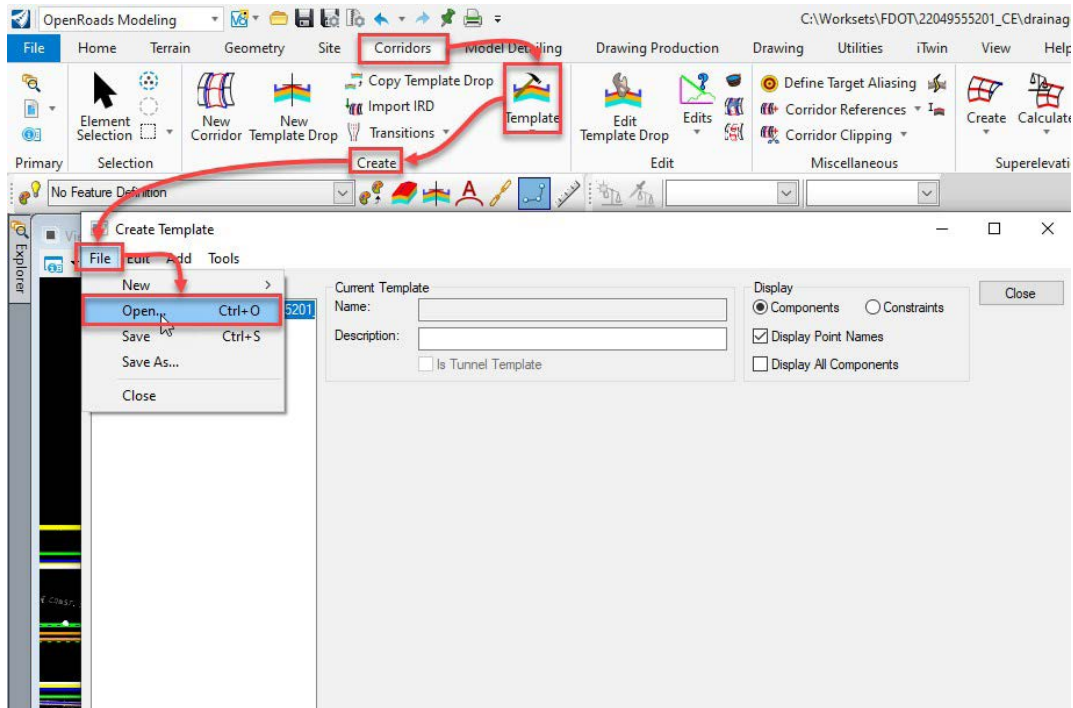


- Now left click (Data Point) two times in view 4 to activate it. Using the *Element Selector* tool, select the new Pond Control Profile line. Hover over the Pond Control Profile line until the context menu pops up and move the cursor to the second icon. Left click (Data Point) to set this as the Active Profile. Now left click (Data Point) in the open to clear the selection set.

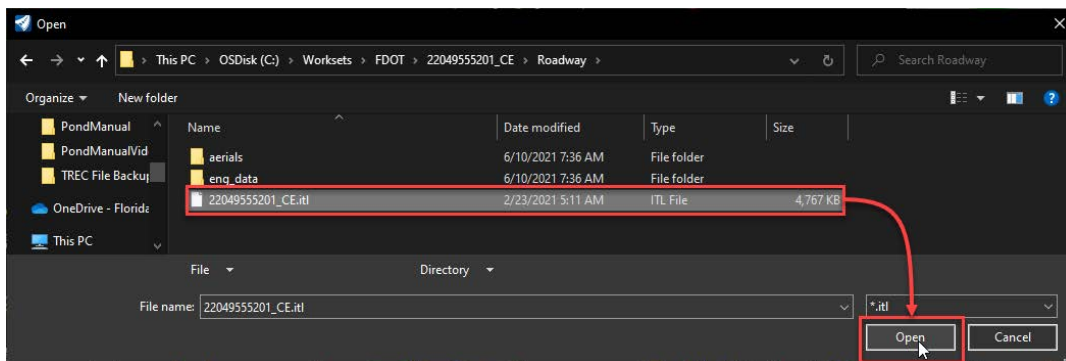


Exercise 2.3 Place A Pond Design Linear Template

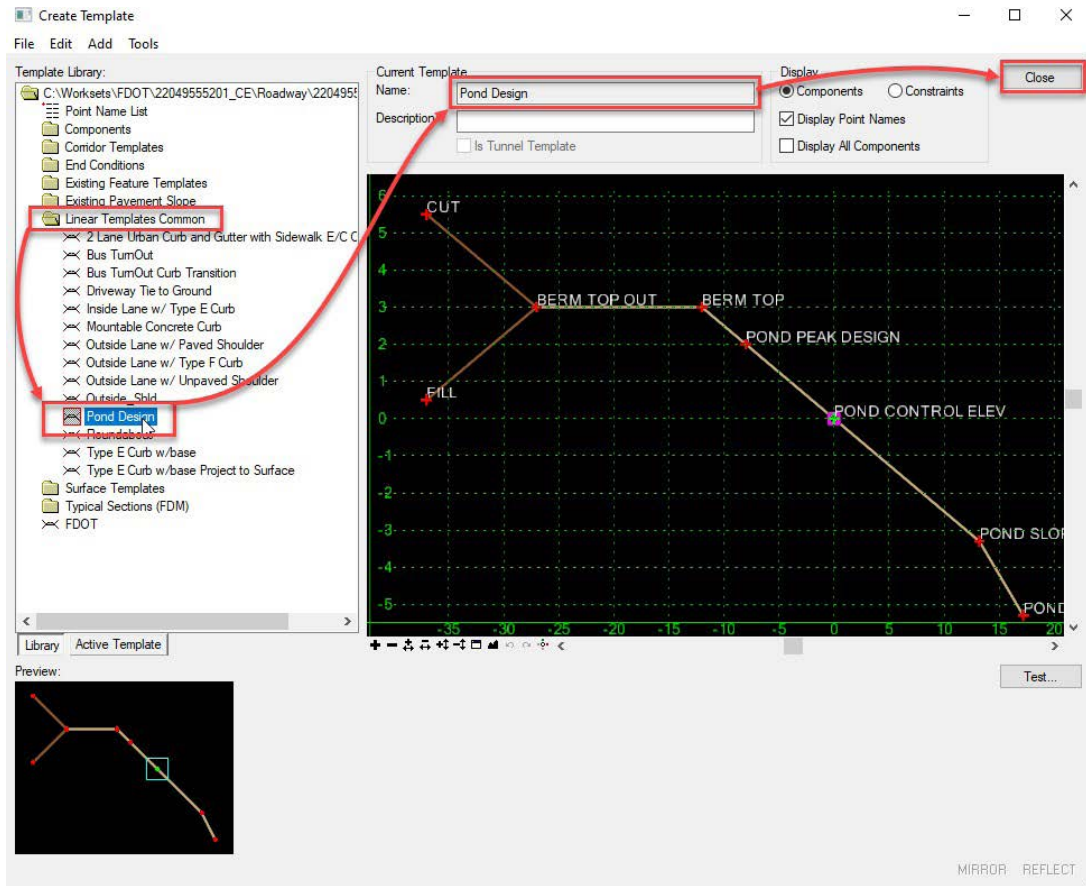
1. In preparation for the use of a Linear Template later in this exercise, it is necessary to make sure the proper Template Library is available. Choose the **Corridors** tab and in the **Create Group** left click on the **Create Template** tool. The **Create Template** dialog box will open. On this dialog left click on the **File** menu and choose the **Open** option. This will open the **Open File** dialog.



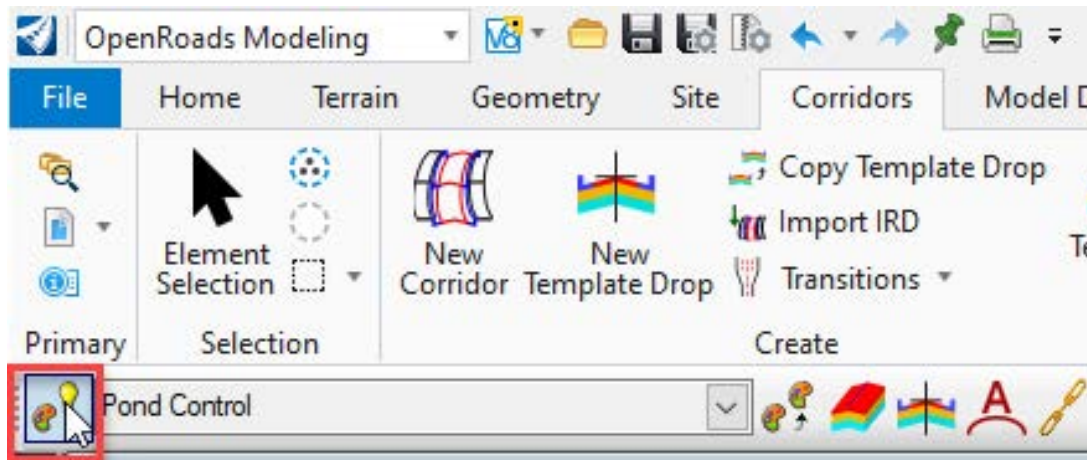
2. In the **Open File** dialog navigate to the *Roadway* folder of the current Project folder and select the *22049555201.itl* file. Now left click on the *Open* button in the lower right corner of the dialog box.



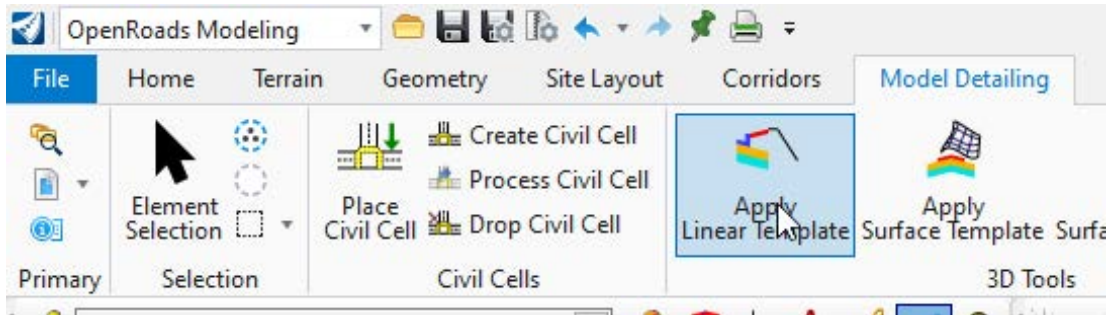
3. On the **Create Template** dialog box in the *Template Library* list, open the Linear Templates Common folder and double left click on the Pond Design linear template. The Current Template field should now be Pond Design. Left click on the **Close** button in the upper right corner of the dialog box.



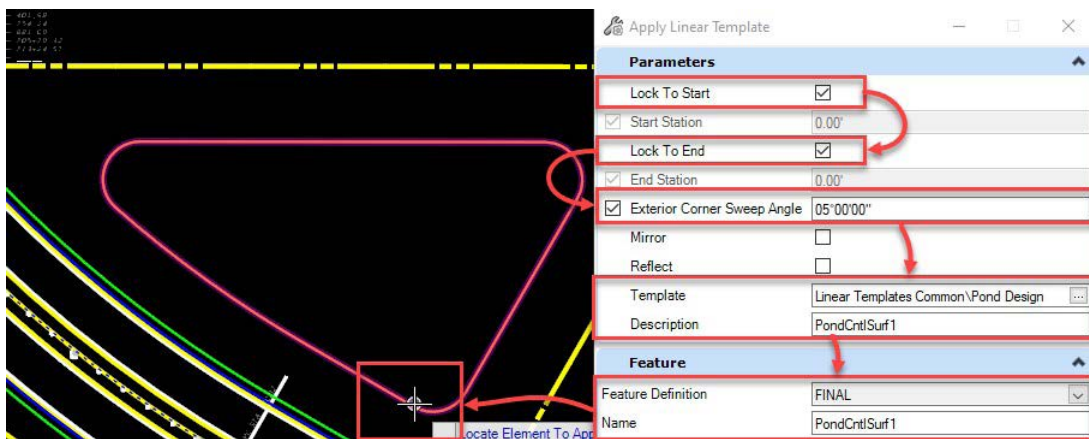
- Now left click on the *Use Active Feature Definition* button next to the **Feature Definition** drop down to deactivate this setting.



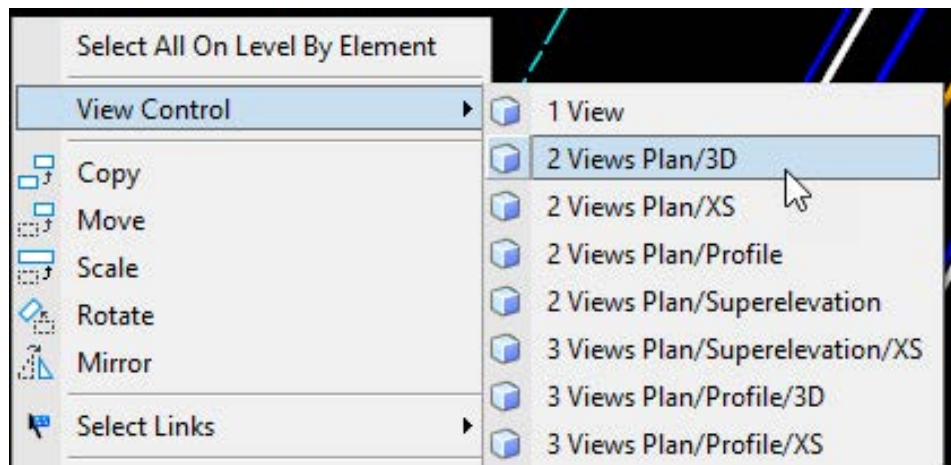
- Change to the **Model Detailing** tab and in the **3D Tools** group left click on the **Apply Linear Template** tool. This opens the **Apply Linear Template** dialog box.



- On this dialog make sure that only the *Lock To Start*, *Lock To End* and *Exterior Corner Sweep Angle* check boxes are checked. The *Exterior Corner Sweep Angle* should be set to **5** degrees and the *Template* should be set to **Linear Templates Common\Pond Design**. The *Description* field should be set to **PondCntlSurf1**. The *Feature Definition* should be set to **Final** and the *Name* should be set to **PondCntlSurf1**. Now left click (Data Point) on the lower right corner of the Pond Control shape and left click (Data Point) in the center of the shape 6 times to apply the Pond Design Linear template. Hit the Escape key to close the **Apply Linear Template** dialog box and exit the tool.

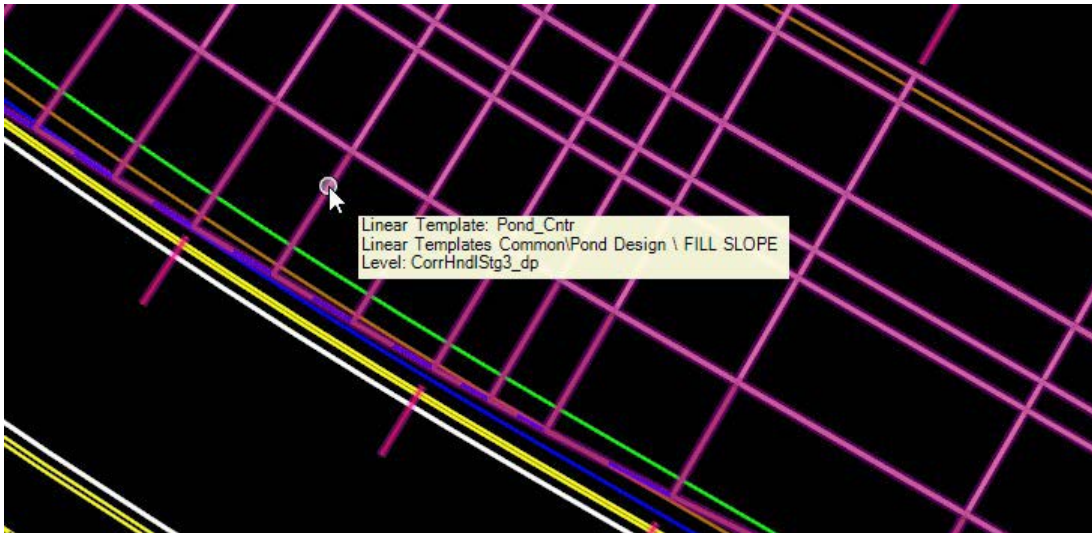


- With view 1 active right click and hold until the pop-up menu appears. Hover over the *View Control* flyout and choose the **2 Views Plan/3D** option.

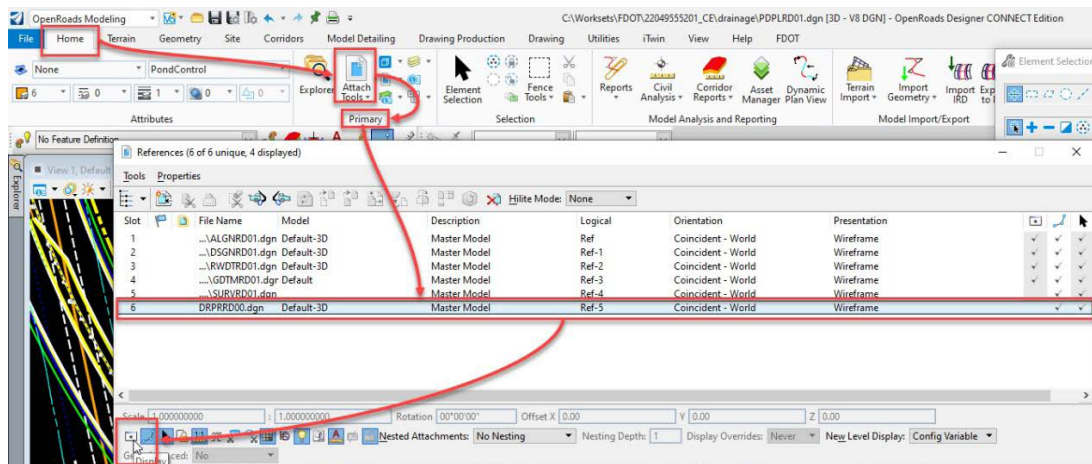


Exercise 2.4 Manipulate Pond Dimensions And Elevations

1. The example Pond's fill slope extends too far and is encroaching on the proposed sidewalk. Fixing this will be simple and easy to do. First thing to do, is to make it easier to see what can be changed by turning off the 3D view reference in the 2D view. Make sure that the 2D view, view 1 is the active view. Zoom to the side of the proposed roadway design that runs alongside the Pond fill slope. There is a portion of the proposed sidewalk that is covered by the Pond fill slope.



2. Under the **Home** tab in the **Primary** group left click on the **Attach Tools** icon. This will open the **References** dialog box. Find the Default-3D model reference and select it. Now just turn off the display by either removing the check mark under the *Display* column or left clicking on the Display button in the bottom left corner of the dialog. Close the References dialog box.



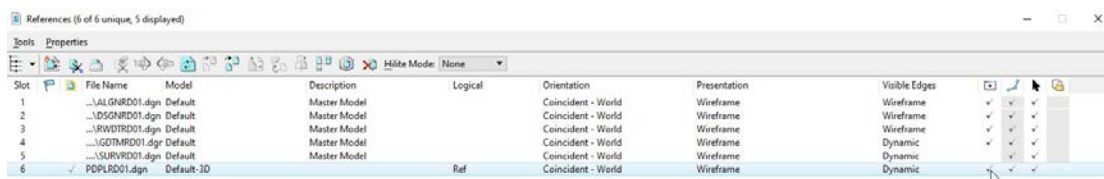
- Zoom view 1 out so the entire Proposed pond is visible. Left click (Data Point) on the Pond Control line to see all its parameters that can be changed in the 2D plan view. Dimensions, angles, bearings, offsets and even the radius of the arcs can be manipulated in this view.



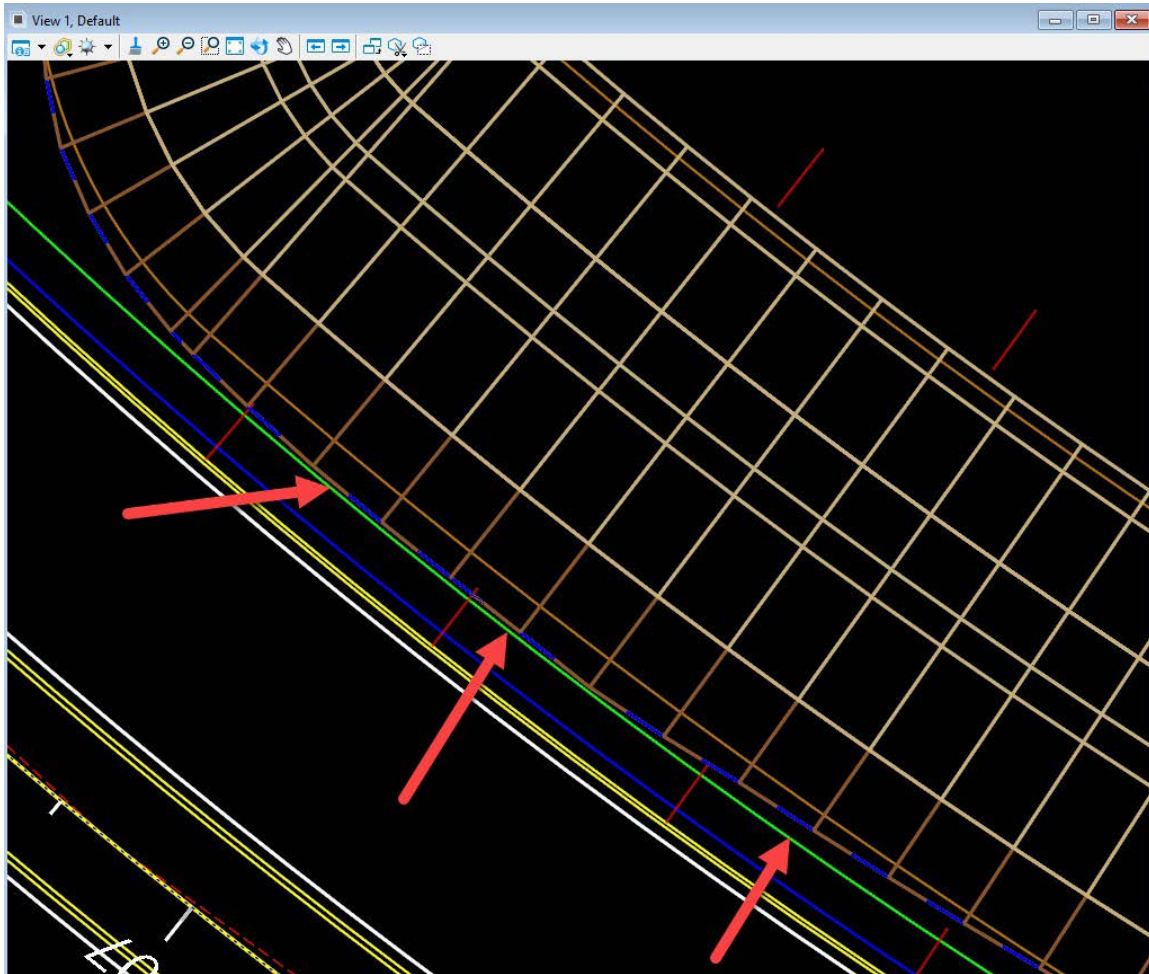
- Open and activate view 4, the profile view. This is the view that will be used to change the elevation of the Pond Control Profile to fix the encroachment issue with the proposed sidewalk. Use the Element Selector to left click (Data Point) on the Pond Control profile line. Once selected there will be a value of 33 feet located near the center of the profile line. Left click on the number and enter the change in the field provided next to the cursor. Type in **31** and hit the **Enter** key on the keyboard. The level of the Pond Control Profile will update.



- Activate view 1, the 2D plan view and reopen the References dialog box by hitting the **F9** key on your keyboard. Select the Default-3D model reference. Now just turn on the display by either left clicking to replace the check mark under the *Display* column or left clicking on the **Display** button in the bottom left corner of the dialog. Close the **References** dialog box.

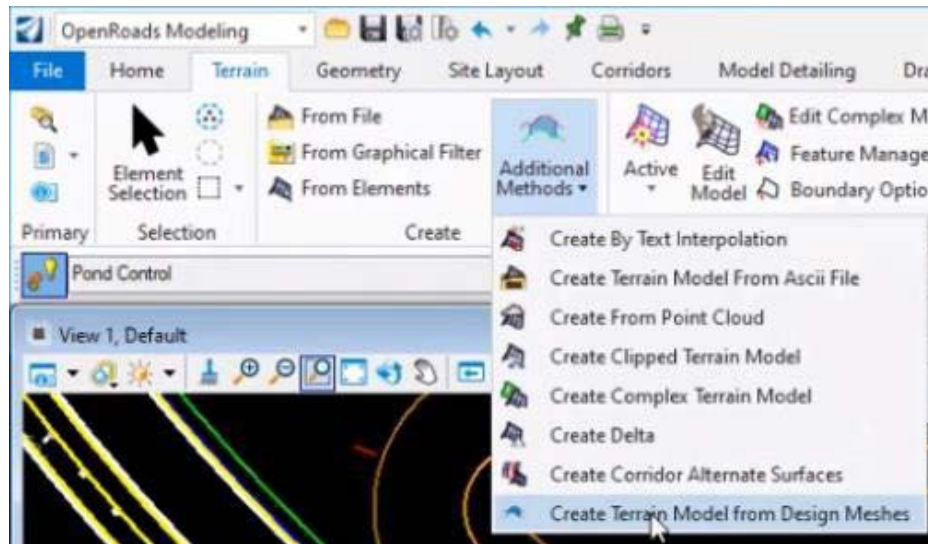


- Left click (Data Point) in view 1 and zoom in close to where the problem was with the fill slope. The fill slope no longer encroaches on the proposed sidewalk.

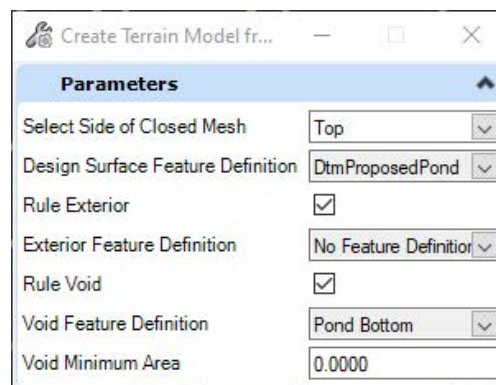


Exercise 2.5 Create A Pond Design Surface

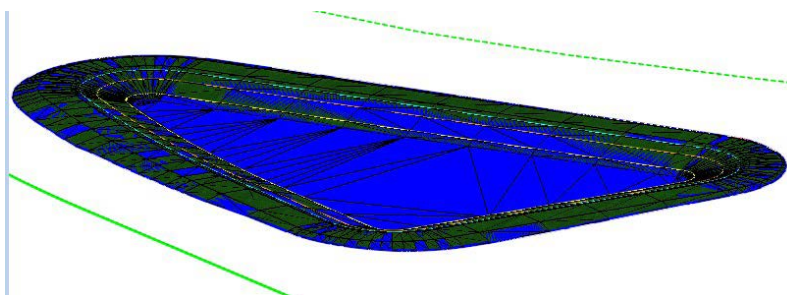
1. Using the **OpenRoads Modeling** Workflow under the **Terrain** tab in the **Create** group left click on the **Additional Methods** dropdown and select the **Create Terrain Model** from **Design Meshes** option. The **Create Terrain Model** from **Design Meshes** dialog opens.



2. Set the **Select Side Of Closed Mesh** dropdown to **Top**. Set the **Design Surface Feature Definition** dropdown to **DtmProposedPond**. Check the **Rule Exterior** check box. Set the **Exterior Feature Definition** dropdown to **No Feature Definition**. Check the **Rule Void** check box. Set the **Void Feature Definition** dropdown to **Pond Bottom**. Set the **Void Minimum Area** field to **0**.



3. Left click (Data Point) on the fill slope area of the proposed pond and then left click (Data Point) in the open 6 more times to complete the command. It will take a few seconds, but the new terrain element will appear, including the pond bottom that was not present before.



3 LAYOUT TOOLS & PROFILE RUNS

INTRODUCTION

The main focus in this chapter will be on: Reviewing the Layout Tools.

This chapter will introduce several important tools and features available in the Drainage and Utilities Workflow and FDOTConnect Workspace to build a drainage network. They are:

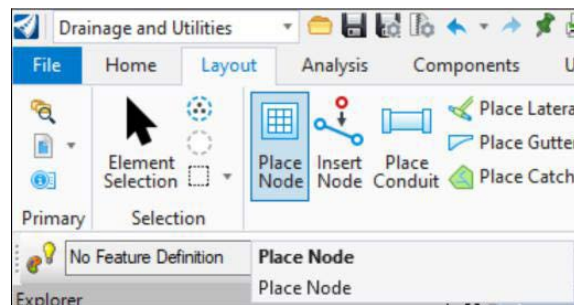
- Place Node
- Place Conduit
- Place Gutter
- Place Catchment
- Profile Runs

This chapter will also introduce the user to a new workflow terminology using the Ribbon. If you see a direction like this: **Drainage and Utilities > Layout > Layout > Place Node**, it means we are in the **WorkFlow of Drainage and Utilities** which has a **Tab** named **Layout**, and has tools that are located in the **Layout Group**. Now that we are in the right workflow, tab and group we may need to click on a tool that has more than one option.

PLACE NODE

Nodes are used to define drainage structure points within a drainage network. Nodes include all the Inlets, Junctions, and Outlets in the network and provide for the connectivity of the Conduit system. Nodes are also used to indicate physical changes in Conduit sizes or slopes. Conduits cannot change size or slope, other than at Nodes.

The general workflow includes a series of steps that are prompted by the Place Node tool to define the parameters for elevation, location, and rotation.



Workflows include the following, as defined in Bentley Drainage and Utilities CONNECT Edition Help:

Select Reference Element for Node Elevation. Reset to Type an Elevation - pick the element that you want to use to define the top elevation of the node. This can be a linear element which has an active profile, a mesh, or a terrain model. The elevation normally represents the top of the cover for a chamber. Press Reset if you want to enter an elevation.

Define Location - define a point to locate the node (by clicking in the graphics, Civil AccuDraw, or snapped to other graphics). Note that the text of the prompt tells you the type of node being place, such as Place Manhole for example. If you chose a reference element in the previous prompt, then this prompt lets you define a vertical offset from that element. If you pressed Reset, then this prompt lets you type in an elevation.

Select Rotation Mode - choose whether you want to define the rotation of the node using an absolute value, or relative to an alignment (which can be any linear element).

If you choose Absolute, then next prompt is to Select Rotation or Reset to Place again. The rotation is defined as an absolute value, using the settings defined in **File > Settings > File > Design File Settings > Angle Readout**. If Civil AccuDraw is used to define the location of the node, then the compass will lock to the nearest compass point, which is defined in the Civil AccuDraw Settings. The rotation value is still absolute -it will not update if the element selected in Civil AccuDraw Station and Offset is subsequently modified.

If you choose Relative to alignment, then the next prompt is to Locate Reference Element for Rotation. Select a linear element, from the active design file or a reference. The next prompt is to Select Rotation or Reset to Place again. The rotation value is relative to the selected linear element, and will be updated if the element is subsequently modified.

Feature Definition - Defines the feature definition to be assigned to the new node.

Name Prefix - the feature definition provides a default naming prefix, which can be overridden here.

Node placement is one of several steps in the FDOT drainage design and modeling process. After placement, nodes may require additional input from the designer within the Element Info and Quick Properties dialogs.

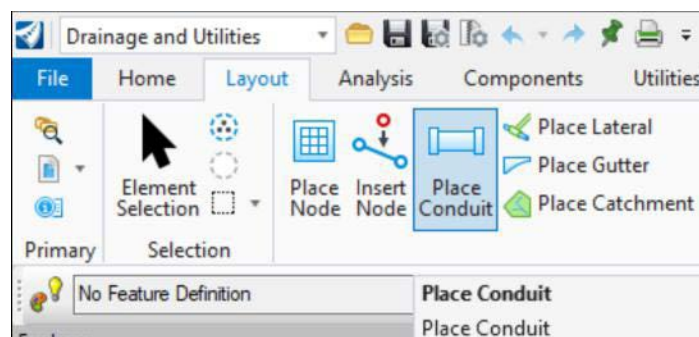
Nodes created in drainage models can be managed through Project Explorer, from the following path: **Drainage and Utilities > Home > Primary > Explorer > Drainage and Utilities Model > (dgn file) > Nodes**.

PLACE CONDUIT

Conduits connect and convey intercepted runoff from the various Nodes within a network to the Outfall, and may consist of pipes, boxes, or ditches. A multitude of options for sizing, and profiling Conduits are supported.

A Conduit represents a linear feature depicting a path connecting two Nodes. The path may be a straight line, line string, curvilinear, or a combination and series of linear MicroStation elements and should be placed from upstream to downstream.

The tool is accessed from the path: **Drainage and Utilities > Layout> Layout > Place Conduit**.



As defined in Bentley Drainage and Utilities CONNECT Edition Help,
The characteristics of the Place Conduit command are:

- Utilize a feature definition which defines conduit characteristics
- Will create the conduit to connection points defined in the nodes
- Will model the conduit in 3D

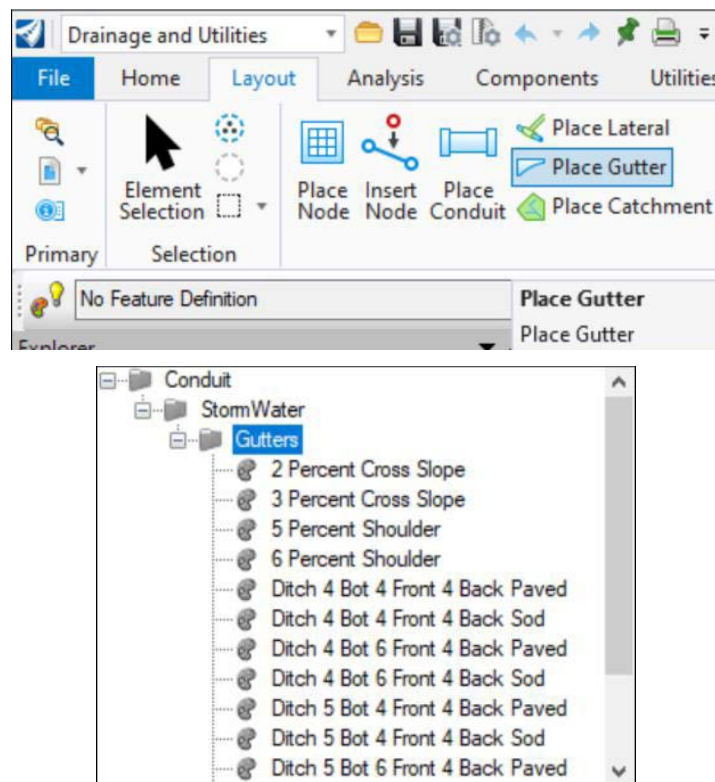
Elevations at the conduit ends are determined as follows:

1. The Conduit Feature definition for a utility (non-hydraulic) line contains a minimum depth of cover property, in the conduit table. For a drainage (hydraulic) conduit, the depth of cover is read from the Default Design Constraints, unless this is overridden in the prototype for the Conduit Feature Definition, by changing Set Local Design Constraint to True, then specifying the minimum depth of cover there. The minimum depth of cover will result in an elevation at the end points. If Consider Cover Along Pipe Length is checked on in Default Design Constraints, then the minimum depth of cover will be adhered over the whole length of the pipe - not just at the end points.
2. If you enter a slope on second prompt the slope may result in an elevation on the second node which is different than the minimum depth of cover for the conduit or the node cell.
3. The nodes will have an invert elevation point defined in the bottom 3D cell. This is the elevation that will be used in absence of other information.

PLACE GUTTER

Gutters are required to model bypass flow along the surface between nodes. Typical applications of gutters in FDOT designs are Curb & Gutter, median and adjacent barriers, and shoulder gutter. These are included as feature definitions with the FDOTConnect Workspace and are available when the Place Gutter tool is activated.

The tool is accessed from the path: **Drainage and Utilities > Layout > Layout > Place Gutter.**

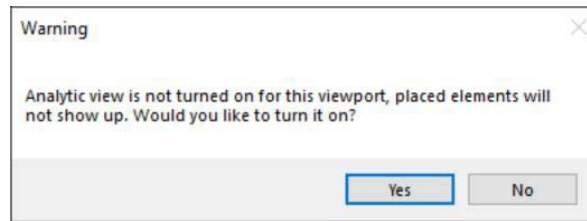


As defined in Bentley Drainage and Utilities CONNECT Edition Help, Place Gutter is used to define the following hydraulic characteristics of a drainage network:

1. The path of bypass flow between inlets
2. The shape of gutter between inlets.

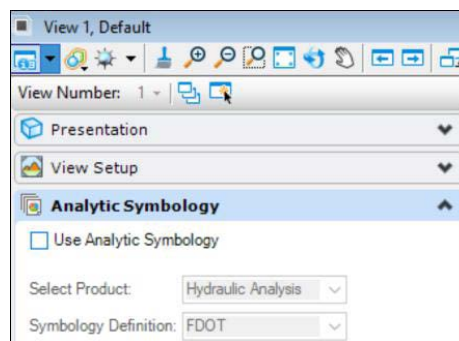
There is no relationship between the hydraulic definition of a gutter defined with this command and the physical model. The hydraulic and physical characteristics are handled separately and independently.

When the tool is started there is a check made to determine if Analytic View is turned on. It is necessary for analytic view to be toggled on because hydraulic gutter definitions are visible only by way of analytic view

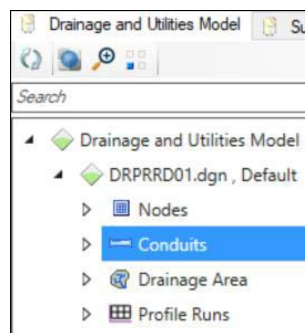


NOTE In the FDOTConnect Workspace, the default Drawing Scale for Drainage Design DGN file is 1" = 50'. When Analytic view is active, the DGN is best viewed at Full Size 1 = 1. The drawing scale can be accessed at the following path: **Drainage and Utilities > DRAW > Drawing Scales > Annotation Scale.**

Analytic View can be toggled on or off by activating View Attributes and the checkbox for 'Use Analytic Symbology'. When toggled on, transient information is displayed for designer information but is not intended for plans production.



Both Gutters and Conduits created in drainage models can be managed through Project Explorer, from the following path: **Drainage and Utilities > Home > Primary > Explorer > Drainage and Utilities Model > (dgn file) > Conduits.**



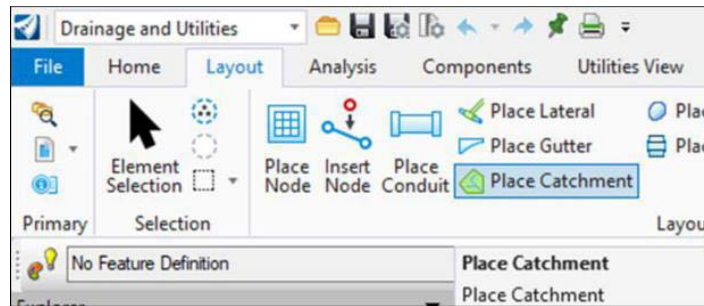
PLACE CATCHMENT

Catchments (drainage areas) in OpenRoads may be used to compute peak discharges or to attach computed discharge values to Nodes. The physical drainage area boundaries may be delineated using a digital terrain model, simply drawn with MicroStation, or keyed in as a total area value.

The Drainage Library is an integral part of defining and computing discharges for Drainage Areas. With graphical definition of the area boundary, runoff coefficients may be extracted from the available Land use areas include with **Drainage Area > Surface Polygon** features definitions in the Drainage Library.

Intensity values, for the peak discharge computations, are computed based on the time of concentration (Tc) assigned to catchments and the project-specific NOAA Atlas 14 Intensity-Duration-Frequency curves that are part of the Department's Drainage Library.

The tool is accessed from the path: **Drainage and Utilities > Layout > Layout > Place Catchment**.



As defined in Bentley Drainage and Utilities CONNECT Edition Help the Place Catchment Workflow includes the following:

Method - choose the method to describe the boundary of the area:

- Pick Points lets you pick a series of points (by clicking in the graphics, Civil AccuDraw, or snapped to other graphics)
- Pick shape lets you select a graphic
- Flood Fill lets you pick intersecting graphics

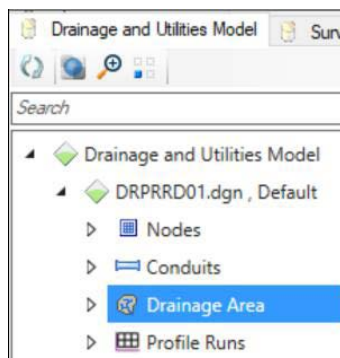
Select Outflow - pick the node that the catchment outflows to, or Reset if this element has not been created.

Select reference surface - pick a terrain model if you want a graphic to be created in the 3D model (by draping the catchment boundary over the terrain model) or Reset if you do not want this.

Use Scaled Area - if checked, the enclosed area of the boundary will be used. If unchecked, you can type in the area to use in the *Area* field.

Feature Definition - Defines the feature definition to be assigned to the new catchment

Design intent builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. If an element is modified, any related elements will recreate themselves based on these stored relationships.

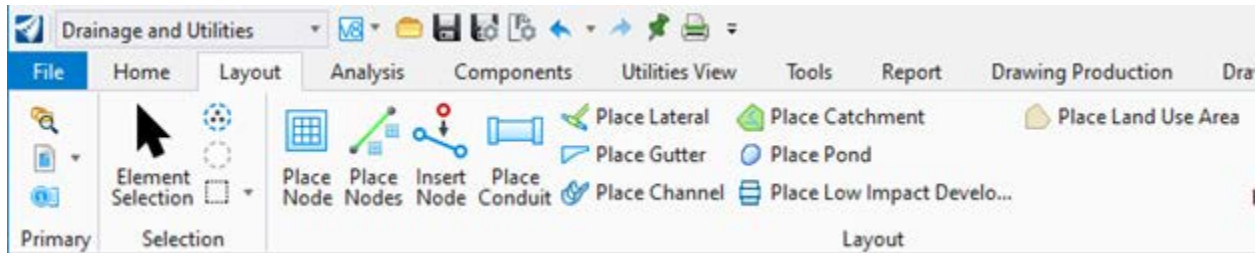


PLACE LAND USE AREA

Land use areas in OpenRoads may be used to visually assign runoff coefficients (Rational Method 'C' values or NRCS SCS curve number values) and friction coefficients (Manning's n values) throughout the project limits. The Department's Drainage Library includes a few predefined land covers with accessibility for users to edit these hydrology or roughness coefficients as needed depending on appropriate site-specific information, such as associated soil properties or project-specific design parameters.

In order for the land use areas to be used in hydrologic analysis, verify catchments utility properties are set to have the *Area Defined By* set to **Land Cover Areas**.

The tool is accessed from the path: **Drainage and Utilities > Layout > Layout > Place Land Use Area**.



As defined in Bentley Drainage and Utilities CONNECT Edition Help the Place Land Use Area Workflow includes the following:

Method - choose the method to describe the boundary of the area:

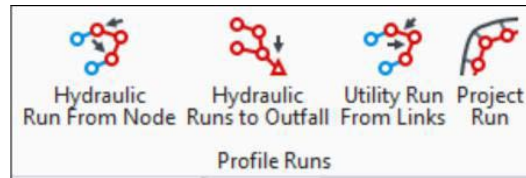
- Pick Points lets you pick a series of points (by clicking in the graphics, Civil AccuDraw, or snapped to other graphics)
- Pick shape lets you select a graphic
- Flood Fill lets you pick intersecting graphics

Feature Definition - Defines the feature definition to be assigned to the new land use area.

PROFILE RUNS

A Profile is a path between two nodes, spanning one or more links. This chapter will cover creation of profile runs. Analysis and plans production uses of profile runs for FDOT projects will be discussed in later chapters.

The tools are accessed from the path: **Drainage and Utilities > LAYOUT > Profile Runs.**



As defined in Bentley Drainage and Utilities CONNECT Edition Help, there are several methods available to create profile runs:

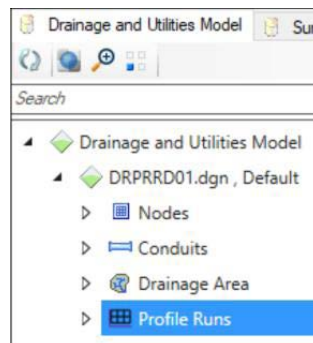
Hydraulic Run From Node - Creates a profile run from a selected node to the outfall, or between two selected nodes. This tool only works on hydraulic (i.e. storm or sanitary) networks.

Hydraulic Runs to Outfall - Creates a profile run for every path, from the most upstream nodes to the outfall. These paths are sometimes known as trunks or branches. This tool only works on hydraulic (i.e. storm or sanitary) systems.

Utility Run From Links - Creates a profile run from selected links, for any type of utility (e.g. storm, communications, electric, etc.) The links must be consecutive, without gaps between them.

Project Run - Projects a profile run created using the tools above onto a linear element, which could be a road centerline, or another profile run.

Profile Runs created in drainage models are managed through Project Explorer, from the following path: **Drainage and Utilities > Home > Primary > Explorer > Drainage and Utilities Model > (DGN file) > Profile Runs**



EXERCISES

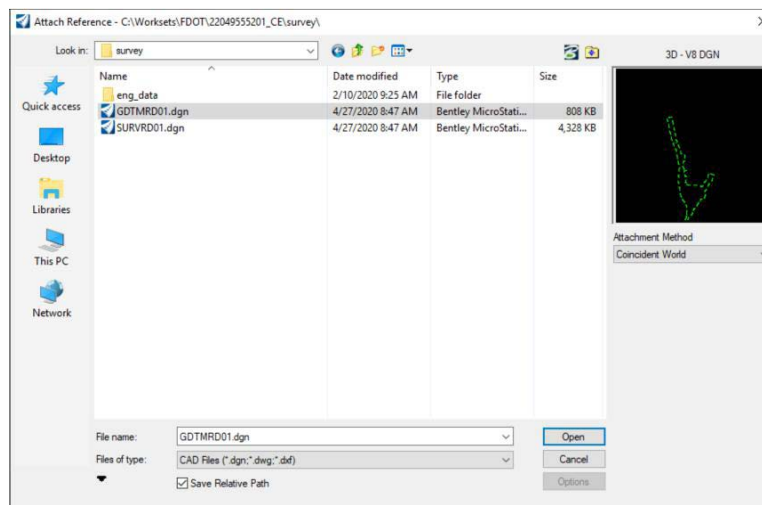
EXERCISE OVERVIEW – LAYOUT TOOLS & PROFILE RUNS

In this chapter exercise, users will create a simple drainage network. The existing terrain, proposed Centerline of Construction and SR61 roadway models will be added as references. Display settings will be adjusted to aid identification of drainage patterns. An inlet, a manhole and an outfall will be placed and connected into a drainage network.

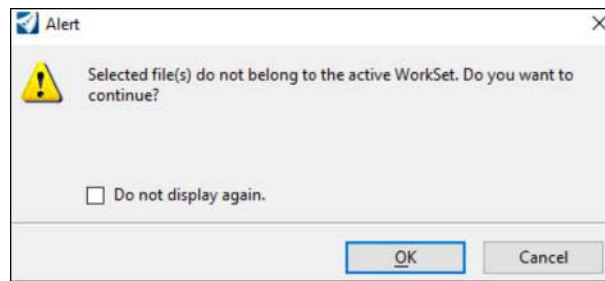
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Exercise 3.1 Attach References and Set Active Terrain

1. Open FDOTConnect, set the Workspace to “FDOT” and select the Workset – **22049555201**.
2. Browse to the drainage folder and open *DRPRRD01.dgn*.
3. Navigate through the following path to open the References dialog and attach the files listed below:
Drainage and Utilities > Home > Primary > Attach Tools > References > Tools > Attach
 - a. Survey folder: *GDTMDR01.dgn*.

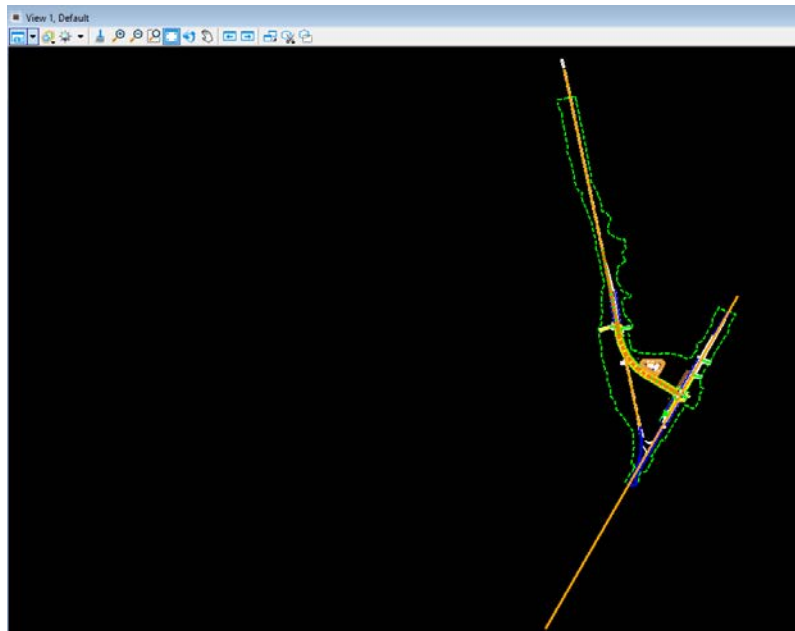
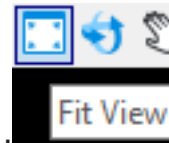


- i. If prompted, select OK to the alert shown below.

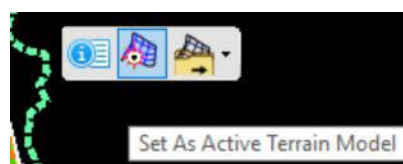


- b. Drainage folder: *PDPLRD01.dgn*
- c. Roadway folder: *ALGNRD01.dgn, DSGNRD01.dgn*

4. Select **Fit View** to reset window extents to new references

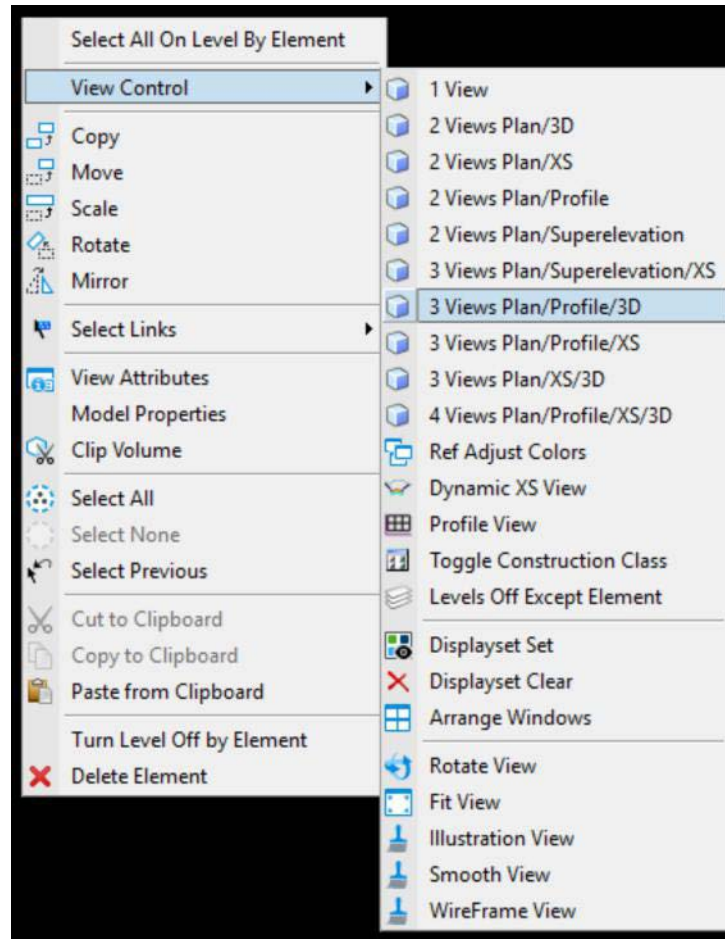


5. Click on the outer perimeter of the existing terrain in the *GDTMRD01.dgn* file and hover over the perimeter to activate the pop-up menu.
6. Click on the middle icon in the pop up menu to Set as Active Terrain Model.

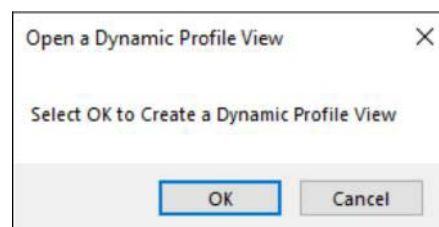


Exercise 3.2 Set View, Display, Window Settings

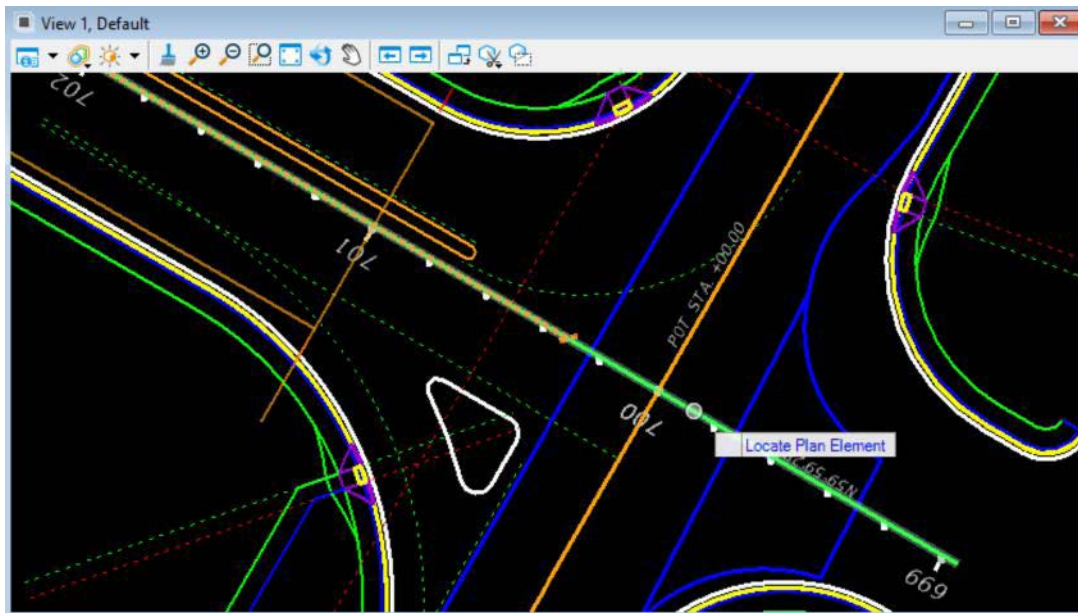
1. Next, move the mouse over to blank space in View 1, hold down the right mouse button to open the quick menu for display, and select **View Control > 3 Views Plan/Profile/3D**.



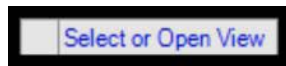
2. The views will automatically orient Plan View in top left, 3D View in top right, and Profile View along the bottom. The 'Open a Dynamic Profile View' window also pops up.



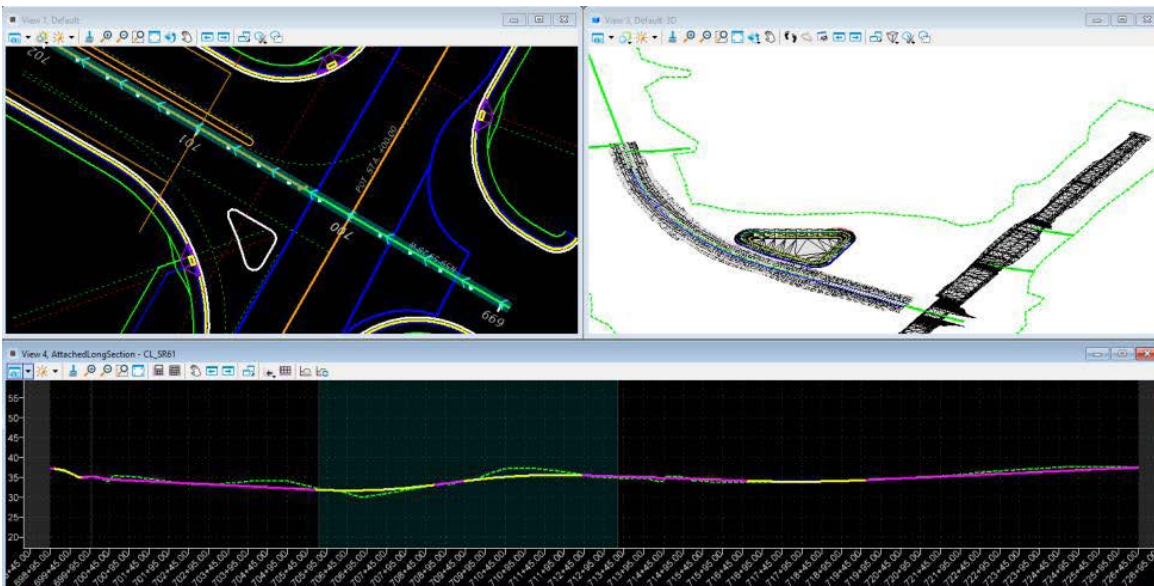
- a. Click **OK** and follow the prompt to Locate Profile Element. Zoom into the plan view and select the alignment for SR 61, as shown below.



- b. Next, move cursor to profile view and left click to accept the prompt **Select or Open View**.



- c. As shown below, the proposed profile along SR 61 is populated in the bottom profile window and the corresponding alignment in plan view is highlighted teal with arrows for direction of profile.

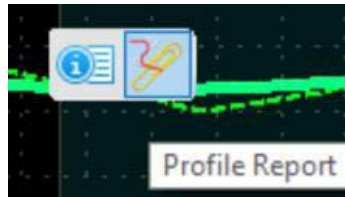


Exercise 3.3 Review Tools to Identify Drainage Patterns

In this exercise, the user will review a sample of tools available to designers for use in delineation of drainage areas. Refer to Learning Resources for information on additional tools and OpenRoads features.

1. Profile Reports

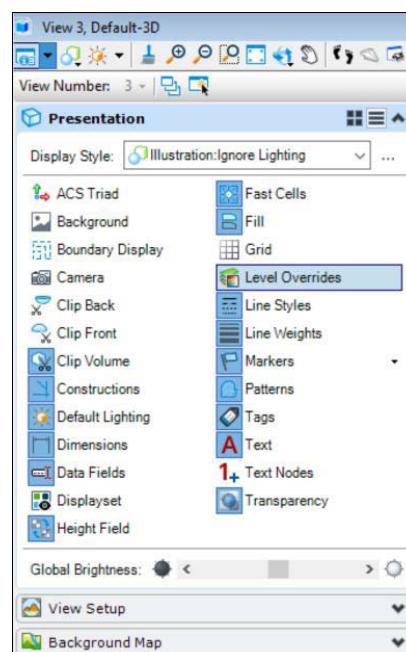
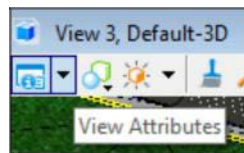
- a. Click on and hover over the proposed profile, CL_SR61 to activate the quick menu. Select the **Profile Report** icon from the quick menu.



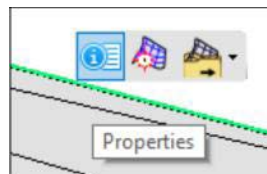
- b. From the Bentley Civil Report Browser, select *VerticalAlignmentReview.xsl* from list on the left.
- c. Review this report in the vicinity the SR 61 and US 98 intersection. See VPI at STA 699+99.14 with a high point elevation of 35.24, a vertical high point (VHP) at STA 711+79.56, elevation 35.63, and a vertical low point (VLP) at STA 706+49.68, elevation 31.65. Close the report browser.

2. Terrain Display

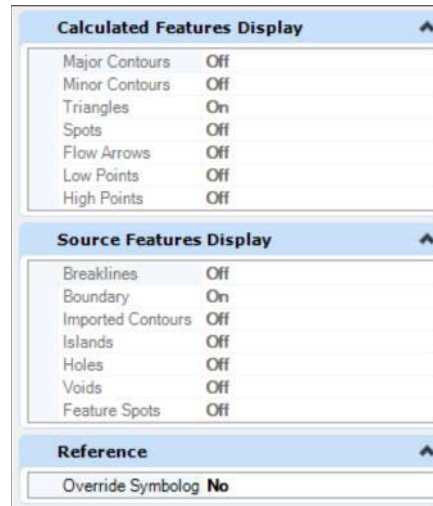
- a. Another visualization tool is in the 3D view on the terrain itself. Expand the 3D view and click on the down arrow to expand the view attributes tool, located at the top left of the window. Click and turn on Level Overrides. Close the dialog.



- b. Next, click on and hover over the boundary of the proposed terrain.to activate the quick menu.



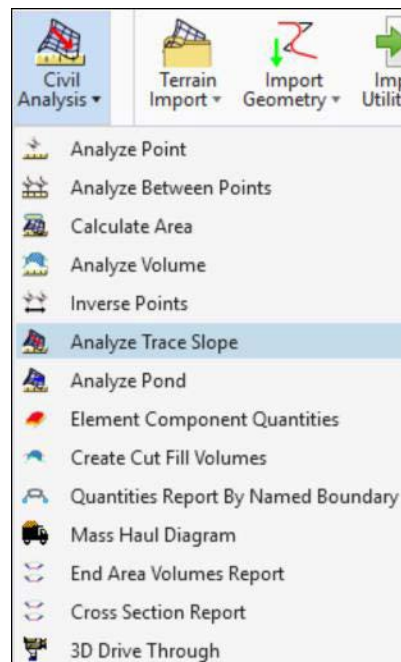
- c. From the quick menu scroll down to **Calculated Features Display**, **Source Features Display**, and **Reference**. Note, read only attributes are greyed out.



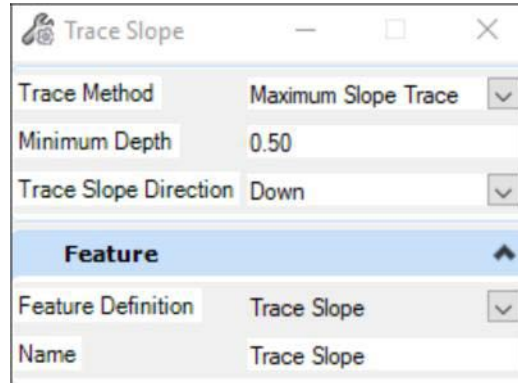
- d. Under **Reference**, change *Override Symbology* to **Yes**. Attributes from **Calculated Features Display** and **Source Features Display** are now available to edit. For example, change *Flow Arrows* to **On**. Close properties window and review the 3D terrain display.

3. Analyze Trace Slope

- a. The final tool review in this exercise is at the following path: **Drainage and Utilities > Home > Model Analysis > Civil Analysis > Analyze Trace Slope**. Activate the tool.



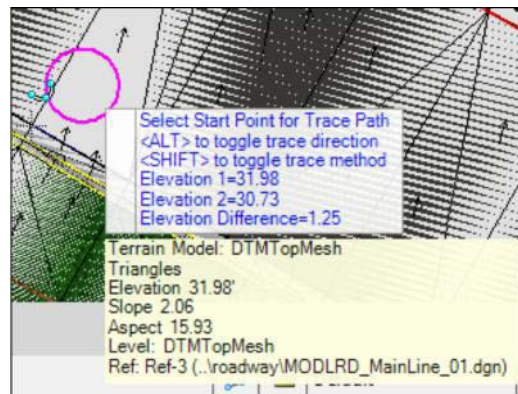
- b. For this exercise, select **Maximum Slope Trace** method, with *Minimum Depth* set to **0.50** and *Trace Slope Direction* set to **Down**. Under **Feature**, find and select the **Trace Slope** feature definition. You can enter a name for this feature or use the default.



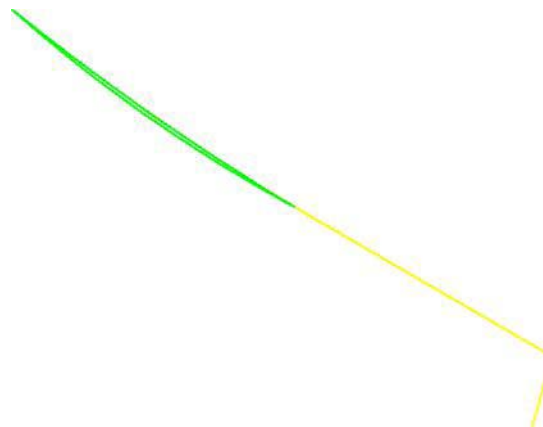
- c. Follow the prompt to select the terrain model element. This is done by selecting the boundary of the terrain.



- d. Follow the next prompt in the lower corner of the screen, Select a Start Point for Trace Path.



- e. The resulting path is the steepest descent from the point selected through the terrain model that terminates at the low point. In the sample shown below, a yellow path originates at the point selected, and the green polygon represent the low point location.

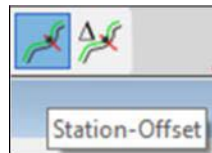


Exercise 3.4 Review Civil Accudraw

1. Reset the view controls to 2 Views Plan/3D, (hold down right-click in the plan view, navigate to *View Control*, select **2 Views Plan/3D**).
2. Navigate to: **Drainage and Utilities > Layout > Toggles > Civil Accudraw** and click to toggle on. The **Civil Accudraw** menu can be docked, and when expanded looks like the following:



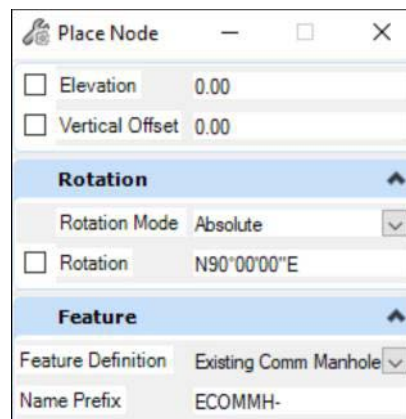
3. This tool is useful for designers when placing drainage features using precise input. Hover over the icons for descriptions of each. The upcoming exercise will demonstrate use of Accudraw with Station-Offset. Click the **Station-Offset** icon to activate.



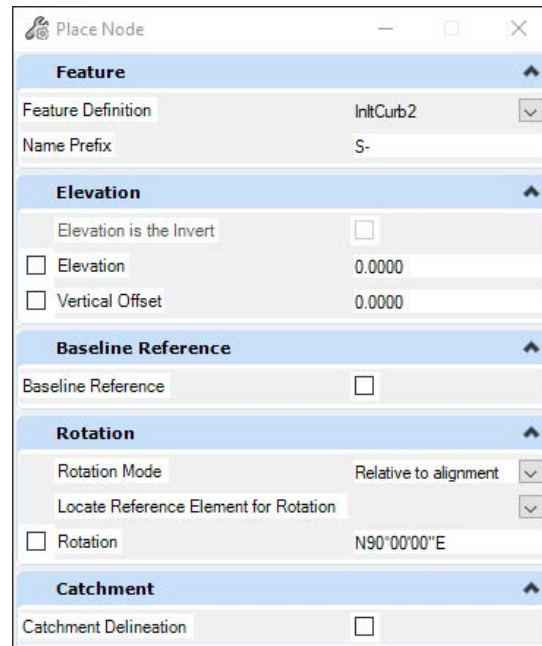
Exercise 3.5 Place Node with Civil Accudraw

The processes followed in this exercise will result in a node location that automatically adjusts to changes in alignment or terrain elevation to maintain the relative horizontal and vertical placement properties.

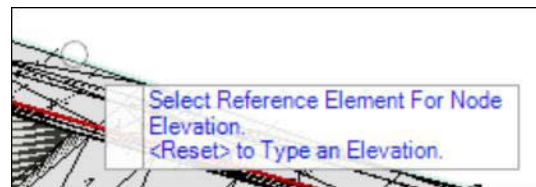
1. Navigate to: **Drainage and Utilities > Layout > Layout > Place Node** and click to activate tool. The tool may open by default with the following window and a prompt for Select Reference Element for Node Elevation:



2. Before following plan view prompts, update the dialog with the following:
 - a. Change *Rotation Mode* to **Relative to alignment**.
 - b. Select the **FDOT Curb Inlet Type 2** feature definition from the pull-down menu: **Node > Stormwater Node > Drainage Structures > Curb > InitCurb2**. Upon selection, the dialog may expand to show the **DrainageInlet Item Type** attributes. FDOT Drainage Item Types will be discussed in a later chapter.

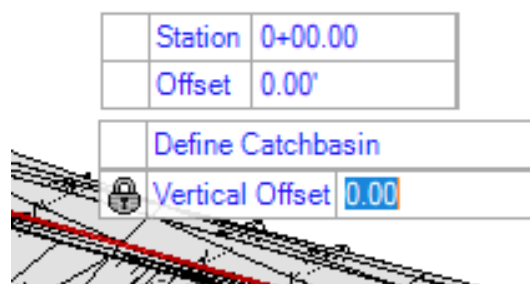


- Now that the dialog is set up, follow the prompts to place the curb inlet. The current prompt is Select Reference Element for Node Elevation. With the 3D view open, move the cursor over to the 3D model and left click on the edge of the proposed terrain.

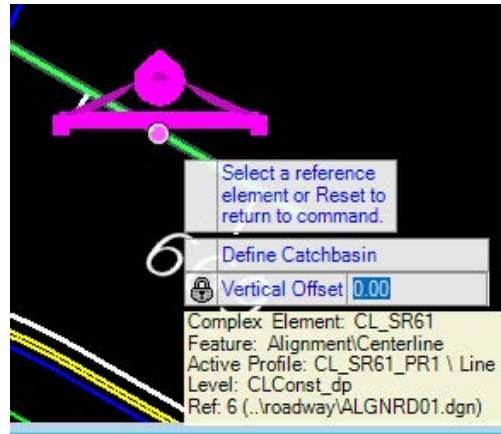


HINT If an OpenRoads tool is prompting the user for additional input, the specific prompt can usually be seen both on the cursor and in the messages located in the lower left of the OpenRoads window.

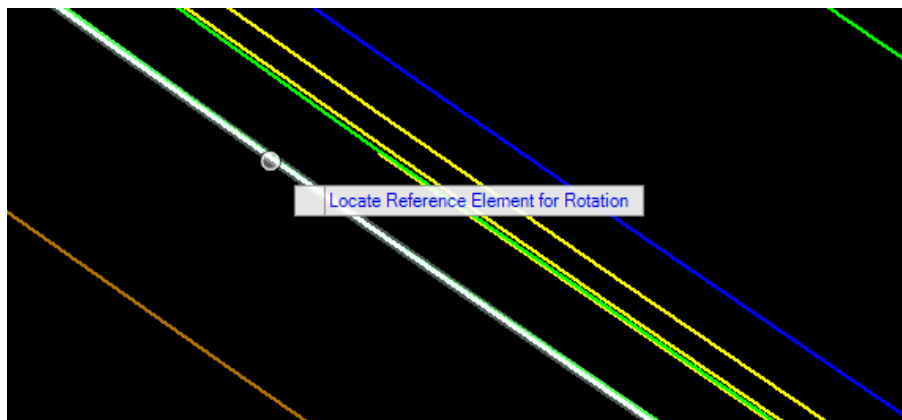
- The next prompt is Define Catchbasin. This exercise will not choose to activate this option, left click to move on to next prompt. There are available workflows within OpenRoads tools to automatically place catchbasins, assign to node, and update based on terrain properties and node locations. Refer to Bentley Product training and online help for further details. The FDOT sample exercises will place the node and catchbasin features separately.
- Since Civil Accudraw – **Station-Offset** was activated when we initiated the place node tool, the cursor prompts now include the following fields for *Station* and *Offset*:



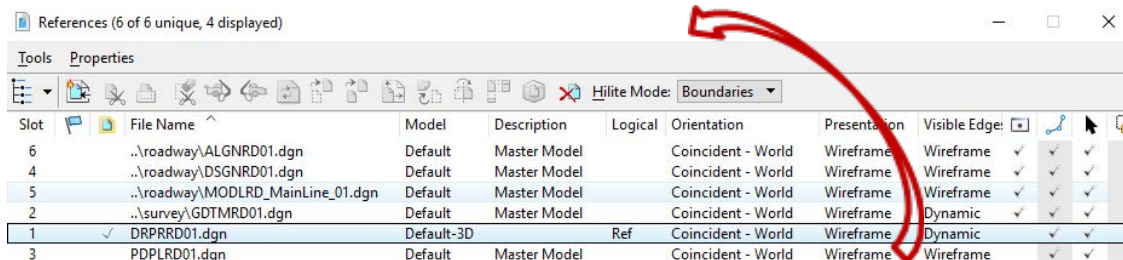
- Use the tab button to cycle through the prompt fields so that *Offset* is active and type in the letter 'o' (for origin). The tool prompts change to Select a reference element or reset to return to command. Move cursor back to plan view and select the centerline alignment CL_SR61.



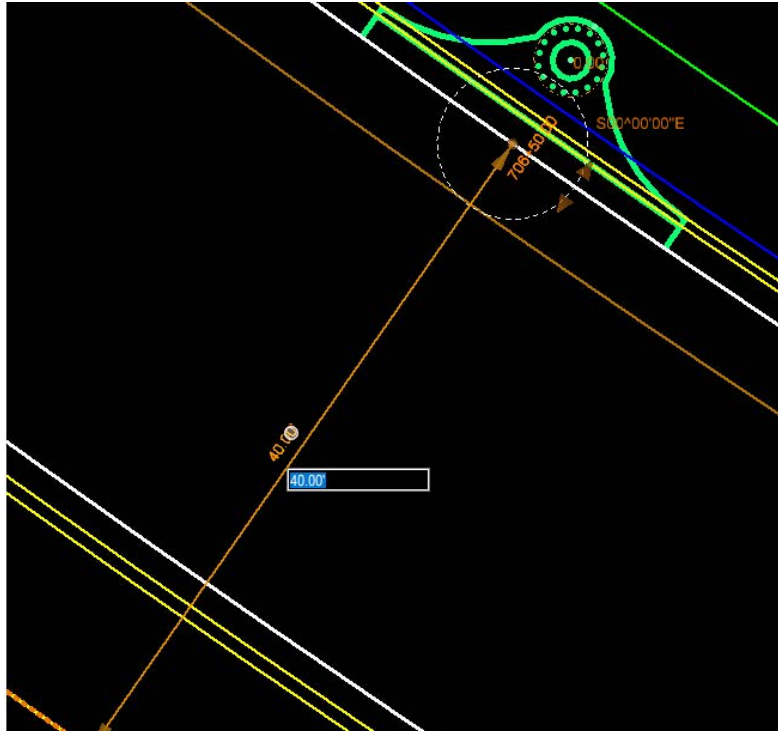
- Now, the node placement is associated with the project alignment. Moving the cursor dynamically updates the tool display of Station Offset. Use tab to cycle to the *Station* line and enter **70650.00**. Tab to the *Offset* line and enter **40.0**. This has 'locked in' the location of the curb inlet to STA 706+50, 40' RT.



- The next prompt is *Select Rotation Mode*. In the earlier setup, we selected **Relative to Alignment**. Left click to accept this mode and the next prompt is to select the element that defines the node rotation. Select the CL_SR61 alignment from Step 6 and enter **S00°00'00"E** in the *Rotation* field.
- After accepting settings, the program takes some time to process. This is normal when placing a new node type for the first time. Left click to exit the place node tool. Next we will explore and update properties of the node just placed.
- With the plan view active, open **References** dialog and turn off the 3D model. This can make it easier to isolate the 2D linework.



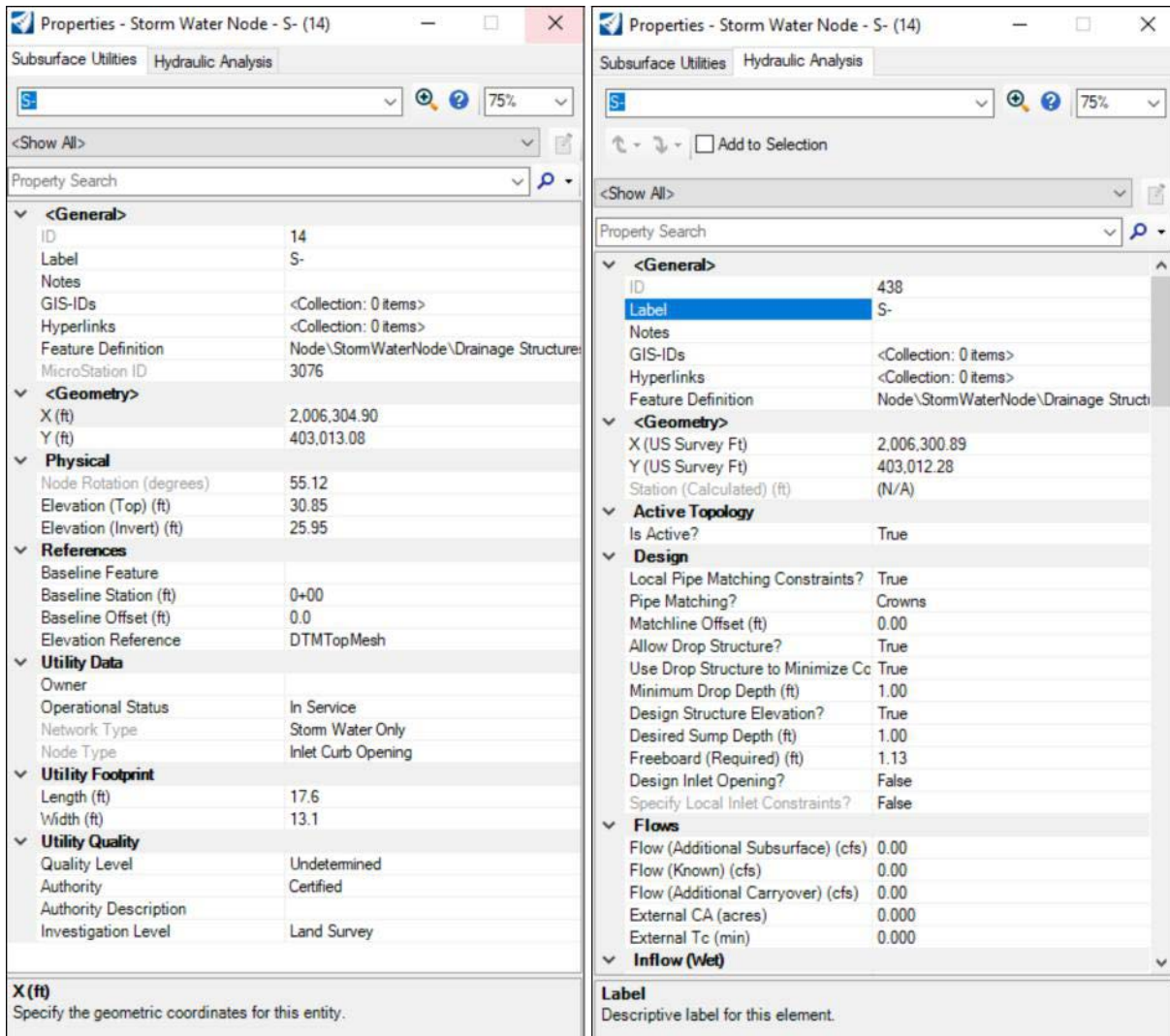
11. Select the node. Since this was placed using Civil Accudraw, Station-Offset, the location is locked along these parameters, but may be edited with the orange label and dimension manipulators. For example, click on the 40.00' dimension and type in **100.00** in the text box and enter. The structure location is automatically moved to 100.00' RT offset. Test changing the station to a new location and when done, relocate the node to original STA 706+50, 40' RT location.



12. With the node selected, hover over the node linework and open the center icon from the quick menu, Utility Properties.



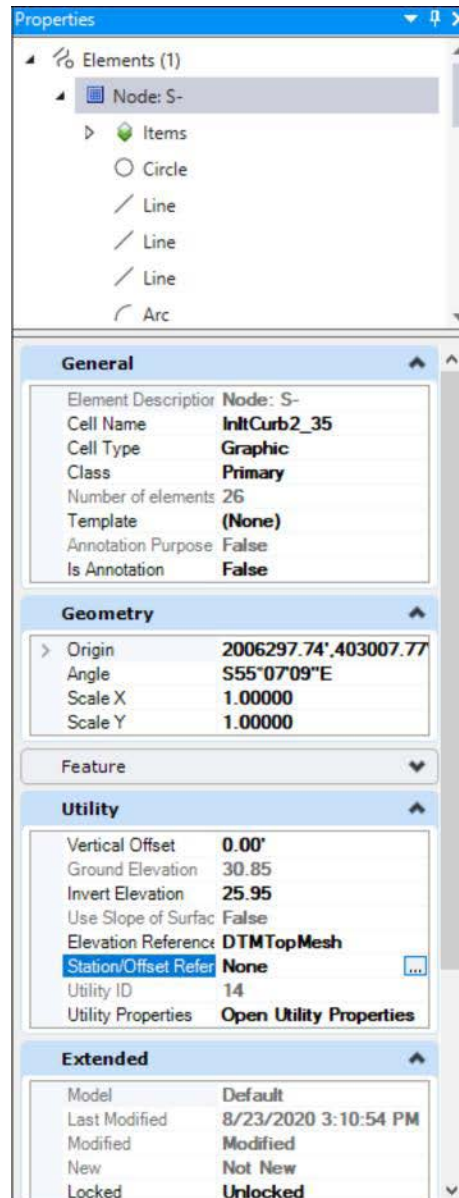
13. The Utility Properties contain two tabs: **Utilities** and **Drainage**, shown side by side. Most of the properties have been automatically loaded based off the feature definition and prototype.



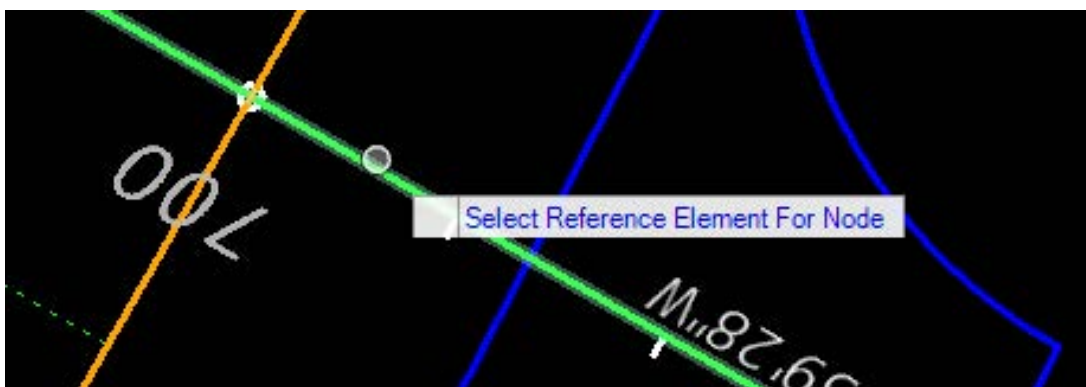
NOTE *Feature Definition and Prototype properties used for drainage nodes, conduits, and catchments are onetime and one-way. For example, if a prototype is edited after a node is placed, those edits will not be reflected in the node properties. Conversely, if edits are made to a placed node, this has no effect on the prototype or feature definition.*

14. In each tab, the **References** sections, the *Baseline, Station, Offset* information is either blank or zero. For these location properties to be associated to individual drainage features in the model, there is another workflow that is needed and can be performed individually or with multiple features simultaneously.

- a. Close the **Utility Properties**. With the node still selected, open the element properties. Scroll down to the **Utility** section and see that *Station/Offset Reference* is None.



- b. If the baseline was not referenced when placing node Click the ellipse and follow the prompts to define the reference baseline. Select the same alignment used for node placement, CL_SR61.

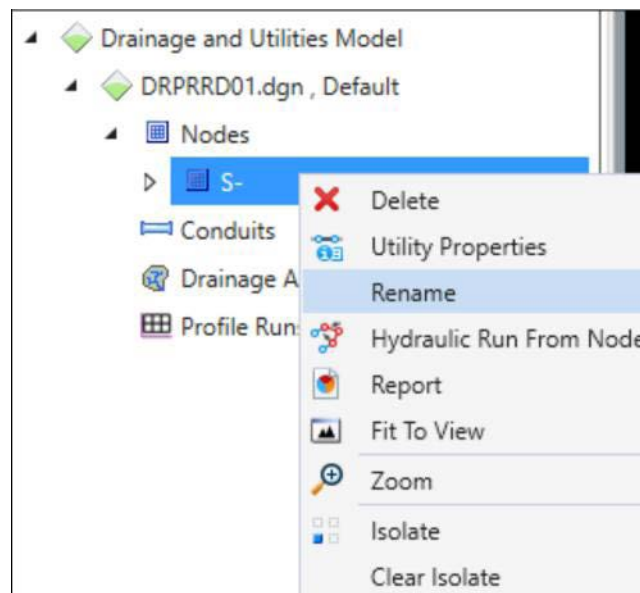


- c. To verify this has taken effect, unselect & reselect the node. Reopen the utility properties and check the References section. Close the properties dialogs.

References	
Baseline Feature	CL_SR61
Baseline Station (ft)	706+50
Baseline Offset (ft)	40.000
Elevation Reference	DTMTopMesh

NOTE *If the Station/Offset Reference (alignment file) is turned off or detached, the corresponding Station and Offset fields may not report correctly. If Station / Offsets are reporting 0+00 and 0.00, follow steps 11a. and 11b to reestablish the link. This can also be accomplished with a selection set.*

15. Before we move on, let's explore another way to access the node properties. Navigate to this node in **Project Explorer > Drainage and Utilities > HOME > Primary > Explorer > Drainage and Utilities Model > DRPRRD01.dgn > Nodes.**
16. Right click on the node, 'S-' to expand the tools available for nodes in Project Explorer. Rename this node to **S-101**. Node names can be set during placement in the place node prompts or renamed subsequently in Project Explorer.



Exercise 3.6 Place Node (Outfall, no Civil Accdraw)

In Exercise 2.5, the node was placed with horizontal properties dependent to a roadway alignment. In this exercise, the node location is not dependent on an alignment, and would not change if the roadway alignment were updated. However, the node rotation would update automatically for changes in the pond geometry.

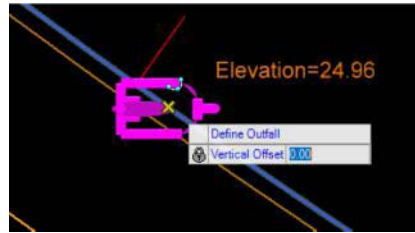
1. Navigate to: **Drainage and Utilities > LAYOUT>Toggles> Civil Accdraw** and click to toggle off.



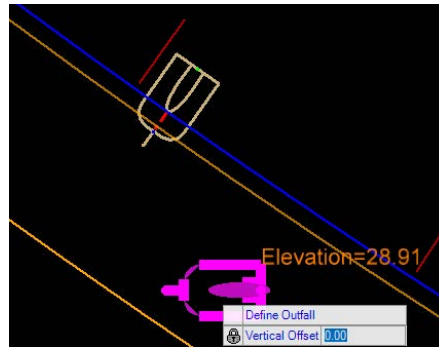
2. Navigate to: **Drainage and Utilities > LAYOUT>Layout> Place Node** and click to activate tool. The tool may open by default with the following window and a prompt for Select Reference Element for Node Elevation.
3. Before following plan view prompts, update the dialog with the following:
 - a. Check the Vertical Offset box and enter the value **0.001**. This is a temporary work-around for the FDOT structure elevation to properly align with the top mesh surface.
 - b. Change *Rotation Mode* to **Relative to alignment**.
 - c. Select the **FDOT Cross Drain Mitered End Section (1:4 slope, single 18” pipe)** feature definition from the pull-down menu: Node > Stormwater Node > Drainage Structures > Outlet > Mitered End Section (Cross Drain) > **MESC18RCP4S**.
 - d. Type in the *Name Prefix* **S-102**.
4. Now that the dialog is set up, we'll follow the prompts to place the outlet. The current prompt is Select Reference Element for Node Elevation. In plan view, move the cursor over to the pond and left click on one of the handles of the pond corridor (the small ticks around the top and bottom perimeter).



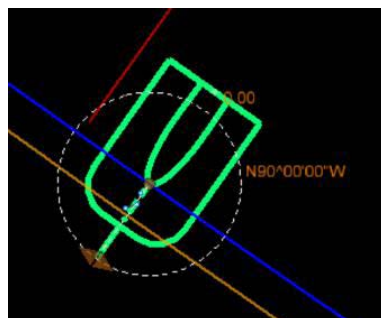
- With the pond surface selected, moving the cursor along the pond side slopes will dynamically report the elevation of the surface. Find a location along the pond bottom (blue line) approximately aligned with S-101 and left click to select location and advance to the next prompt, rotation.



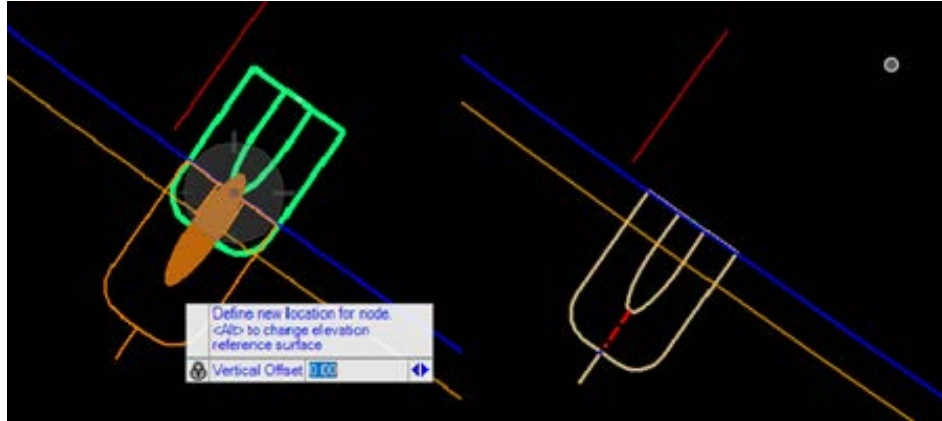
- Select the pond bottom blue line as reference element for rotation. The Rotation angle or bearing will be about this line, enter **N90°00'00"W**. Left click to accept and allow the software to process and place the MES. Once complete, right click to exit the tool, which is ready to place the next node.



- The MES is not yet at the desired location. Next we'll explore and use the manipulators available on the node.
 - Using Element Selection tool, click on the node. The brown dot & arrows and orange text are all editable when the node is selected. If the node was initially placed at the wrong rotation, overriding the value here is an easy way to fix it.



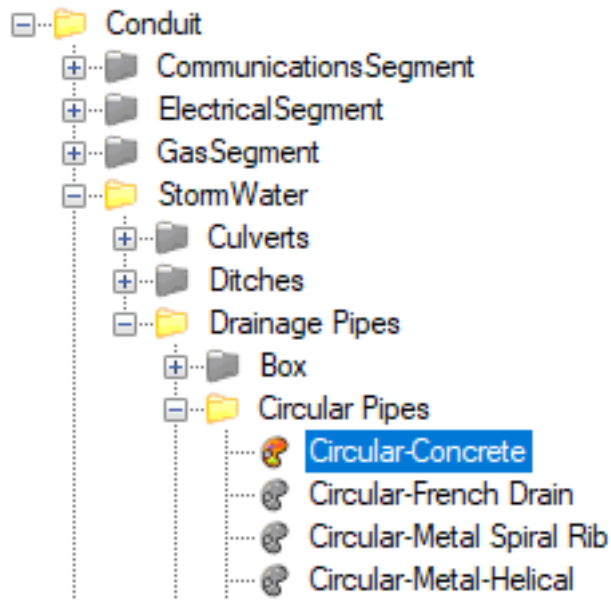
- b. Select the dot at the reference location point and move downward so that the end of the MES is aligned with the pond. Left click to accept new location.



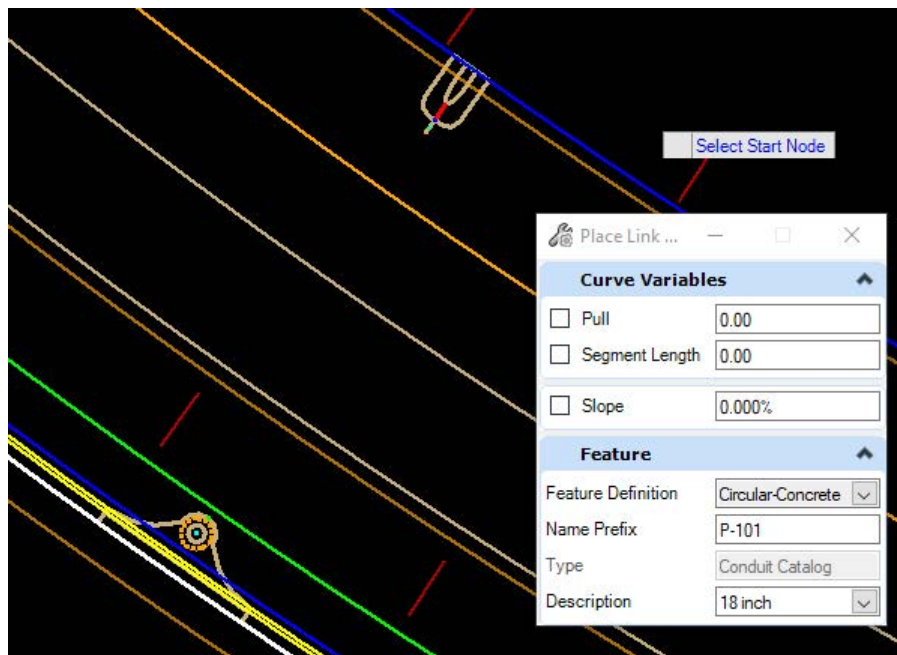
- c. Finally, reselect the node and open the element properties. Scroll down to the Utility section and see that Station/Offset Reference is 'None'. Click in this field and then click the adjacent ellipse and zoom out as needed to select **CL_SR61**.

Exercise 3.7 Place Conduit

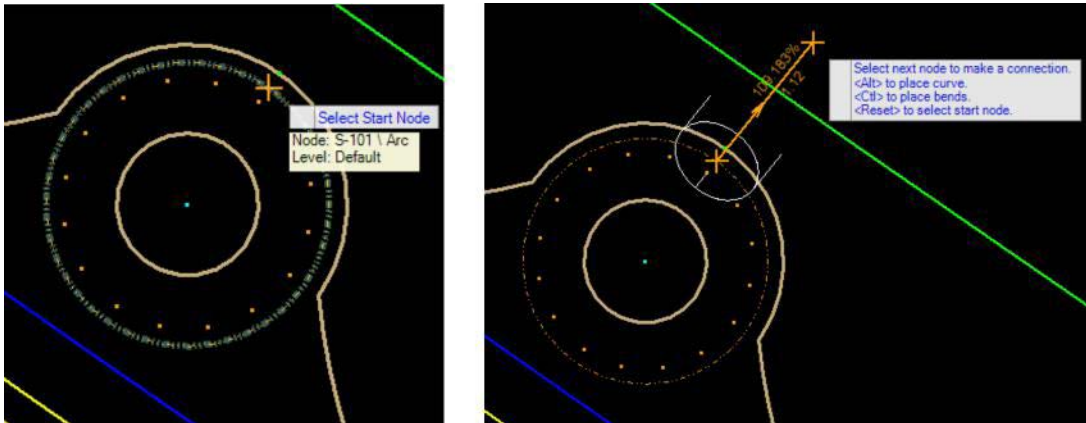
1. Navigate to: **Drainage and Utilities > Layout > Layout > Place Conduit** and click to activate tool. The tool will open by default with the prompt for Select Start Node.
2. Before following plan view prompts, update the dialog with the following:
 - a. Select the *Circular-Concrete* feature definition from the



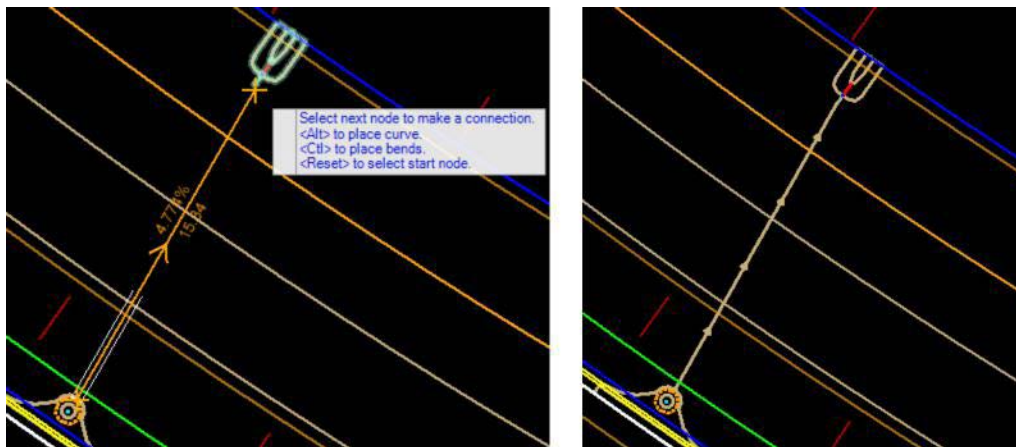
- b. Since the pipe we intend to place is from S-101 (upstream) to S-102 (downstream), type in the *Name Prefix P-101*.
- c. For the *Description* field, use the pulldown menu to select **18 inch**.
- d. Leave the remaining input blank, the completed dialog is shown below:



- Now that the dialog is set up, we'll follow the prompts to place the conduit. The current prompt is Select Start Node. In plan view, zoom towards the curb inlet, S-101 and move the cursor along the connection region, shown in dashed orange. Locate an area that is approximately between the center of the structure and the MES, S-102 and left click to accept the starting point.



- The next prompt is to Select node to make a connection. Since we intend to place a straight pipe with no curves or bends towards S-102, we will ignore the <Alt> and <Ctrl> options available in the prompt. Move the cursor to the connection region on S-102, left click to accept.

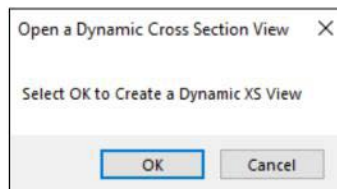
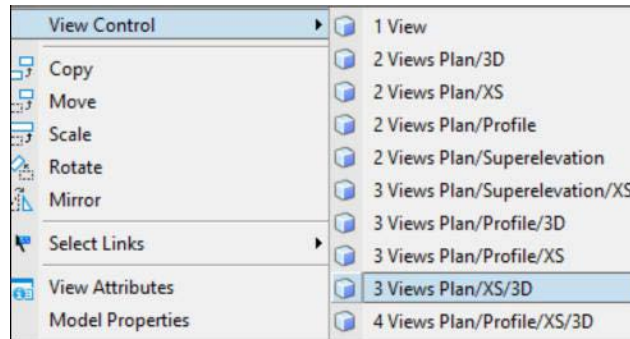


HINT In the FDOT CONNECT Workspace, default pipe symbology includes arrows to indicate direction of flow from upstream to downstream.

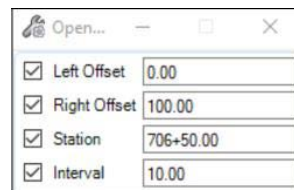
- For pipes, the manipulators are at the ends and may be used to adjust the start or end of pipe.

Exercise 3.8 Evaluate Nodes and Conduit in XS and 3D views. Adjust Elevations

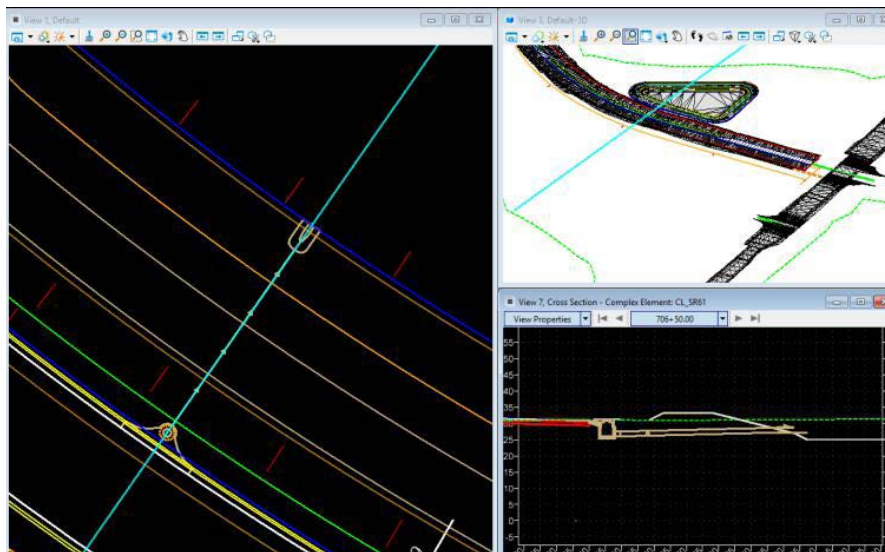
- So far, the place node and conduit exercises have kept the initial default elevation properties. This exercise will show how to view the vertical properties and edit. Activate **View Control** by holding down the right mouse button and select **3 Views Plan/XS/3D**. The windows will automatically adjust and Select **OK** to the prompt to Create a Dynamic XS View.



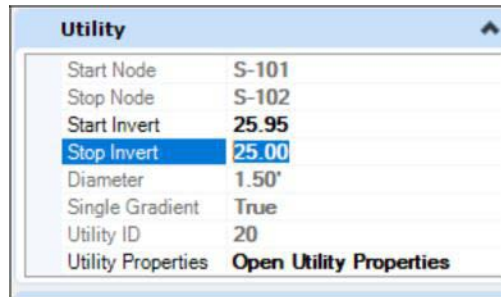
- Follow the next prompt to Locate Corridor or Alignment by selecting **CL_SR61**.
- Fill in the dialog with the settings: *Left Offset = 0*, *Right Offset = 100*, *Station = 706+50*, *Interval = 10*. Left click to accept these settings in the prompts until the Select or Open View prompt is active. Click anywhere within the blank window to automatically load the cross section.



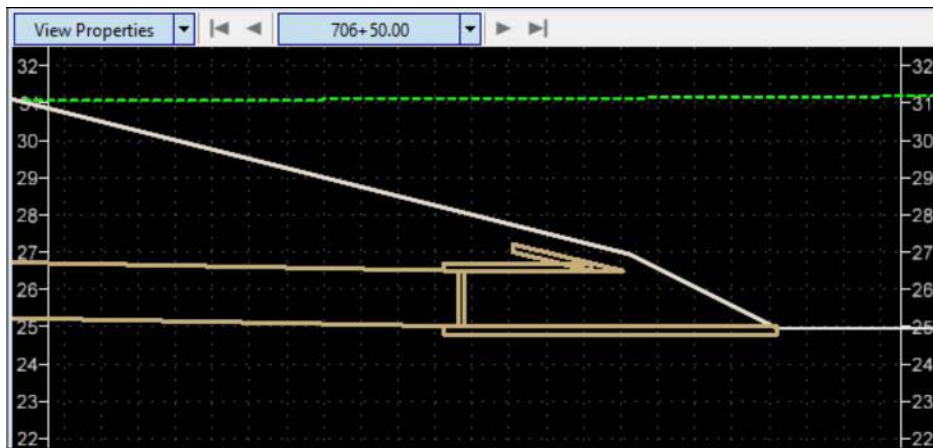
Select or Open View



2. Since the MES was placed using a 0.00' vertical offset from the pond surface, the initial pipe invert of P-101 defaulted to the elevation of the pond at the node reference point location. However, now that the S-102 outlet structures is linked to P-101, when we override the downstream invert to EL 25.00, the MES invert elevation will follow.
 - a. In plan view, select and open properties for P-101. Type in **25.00** in the *Stop Invert* field:



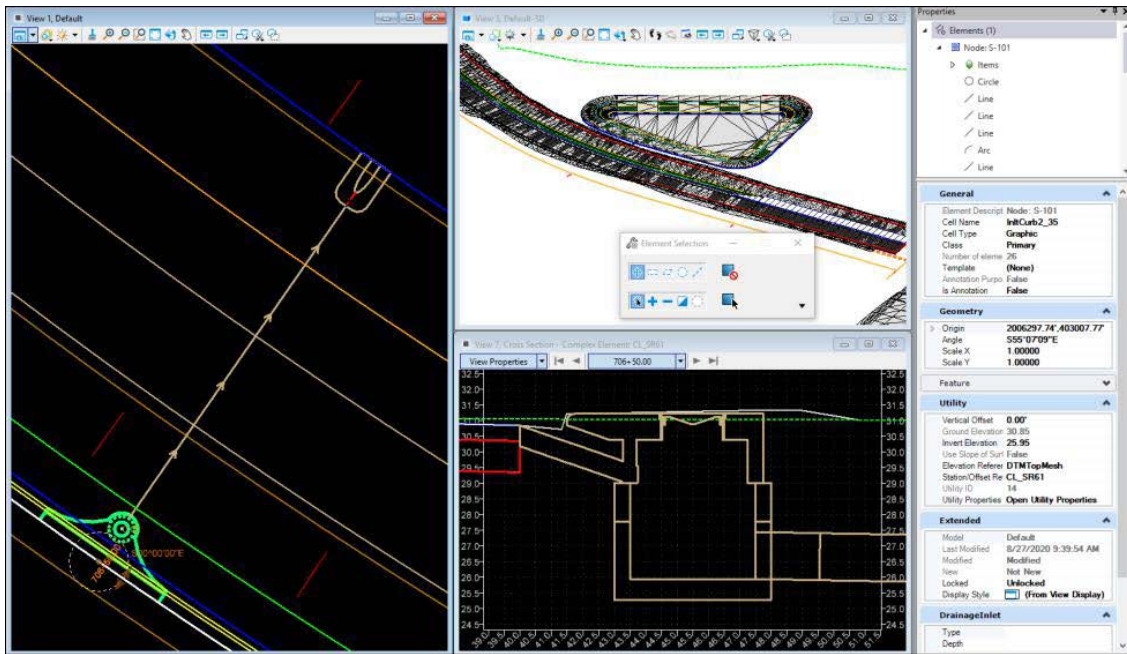
- b. In cross section view, click in the window to refresh and see updates both to P-101 and S-102 inverts.



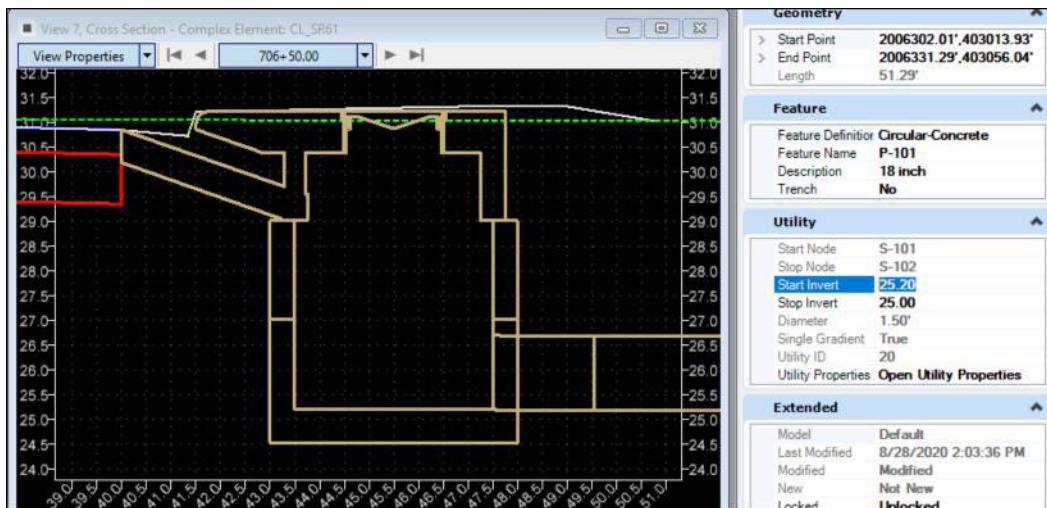
- c. Next, verify the change in S-102 by selecting the node in plan view and open properties.



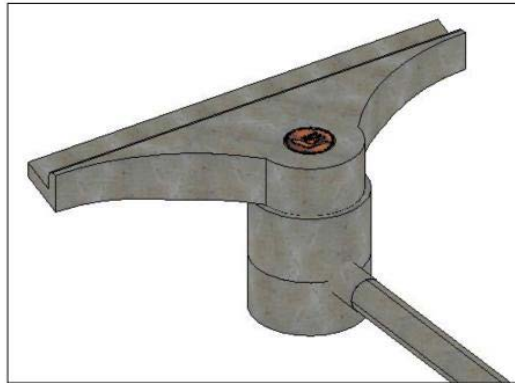
3. Finally, in cross section view, zoom in towards the curb inlet, S-101. In plan view, open S-101 properties.



- a. *Invert Elevation 25.95* is the default structure invert elevation assigned to S-101, based on the default height defined in the feature definitions. Similar to the default pipe invert assigned at S102, the initial P-101 upstream invert matches the structure invert of S-101. The pipe and structures inverts are linked to a point. The steps below will demonstrate this.
 - i. If the pipe invert is lowered below the structure invert, the structure invert will automatically be lowered to match. Select P-101, open properties, and edit the upstream invert elevation to 25.20.



- ii. However, to allow for pipe thickness, select S-101 and open properties to edit the structure invert to 24.20. This time, the P-101 pipe invert, does not follow, but remains at 25.20.

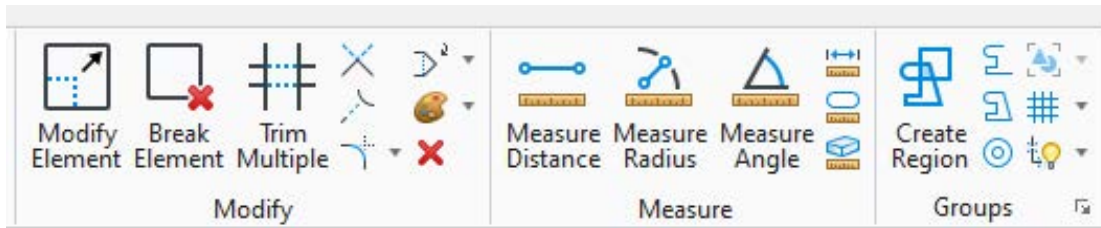


NOTE Refer to Standard Plans Index 425-001 for standard placement of structure bottom relative to pipe.

Exercise 3.9 Place Land Use Areas

This example will show how to draw land use areas that can be used for automatically calculating composite runoff coefficients from pre-defined land covers. To develop project-specific land uses and associated runoff coefficient values with this same functionality, refer to Example 1.2.

1. Reset view control to plan view and zoom extents the design project.
2. Develop regions for areas to be used for land use: **Drainage and Utilities > Drawing > Groups > Create Region**

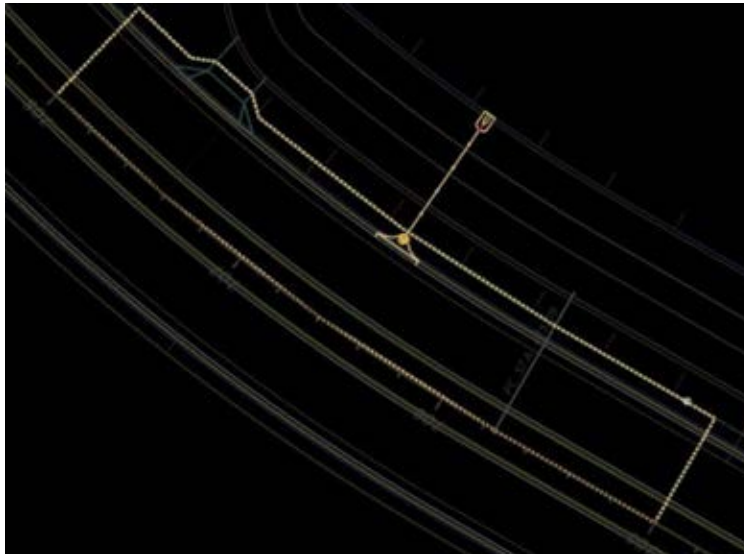


NOTE *If a created region has an embedded hole (e.g. a grassed median within a roadway pavement land cover) then the Place Land Use Area will not recognize the polygon. Suggest creating two polygon regions so there is not a hole within any of the regions.*

3. Convert those regions into land use areas:
 - a. **Drainage and Utilities > Layout > Layout > Place Land Use Area**
 - b. *Method = Pick Shape*
 - c. Choose appropriate land cover feature definition.

Exercise 3.10 Place Catchment

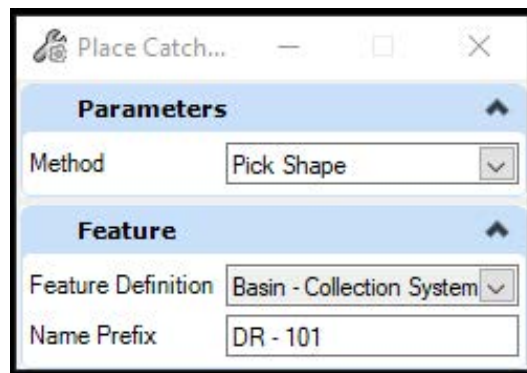
1. Reset view control to plan view and zoom in towards S-101. Use F5 to Toggle Dim References. Navigate to: **Drainage and Utilities > Drawing > Placement > Place Shape** and click to activate tool. For this exercise, draw a polygon from approximately center of median to back of sidewalk (RT) from Station 705+00 to 708+00. For this exercise, the active level (the level the preliminary shape is drawn) does not matter.



2. Navigate to: **Drainage and Utilities > Layout > Layout > Place Catchment** and click to activate tool. The tool and dialog will open by default with the prompt for 'Select Layout Method'.



3. Before following plan view prompts, update the dialog with the following:
 - a. Select the **Basin – Collection System** feature definition from the pull-down menu. This basin feature definition is set up to automatically extract land use areas to generate a composite runoff coefficient for the basin when the Hydrology Analysis is performed.
 - b. Since the catchment we intend to place drains to S-101, type in the *Name Prefix* **DR-101**.

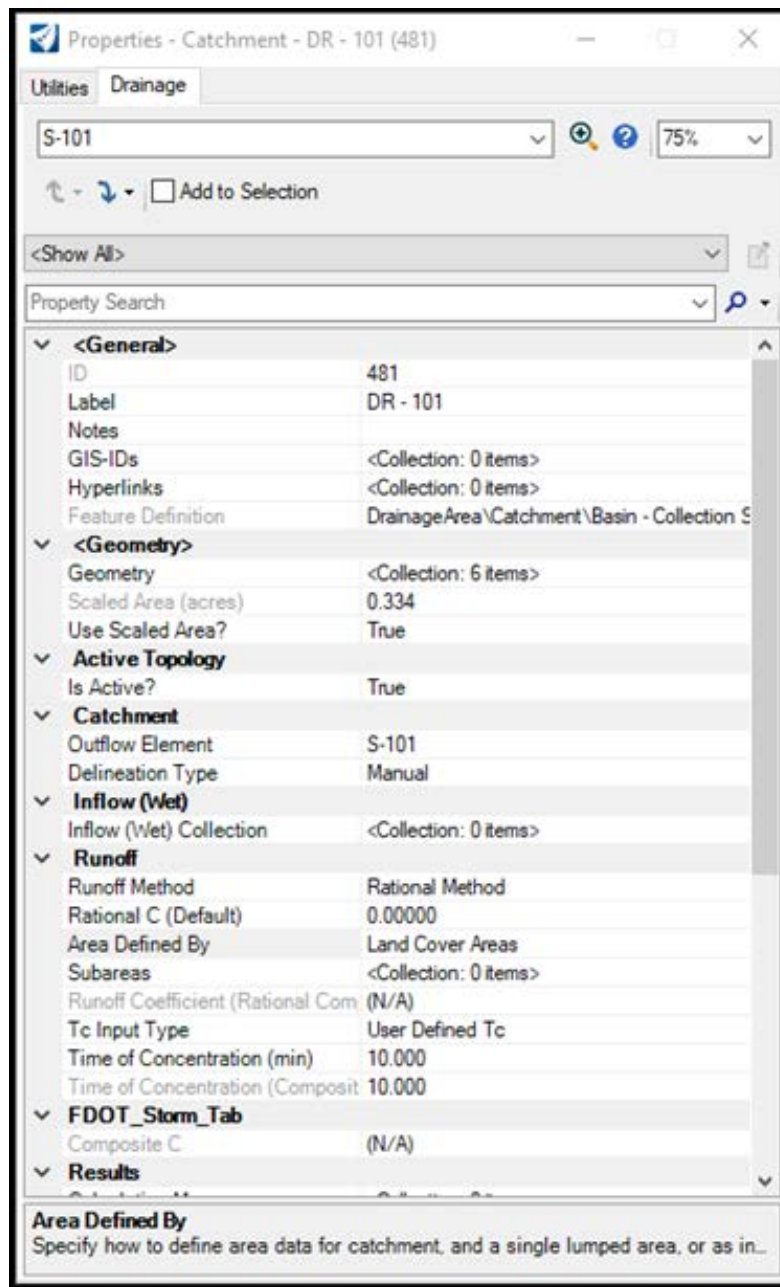


4. Follow the plan view prompts, left clicking to accept the settings.
 - a. Pick the shape drawn in Step 1.
 - b. Select S-101 as the outflow.
 - c. <Reset> (right click) to continue picking without reference surface and close tool.

5. Select the shape and hover over the linework to bring up quick menu. Select Utility Properties.

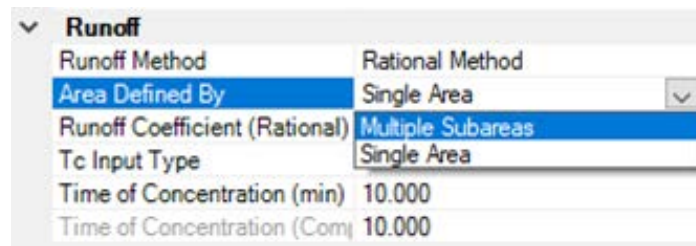


6. The input used for hydraulic analysis are shown below. Most properties are inherited from the pavement feature definition. The composite rational method runoff coefficient will not be computed until Compute Hydrology is performed.

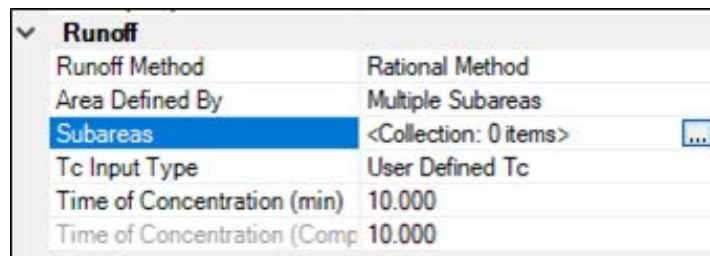


NOTE For drainage structures that have two inlets, such as a Median Barrier Wall - Type 2 (inlet on either side of the barrier wall), the catchment Runoff Area Defined By method could be adjusted to 'Multiple Subareas' where a catchment area is drawn for each inlet opening of the drainage structure and the runoff coefficient for each catchment can be hard coded. Alternatively, there is another Area Defined By 'Single Area' where a site-specific runoff coefficient could be hard coded into the basin's Utility Properties.

- There's one more change to DR-101 to better represent the ratio of pervious and impervious cover. As an alternative to placing separate shapes for different C values, we're going to edit the properties of DR- 101 to calculate the weighted C value. In the Runoff category, select the pull-down for *Area Defined By* and **Select Multiple Subareas**.



- In the *SubAreas* line, click the ellipse next to <Collection: 0 Items>



- Enter the following into the **Subareas – Catchment (DR-101)** window prompted by the ellipsis, select **OK** to close the dialog. Close utility properties.

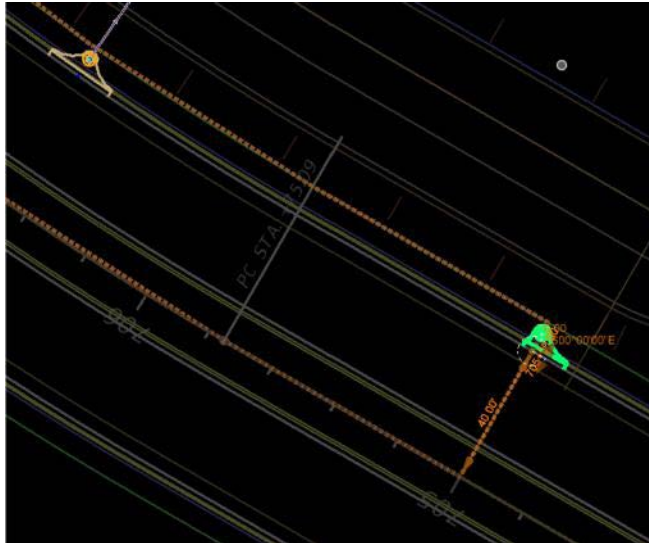
	Area / Total Area (%)	Area (acres)	Surface Description	Runoff Coefficient
1	80.0	0.267	Pavement	0.95000
2	20.0	0.067	Grass	0.25000
*				

Buttons: OK, Cancel, Help

HINT In OpenRoads, the Drainage and Utilities tables usually represent calculated values in yellow cells and editable fields in white cells.

Exercise 3.11 Place Gutter

1. Before placing a gutter, use **Place Node** tool to add **S-103**, a new curb inlet, Type 1 (RT), at Station 705+00, 40' LT. Refer to steps in Exercise 3.5 as needed.



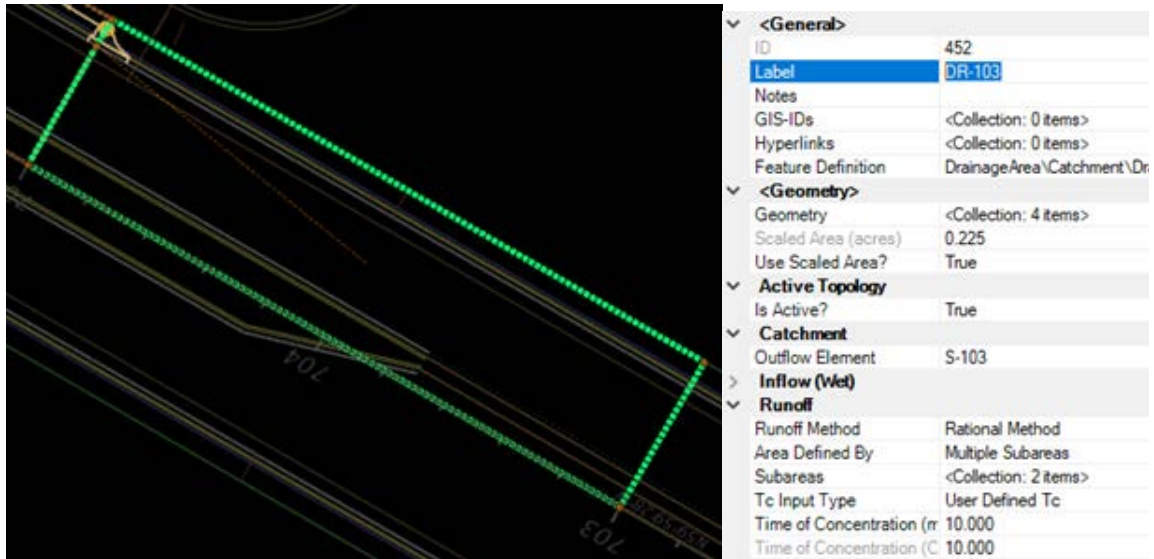
2. Next, use **Place Conduit** tool to add **P-103**, a new 18" Circular-Concrete pipe, from S-103 to S-101. Refer to steps in Exercise 3.7 as needed.

Geometry	
> Start Point	2006424.11',402937.62'
> End Point	2006302.51',403011.11'
Length	142.08'

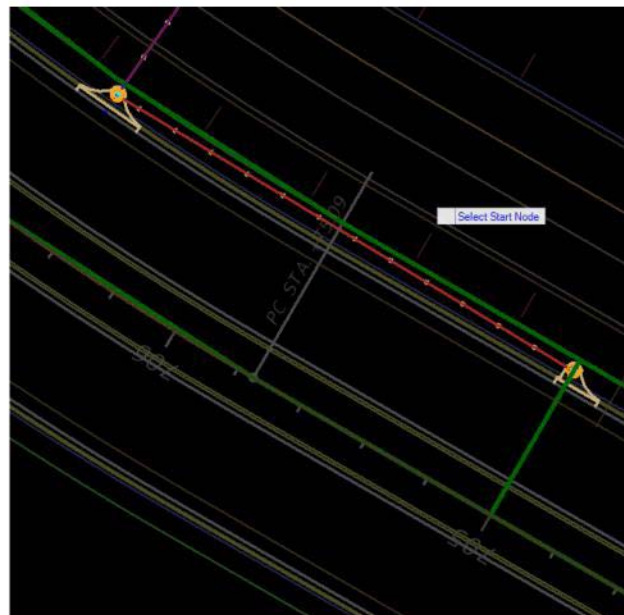
Feature	
Feature Definition	Circular-Concrete
Feature Name	P-103
Description	18 inch
Trench	No

Utility	
Start Node	S-103
Stop Node	S-101
Start Invert	26.50
Stop Invert	24.20
Diameter	1.50'
Single Gradient	True
Utility ID	25
Utility Properties	Open Utility Properties

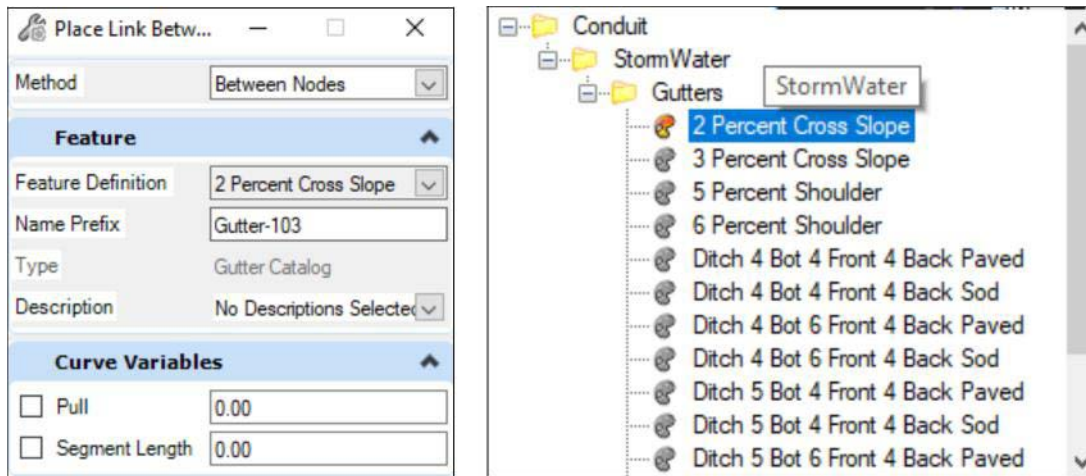
- Also, use **Place Catchment** tool to add **DR-103**, a new drainage area, from approximately Station 703+00 to 705+00. Refer to steps in Exercise 3.10 as needed.



- Navigate to: **Drainage and Utilities > Layout > Layout > Place Gutter** and click to activate tool. The tool will open by default with the prompt for Select Start Node and a change to the view symbology:



5. Before following plan view prompts, update the dialog with the following:
 - a. Select the **Between Nodes Method**
 - b. Select the **2 Percent Cross Slope** feature definition from the pull-down menu: **Conduit > Stormwater > Gutters**:
 - c. Since the pipe we intend to place is from S-103 to S-101, type in the *Name Prefix* **Gutter-103**.



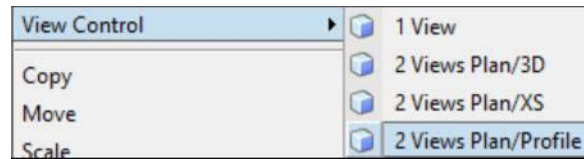
6. Now that the dialog is set up, we'll follow the prompts to place the gutter. Select S-103 as the Start Node and S-101 as the Stop Node.
7. Once placed, select the new Gutter-103 and open properties. By default, the inverts of Structures S-103 and S-101 are set as *Start* and *Stop Invert* of the gutter. Override these elevations to match the surface, the structure top elevations shown in the corresponding node properties.

Feature	
Feature Definition	2 Percent Cross Slope
Feature Name	Gutter-103
Trench	No
Utility	
Start Node	S-103
Stop Node	S-101
Start Invert	31.40
Stop Invert	30.85
Single Gradient	True
Utility ID	453
Utility Properties	Open Utility Properties

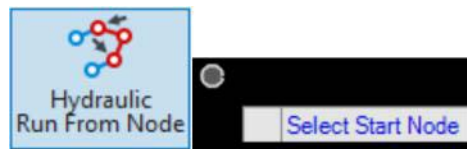
8. Close open dialogs. With the gutter placed, the sample network is complete and ready for computations.

Exercise 3.12 Create Profile Run

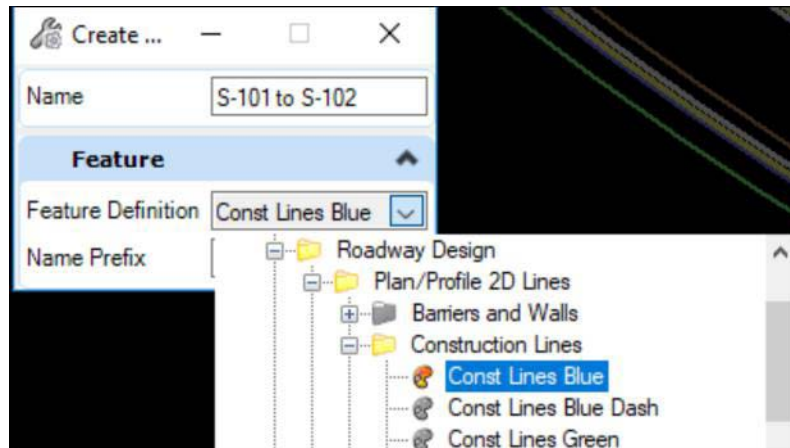
1. Use *View Control* to select **2 Views Plan/Profile**. Select **Cancel** at the Open a Dynamic Profile View prompt.



2. Navigate to: **Drainage and Utilities > Layout > Profile Runs > Hydraulic Run from Node** and click to activate tool. The tool will open by default with the prompt for *Select Start Node*

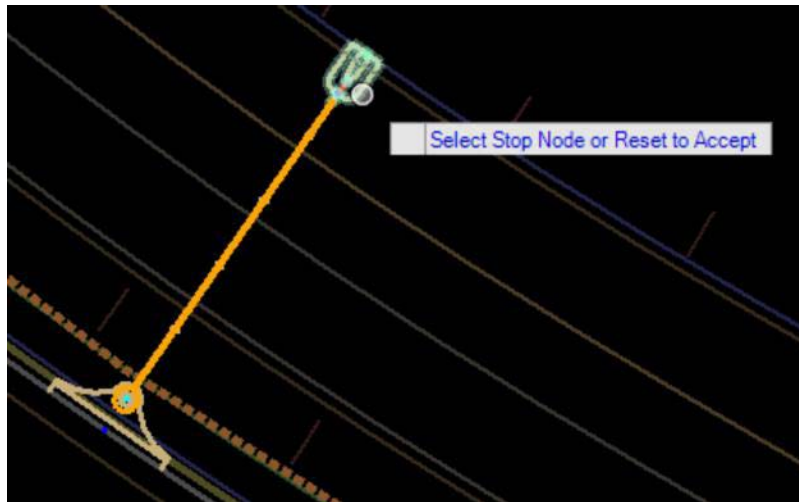


3. Before following plan view prompts, update the dialog with the following:
 - a. Enter **S-101 to S-102** in the *Name* field.
 - b. Select the **Const. Lines Blue** *Feature Definition* from the pull-down menu **Linear > Roadway Design > Plan/Profile 2D Lines > Construction Lines > Const. Lines Blue**.

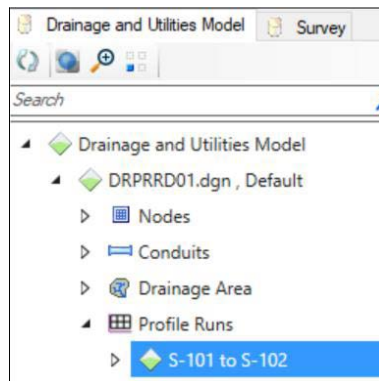


4. Follow prompt and select S-101 start node.

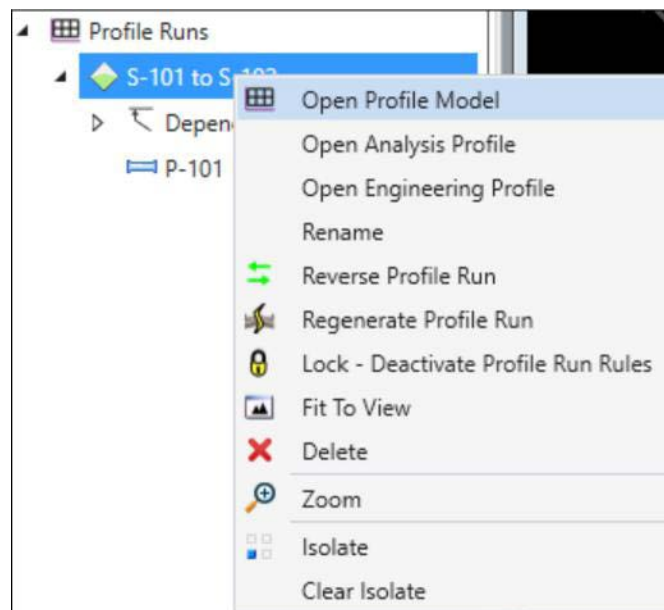
5. Select S-102 as Stop Node and left click to Accept Profile Run.



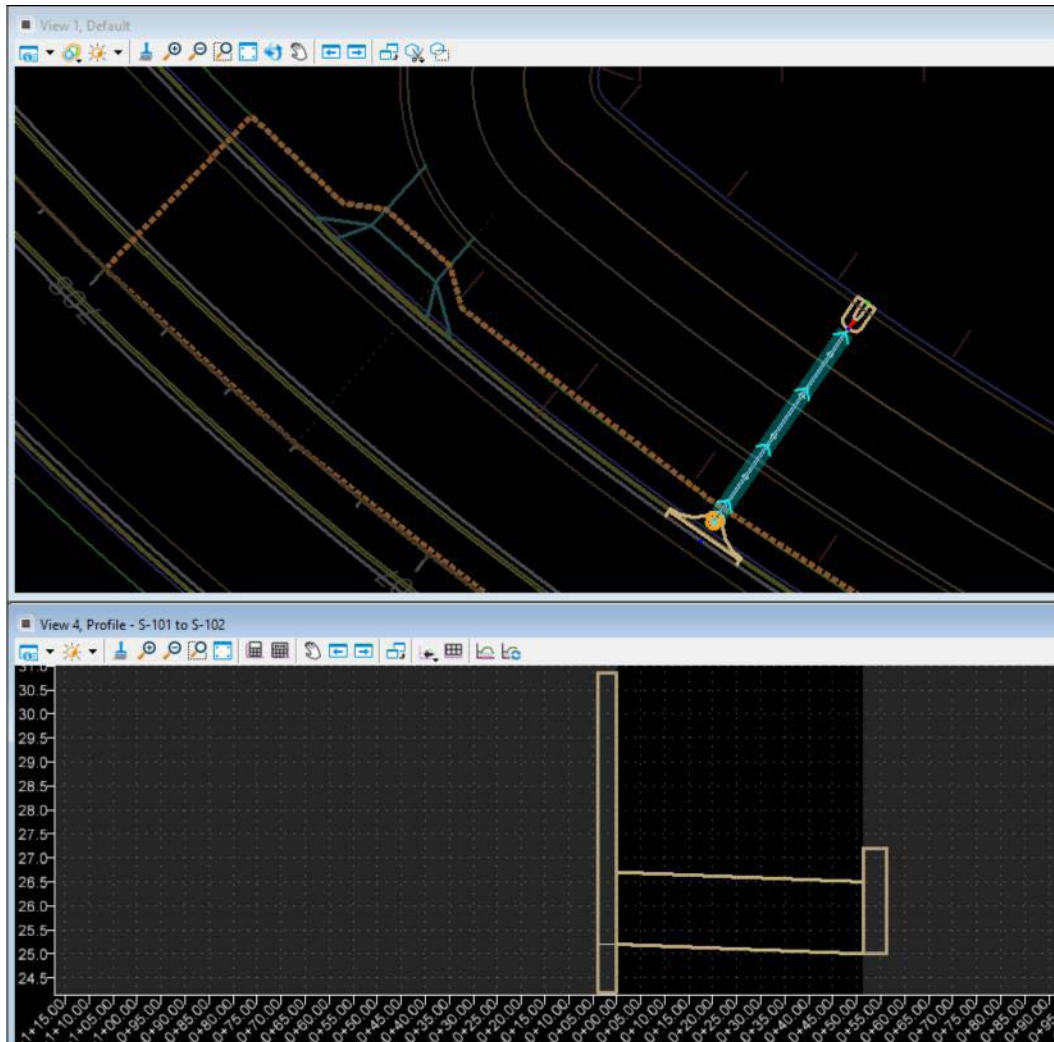
6. If not already docked and open, click F11 to Toggle Project Explorer, or use following path and navigate to profile runs: **OpenRoads Standards tab > Drainage and Utilities > Home > Primary > Explorer > Drainage and Utilities > Drainage and Utilities Model > DRPRRD01.dgn > Profile Runs.**



7. Right click on S-101 to S-102 to view the tools available to manage this profile from explorer.



8. Select Open Profile Model and follow prompt to Select or Open View by clicking anywhere within the blank profile view window below the plan view window.

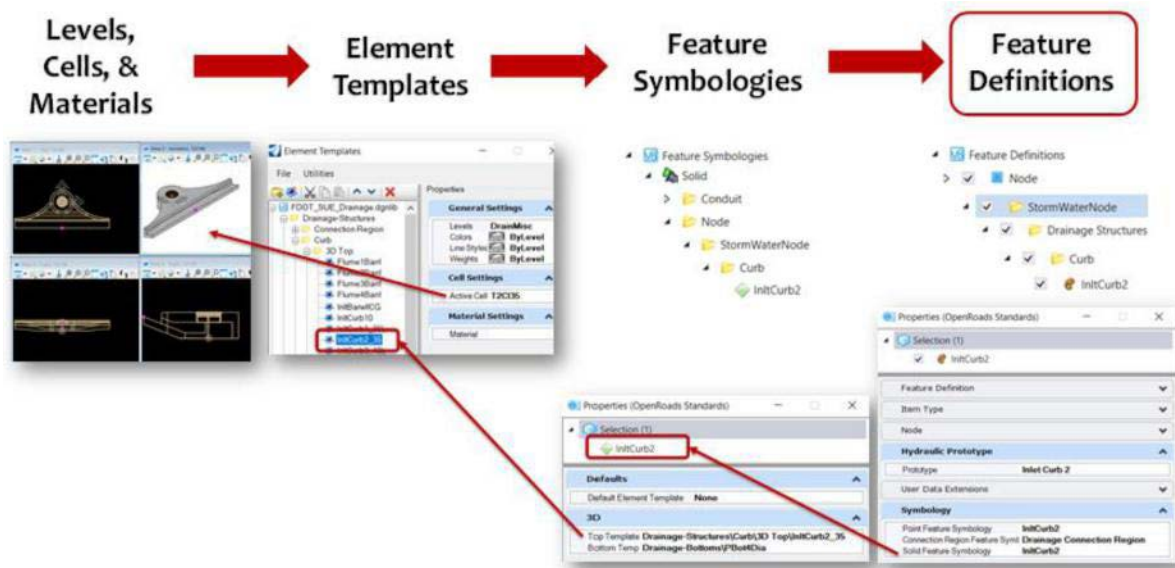


NOTE In OpenRoads, if a profile is active in a view, the related linework in plan, including direction of stationing is shown highlighted in plan view. Stationing in Drainage and Utilities profiles are along the pipe run and always start at 0+00.00.

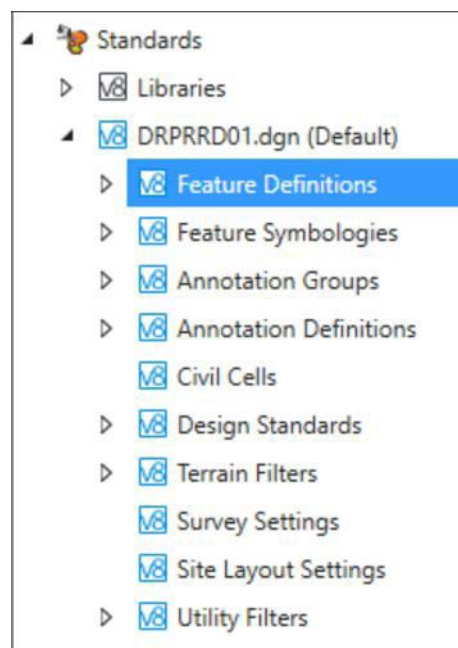
Exercise 3.13 Create a J-Bottom drainage structure Feature Definition

There will be cases where a project needs a variation of a drainage structure that is not provided in the default FDOT DGNLib. This exercise shows how to create a new Feature Definition in the DGN design file, by copying a similar structure and editing for changes. A Type 2 Curb Inlet with a 5' diameter J-bottom will be created based off the InletCurb2 (P-bottom) definition.

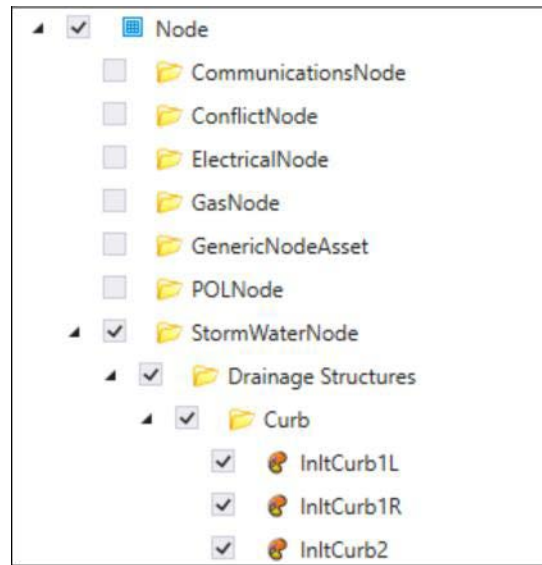
To trace how the Symbology links are made in a Features Definition, this exercise is going to start from the right side of graphic below, at the Feature Definition and work its way left through Feature Symbology's and Element Templates (Steps 1 - 5). Finally, the exercise will work from left to right to re-link connections to the new symbology's (Steps 5-6).



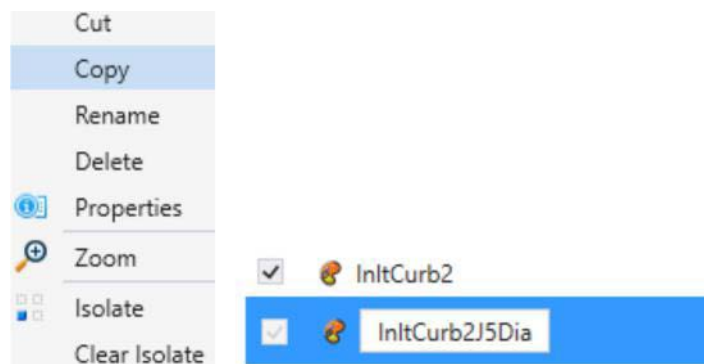
1. While in the Default or Multi-Model Views in *DRPRRD01.dgn*, use the Explorer Dialog (Function Key F11 if you do not have it docked). Navigate to the OpenRoads Standards Tab then click on Standards to expand list. The list contains loaded DGN Libraries and the current file you are in. Expand *DRPRRD01.dgn*.



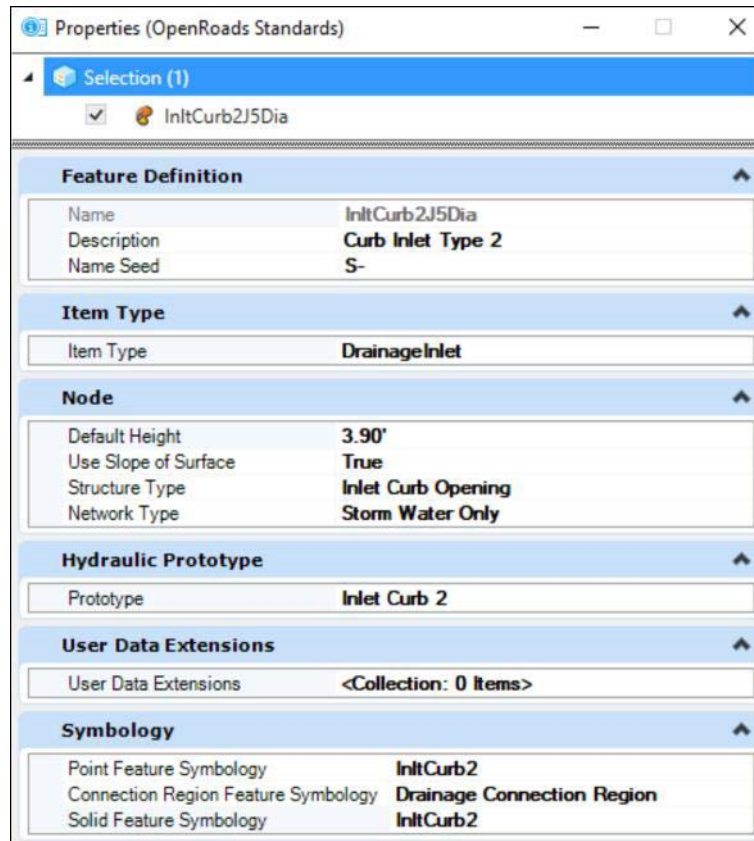
- Expand Feature Definitions and scroll down to Node: Stormwater Node: Drainage Structures: Curb: to view all the feature definitions that have been brought into this DGN from the default DGNLib through placement of structures.



- Right click on **InltCurb2** and select **Copy**. This will automatically duplicate the feature definition. For this example, the new feature is for a Type 2 Curb Inlet with a 5' diameter J-bottom; rename **InletCurb2J5Dia**.



4. Right click on **InltCurb2J5Dia** and open properties. Review and see properties copied from the P-bottom definition. It is appropriate for some properties to remain, but some need changes for the J-bottom.

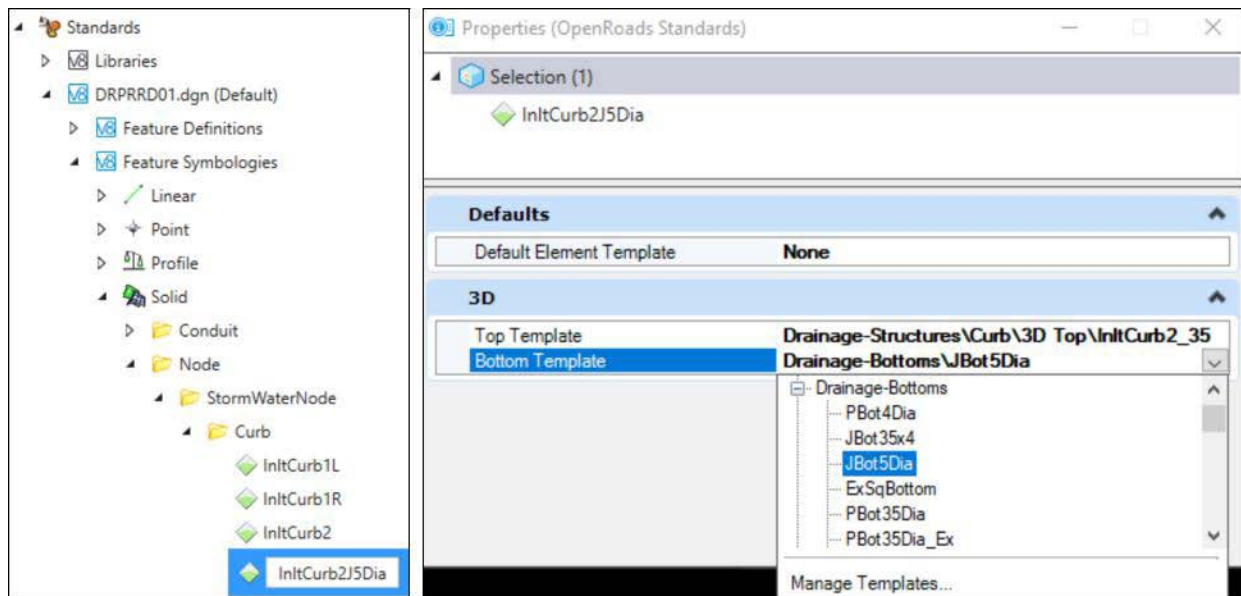


- a. **Feature Definition:** *Name, Description, and Name Seed:*
- i. Add to *Description:* **J-Bottom 5' Dia.**
- b. **Item Type:** no change needed.
- c. **Node:** no changes needed.
- d. **Hydraulic Prototype:** no change needed.

NOTE *The Physical properties within the Hydraulic Prototypes include structure bottom sizes and dimensions. For networks that model losses within structures, it may be appropriate to create a new Prototype for J-bottom structures. However, for simple drainage networks, the bottom size does not significantly impact the hydraulic performance.*

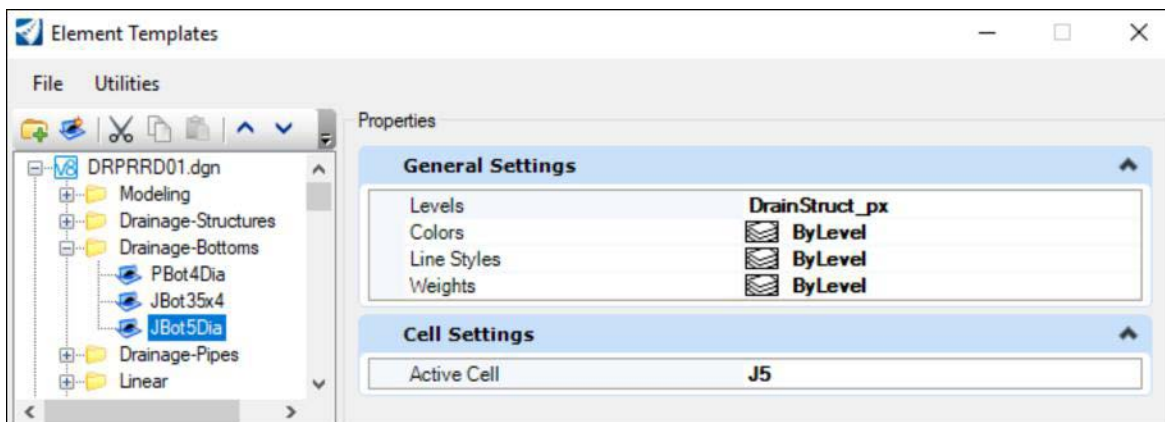
- e. **User Data Extensions:** no change needed.
- f. **Symbology:** only the *Solid Feature Symbology* will need changes (see Step 6), but first a new symbology is required.

- Close the properties dialog and navigate back through Explorer and right click to make a copy of the InltCurb2 Solid Feature Symbology: **OpenRoads Standards > DRPRRD01.dgn > Feature symbology > Solid > Node > Stormwater Node > Curb > InltCurb2**. Name the new symbology to match the new feature definition: InltCurb2J5Dia and right click to open properties.

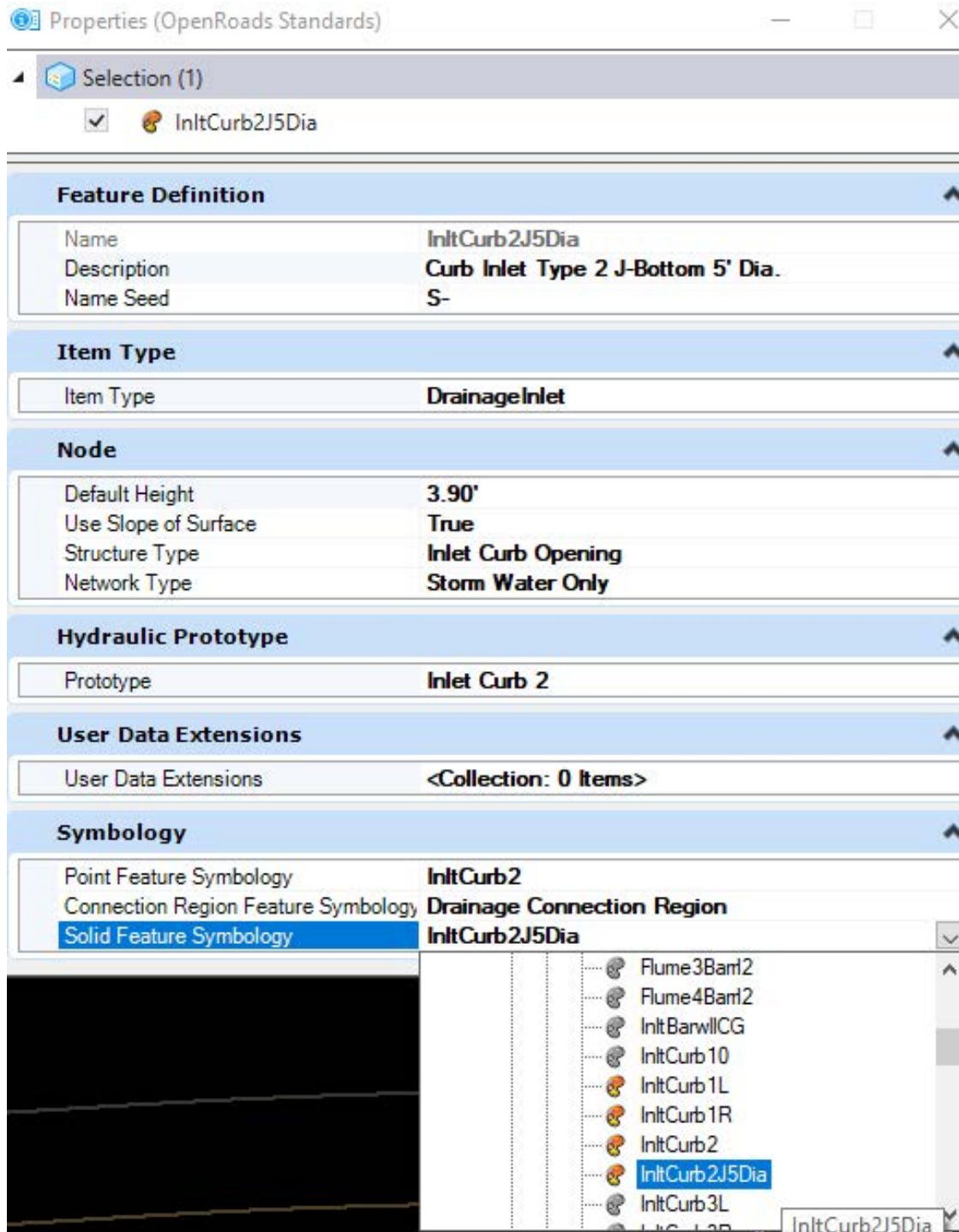


- The *Bottom Template* for **3D** will need to be updated for a J-bottom structure. Use the pulldown menu to select **JBot5Dia**.

NOTE *Bottom cells and corresponding Element Templates are available for standard J-bottom sizes. If a special structure cell has been added to a cell library, a corresponding Element Template can be created from the Manage Templates... dialog. As shown below, Element Templates generally define which cell is used and how it is displayed.*



- Now that the *Solid Feature Symbology* is set, re-link the symbology properties in Feature Definitions. The feature definition will now be ready to place.



4 DESIGN AND ANALYSIS

INTRODUCTION

The main focus in this chapter will be on: Drainage Design and Analysis.

This chapter will introduce several important tools and features available in the Drainage and Utilities Workflow and FDOTConnect Workspace to design, analyze, and view computation results for a drainage network. They are:

- Default Design Constraints
- Engineering Standards
- Scenarios
 - Alternatives
 - Calculation Options
- Calculation and Analysis
 - Validation and Notifications
 - Compute Center
 - Calculation Summary
 - Flex Tables
 - Analytic Profiles

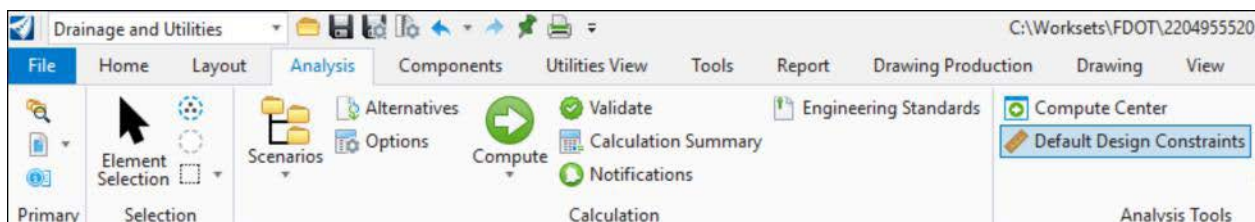
In OpenRoads Designer CONNECT Edition, the Drainage and Utilities tools include automatic design capabilities including size conduits, set node invert elevations and determine the size of inlets to pass a design storm while meeting user-specified constraints. For purposes of this chapter, the term Design generally refers to the various automated design functions in OpenRoads.

NOTE *Design Considerations from Bentley Drainage and Utilities CONNECT Edition help: “As with any automated design, the program’s design is intended only as a preliminary step. It will select pipe sizes and pipe invert elevations based on the input provided, but no computer program can match the skills that an experienced engineer has. The modeler should always review any automated design, and should make any changes required to adjust, improve, and otherwise polish the system.”*

DEFAULT DESIGN CONSTRAINTS

When Drainage and Utilities is used for Automatic Constraint Based Design, the Default Design Constraints allow users to define global constraints that are considered in the design algorithm.

Default Design Constraints is accessed from the path: **Drainage and Utilities > Analysis > Analysis Tools > Default Design Constraints**

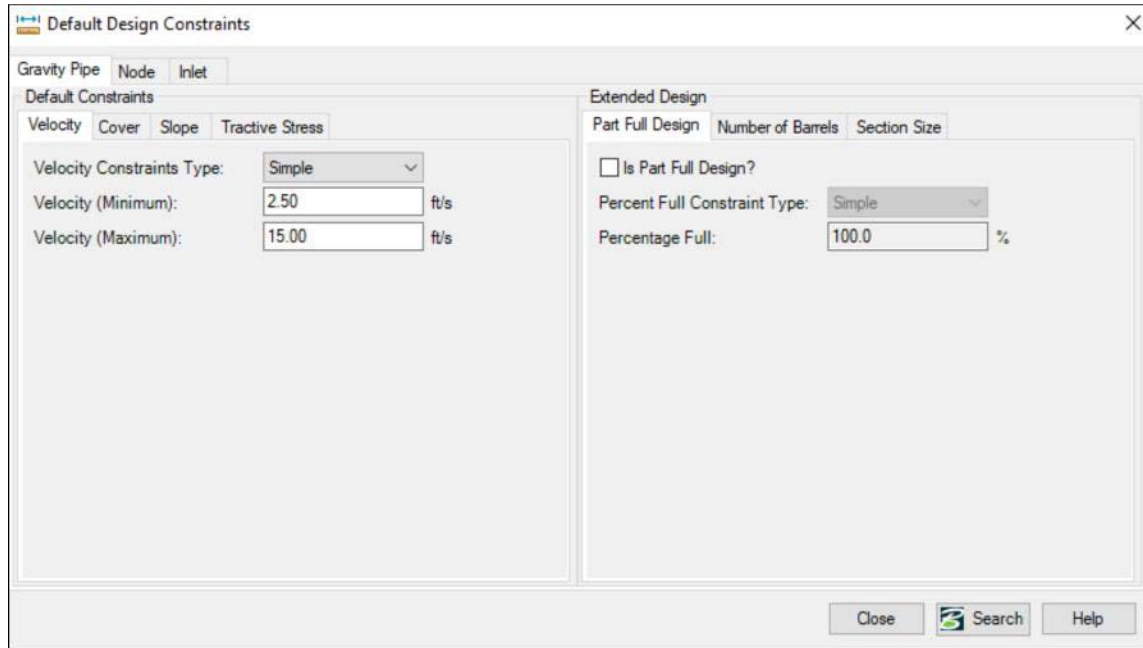


As described in Bentley Drainage and Utilities CONNECT Edition Help:

Pipe diameters, invert elevations, node structures, and inlets can be all designed with the same set of design constraints. You also have the option to adjust these values individually for each pipe or structure.

The Default Design Constraints dialog is divided into the three following tabs:

- Gravity Pipe
- Node
- Inlet

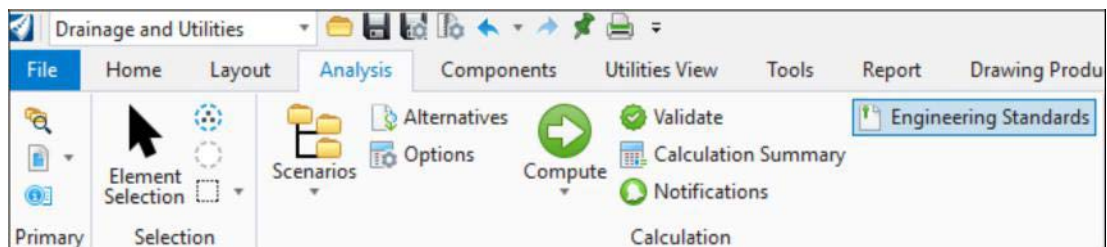


In the FDOTConnect Workspace, default settings have been assigned where applicable to align with FDOT standard practices and criteria. There are also some defaults that will be project-specific, such as Inlet: Maximum Spread.

For additional details on how constraints are evaluated during automated design, see Design Priorities topic in Bentley Drainage and Utilities CONNECT Edition Help.

ENGINEERING STANDARDS

Engineering Standards allow users to assess the model relative to user defined criteria and is accessed from the path: **Drainage and Utilities > Analysis > Calculation > Engineering Standards**:



As described in Bentley Drainage and Utilities CONNECT Edition Help:

“Engineering Standards allow you to define custom validation rules that will generate messages pointing to input values in the model that, while they could be computed without causing errors, are not of good engineering judgement.”



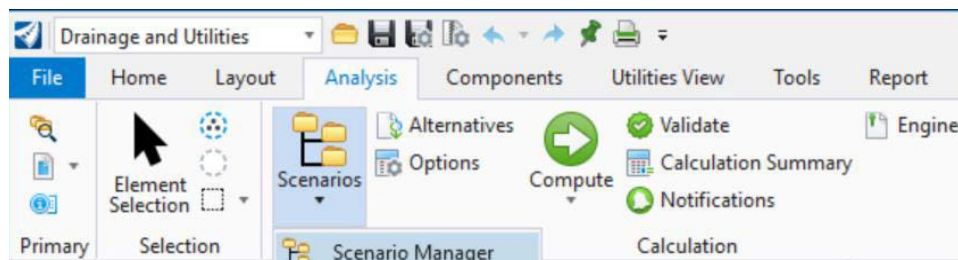
Results of the Engineering Standards validation are reported in the Engineering Standards tab within the User Notifications Manager.

In the FDOTConnect Workspace, there are no predefined Engineering Standards.

SCENARIOS

In the OpenRoads Designer CONNECT Edition environment, Scenarios are used by the Drainage and Utilities Model to manage all the data, properties, and settings required to perform hydraulic calculations.

The Scenario Manager tool is accessed from the path: **Drainage and Utilities > Analysis > Calculation > Scenarios > Scenario Manager**.



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

A Scenario contains all the input data (in the form of Alternatives), calculation options, results, and notes associated with a set of calculations. Scenarios let you set up an unlimited number of What If? situations for your model, and then modify, compute, and review your system under those conditions.

You can create scenarios that reuse or share data in existing alternatives, submit multiple scenarios for calculation in a batch run, switch between scenarios, and compare scenario results--all with a few mouse clicks. There is no limit to the number of scenarios that you can create.

There are two types of scenarios:

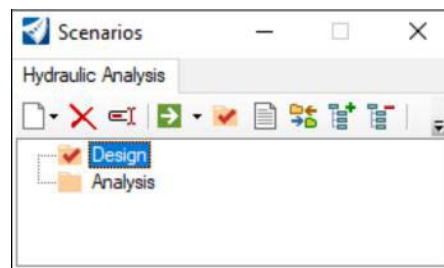
- Base Scenarios--Contain all of your working data. When you start a new model, you begin with a default base scenario. As you enter data and calculate your model, you are working with this default base scenario and the alternatives it references.

- Child Scenarios--Inherit data from a base scenario, or other child scenarios. Child scenarios allow you to freely change data for one or more elements in your system. Child scenarios can reflect some or all of the values contained in their parent. This is a very powerful concept, giving you the ability to make changes in a parent scenario that will trickle down through child scenarios, while also giving you the ability to override values for some or all of the elements in child scenarios.

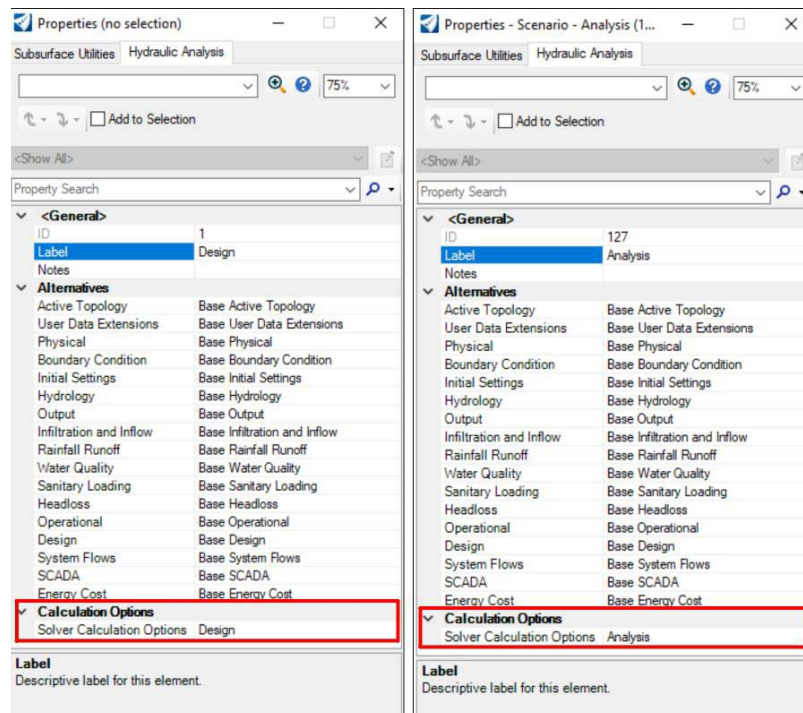
When creating new scenarios, the inherent capabilities can be utilized within Parent-Child scenario relationships to define whether the new scenarios are independent or share data and to help manage variations in global properties. Refer to Bentley Learn Resources, Managing Multiple Scenarios for further training.

In the FDOTConnect Workspace, there are two base scenarios copied into the DGN file from the Hydraulic Seed File: Design and Analysis. Both base scenarios use the Base Alternatives but differ in Calculation Options.

- An Analysis performs calculations but does NOT change structure properties
- A Design option performs calculations and MAY change structure properties.



NOTE When working in a DGN with multiple scenarios, it is important to know which Scenario is current. This is designated by a red check and dictates what information is active / displayed in the model and available in tables and calculation results.



By default, the Properties of Design (shown left) and Analysis (shown right) Scenarios have the same Base settings except for Solver Calculation Options.

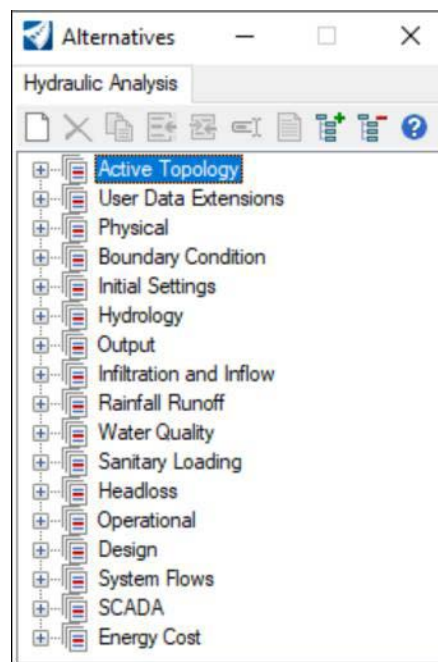
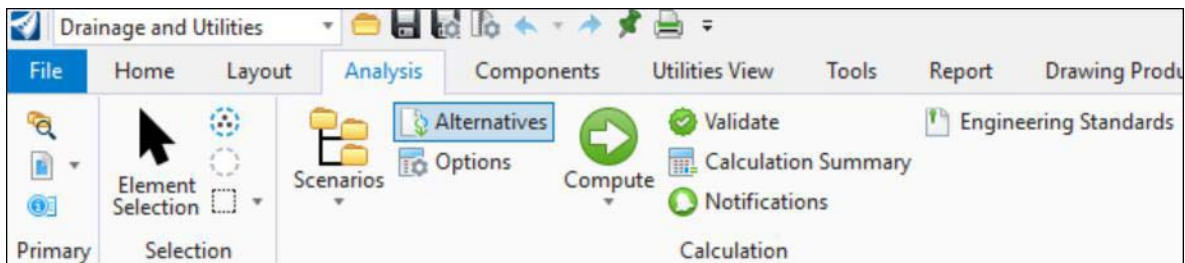
ALTERNATIVES

As shown in the Design and Analysis scenario properties above, Scenarios do not contain any specific data, but rather reference the various Alternatives.

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Alternatives are the building blocks behind scenarios. They are categorized data sets that create scenarios when placed together. Alternatives hold the input data in the form of records. A record holds the data for a particular element in your system.

Similar to Scenarios, Drainage and Utilities models start with Base Alternatives but allow for creation of child alternatives. Alternatives can be edited and created through the Alternatives Manager tool, accessible from the path: **Drainage and Utilities > Analysis > Calculation > Alternatives**.



Not all types of Alternatives will be used on typical FDOT drainage design projects. Listed below are several types that may be useful for typical FDOT projects.

ACTIVE TOPOLOGY ALTERNATIVE

As defined in Bentley Drainage and Utilities CONNECT Edition Help:

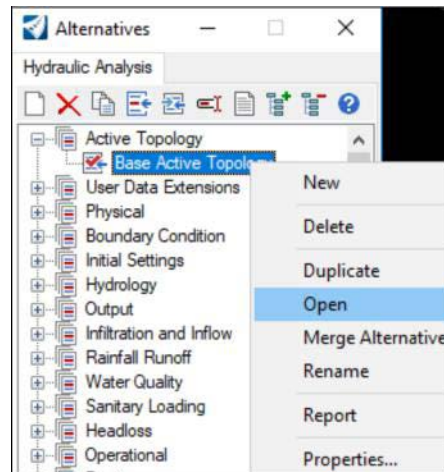
The Active Topology Alternative lets you temporarily remove areas of the network from the current analysis.

The Active Topology dialog box is divided into tabs for each element type.

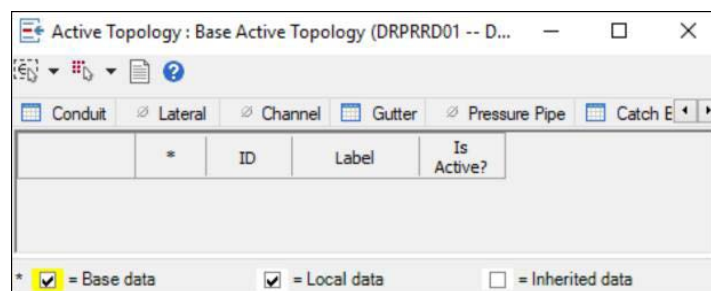
For each tab, the same setup applies—the tables are divided into three columns. The first column displays whether the data is Base or Inherited, the second column is the element Label, and the third column allows you to choose whether or not the corresponding element is Active in the current alternative.

To make an element Inactive in the current alternative, clear the check box in the Is Active. field that corresponds to that element's Label.

The Alternative Editor Dialog Boxes, including the Active Topology Alternative Editor, can be accessed through the Alternatives Tool and right-click: open or double-clicking the specific alternative.



The Alternative Editor dialog boxes are typically organized with tabs for different Drainage and Utility features:



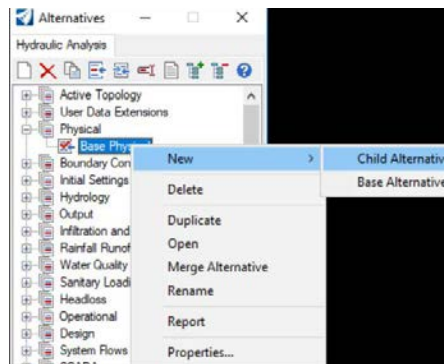
USER DATA EXTENSIONS ALTERNATIVE

In the FDOTConnect Workspace, there are several User Data Extensions that have been defined for various drainage feature types (Conduit, Catch Basin, Manhole, Outfall, and Headwall). These do not affect hydraulic calculations but are provided to help expedite plans production and drainage documentation. Many are pick lists which can be selected for proposed drainage features within this dialog box, other flex tables, or in Utility Properties. User Data Extensions will be discussed later in this manual.

PHYSICAL ALTERNATIVE

A Physical Alternative stores the various physical properties used for hydraulic calculations that are assigned to drainage features, primarily sizes and elevations. The Physical Alternative Editor can be a useful interface to make individual or global edits to the drainage features in the model.

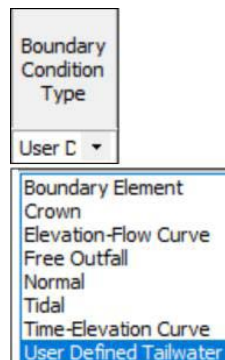
Multiple Physical Alternatives allow for comparison between different variations in design (e.g. pipe sizes, inverts, etc.) without losing older versions that may still be useful during the design process. New Base or Child Physical Alternatives can be created within the Alternative Dialog. Also, Physical Alternatives may be created automatically through prompts when computing a Design Scenario.



BOUNDARY CONDITION ALTERNATIVES

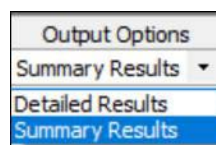
The boundary condition alternative allows users to define boundary condition settings for outfall elements. Generally, Crown or User Defined Tailwater settings are best suited to meet FDOT Drainage Manual requirements.

Multiple boundary condition alternatives are useful when tailwater elevations change for different storm events.



OUTPUT ALTERNATIVES

The output alternative allows users to define output options for network elements, including conduits and channels.



As described in Bentley Drainage and Utilities CONNECT Edition Help:

When **Summary Results** is selected, the result attributes are displayed for the start, end, and middle of the conduit. Drainage and Utilities breaks a conduit up into a number of longitudinal sections.

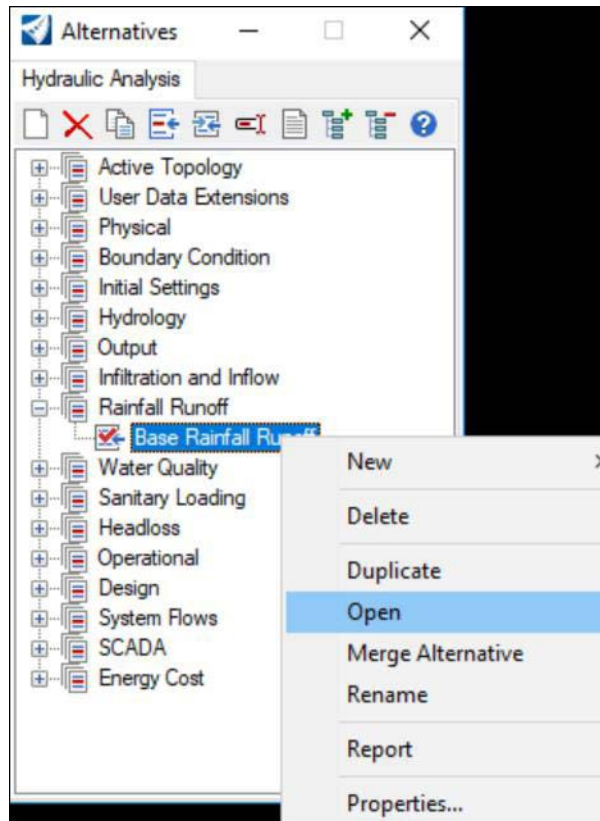
When Detailed Results is selected, the result attributes are displayed for each of the longitudinal sections of the conduit. Only Summary Results are displayed in the graphs and reports for conduits.

In FDOTConnect Workspace, Summary Results is the default option selected in the Base Output.

RAINFALL RUNOFF ALTERNATIVES

The rainfall runoff alternative allows users to define runoff data for global rainfall or specific drainage elements such as outfalls, catchments and ponds for multiple storm events. By default, there is a single alternative, Base Rainfall Runoff. Users can set this event within the Rainfall Runoff Alternative Editor or the Global Storm Events dialog.

New rainfall runoff alternatives can be added for use in other scenarios, such as the absolute 4 in/hr intensity for spread analysis at curb inlets.



Global Rainfall | Manhole | Outfall | Catchment | Pond | Wet Well

Storm Events

Alternative: Base Rainfall Runoff

Global Storm Event: Zone 2 - 3 Year

Source: Orphan (local)

Return Event: 3

Intensity (Average): (N/A) in/h

Depth: (N/A) in

Duration (Modified Rational): 0.000 min

Maximum Storm Intensity: 7.596 in/h

Climate Adjustments

Climate Adjustment Type: None

Climate Adjustment: 0.0 %

SWMM Climatology...

* = Base data = Local data = Inherited data

Global Storm Events

Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Ba Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0

Close Help

HEADLOSS ALTERNATIVE

The headloss alternative editor allows users to define headloss properties for manhole, catch basins and conduit elements.

In the FDOTConnect Workspace, the Base Headloss alternative default methodology for Minor Losses is the Standard Loss Method. This is consistent with FDOT Drainage Design Guide 6.5.7 and FDOT drainage structure feature definitions are set up for user-defined loss coefficients.

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Standard loss method - a user-defined loss coefficient is used to calculate the head loss based on the velocity head of the exit conduit. The standard method calculates structure headloss based on the exit pipe's velocity. The exit velocity head is multiplied by a user-entered coefficient to determine the loss.

	*	ID	Label	Headloss Method	HEC-22 Benching Method	Absolute Headloss (ft)	Headloss Coefficient (downstream)	Headloss Coefficient (Upstream)	Headloss Coefficient (Standard)	AASHTO Shaping Method	Down-Headloss Curve
438: S-101	<input checked="" type="checkbox"/>	438	S-101	Standard					0.00000		
450: S-103	<input checked="" type="checkbox"/>	450	S-103	Standard					0.00000		

* = Base data = Local data = Inherited data

There are several other head loss methods available, depending on the selected solver. Refer to Bentley Drainage and Utilities CONNECT Edition Help for further information.

Supported Head Loss Methods by Solvers								
	Absolute	Standard	Generic	HEC-22 (2 nd)	HEC-22 (3 rd)	AASHTO	Flow vs. Loss	HEC-22 (Minor Loss Eq)
GVF-Convex	Y	Y	Y	Y	Y	Y	Y	Y
GVF-Rational	Y	Y	Y	Y	Y	Y	Y	Y
DW	Y	Y	Y	Y (simplified)				
SWMM	Y	Y			Y			

Supported Head Loss Mode by Solvers						
	Absolute	Standard	Generic	HEC-22 (2 nd)	HEC-22 (3 rd)	AASHTO
GVF-Convex	HGL/EGL	HGL/EGL	HGL/EGL	HGL/EGL	EGL	HGL/EGL
GVF-Rational	HGL/EGL	HGL/EGL	HGL/EGL	HGL/EGL	EGL	HGL/EGL
DW	HGL	HGL	HGL	HGL		
SWMM	HGL	HGL			EGL	

DESIGN ALTERNATIVE

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

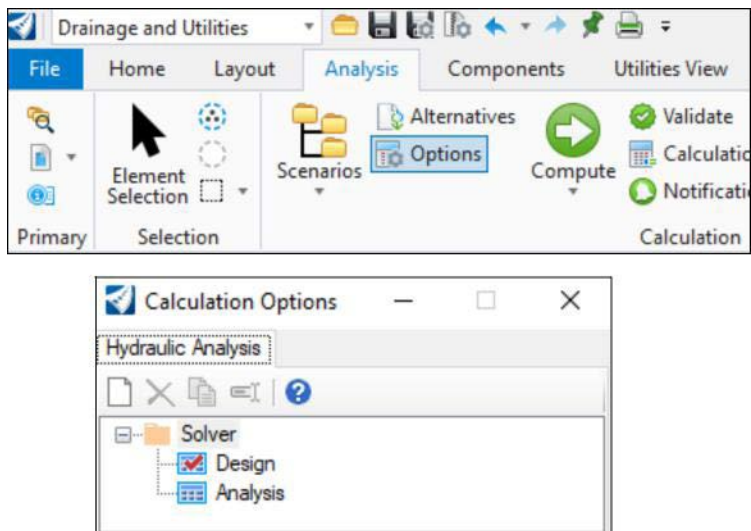
The Design Alternative Editor allows you to edit the pipe, node and inlet constraints governing the design of the system. It also allows you to specify which gravity elements you want designed, and the extent to which you want them designed.

The tabbed dialog for each particular type of element follows the same general format. The top of the dialog box contains several fields where the design constraints can be entered. The constraints entered in these fields are applied to every element in the table on the bottom of the dialog, except the elements that are specified to contain local values. This system allows you to rapidly enter the values that govern most of the elements in the table, and then manually override the constraints for those elements that are exceptions to the majority.

By default, the Base Design Alternative applies the global Design Constraints to all drainage gravity pipe, nodes and inlets.

CALCULATION OPTIONS

Calculation Options can be edited and created through the Calculation Options Manager, accessible from the path: Drainage and Utilities > ANALYSIS > Calculation > **Options:**



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Calculation options contain attributes that define how your model is calculated in the software. You create calculation options in the Calculation Options Manager. You can create several calculation options with different attributes depending on the requirements of your model.

The software contains a default calculation option called Base Calculation Options. If you do not create additional calculation options, the software will use this default option whenever you calculate your model.

In the FDOTConnect Workspace, several defaults defined in the Design and Analysis options have been updated from the default Bentley selections to better align with FDOT standard practices. Additional details are provided in Technical Resources. However, users are responsible to ensure calculations meet design intent and FDOT Drainage Manual criteria.

NOTE *In FDOTConnect Workspace, the only difference between the default Design and Analysis options is the Calculation Type selection (Design or Analysis): an Analysis performs calculations but does NOT change structure properties; a Design option performs calculations and MAY change structure properties.*

Properties (no selection)

Subsurface Utilities Hydraulic Analysis

75%

Add to Selection

<Show All>

Property Search

<General>	
ID	27
Label	Design
Notes	
Active Numerical Solver	GVF-Rational (StomCAD)
GIS-IDs (Delimited)	
Calculation Type	Design
Minimum Time of Concentration (min)	10.000
Use Minimum Tc as Minimum System Time?	True
Gravity Hydraulics	
Maximum Network Traversals	5
Flow Convergence Test	0.00100
Flow Profile Method	Capacity Analysis
Number of Flow Profile Steps	5
Hydraulic Grade Convergence Test (ft)	0.00
Average Velocity Method	Actual Uniform Flow Velocity
Minimum Structure Headloss (ft)	0.00
Governing Upstream Pipe Selection Method	Pipe with Maximum QV
Structure Loss Mode	Hydraulic Grade
Include Conduit Flow Travel Time in Design	True
Save Detailed Headloss Data?	False
Gravity Friction Method	Manning's
Use Explicit Depth and Slope Equations?	False
Ignore Pipe Travel Time in Carrier Pipes?	False
Correct for Partial Area Effects?	True
Inlets	
Active Components for Combination Inlets on Grade	Grate and Curb
Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	True
Neglect Side Flow?	False
Grating Parameters (United Kingdom)	<Collection: 5 items>
Pressure Hydraulics	
Liquid Label	Water at 20C(68F)
Pressure Friction Method	Manning's
Rational Method	
Use Rational Method Frequency Factors	False
Allow Runoff Coefficient to Exceed 1.0?	False
Carryover Modeling Method	As Flow (HEC-22)
> Headloss (AASHTO)	

Active Numerical Solver
Numerical solver to use in scenarios referencing this calculation option.

HINT See the bottom of Properties dialogs for detailed description of the selected field.

CALCULATION AND ANALYSIS

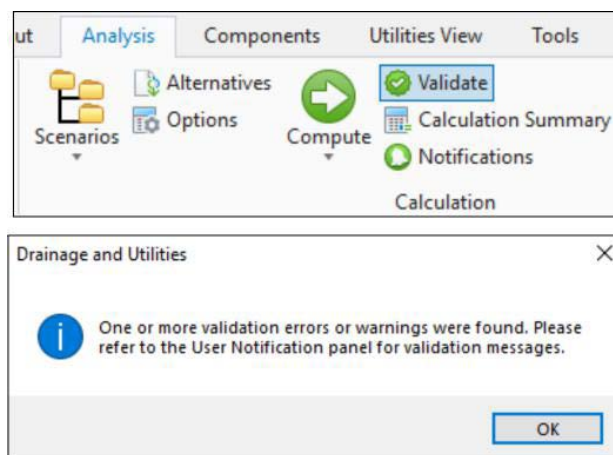
Once default design constraints, scenarios, alternatives and calculation options are set, the model is ready to begin calculating. Computing the model can be initiated directly from the ribbon, from Scenario Manager, and from the Compute Center.

Before computing, there is an optional tool available, Validate, for users to identify any input errors. If 'Compute' is run before validation, the same user notifications will appear.

VALIDATE

As defined in Bentley Drainage and Utilities CONNECT Edition Help, the **Validate** tool

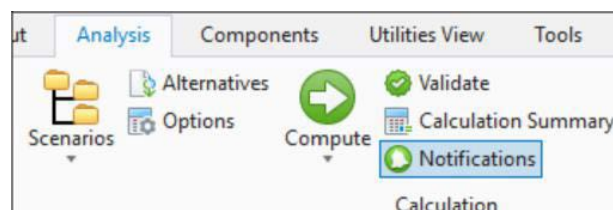
“Runs a diagnostic check on the network data to alert you to possible problems that may be encountered during calculation. This is the manual validation command, and it checks for input data errors.”



Results of the validation are reported in the User Notifications Manager.

NOTIFICATIONS

User Notifications are messages about the model and can be accessed from the path: **Drainage and Utilities > Analysis > Calculation > Notifications**



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

The User Notifications Manager displays warnings and error messages that are turned up by Drainage and Utilities validation routines. If the notification references a particular element, you can zoom straight to that element by either double-clicking the notification, or right-clicking it and selecting the Zoom To command.

Warnings are denoted by an orange icon and do not prevent the model from calculating successfully.

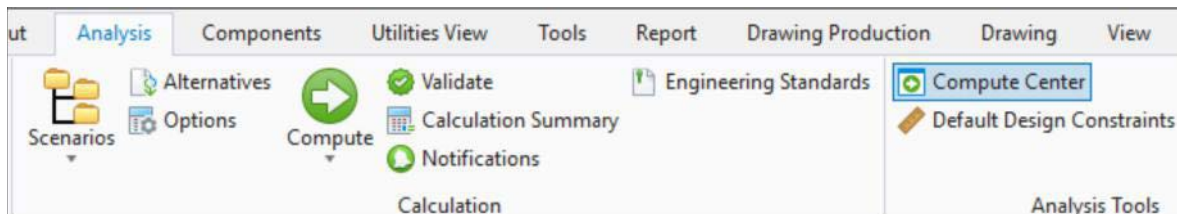
Errors are denoted by a red icon, and the model will not successfully calculate if errors are found.

Message Id	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source
44045	Analysis	Catchment	446	DR-101	(N/A)	Time of concentration for...	Hydraulic Results
44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet m...	Hydraulics Validation

HINT Corresponding warning icons are shown in plan view. The subject drainage element label, Message ID, and Message will display when the mouse hovers over these icons.

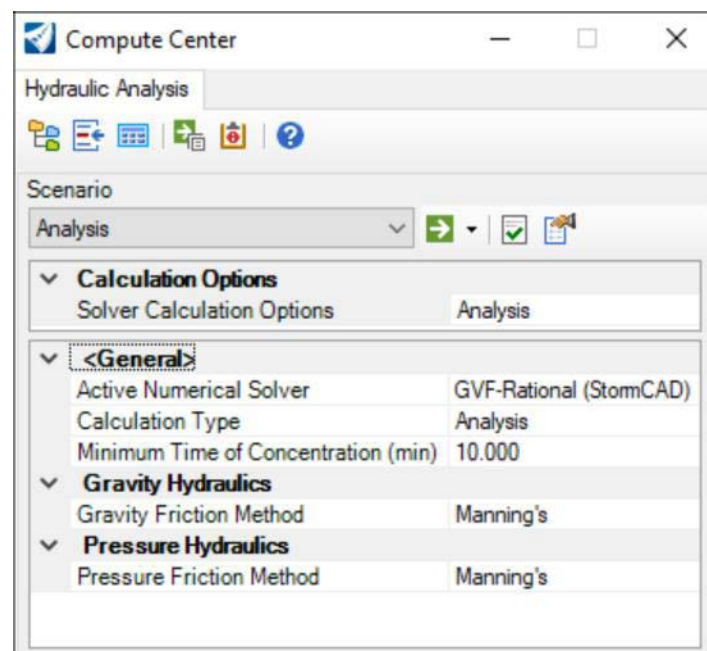
COMPUTE CENTER

The Compute Center is accessed from the path: Drainage **and Utilities** > **Analysis** > **Analysis Tools** > **Compute Center**



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

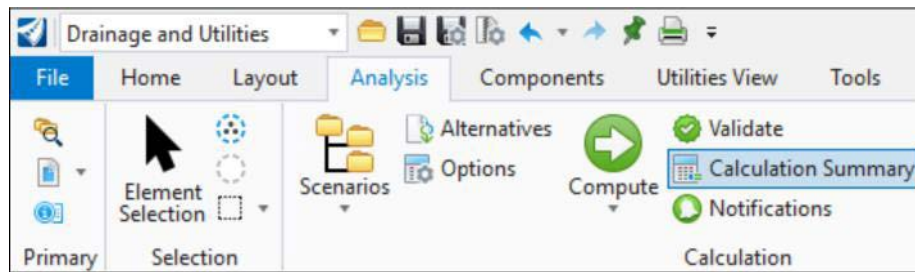
The compute center is a dialog box that enables the user to quickly and easily keep track of and modify high level settings for the current scenario. At a glance, the user can determine what the current scenario is, what the active solver is and what set of calculation options are being used. The user can also change these without getting into the detailed scenario selection and calculation options dialogs.



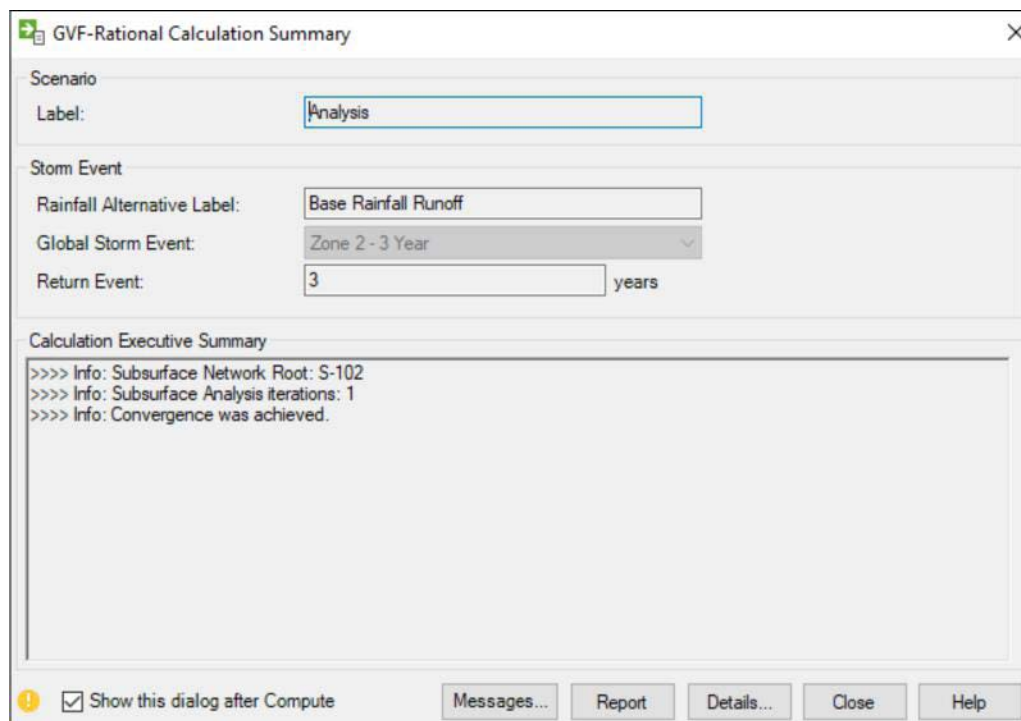
HINT The Compute Center contains icons to activate most of the tools located in the Analysis Tab and Calculation Group.

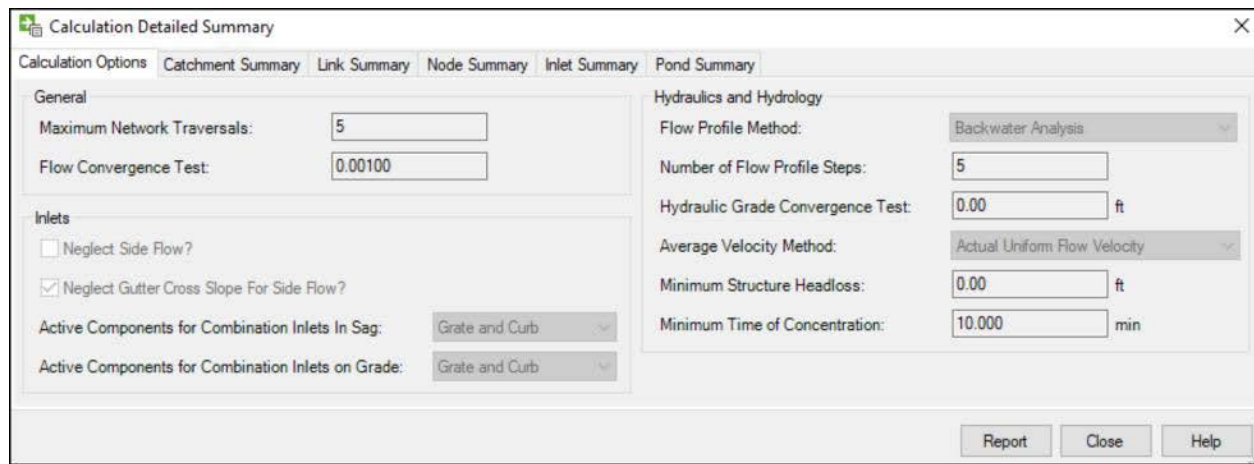
CALCULATION SUMMARY

The Calculation Summary window can be accessed from the path: **Drainage and Utilities > Analysis > Calculation > Calculation Summary**



As long as the Show this dialog after Compute checkbox is checked, the following Calculation Summary window will open after Compute Scenario has been initiated and completed. A successful compute will include the line Convergence was achieved in the Calculation Executive Summary. Details... opens the Calculation Detailed Summary, with more information organized into tabs for each drainage element type.

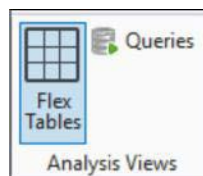




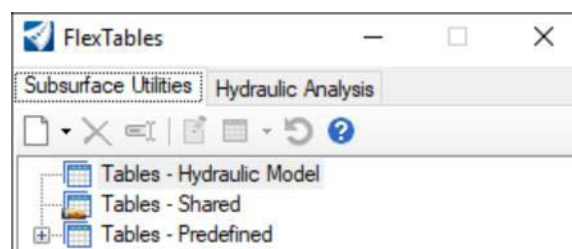
FLEX TABLES

In addition to the Calculation Summary tables, Flex Tables are used to access information for specific types of elements in the drainage model database. The tabular format allows for easy viewing, sorting, editing, and exporting of model input and calculation results.

The **Flex Table Manager** can be accessed from the path: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables**

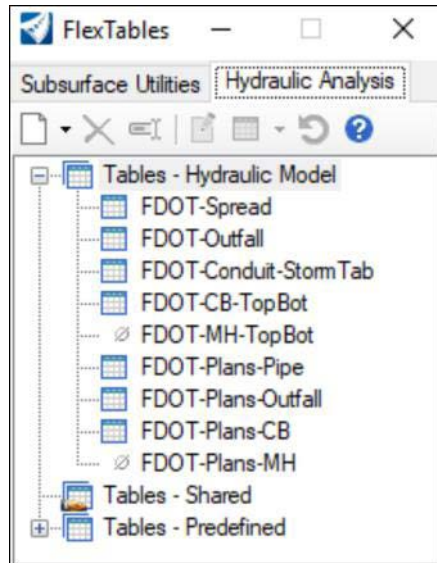


The **Flex Table Manager** contains two tabs: **Subsurface Utilities** and **Hydraulic Analysis**. Each tab includes a section for tables defined in the **Hydraulic Model** (this DGN), shared (available to multiple DGNs), and predefined (from Bentley).



In the FDOTConnect Workspace, FDOT Flex Tables have been added to the Hydraulic Analysis tab, in the Hydraulic Model section. The FDOT tables are formatted for both plans production and design documentation purposes to follow the FDOT Design Manual and Drainage Manual. Flex Tables for plans production and drainage documentation workflows will be discussed later in this manual.

NOTE *Any flex table can be edited to best fit the project. Designers should use the Drainage Manual and Drainage Design Guide to determine the information needed to represent the drainage system.*



HINT Icons in the Flex Table Manager indicate whether the particular type of drainage element is present in the model. In the graphic above, the Ø icon next to the MH tables indicates this model does not include manholes. The table icon is adjacent to elements that are present, such as catch basins (CB) and outfalls.

PROFILES

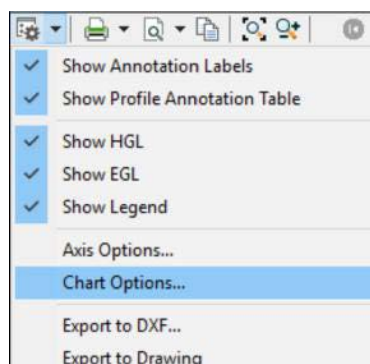
There are several ways to visualize the computation results and evaluate the network performance including three profile visualization tools that can be accessed from the path: **Drainage and Utilities > HOME > PRIMARY > Explorer > Drainage and Utilities Model > (dgn file) > Profile Runs** and right clicking on any profile run. Refer to Chapter 3 of this course guide for creating Profile Runs.

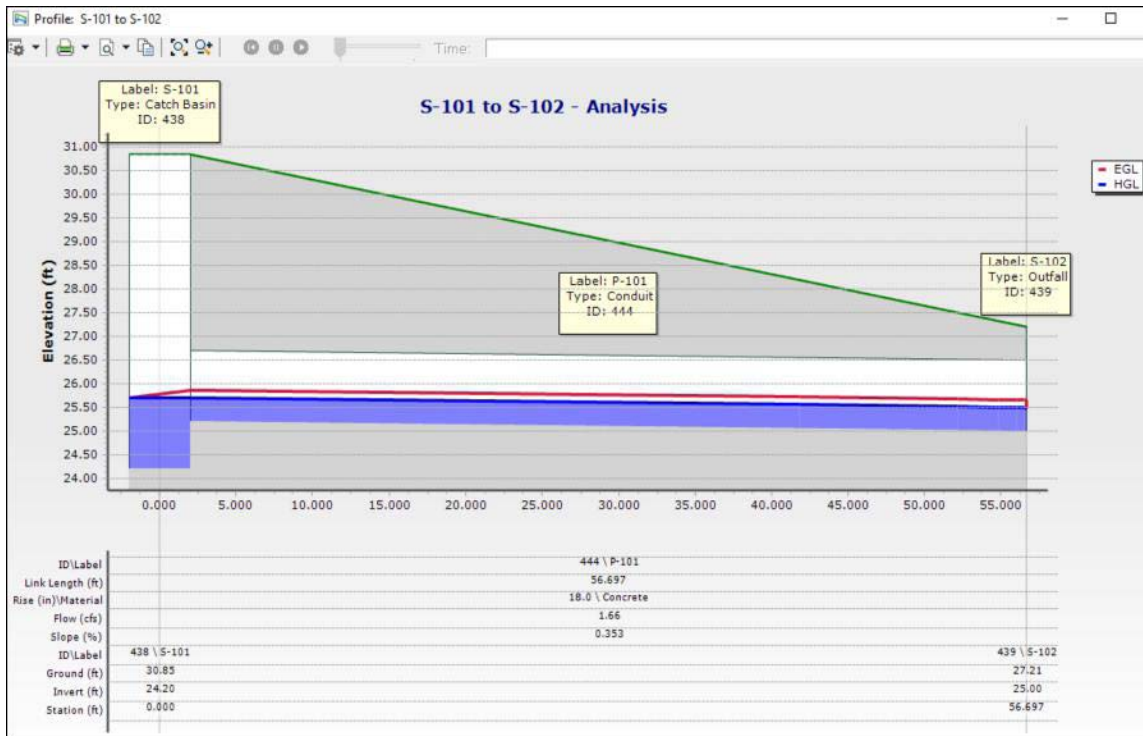
OPEN PROFILE MODEL

In FDOTConnect Workspace, Open Profile Model is a key tool for Plans Production, discussed later in this manual. It is used to generate a View that presents the profile run and enables the Vertical Geometry tools to interact with the features.

OPEN ANALYSIS PROFILE

This analytic profile displays the profile run with HGL and EGL results. There are multiple options to customize the display.

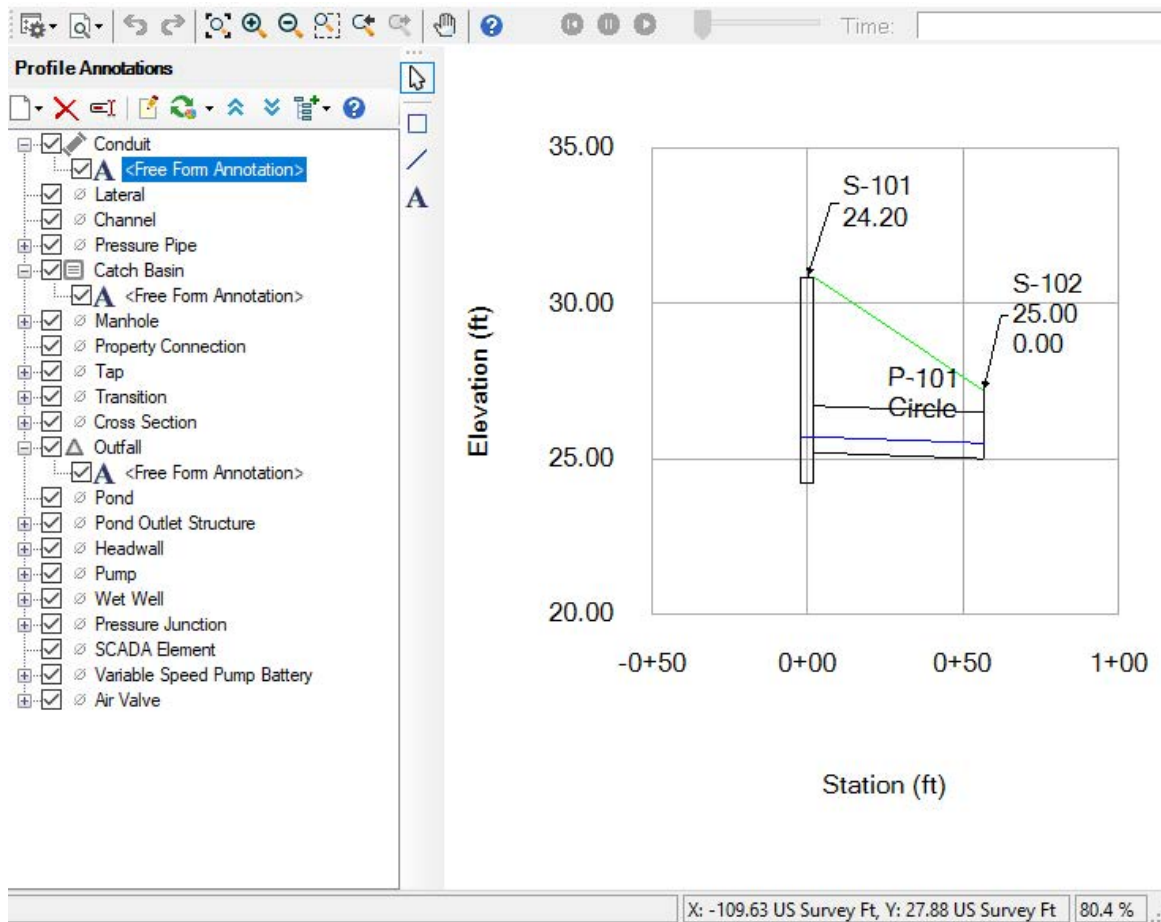




NOTE Although this Analysis and Engineering profiles can be exported to drawing, it is a snapshot only and would not be automatically updated if the design changes.

OPEN ENGINEERING PROFILE

Similar to the Analysis Profile, Engineering Profile displays the HGL results, but includes additional customizable label options for the drainage features.



EXERCISES

EXERCISE OVERVIEW – DESIGN & ANALYSIS

In this exercise, users will select calculation settings, compute a scenario, and analyze results in a variety of methods. The network created in Chapter 3 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

Exercise 4.1	Review and Set Default Design Constraints.....	128
Exercise 4.2	Create a new Engineering Standard.....	130
Exercise 4.3	Create a new Analysis Scenario with adjusted Alternatives.....	133
Exercise 4.4	Compute Center, Validate the model, resolve Notifications, & Compute Scenario.....	136
Exercise 4.5	Review Results in Flex Tables.....	140
Exercise 4.6	Review Results in Analytic Profiles.....	142

Exercise 4.1 Review and Set Default Design Constraints

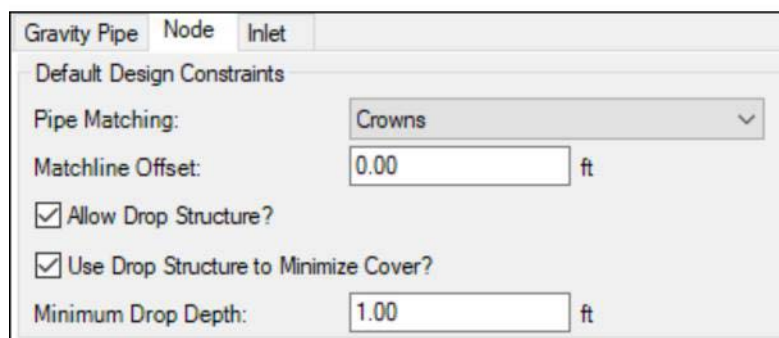
1. Open FDOTConnect, set the Workspace to FDOT and select the Workset – **22049555201**.
2. Browse to the drainage folder and open *DRPRRD01.dgn*.
3. Navigate through the following path and open: **Drainage and Utilities > ANALYSIS > Analysis Tools > Default Design Constraints**



4. Review the available input variables that the software will consider if automated design is performed for:
 - a. Gravity Pipe: Velocity, Cover, Slope, Tractive Stress, Part Full Design, Number of Barrels, and Section Size:



- b. Node:



- c. Inlet: Maximum Spread and Maximum Gutter Depth are project-specific and require user input to compute analysis or design.

Gravity Pipe	Node	Inlet
Maximum Spread:	<input type="text" value="0.000"/>	ft
Maximum Gutter Depth:	<input type="text" value="0.00"/>	ft

Default On Grade Inlet Design Constraints

Minimum Efficiency on Grade: %

NOTE *Minimum Efficiency on Grade is used when inlet lengths are adjusted to meet a specified efficiency and is not applicable in FDOTConnect Workspace, where all inlet lengths have fixed dimensions based on Standard Plans.*

- i. For this example, SR 61 has a 45 mph design speed with an 11 ft outside travel lane, 7 ft bike lane and Type F Curb and Gutter. Enter *Maximum Spread* = **14 ft**. Conservatively ignoring the gutter depression, at 0.02 cross slope, enter the corresponding *Maximum Gutter Depth* = **0.28 ft**.

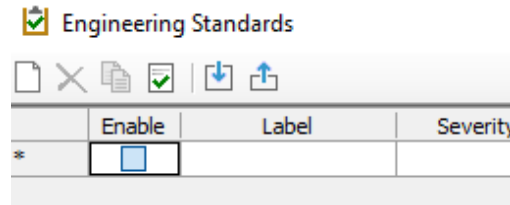
Gravity Pipe	Node	Inlet
Maximum Spread:	<input type="text" value="14.000"/>	ft
Maximum Gutter Depth:	<input type="text" value="0.28"/>	ft

NOTE *Exercise 3.1 set the global Default Design Constraints. However, if a project or network has varying conditions, use Design Alternatives to assign design constraints to individual and/or groups of drainage structures as needed.*

Exercise 4.2 Create a new Engineering Standard

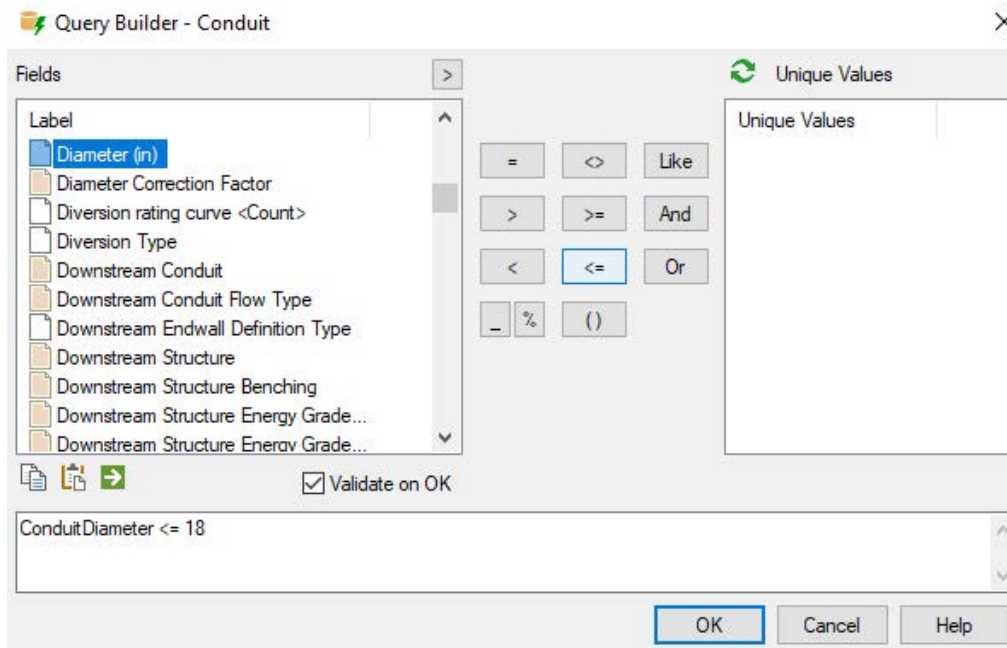
In this exercise, users will create an Engineering Standard to check that Pipe Size and Length requirements for 18 inch pipes are met in the drainage model, according to FDOT Drainage Manual, 3.10.1.

1. Navigate through the following path and open: **Drainage and Utilities > ANALYSIS > Calculation > Engineering Standards.**
2. At the top left of the first row, click the checkbox for Enable.



	Enable	Label	Severity
*	<input checked="" type="checkbox"/>		

3. Proceed from left to right, completing the columns for the 3.10.1 18" pipe criteria as follows:
 - a. **Label = 3.10.1 18 inch**
 - b. **Severity** (select from list: Information, Warning, or Error) = **Error**
 - c. **Element Type** (select from list) = **Conduit**
 - d. For Include Elements, click the ellipse and populate the query with the following statement by double clicking from the field and symbol lists. Enter **18** at the end, and check the box for **Validate on OK**. Click **OK**.



Query Builder - Conduit

Fields: Diameter (in), Diameter Correction Factor, Diversion rating curve <Count>, Diversion Type, Downstream Conduit, Downstream Conduit Flow Type, Downstream Endwall Definition Type, Downstream Structure, Downstream Structure Benching, Downstream Structure Energy Grade..., Downstream Structure Energy Grade...

Unique Values: Unique Values

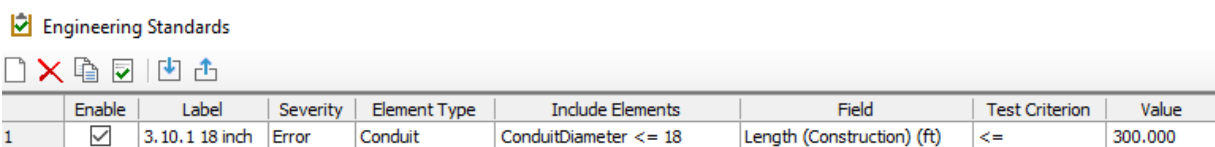
Operators: =, <>, Like, >, >=, And, <, <=, Or, -, %, ()

Validate on OK:

Query: ConduitDiameter <= 18

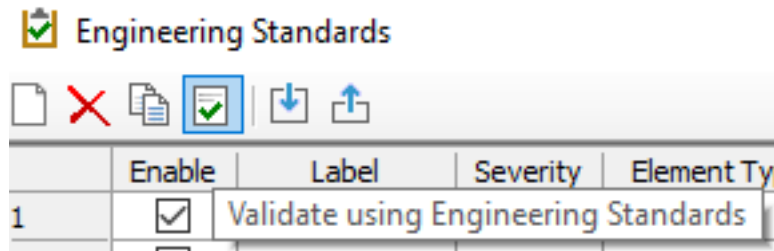
Buttons: OK, Cancel, Help

- e. **Field = Length (Construction) (ft)**
- f. **Test Criterion = <=**
- g. **Value = 300.00**

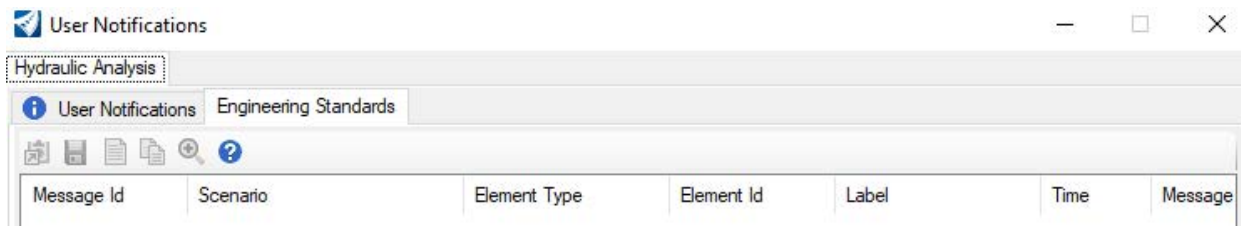


	Enable	Label	Severity	Element Type	Include Elements	Field	Test Criterion	Value
1	<input checked="" type="checkbox"/>	3.10.1 18 inch	Error	Conduit	ConduitDiameter <= 18	Length (Construction) (ft)	<=	300.000

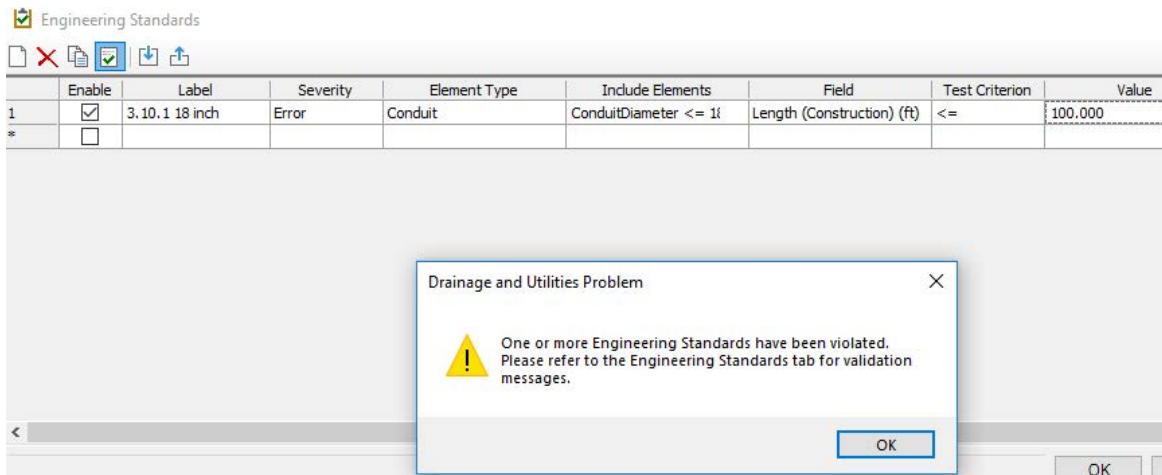
- Click the Icon for *Validate Using Engineering Standards*



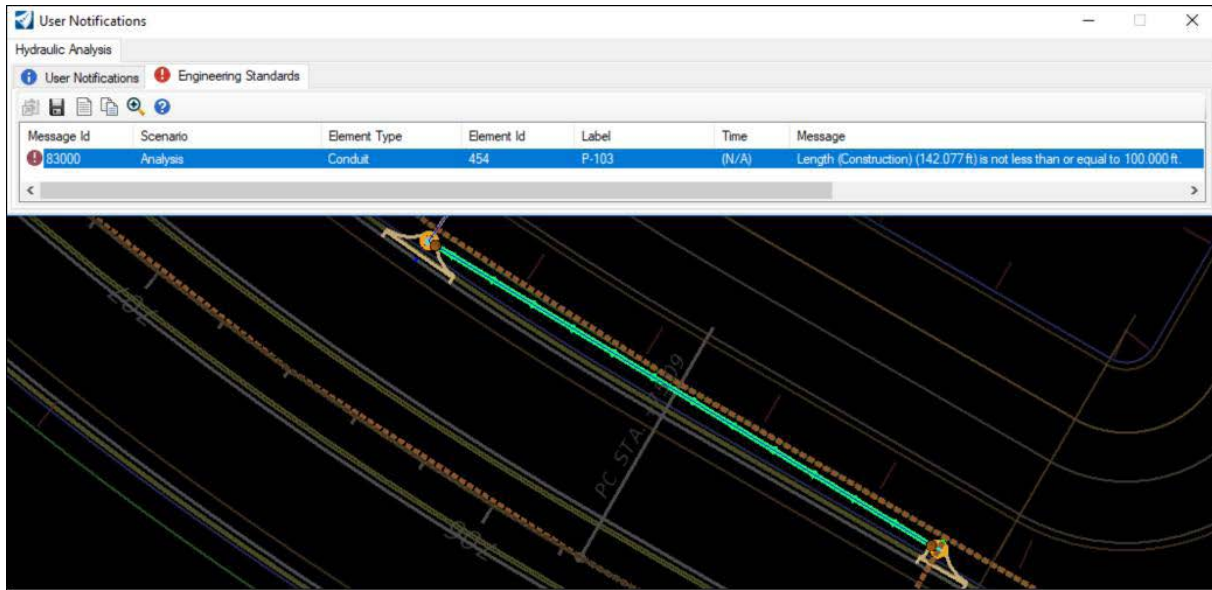
- The validation will process and automatically close the Engineering Standards Window. Navigate to the following path to open the results: **Drainage and Utilities > Analysis > Calculation > Notifications.**



- Since there are no pipes that violate this criteria, the Engineering Standards tab in User Notifications is blank.
- To see what happens when a Error level severity Engineering Standard is violated, reopen the Engineering Standards, overwrite the **300.00** with **100.00**, and click the icon for Validate using Engineering Standards.



- Click **OK** to close the error message and Reopen User Notifications. Right click on the error and select Zoom To. The conduit that violated the length ≤ 100.00 ft criteria is now selected.



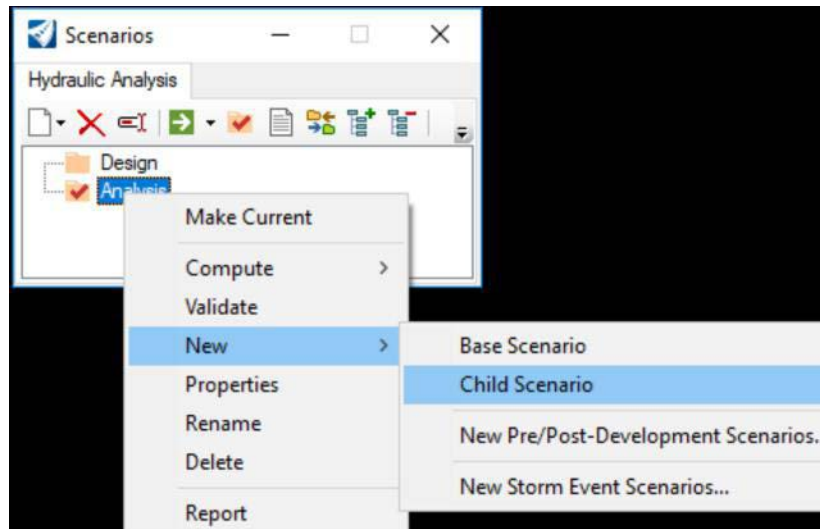
HINT Errors will not allow the model to compute, until the violation is resolved. Users can set Engineering Standards severity based on the level of notification.

- Close User Notifications, reopen **Engineering Standards**, replace **100** with **300** in the value field, and revalidate.

Exercise 4.3 Create a new Analysis Scenario with adjusted Alternatives

In this exercise, users will create a new scenario for a 4 inch/hr intensity event that corresponds to the Drainage Manual 3.9.1 spread criteria.

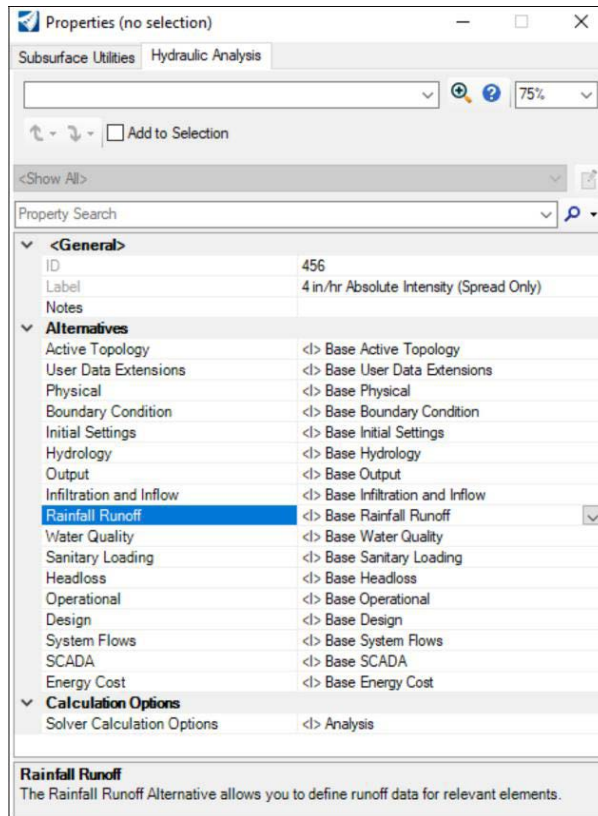
1. Navigate through the following path and open: **Drainage and Utilities > Analysis > Calculation > Scenarios > Scenario Manager**.
2. Since we want this scenario to acquire most of the default properties from the base Analysis scenario, right click on Analysis, and select **New: Child Scenario**.



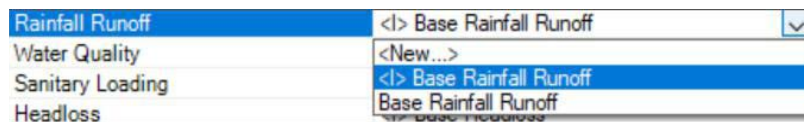
3. Name this scenario **4 in/hr Absolute Intensity (Spread Only)**



4. Double-click this scenario to open the properties. The <I> indicates the various Alternatives and Calculation Options that can be acquired.



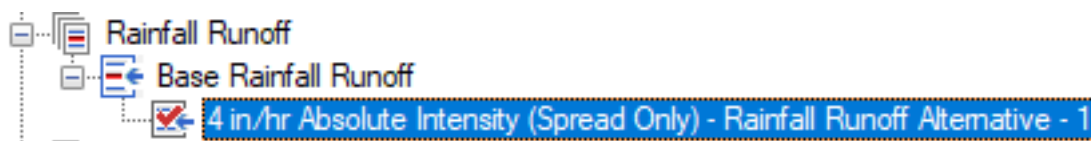
- Click the pull down list for Rainfall Runoff to view the available Rainfall Runoff Alternatives.



- Select **<New...>**. The Create New Alternative Window appears with a prompt for the new name. By default, the field is populated with a combination of the scenario name and alternative sequence. Select **OK** and close the scenario properties.



- Open the Alternatives Manager from the following path: **Drainage and Utilities > Analysis > Calculation > Alternatives**. Find the new Rainfall Runoff Alternative and double click to open properties.



Rainfall Runoff : 4 in/hr Absolute Intensity (Spread Only) - Rainfall Runoff Alternative - 1 (DRPRRD01 -

Global Rainfall | Manhole | Outfall | Catchment | Pond | Wet Well

Storm Events

Alternative: 4 in/hr Absolute Intensity (Spread Only) - Rainfall Runoff Alte

Global Storm Event: Zone 2 - 3 Year

Source: Orphan (local)

* = Base data = Local data = Inherited data

8. For Global Storm Event, use the pull-down menu to select Absolute Intensity 4 in/hr – 0 Year. Close properties and Alternatives Manager.
 - a. This can also be selected/edited under the **Global Storm Events > Drainage and Utilities > Components > Common > Storm Data > Global Storm Events**.

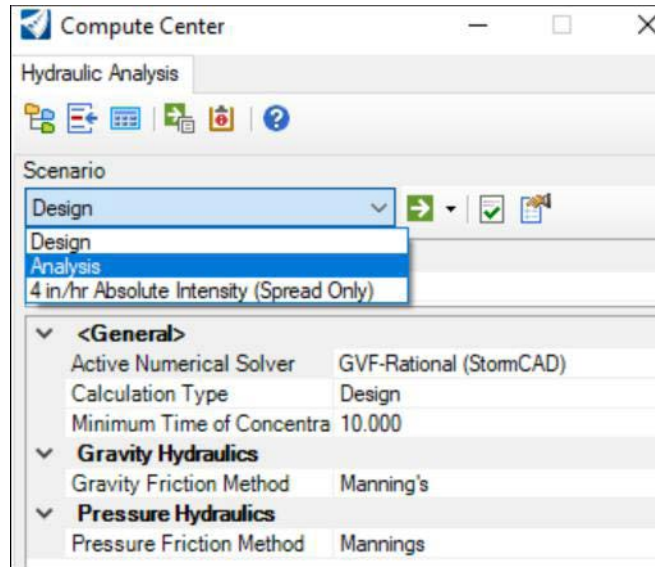
Global Storm Events

	Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: 8a	Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4	4 in/hr Absolute Intensit...	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000	None	0.0

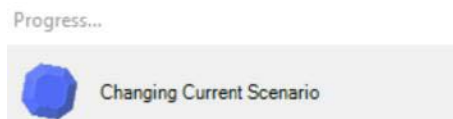
Exercise 4.4 *Explore Compute Center, Validate model, resolve Notifications, and Compute Scenario*


In this exercise, users will review the Compute Center settings and compute the Analysis Scenario, for the Zone 2 – 3 Year event.

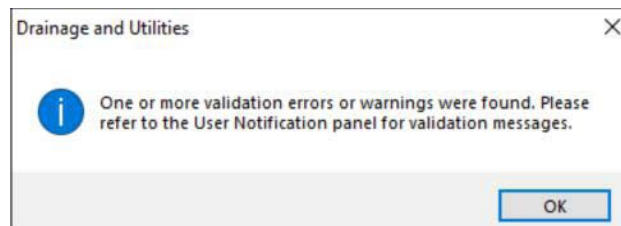
1. Navigate through the following path and open: **Drainage and Utilities > Analysis Analysis Tools > Compute Center.**



2. The Scenario section includes a pull-down menu to select the current scenario. As this is changed between Design and Analysis type scenarios, the Calculation Type will be updated automatically, based on the Calculation Option.



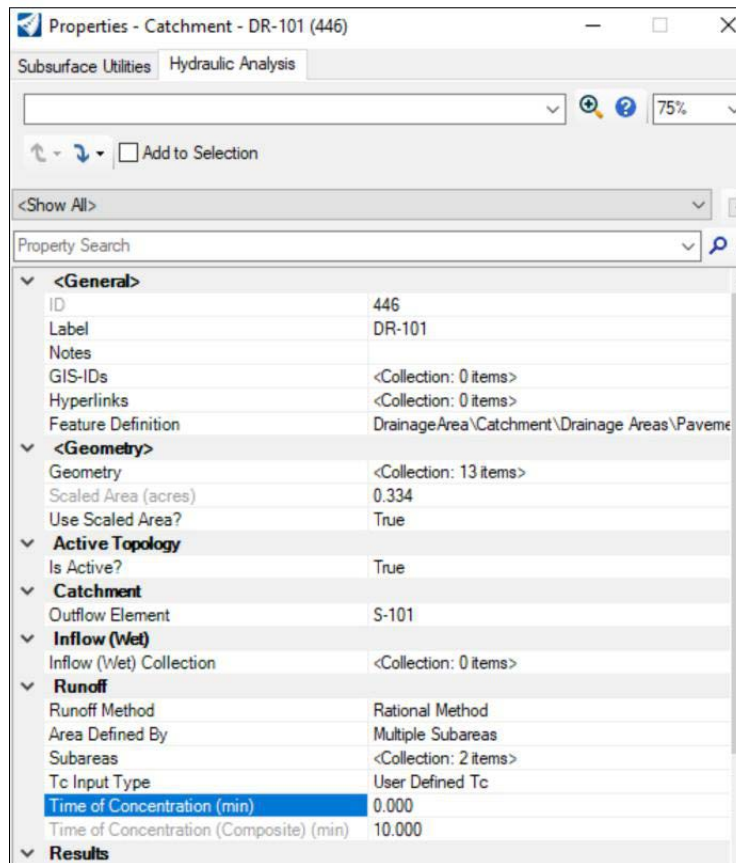
3. Select **Analysis** as the current Scenario.
4. Click the  icon to Validate the model. Click **OK** to close the error message.



5. Click the  icon to open the User Notifications Manager and review messages:

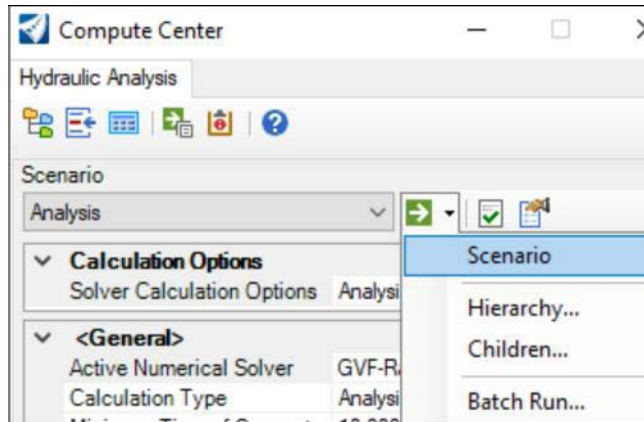
Message Id	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source
44045	Analysis	Catchment	446	DR-101	(N/A)	Time of concentration for catchment is less than the minimum Tc value defined in the calcul...	Hydraulic Results
44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet minimum cover constraint.	Hydraulics Validation

6. The yellow icons indicate the severity is warning for these notifications and will not prevent the model from computing. Generally, these can be addressed at the designer's discretion.
 - a. In this example, we are not going to address the pipe cover warning, since P-101 is a pipe to the pond bottom, which will not have 1' cover at the MES.
 - b. To resolve the time of concentration warning, right-click the row and select **Zoom To**. This will automatically select the catchment DR-101. Hover the mouse over the drainage area boundary and open Utility Properties from the quick menu.

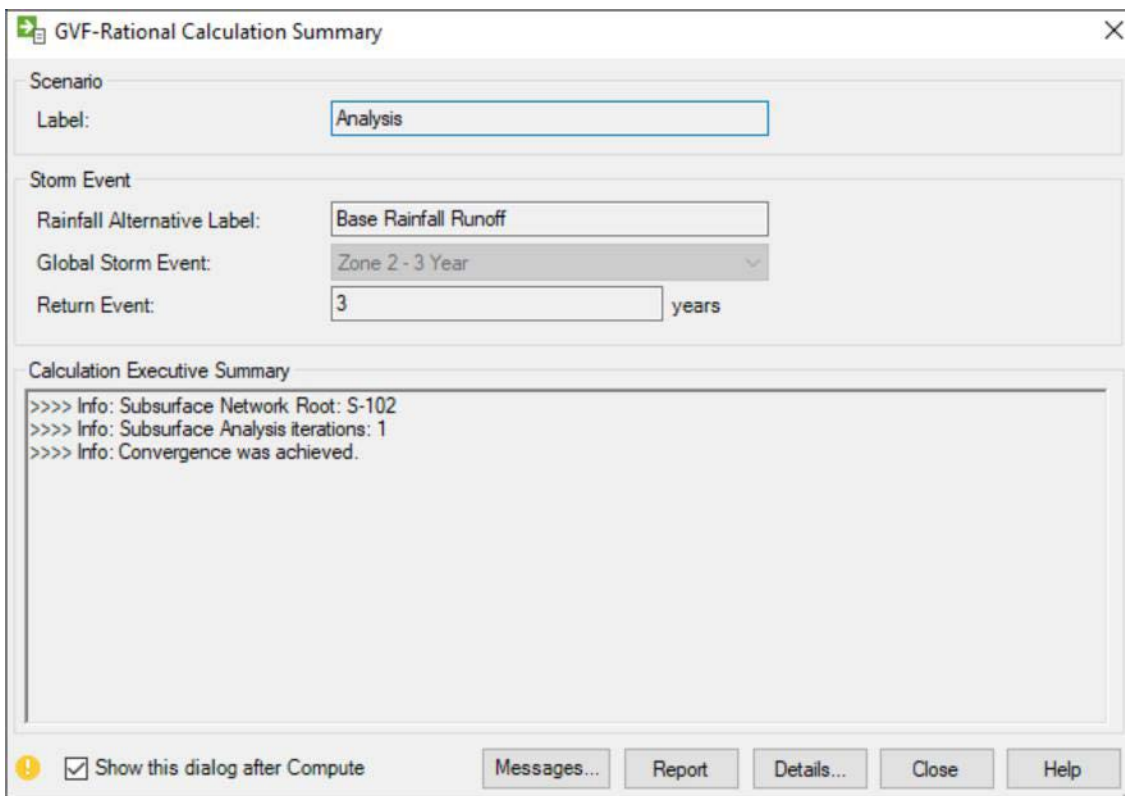


- c. Enter **10.00** in the *Time of Concentration (min)* field and close the properties dialog.
- d. Repeat Steps 4 and 5 to re-validate the model and view user notifications to see that the time of concentration warning has been resolved.

- Click the Compute icon next to the current scenario and select Scenario.



- Review the Calculation Summary.



- The default view displays the current scenario and rainfall. The executive summary includes Convergence was achieved indicating a successful compute.
- Open **Messages...** and review warning and information only notifications about the model.

Message...	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source
44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet minimum cover constraint.	Hydraulics Validation
44120	Analysis	Catch Basin	438	S-101	(N/A)	The depth of ponding exceeds the maximum depth constraint for this 'In Sag' inlet.	Hydraulics Validation
44131	Analysis	Outfall	439	S-102	(N/A)	User defined tailwater is ignored. Frontwater analysis for a hydraulically steep condition or a minimum tailwater control will govern.	Hydraulic Results
22019	Analysis	(N/A)	-1	(N/A)	0.000	One or more conduits are operating under pressure at this time step.	Hydraulic Results

- Open **Details...** and review the Calculation Detailed Summary with tabs for each type of drainage feature.

Calculation Detailed Summary

Calculation Options Catchment Summary Link Summary Node Summary Inlet Summary Pond Summary

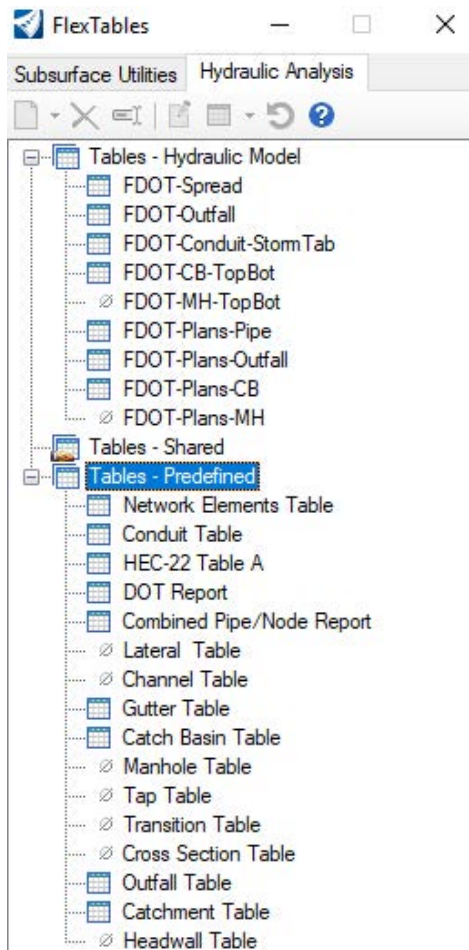
	Label	Section Type	Branch ID	Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
	P-101	Circle	1	S-102	1.66	3.16	25.71	25.48	0.51	0.48
	P-103	Circle	1	S-102	1.12	3.93	26.89	25.71	0.39	0.51

Report Close Help

9. Close the open dialogs and Compute Center.

Exercise 4.5 Review Results in Flex Tables

1. Navigate through the following path and open: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables.**
2. In the Hydraulic Analysis tab, review the available Flex Tables in the Hydraulic Model and Predefined groups.

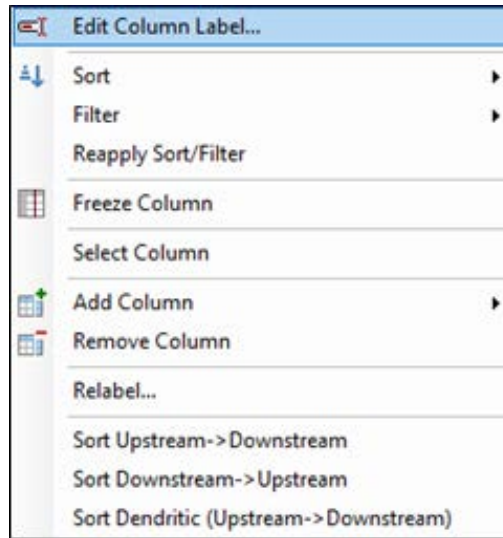


3. Open FDOT-Conduit-StormTab, the FDOTConnect Workspace equivalent to the Drainage Manual Storm Tabulation format.

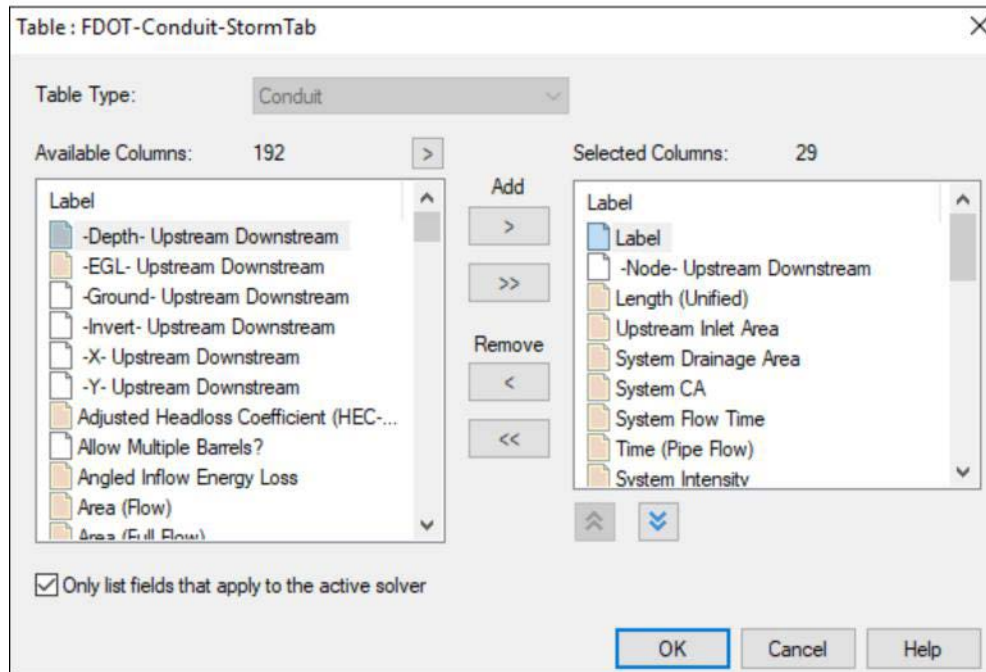
FlexTable: FDOT-Conduit-StormTab (Current Time: 0.000 min) (DRPRRD01 -- Default.stsw)


	Label	-Node- pstrear wnstre:	engt inifec (ft)	ostrea Inlet Area (acres)	ysten ainag Area (ft ²)	ystem CA (acres)	System Flow Time (min)	Time (Pipe Flow) (min)	ysten tensit (in/h)	ysten ditio Flow (cfs)	ystem atio Flow (cfs)	ystem ratio Flow (cfs)	evatio rounc (ft)	HGL aran (ft)	-HGL- ostrea vnstre (ft)	-Invert (conduit) pstrea wnstre: (ft)	radius (ft)	Fall vert: (ft)	umbe of arret: (ft)	Size isplay (ft)	Rise inifec (ft)	Span (ft)	frictio Slope (%)	Slope iliculate (%)	limin Slope (%)	elocit (ft/s)	ysic elocit (ft/s)	apacit (Full Flow) (cfs)	Notes	
444: P-101	P-101	S-101	5...	0.334	2...	0.452	10....	0.299	5....	0.00	1.66	0.00	30.85	5.15	25.71	25.20	0.22	0....	1	18 ...	1.50	0....	0.356	0.353	0.151	3.16	3.82	6.76		
444: P-101		S-102													25.48	25.00														
454: P-103	P-103	S-103	1...	0.225	9...	0.182	10....	0.620	6....	0.00	1.12	0.00	31.40	4.51	26.89	26.50	1.18	1....	1	18 ...	1.50	0....	0.858	0.887	0.151	3.93	6.06	10.71		
454: P-103		S-101													25.71	25.20														

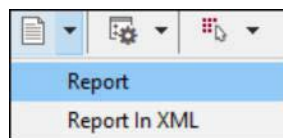
- a. Right click in any column header to see the table formatting and sorting options.



- b. Click the Edit icon  to view which database properties are used to populate the table.



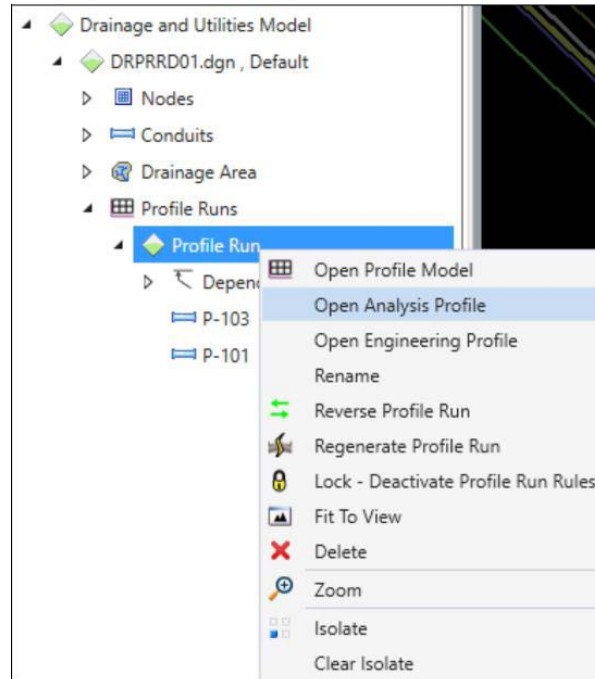
- c. Close Edit dialog and Click the Export icon  to save the table as a .csv file or the Report icon to open the printable views.




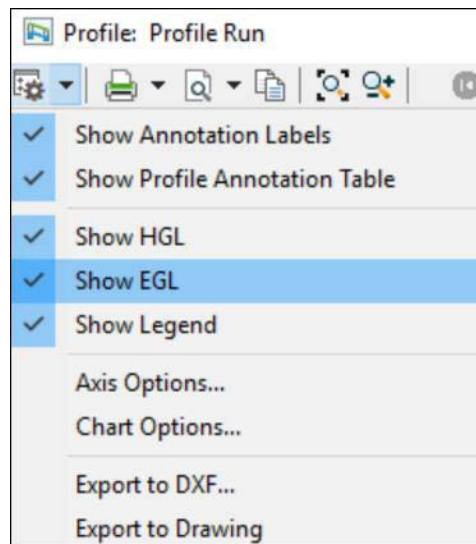
4. Close the open dialogs and Flex Table Manager.

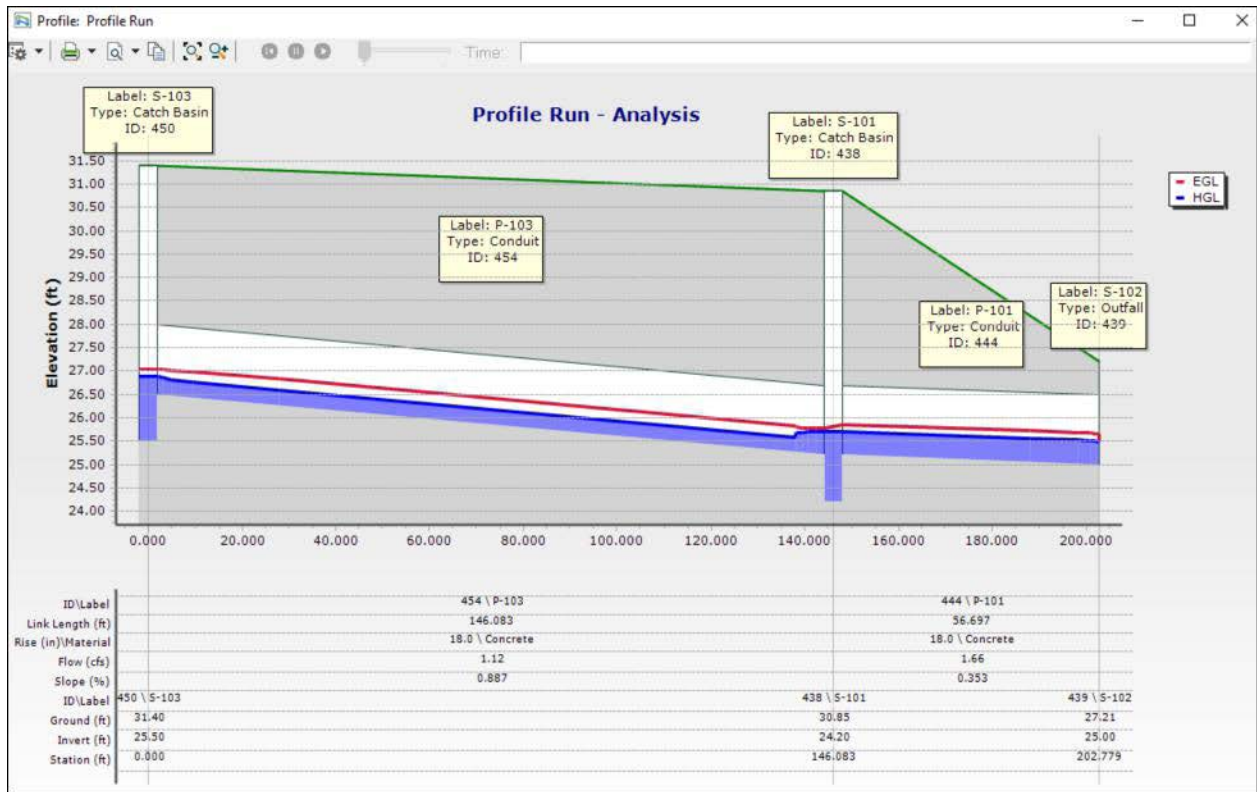
Exercise 4.6 Review Results in Analytic Profiles

1. Navigate through the following path and open: **Drainage and Utilities > Analysis > Calculation > Scenarios > Scenario Manager**.



2. Click the Chart Settings  icon to see and turn on available annotation options.





3. Close the open dialogs.

5

PLAN DEVELOPMENT WORKFLOW FOR DRAINAGE STRUCTURES SHEETS

INTRODUCTION

The main focus in this chapter will be on Plan Development Workflow for Drainage Structures Sheets, as described in FDM 916.

The FDOTConnect Workspace, includes three default sheet sizes for Drainage Sheets: 11x17, 36x48, and 36x72. Part 3, Chapter 900 series of the FDOT Design Manual (FDM) outlines Florida Department of Transportation (FDOT) NexGen Plans.

This chapter will introduce several important tools and features available in The Drainage and Utilities Workflow and FDOTConnect Workspace. They are:

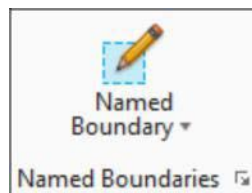
- Named Boundary
- Place Note and Place Label
- Model Annotation
- Tables

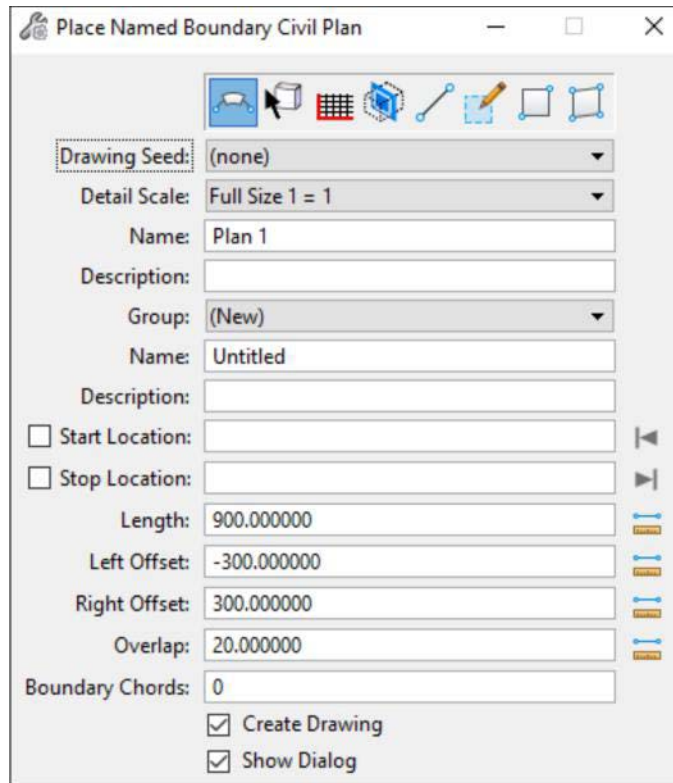
This chapter will also introduce the user to a new workflow terminology using the Ribbon. If you see a direction like this: **Drainage and Utilities > Drawing Production > Named Boundaries > Named Boundary**, it means we are in the **WorkFlow** of **Drainage and Utilities** which has a **Tab** named **Drawing Production** and has tools that are located in the **Named Boundaries Group**. Now that we are in the right workflow, Tab and Group we may need to click on a tool that has more than one option.

NAMED BOUNDARY AND SHEET CUTTING

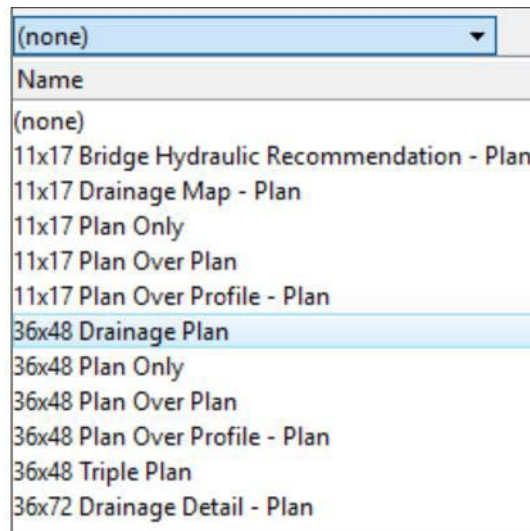
In OpenRoads Designer CONNECT Edition, Named Boundaries are used to define clipping areas for plan and profile. There are several types of boundaries available in the Named Boundary tool; the FDOT Drainage Workflow will typically use Civil Plan and Civil Profile. The Place Named Boundary Civil Plan dialog box is shown below.

The typical FDOT Drainage Workflow is to create a Civil Plan named boundary first with the corresponding sheet(s). Subsequently, when the Civil Profile named boundaries are created, these are not placed on new sheets, but added to the sheet(s) created with the Civil Plan named boundary.






The Drawing Seed selected determines which style sheet is created. In FDOTConnect Workspace, the predefined FDOT sheet seeds populate the list:

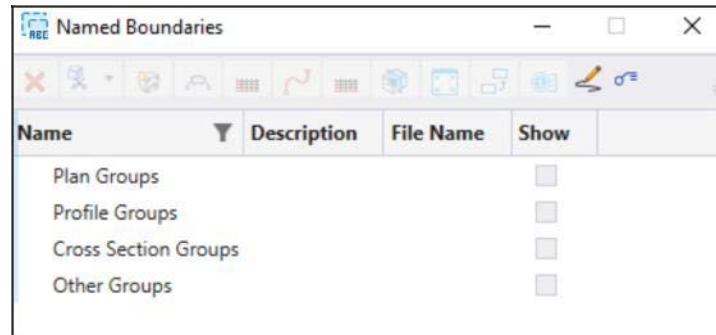


Place Named Boundary Civil Plan > Identify Path Element

Based on the Path Element selected from the prompt, typically the project baseline or centerline, a New Named Boundary Group will be created. The clipping area location and dimensions are defined by the Start and Stop Locations (by station), Length, and Left and Right Offsets. When Create Drawing is checked, the sheet is created automatically.

NAMED BOUNDARIES LIST BOX

The Named Boundaries list box manages named boundaries and groups in or referenced to the design file and can be opened from the  icon at the lower right of the Named Boundaries Group.



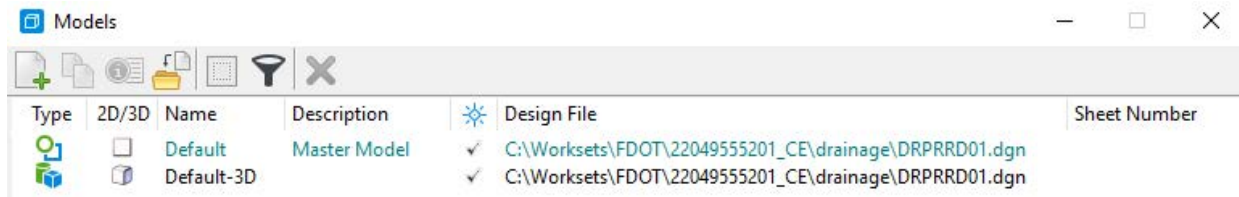
OTHER FILE CHANGES FROM NAMED BOUNDARIES

Once Named Boundaries and corresponding sheets are created, there are a few changes to the DGN file:

Models & References

Models are created for both the Named Boundary View(s) and Sheet(s). The Sheet Model automatically attaches the View Model as a Reference with Live Nesting which can be adjusted (moved or rotated) accordingly.

Models Before:



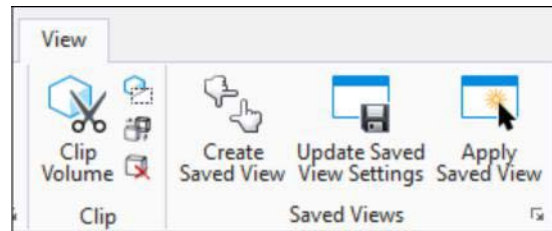
Models After:



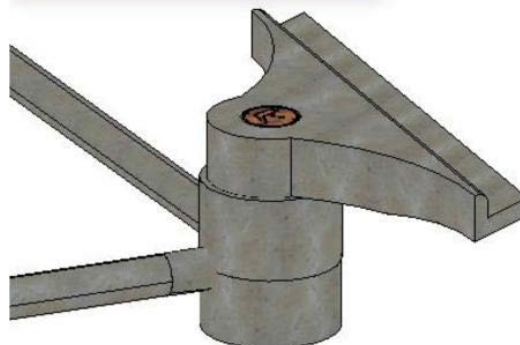
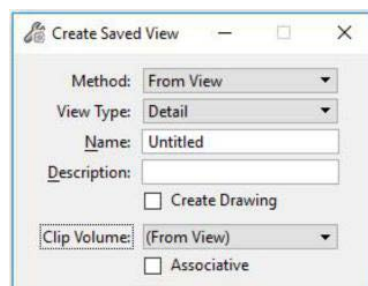
NOTE Like previous versions of MicroStation, References in this workflow use Live Nesting. Display changes, such as turning on or off levels, should only be performed in the Default model.

SAVED VIEWS

Saved Views are also created for Named Boundaries and can be managed from the icon at the following path: **Drainage and Utilities > VIEW > SAVED VIEWS**



In some cases, special details may be needed to show design intent. For example, these cases may include nonstandard structures or structures with multiple or off-centered pipe connections. If these features are modeled, the Create Saved View tool can be used to add an isometric view from the 3D model to plans.

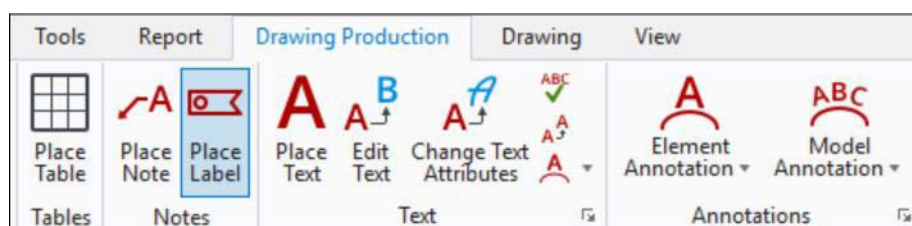


ANNOTATION AND LABELING

For Drainage Workflows in the FDOTConnect Workspace, predefined dynamic and automated FDOT plans labels have been established for use with the Place Label and Model Annotation tools.

PLACE LABEL

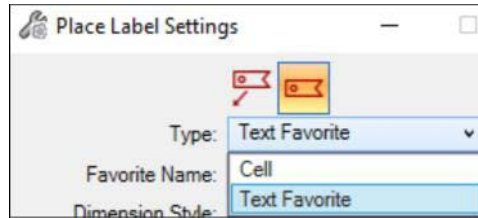
The Place Label tool is used in the FDOT Drainage Plans Production Workflow to manually add dynamic labels for plan view and can be accessed from the path: **Drainage and Utilities > Drawing Production > Notes > Place Label**



As described in Bentley Drainage and Utilities CONNECT Edition Help,


A label is a cell that can maintain association to the element that is being labeled. If the cell definition contains fields, the fields will be updated based on the element being labeled.

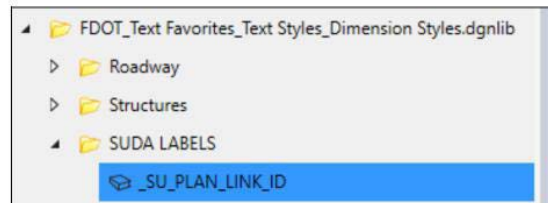
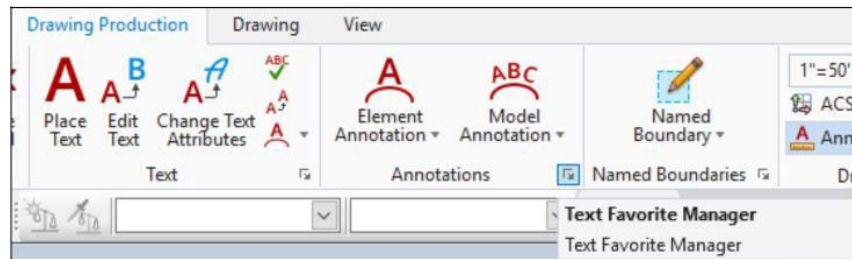
Place Label Settings has two type options, Cell and Text Favorite. For the FDOTConnect Workspace, all Drainage and Utilities Text Favorites and Cells are named with the prefix `_SU_`



NOTE Labels are placed on the active level. Make sure the correct level is active before using the Place Label tool. It is recommended that drainage structure numbers use the level TextLabel and drainage pipe numbers use the level TextMinor so that other plans that attach the drainage file as a reference can isolate which labels are displayed.

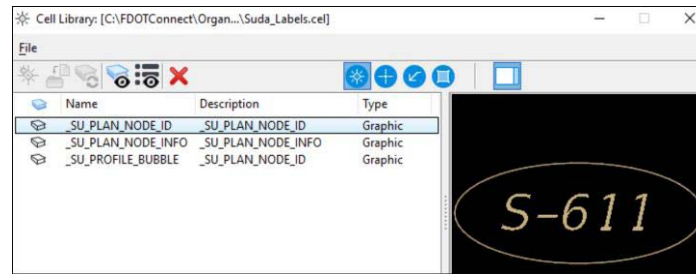
TEXT FAVORITES

For Drainage Workflows in FDOTConnect Workspace, text favorites are used for labeling drainage pipes and drainage areas. The Text Favorites Manager is accessed through the  icon at the following path: **Drainage and Utilities > Drawing Production > Annotations.**



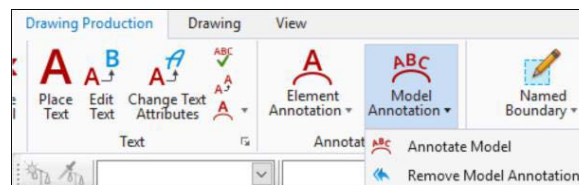
CELL

For Drainage Workflows in FDOTConnect Workspace, cells are used for labeling drainage structure numbers. The cell library is named SUDA_LABELS.cel.



MODEL ANNOTATION

The Model Annotation tools (Annotate Model and Remove Model Annotations) are used in the FDOT Drainage Plans Production Workflow for automated dynamic labeling of drainage profiles and can be accessed from the path: **Drainage and Utilities > Drawing Production > Annotation > Model Annotation**.

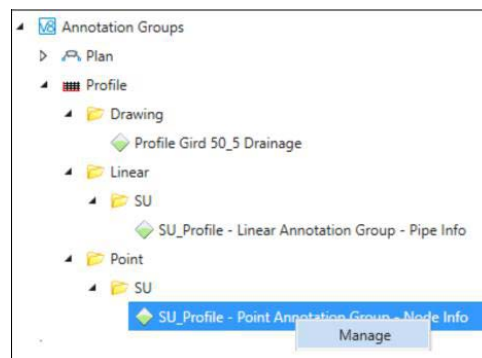


In the FDOTConnect Workspace, Model Annotation is automatically applied to drainage profiles when Named Boundary Civil Profile is used. The drainage structure and pipe annotation should update automatically if changes are made, such as renaming or relocating. However, Remove / Annotate can be activated to refresh the labels without switching models or views.

The Annotate Model tool uses Annotation Groups included with the FDOTConnect Workspace.

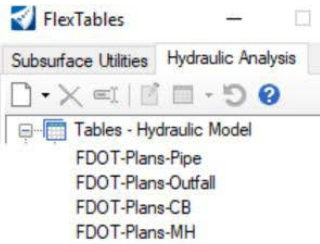
ANNOTATION GROUPS

Profile grid, pipe and drainage structure labels are included with the Profile Annotation Groups. They can be managed from the Project Explorer, OpenRoads Standards tab:



TABLES

In OpenRoads Designer CONNECT Edition, tables are an effective way to organize and report the drainage model database information. In the FDOT Drainage NexGen Plans Production Workflow, most drainage structure and pipe information is shown in plans through tables. Several FDOT flex tables have been developed to follow the Chapter 900 series of the FDOT Design Manual (FDM).



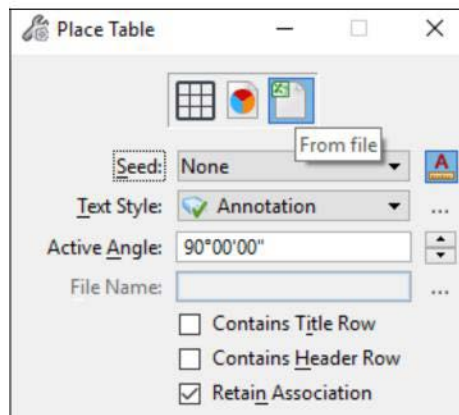
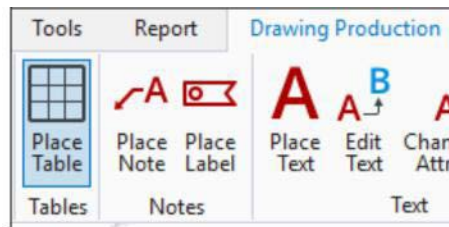
Pipe Data							
Label	Length (Construction) (ft)	Size	Start Node (Upstream)	Invert (Start) (ft)	Stop Node (Downstream)	Invert (Stop) (ft)	Optional Pipe

Structure Data									
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe-Label

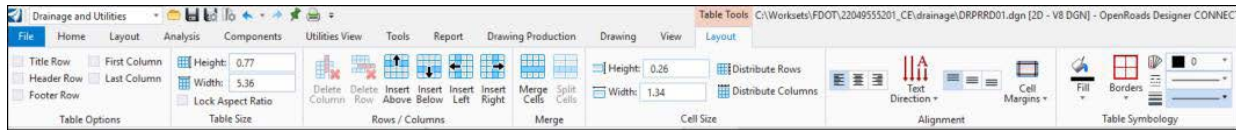
Endwall and MES Data						
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	FDOT Structure Type	Elevation (Invert) (ft)	Notes

NOTE In OpenRoads, there are separate flex tables for different types of drainage features (catch basin, manhole, headwall, and outfall). However, once the flex tables are exported to .csv, similar tables can be merged and sorted to complete a single Structure Data table.

The Place Table tool can be used to place flex tables (exported to .csv / .xls files) in plans and is accessed from the path: **Drainage and Utilities > Drawing Production > Tables > Place Table**.



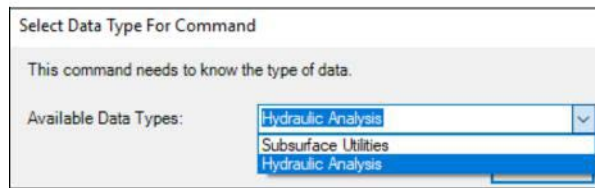
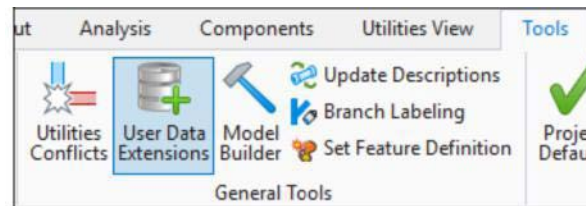
When a placed table is selected, the Table Tools Layout Tab appears with multiple editing and formatting options.



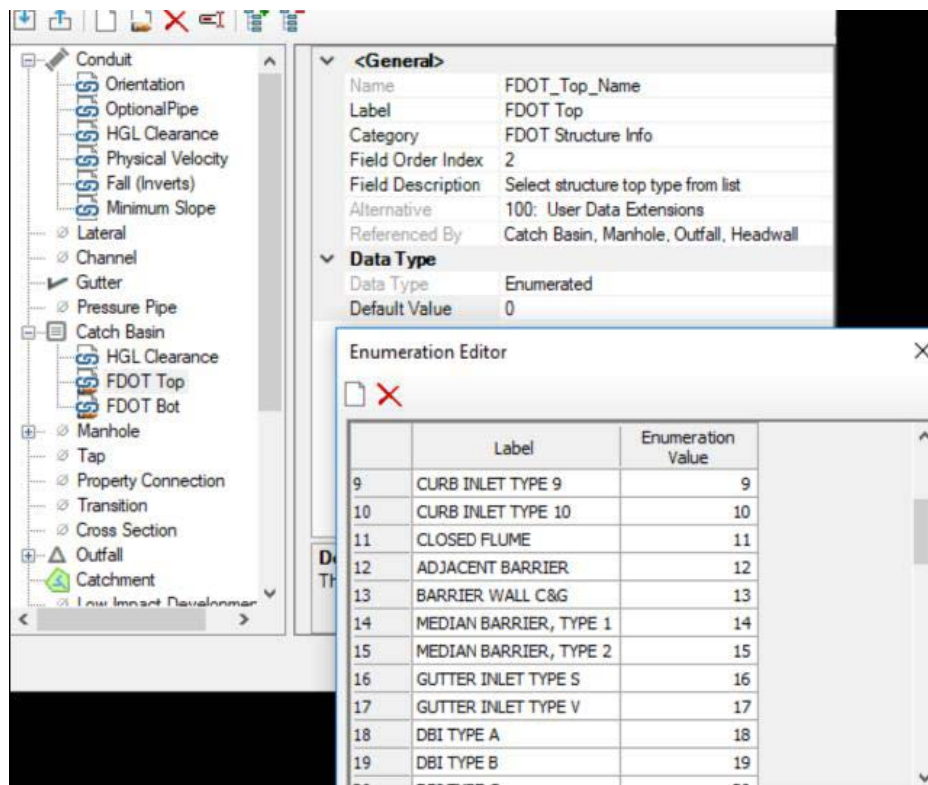
The FDOT flex tables for plans include some custom fields that allow for FDOT-specific data to be included with the drainage model database. The custom fields are defined and managed within the User Data Extensions Tool.

USER DATA EXTENSIONS

The User Data Extensions tool is accessed from the path: **Drainage and Utilities > Tools > General Tools > User Data Extensions**.



In the FDOTConnect Workspace, the User Data Extensions have been defined for use in the FDOT Flex Tables under Hydraulic Analysis Data Type. For most projects, users will not need to make edits to the User Data Extension definitions.



For the FDOT Drainage Workflow, the user selections for the fields with User Data Extension can be made from the pulldown menus within the FDOT Flex Tables.

	Label	FDOT Top Name	FDOT Bot
438: S-101	S-101	CURB INLET TYPE P-2	4' DIA.
450: S-103	S-103	CURB INLET TYPE P-6 DBI TYPE A DBI TYPE B DBI TYPE C DBI TYPE C MOD DBI TYPE D DBI TYPE E DBI TYPE F DBI TYPE G DBI TYPE H DBI TYPE J DBI TYPE K FES GUTTER INLET TYPE S GUTTER INLET TYPE V	

NOTE For catch basins (CB) and manholes (MH) the TopBot FDOT flex tables are where the top and bottom names can be selected. For pipes, headwalls, and outfalls, the User Data Extension selections can be made directly in the respective Plans Flex Tables.

EXERCISES

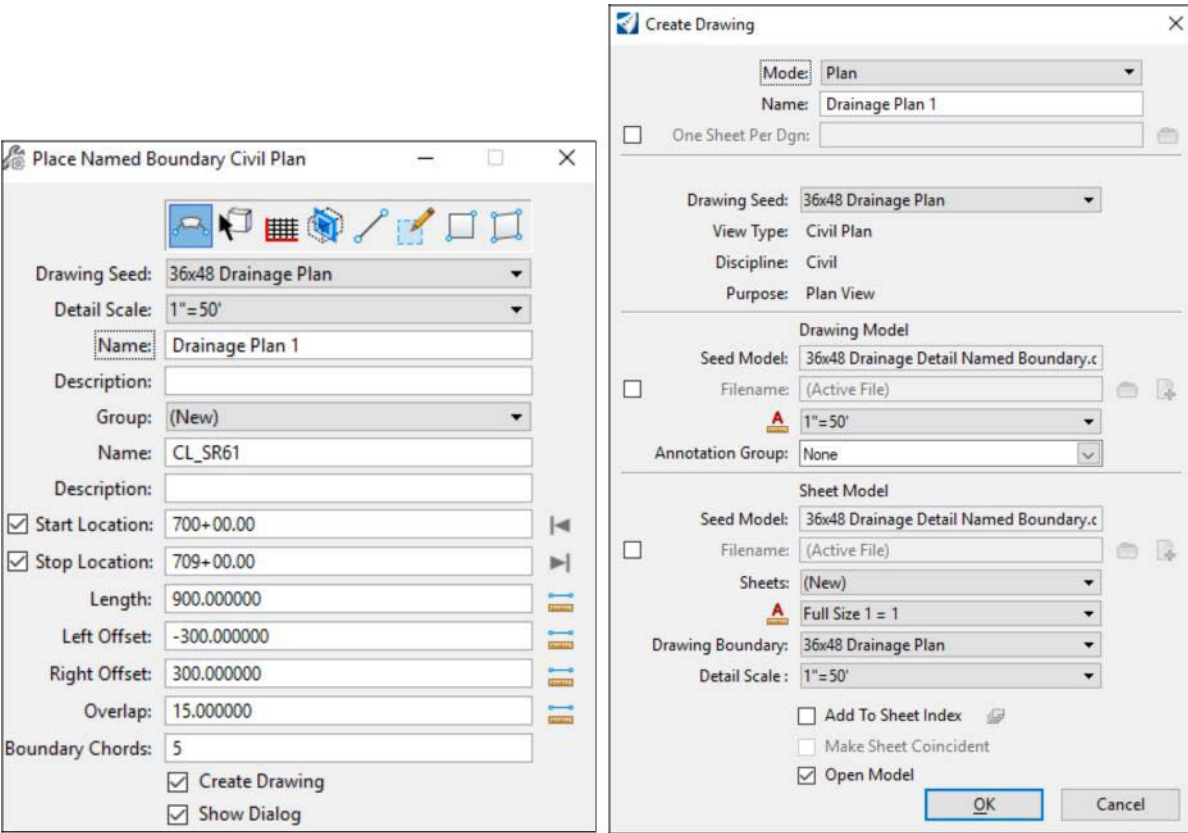
EXERCISE OVERVIEW – PLAN DEVELOPMENT

In this chapter exercise, users will create named boundaries, a drainage structure sheet, and add plans information through labels and tables. The network created in Chapter 3 and used in Chapter 4 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- Exercise 5.1 Place Named Boundary Civil Plan.....153
- Exercise 5.2 Place Named Boundary Civil Profile.....155
- Exercise 5.3 Place Drainage Labels in Plan.....160
- Exercise 5.4 Place Tables.....163

Exercise 5.1 Place Named Boundary Civil Plan

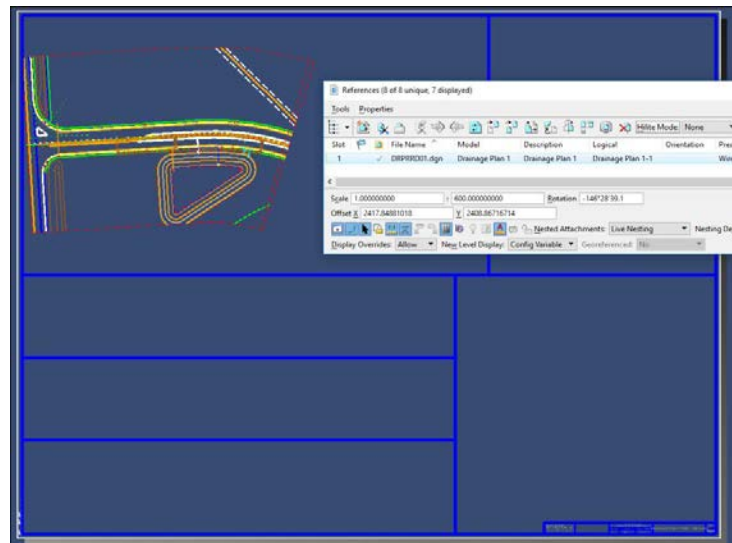
1. Open FDOTConnect, set the Workspace to FDOT and select the Workset – **22049555201**.
2. Browse to the drainage folder and open *DRPRRD01.dgn*.
3. Navigate through the following path and open: **Drainage and Utilities > Drawing Production > Named Boundaries > Named Boundary > Place Named Boundary**.



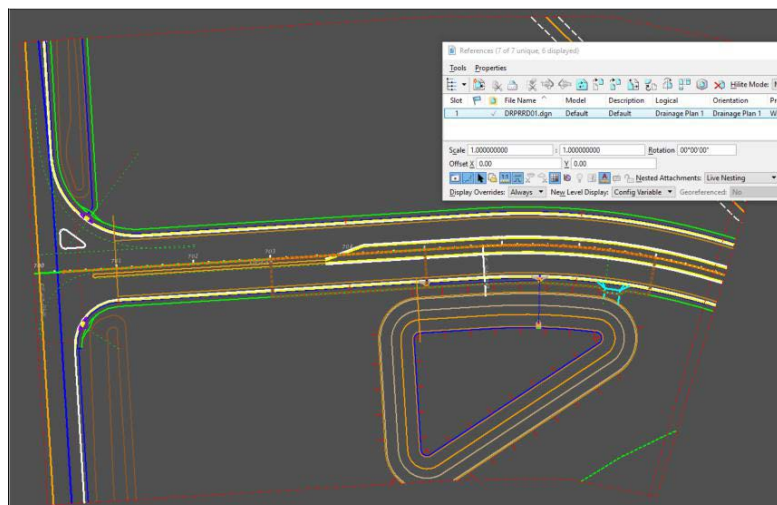
- a. Select the **Civil Plan** mode.
- b. Set *Drawing Seed* to **36x48 Drainage Plan**.
- c. In the 2D view, following the Identify Path Element prompt, select the CL_SR61 alignment along which the plan named boundaries will be created.
- d. Fill out the dialog, as shown.

- e. Follow the prompts in the lower left corner. **Left click** to define the named boundaries. Multiple left clicks may be required.
- f. Two or three clicks are required to (1) accept the Start Location, (2) accept the Stop Location, and (3) create the Named Boundaries. However, if the Start or Stop Location are selected graphically one or more of these clicks has already been completed. Once completed, the Create Drawing dialog automatically opens.
- g. There is typically no need to revise settings in the Create Drawing dialog. With Open Model checked, the sheet model will open automatically after clicking **OK** to create the sheets.
- h. Navigate through the new models to see links between sheets and models.

Drainage Plan 1 [Sheet] Views:

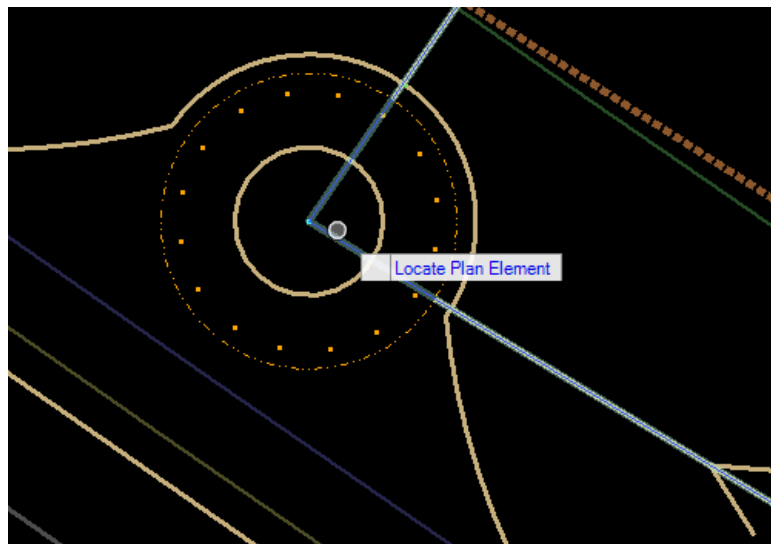
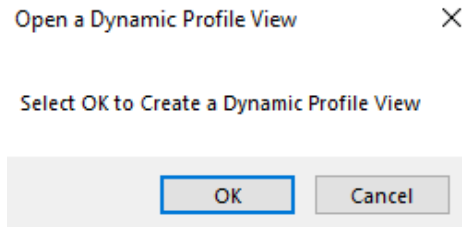



Drainage Plan 1 Views:

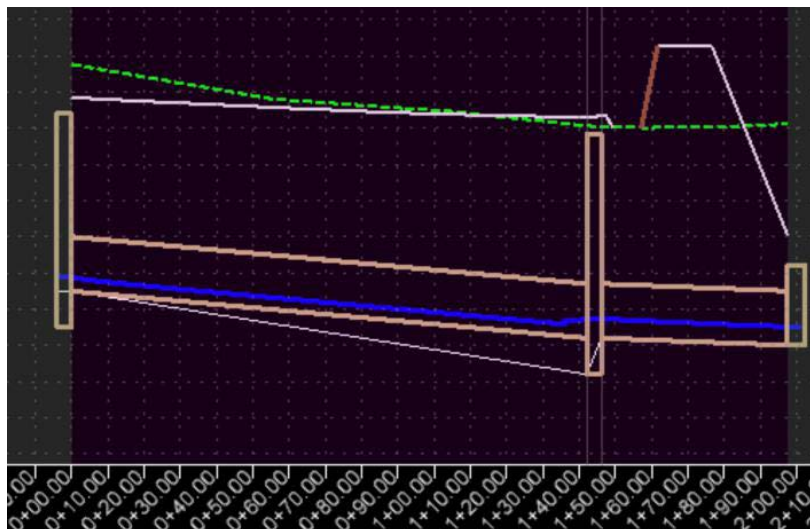


Exercise 5.2 Place Named Boundary Civil Profile

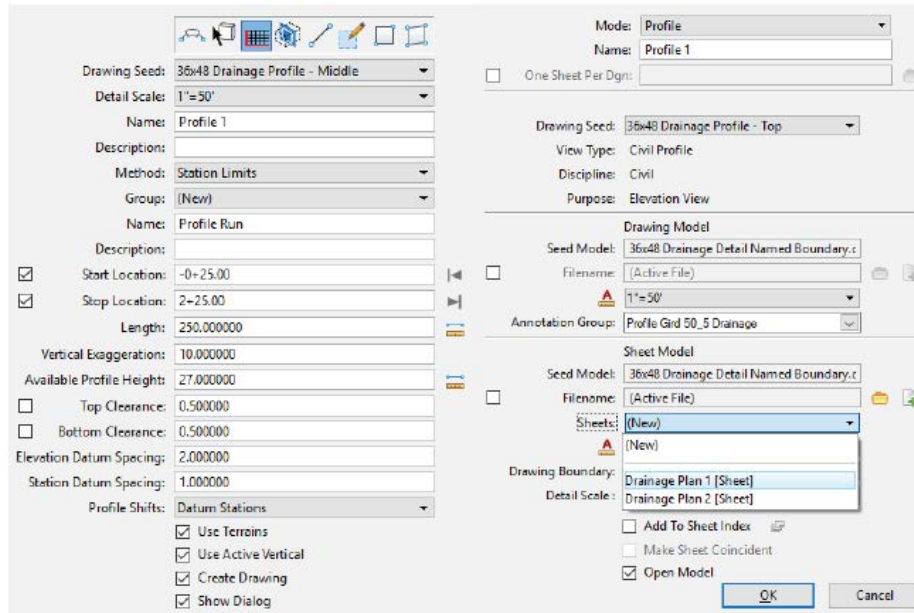
1. Switch to the Multi-Model Views in *DRPRRD01.dgn*, activate View Control (hold down the right mouse button to open the quick menu for display, and select View Control). Select **3 Views Plan/Profile/3D**.
 - a. Click OK to the prompt below and select the Profile Run line drawn in plan view from S-103 to S-102.



- b. Left click anywhere within the Profile Window to load the Profile Run in profile view.
2. Use the  Quick Profile from Surface Tool to add existing and proposed ground lines from the terrains.
 - a. When the Locate Reference Surface prompt activates, a terrain can be selected from the 3D view. Once selected, the surface will be displayed in the Profile Window.

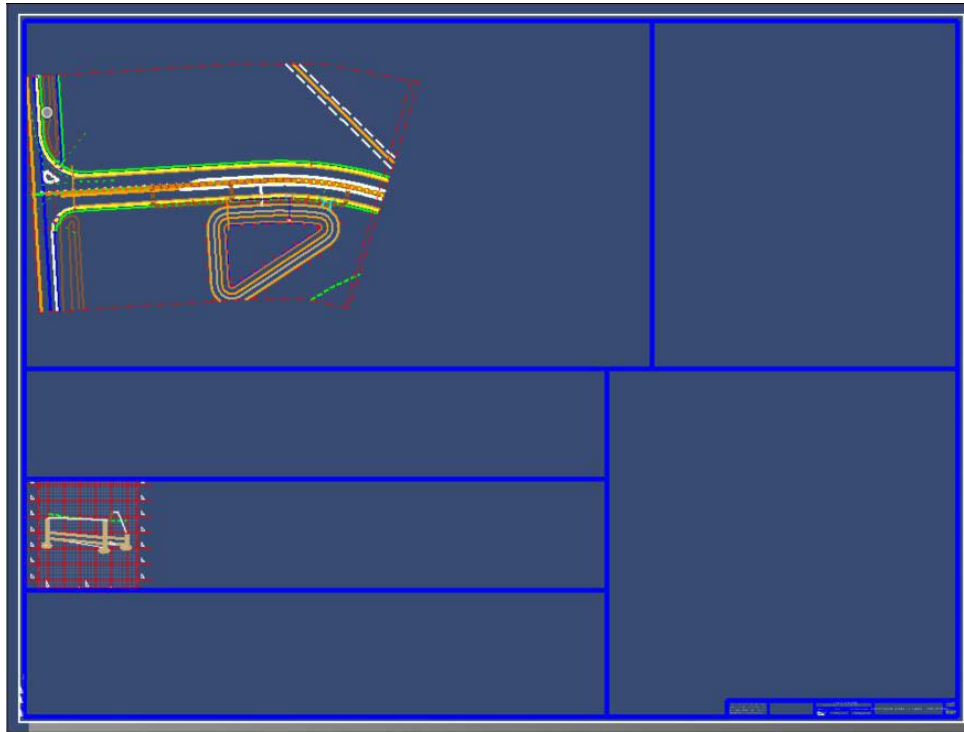


3. Navigate through the following path and open: **Drainage and Utilities > Drawing Production > Named Boundaries > Named Boundary > Place Named Boundary.**

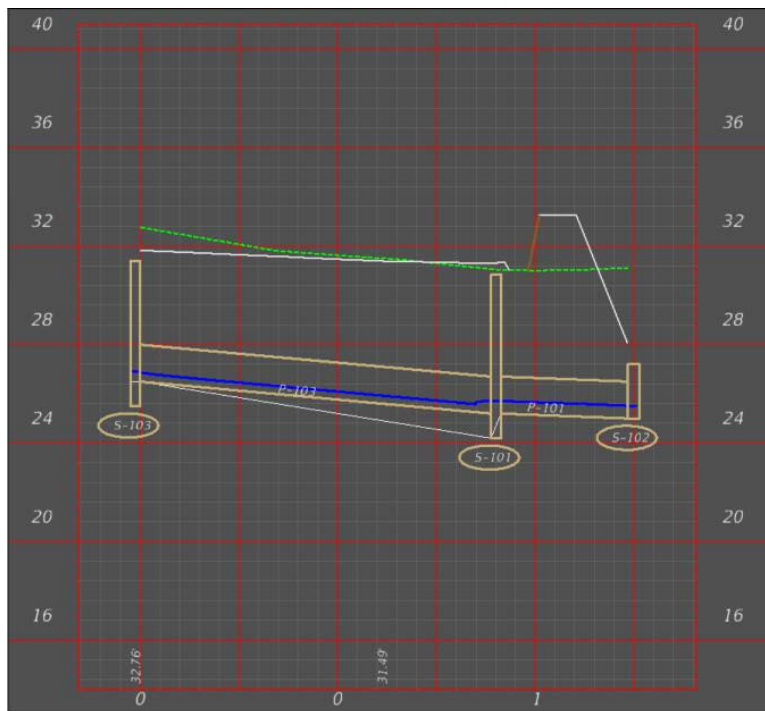


- a. Select the **Civil Profile** mode.
- b. Set *Drawing Seed* to **36x48 Drainage Profile – Middle**.
- c. Click anywhere in the Profile view.
- d. Fill out the dialog, as shown.
- e. Follow the prompts in the lower left corner **left click** to define the named boundaries. Multiple left clicks may be required.
- f. Two or three clicks are required to (1) accept the Start Location, (2) accept the Stop Location, and (3) create the Named Boundaries. However, if the Start or Stop Location are selected graphically one or more of these clicks has already been completed.
- g. In the *Create Drawing* dialog, change the Sheet Model Sheets selection to **Drainage Plan 1 [Sheet]**. With Open Model checked, the sheet model will open automatically after clicking **OK** to create the sheets.
- h. Navigate between models.
- i. Drainage Plan 1 [Sheet] Views:

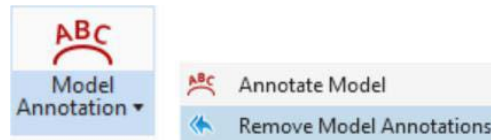
- Drainage Plan 1 [Sheet] Views:



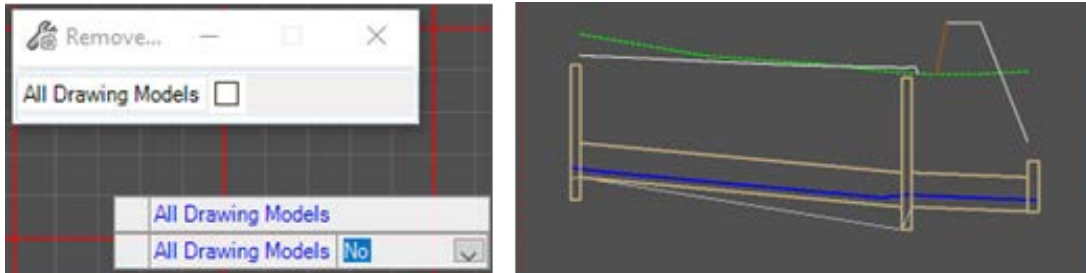
- Profile 1 Views:



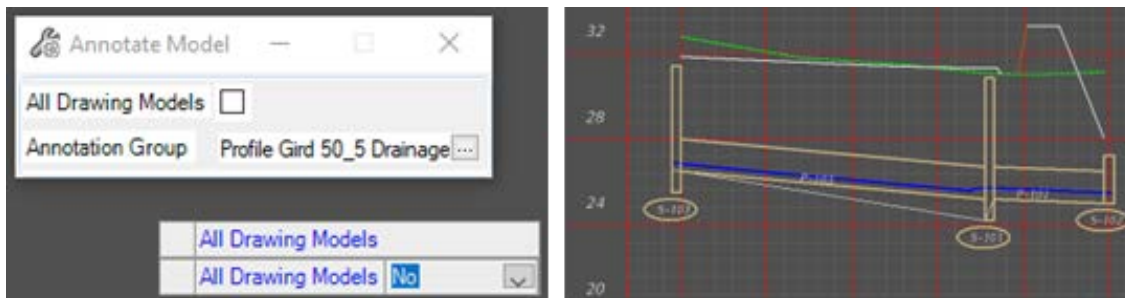
4. In the Profile 1 View, review the characteristics of the Model Annotation. Though this annotation is automated, sometimes it may necessary to Remove Model Annotations and then Annotate Model again. This can help reflect updates to the network and/or fix annotations that did not automatically populate with the Named Boundary process. These tools are available from the path: **Drainage and Utilities > Drawing Production > Annotations > Model Annotation**.



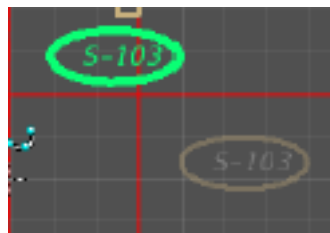
- a. Choose Remove Model Annotations and left click through the prompts.



- b. Choose Annotate Model and left click through the prompts.

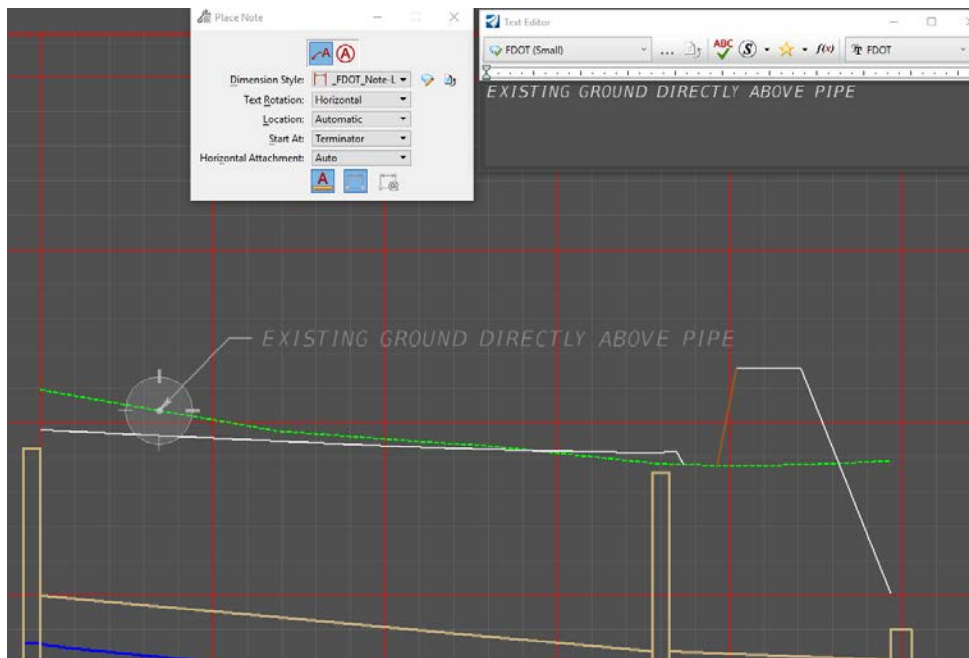


- c. Select one of the labels and move to another position.




- d. Select Annotate Model again and observe the following:
 - i. Annotations can be adjusted, but if re-annotated, the default locations (from the AnnotationGroup definitions) are used.
 - ii. Annotations can be duplicated.
- e. Change active level to TextLabel and activate Place Note.

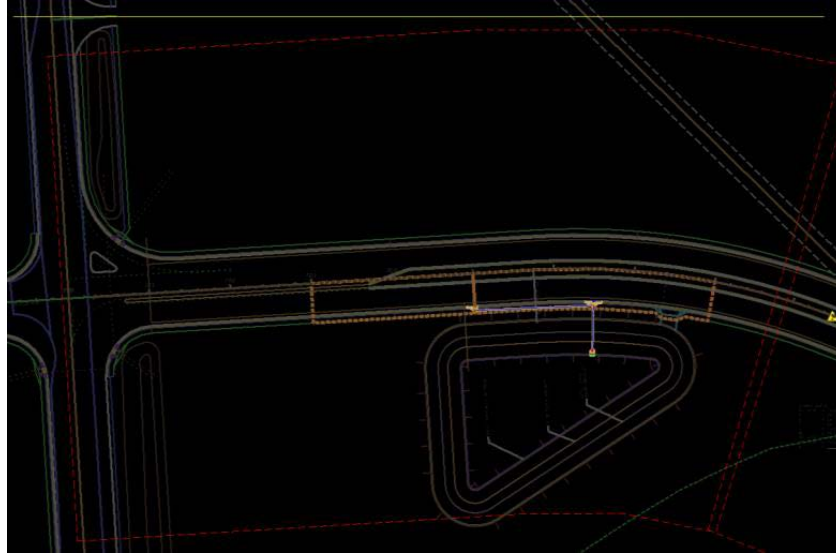
- i. Enter the following in the Text Editor EXISTING GROUND DIRECTLY ABOVE PIPE.



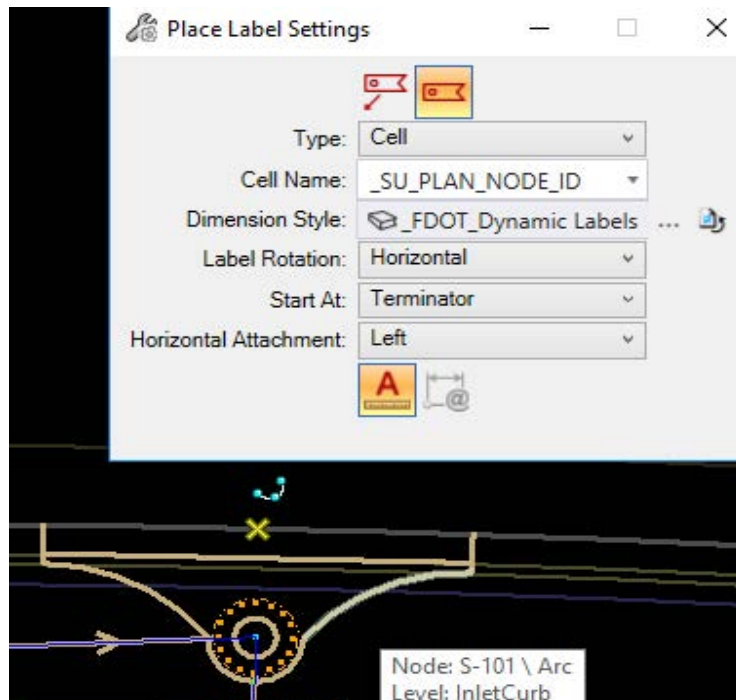
- f. Redo steps a. and b. to restore default annotation and see that the placed note remains.

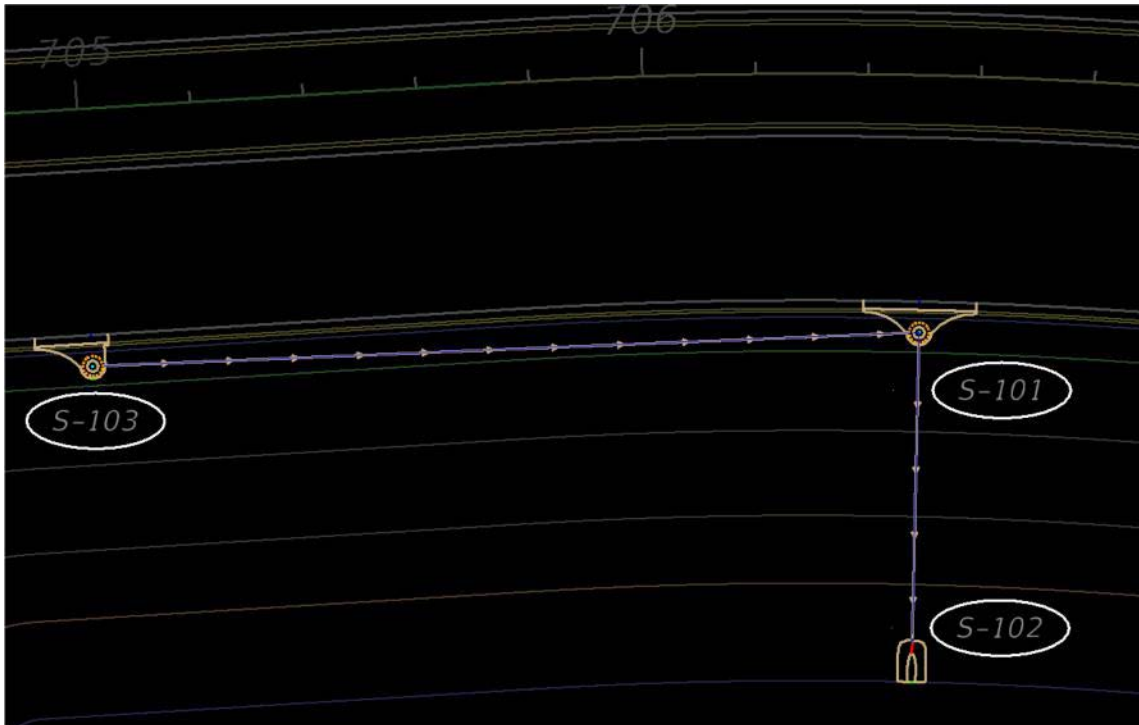
Exercise 5.3 Place Drainage Labels in Plan

1. For curved alignments and chorded named boundaries, it can be a challenge to find the rotation that matches the sheet. This is one way to set the rotation of the plan view so that the labels placed will be horizontal relative to the sheet.
 - a. Rotate  View with 2 Points Method along the Named Boundary to match the sheet orientation.

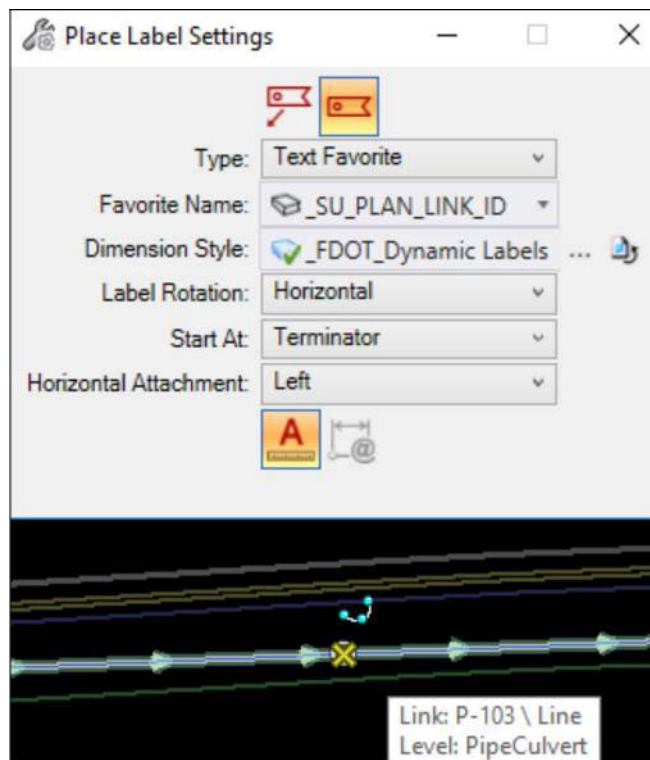


- b. Set the Level to a TextLabel before placing any notes or Labels.
2. Navigate through the following path and activate Place Label tool: **Drainage and Utilities > Drawing Production > Notes > Place Label**
 - a. Fill out the dialog as shown below, select the curb inlet cell, and left click to accept label placement.

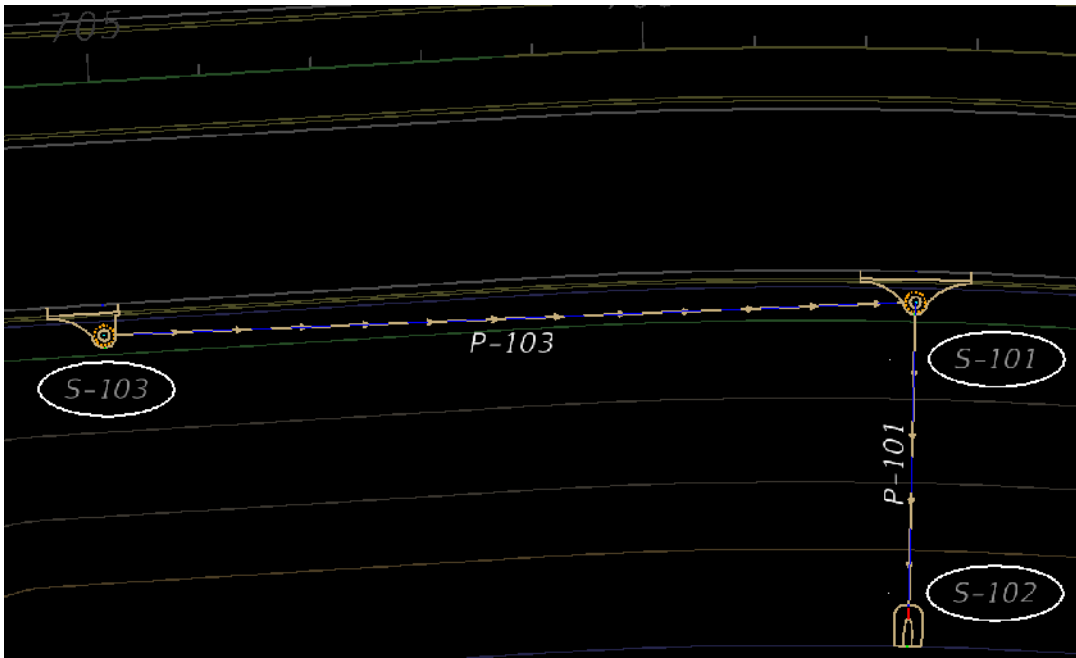




3. Navigate through the following path and activate Place Label tool: **Drainage and Utilities > Drawing Production > Notes > Place Label**
 - a. Fill out the dialog as shown below, select the line for P-103, and left click to accept label placement.

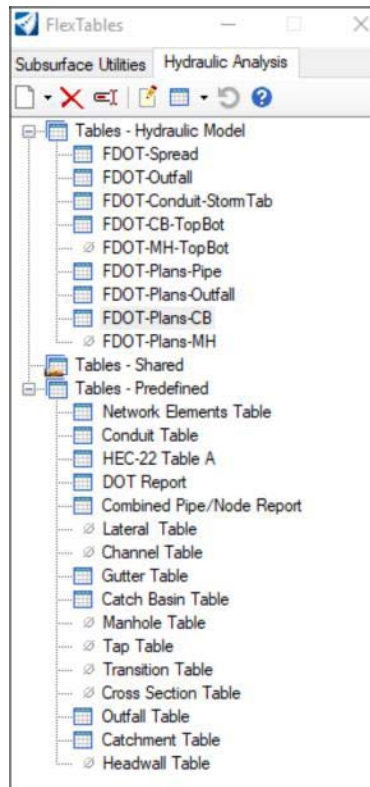


b. Place labels for P-101 and P-103, use rotation tools as needed:



Exercise 5.4 Place Tables

1. Switch to the Multi-Model Views in *DRPRRD01.dgn* and open Flex Tables from the path: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables**.
2. From the Hydraulic Analysis tab, open **FDOT-Plans-CB**.

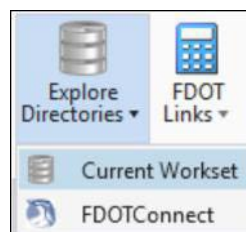


3. From the upper left of the menu, select **Export to File** and save as .csv in the \drainage\eng data folder.

	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	Pipe-Label
438: S-101	S-101	CL_SR61	706+50	40.000	CURB INLET TYPE P-2	4' DIA.		30.85	24.20	(In) P-103 (Out) P-101
450: S-103	S-103	CL_SR61	705+00	40.000	CURB INLET TYPE P-1	4' DIA.		31.40	25.50	(Out) P-103

5 of 5 elements displayed

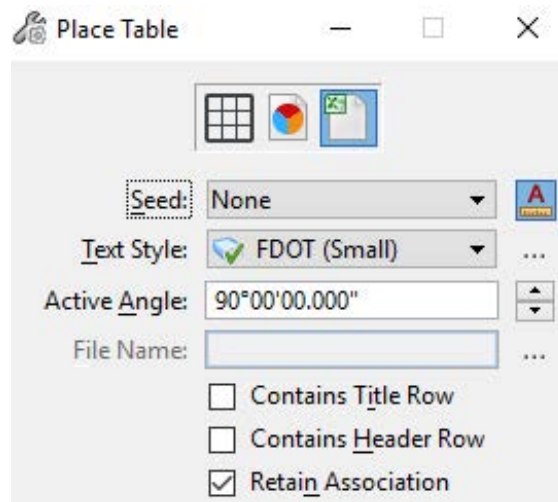
4. Navigate through the following path to quickly open the workset drainage folder: **OpenRoads Modeling > FDOT > Resources > Explore Directories > Current Workset**.



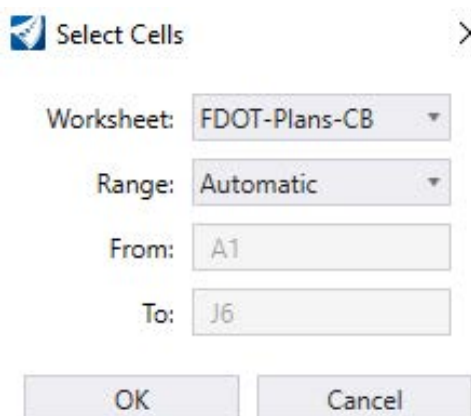
5. Open the .csv file in Excel and update formatting with the following:
 - a. Select from cells A1 to J6, and add borders (Home: Font: Borders: All Borders).
 - b. Select from cells A1 to J6 and change font to FDOT.
 - c. Delete <None> from Cells E3:F4 and E6:F6.
 - d. Adjust units for significant digits and reshape column widths as needed.

Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe-Label
S-101	CL_SR61	706+50	40.00	CURB INLET TYPE P-2	4' DIA.		30.85	24.20	
									(In) P-103
									(Out) P-101
S-103	CL_SR61	705+00	40.00	CURB INLET TYPE P-1	4' DIA.		31.40	25.50	
									(Out) P-103

- e. Save as .xlsx and close.
6. In OpenRoads, switch to the Drainage Plan 1 [Sheet] Views Model and navigate through the path to open **Place Table > Select From File > Drainage and Utilities > Drawing Production > Tables > Place Table**.
7. Select the ellipse next to File Name, browse to and select the new .xlsx.



8. Review and click OK to accept the default range from A1 to J6.



9. Use the cursor to place table in the lower right of the sheet.

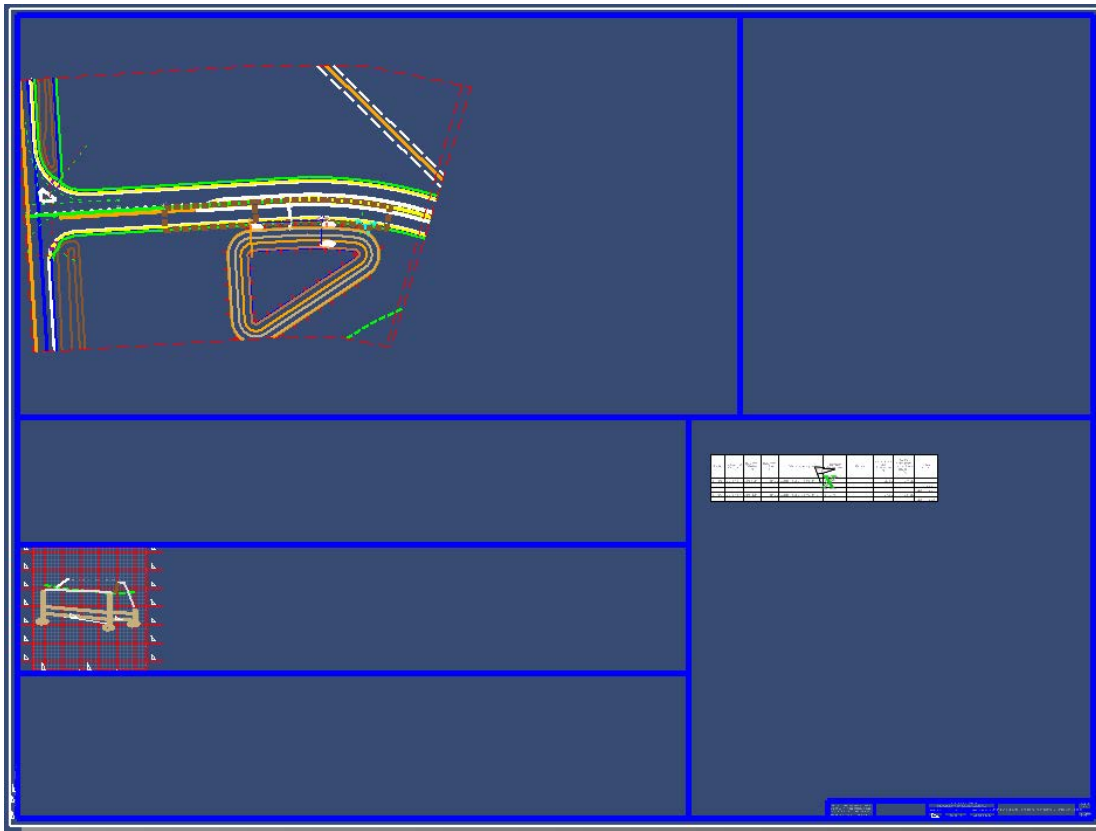


Table Tools C:\Works\DOT\2204955201_CEI\drainage\DRPRRD01.dgn [2D - V8 DGN] - OpenRoads Designer CONNECT Edition

Utilities View Tools Report Drawing Production Drawing View Layout

Delete Column Delete Row Insert Above Insert Below Insert Left Insert Right Refresh Table from Data... Merge Cells Split Cells Height: Width: Distribute Rows Distribute Columns Text Direction Cell Margins Fill Borders Table Symbology

Rows / Columns Merge Cell Size Alignment

Sheet Index Survey

View 1, Drainage Plan 1 [Sheet]

	A	B	C	D	E	F	G	H	I	J
1	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe-Label
2	S-101	CL SR61	706+50	40.00	CURB INLET TYPE P-2	4' DIA.		30.85	24.20	(In) P-103
3										(Out) P-101
4										
5	S-103	CL SR61	705+00	40.00	CURB INLET TYPE P-1	4' DIA.		31.40	25.50	(Out) P-103
6										

6 STORMWATER FACILITIES SHEET

OBJECTIVE

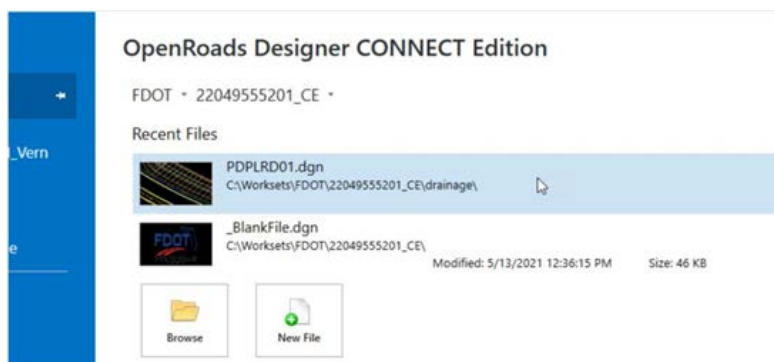
The objective of this chapter is to demonstrate the basic plans production procedures for laying out the Stormwater Facilities Detail Sheet as per FDM 917.

EXERCISES OVERVIEW

Exercise 6.1	Create The Stormwater Facilities Detail Sheet.....	166
Exercise 6.2	Cutting Pond Sections.....	171
Exercise 6.3	Placing Special Details.....	183
Exercise 6.4	Cutting Control Structure Sections.....	188
Exercise 6.5	Control Structure Form.....	193

Exercise 6.1 Create The Stormwater Facilities Detail Sheet

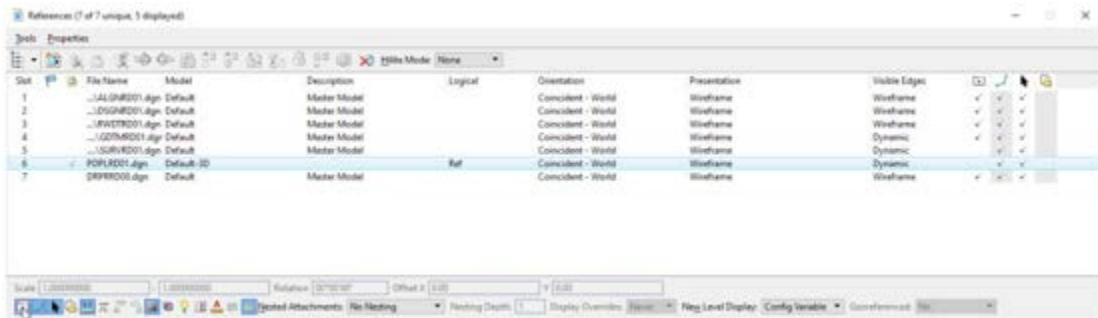
1. From the desktop FDOTConnect folder double left click on the FDOTConnect for OpenRoads Designer icon. Make sure to set the Workspace to FDOT and the Workset to **22049555201** . Open the *PDPLRD01.dgn* file within the 22049555201 Workset.



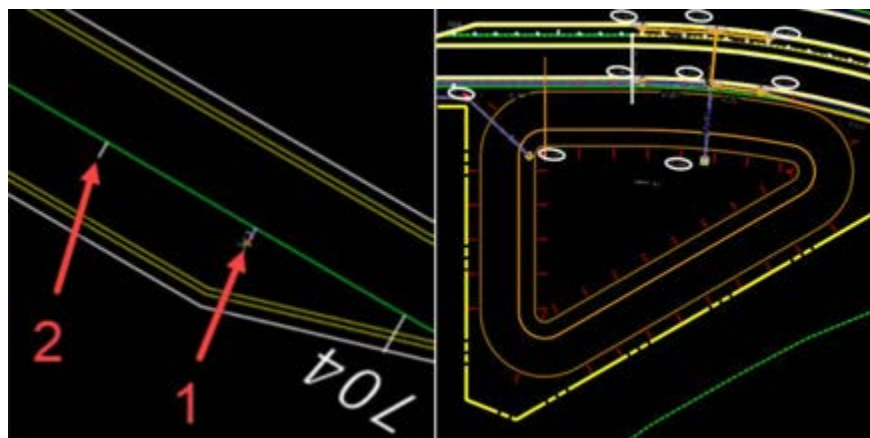
- In order to create the Stormwater Facilities Detail Sheet the *DRPRRD00.dgn* file will need to be referenced. Verify the Workflow is OpenRoads Modeling and the focus is on view 1. From the Home tab in the Primary group left click on the Attach Tools icon to open the References tool dialog.



- Using the References dialog attach the *DRPRRD00.dgn* file in the Drainage folder of the current project. Now turn off the view of the Default-3D reference by selecting it in the list and left clicking on the view button in the lower left corner of the dialog. Close the References dialog. Other drainage elements of this project will now be visible.



- Left click on the Rotate View tool in the view controls bar. Select the Two points method in the Rotate View dialog box. For the first point, snap to the end of the Minor Tic Mark nearest to station 704 of the roadway centerline alignment. Left click (Data Point) to accept. For the second point, snap to the next Minor Tic Mark and left click (Data Point) to accept. The view will rotate to a more useful orientation for sheet creation.



- Go to the **Drawing Production** tab and in the **Named Boundary** group left click on the **Named Boundary** dropdown. Select the **Place Named Boundary** tool to open the **Place Named Boundary** dialog box.

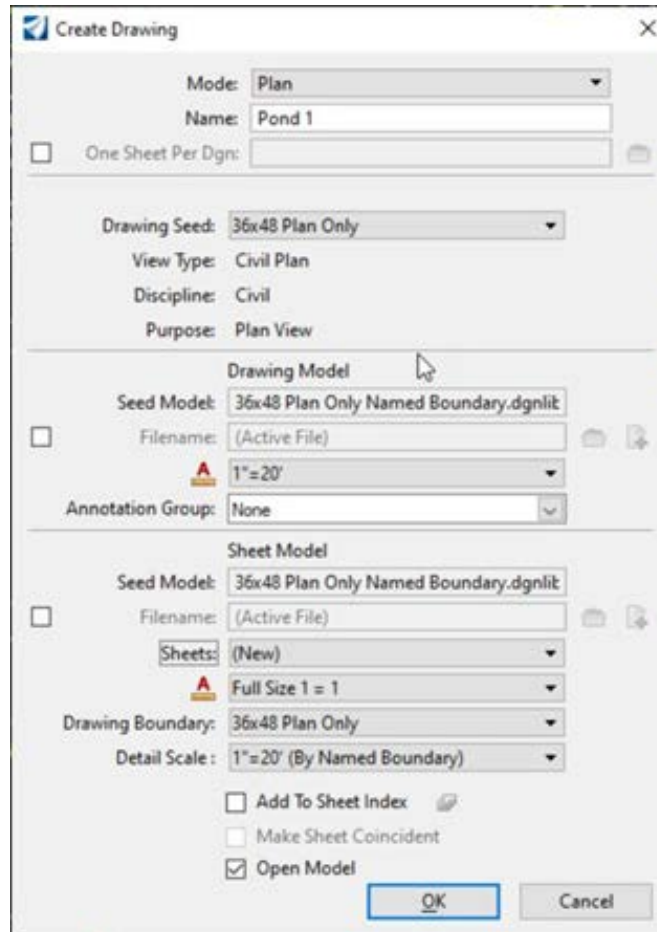


- Choose the *Civil Plan* option and left click on the **Drawing Seed** dropdown. Select the **36x48 Plan Only** option from the list. Now left click on the *Detail Scale* dropdown and choose **1" = 20'**. Now set the Name field to **Pond 1** and the *Description* field to **Pond Plan View**. The **Group** dropdown will automatically be set to **(New)**. Using the Tab key on the keyboard, tab down until the second Name field is highlighted. Now select the Roadway Alignment element in *View 1*. The current Name field will change to **CL_SR61**, the name of the Roadway Alignment. Tab to the *Description* field and type in **Stormwater Facility Detail Sheet**. Check both the *Start Location* and *Stop Location* check boxes. Set the *Start Location* field to **70400** and the *Stop Location* field to **70920**. Set the *Length* field to **520**. The *Left Offset* field should be set to **0** and the *Right Offset* field should be set to **400**. Set the *Overlap* field to **0** and the *Boundary Chords* field to **5**. Make sure the check boxes for *Create Drawing* and *Show Dialog* are checked. Left click (Data Point) in open space in *View 1* to see a preview of the boundary. Left click (Data Point) again in open space to accept this boundary and the **Create Drawing** dialog box will open.

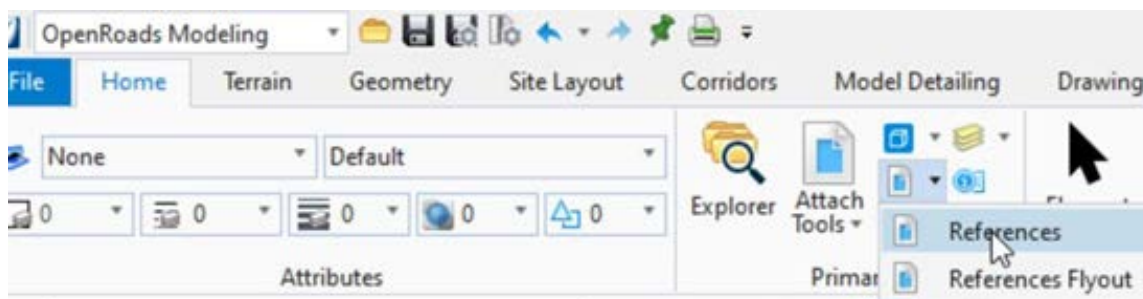
 A screenshot of the 'Place Named Boundary Civil Plan' dialog box. The dialog box contains the following fields and options:

- Drawing Seed:** 36x48 Plan Only
- Detail Scale:** 1"=20'
- Name:** Pond 1
- Description:** Pond Plan View
- Group:** (New)
- Name:** CL_SR61
- Description:** Stormwater Facility Detail Sheet
- Start Location:** 704+00.00
- Stop Location:** 709+20.00
- Length:** 520.000000
- Left Offset:** 0.000000
- Right Offset:** 400.000000
- Overlap:** 0.000000
- Boundary Chords:** 5
- Create Drawing**
- Show Dialog**

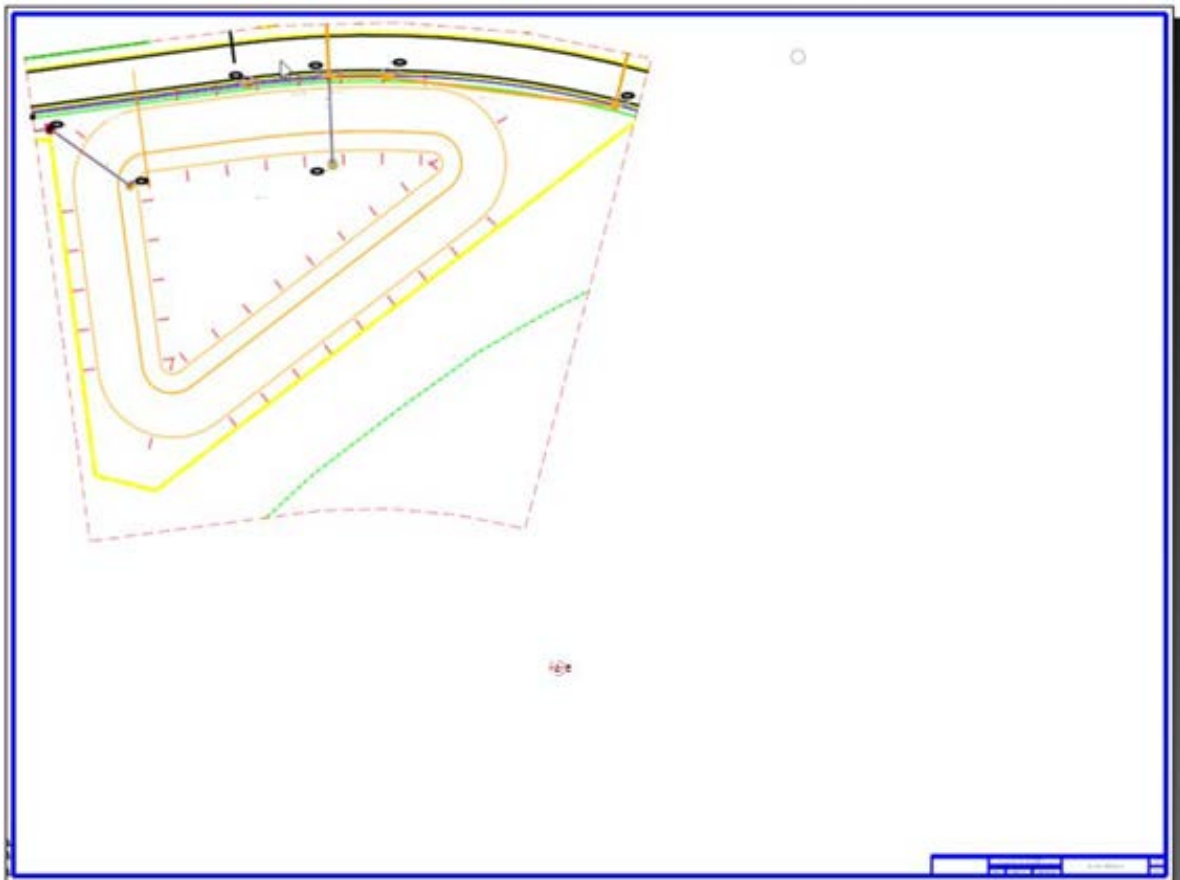
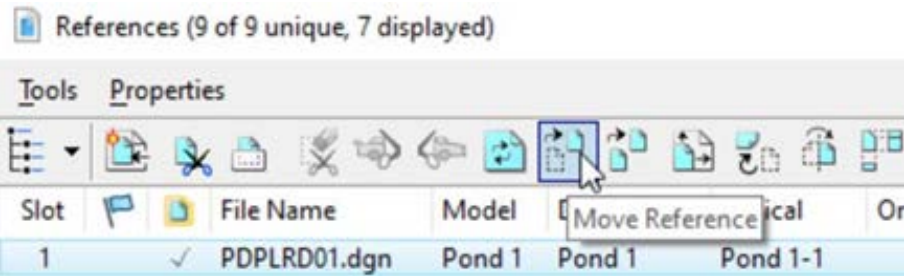
7. Make sure the Mode dropdown is set to Plan and the Name field is set to Pond 1. Verify that the Drawing Seed dropdown and the Drawing Boundary dropdown both say 36x48 Plan Only. Finally, the Detail Scale dropdown should read 1" = 20' by named boundary. With all this set, left click on the Ok button to create the Pond 1 Sheet Views with a Pond 1 Sheet sheet model and the Pond 1 Views with a Pond 1 design model.



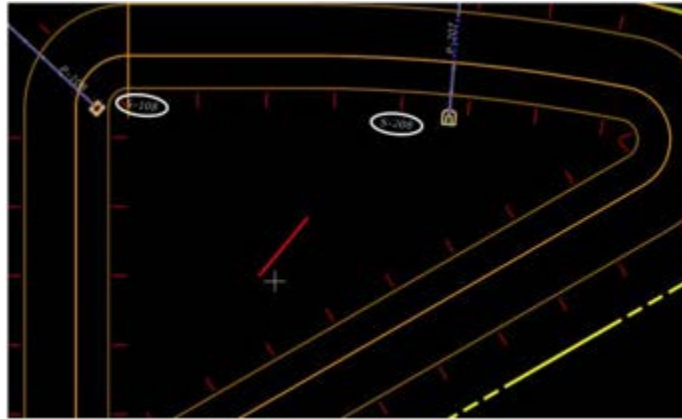
8. The program will now open the Pond 1 sheet view for review. Switch back to the Home tab and in the Primary group left click on the Attach Tools icon to bring up the References dialog.



9. In the References dialog select the Pond 1 Model. Choose the Move command from the button bar and left click (Data Point) in the middle of the proposed pond. Move the reference to the upper left corner of the sheet and left click (Data Point) to accept the move. Close the References dialog and switch back to the Multi-Model view.



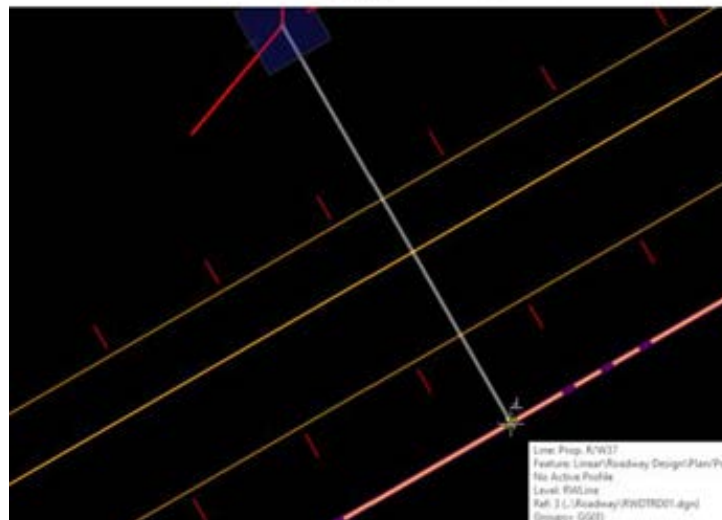
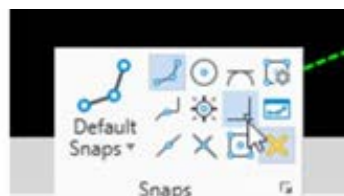
3. Left click (Data Point) to start drawing the temporary line. Move the cursor to the lower left and left click (Data Point) to complete drawing the temporary line.



4. Using the temporary line as a start point, draw a line going straight up ending just past the BSW2 line.



5. Once again, start drawing a line at the upper end of the temporary line. Using the Perpendicular snap option, Snap on the yellow property line to the lower right, left click (Data Point) to finish the line.



- The next line will start at the upper end of the temporary line and run horizontal extending to the left, so Snap to and left click (Data Point) on the upper end of the temporary line. Drag to the left and press the Enter key on the keyboard to lock AccuDraw to the Horizontal Axis. Tentative click on the vertical yellow property line to the left of the pond and left click (Data Point) to complete the line.



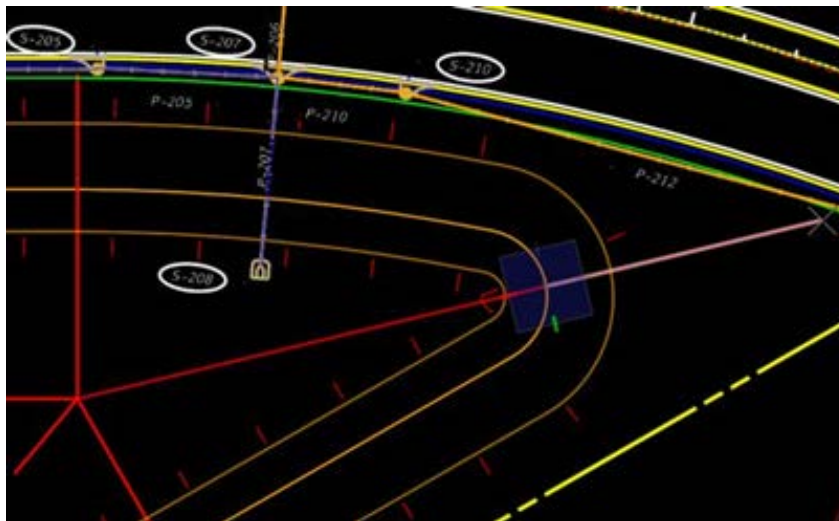
- The final line needed will go from the upper end of the temporary line through the upper right corner of the pond and extend just shy of the SidewalkBack line. There is a small bit of setup to make this line much easier to draw, with the Place Line command active change to the Drawing Aids tab. Left click (Data Point) on the upper end of the temporary line to start drawing the line and tentative click on the midpoint of the Pond_Cntr arc in the upper right corner of the pond.



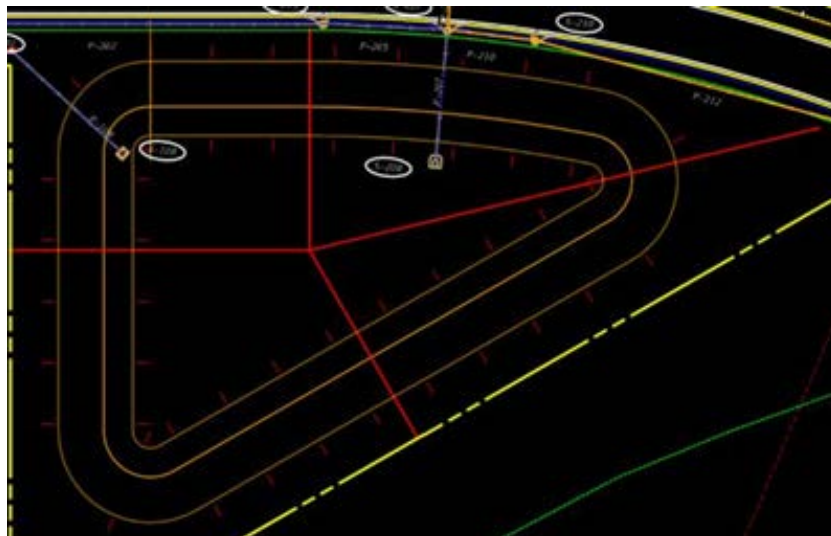
- Switch to the AccuDraw section of the Drawing Aids tab and click on Set Origin. Next press R then Q on the keyboard to begin to rotate AccuDraw. Snap back to the upper end of the temporary line and Left click (Data Point) on it. This will orient AccuDraw to the proper angle as shown below.



- Once this is done, move the cursor up and right just past the AccuDraw Origin and press the Enter key on the keyboard to lock the direction of the line being drawn. Now left click (Data Point) near the green SidewalkBack line to the upper right of Pond 1 to complete this line.



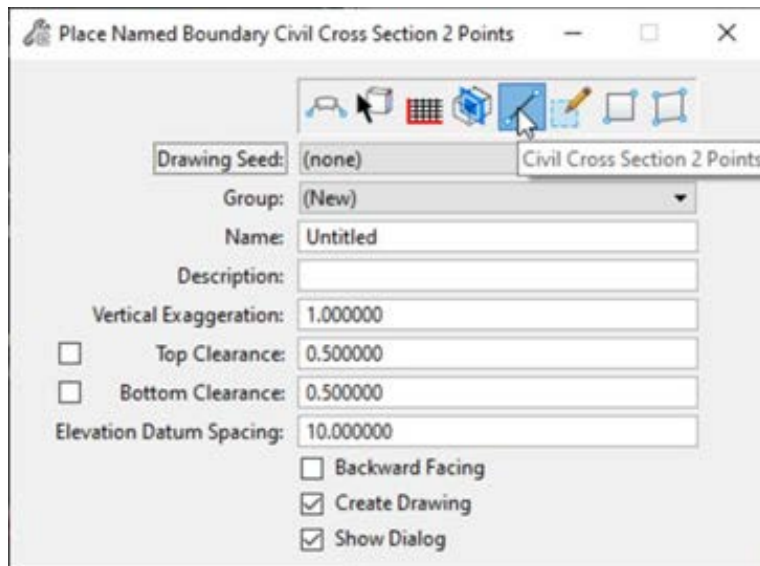
- All the pattern lines are now drawn. Delete the temporary line. View 1 should look like the picture below once the temporary line is deleted.



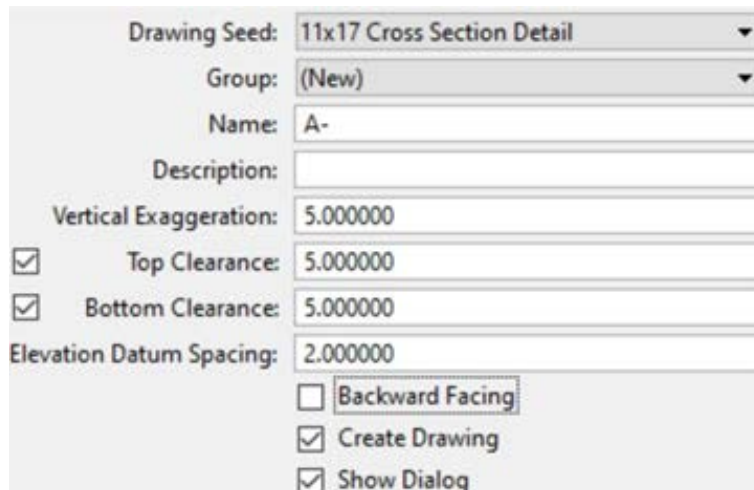
- Switch back to the OpenRoads Modeling Workflow and click on the Drawing Production tab. Then click on Place Named Boundary tool in the Named Boundaries group.



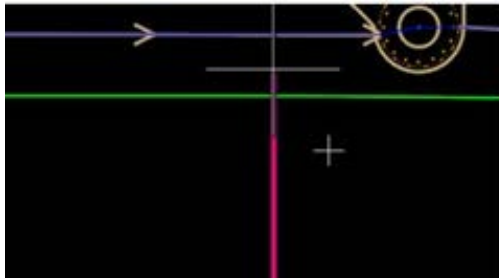
- This will bring up the Place Named Boundary dialog box. Click on the Civil Cross Section 2 Points tool.



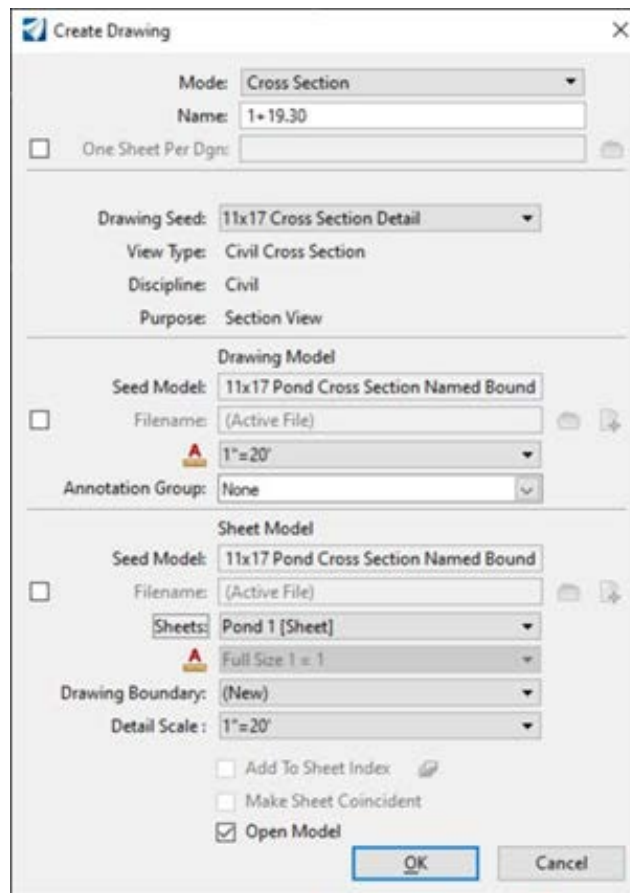
- Set the values in the dialog as shown below.



14. The dialog is now waiting on a Path Element to be identified. Left click (Data Point) on the vertical pattern line. Then tentative click on the top end of the line and left click (Data Point) to accept this as the First Point. Next tentative click on the other end of the line and left click (Data Point) to accept this as the Second Point. Finally left click (Data Point) in open space near the line to accept the selection.

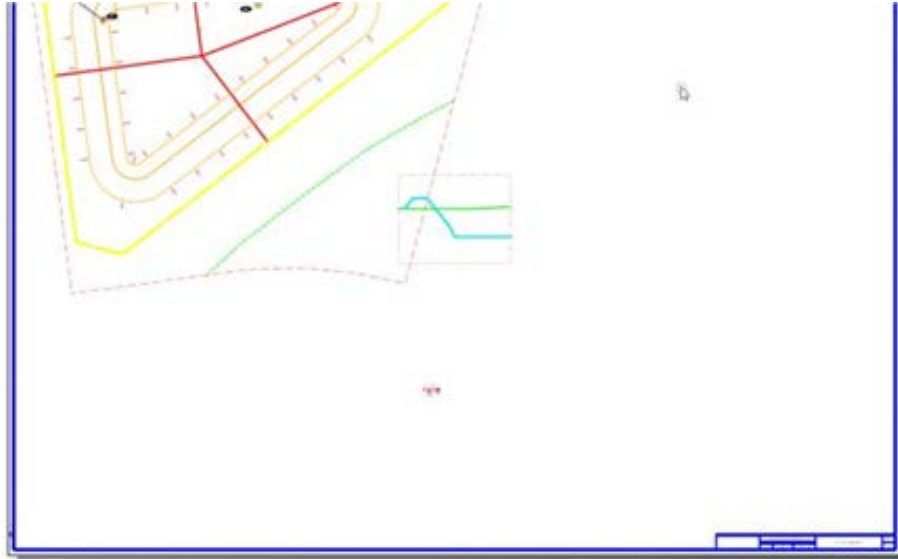


15. The Create Drawing dialog now appears. Most of the settings on this dialog will be set correctly when it appears, but check all of them against the image below and set any values that differ to the values provided. The dropdown value for Sheets will need to be set to Pond 1 [Sheet].



Click the **Ok** button.

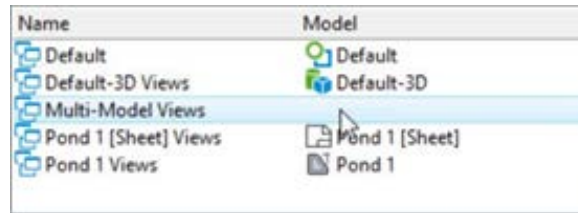
16. This will process the section and open the Pond 1 [Sheet]. The new section will be located as shown in the image below. It will need to be moved using the Reference File tools.



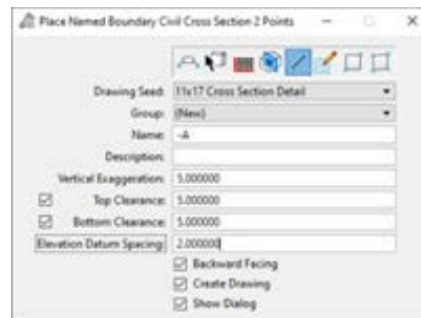
17. Click on the Home tab. Then click on the Attach Tools in the Primary group to bring up the References dialog box. Choose the newly created reference for the section and click on the Move Reference tool.
18. Now left click (Data Point) in the reference boundary for the new section and move it below the Plan View boundary and close to the left edge of the sheet similar to the example below.



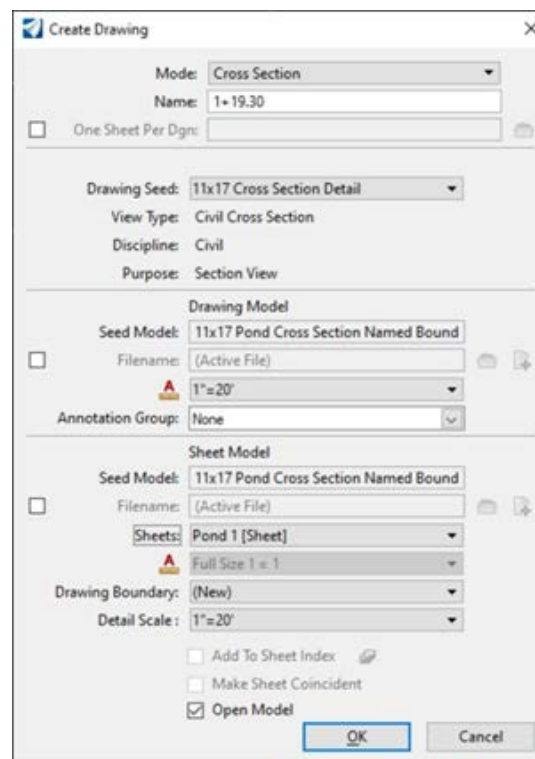
19. Once again change back to the Multi-Model Views View Group.



20. Switch to the Drawing Production tab and click on the Place Named Boundary tool once again to bring up the Place Named Boundary Civil Cross Section dialog. Set all values as indicated below, be sure the Backwards facing checkbox is checked. In View 1 select the lower pattern line and Snap to the top point of that line. Left click (Data Point) to accept the First Point. Now Snap to the other end of the pattern line and left click (Data Point) to accept the second point. Left click (Data Point) in the open to finish the command.



21. The Create Drawing dialog now appears. Most of the settings on this dialog will be set correctly when it appears, but check all of them against the image below and set any values that differ to the values provided. The dropdown value for Sheets will need to be set to Pond 1 [Sheet].

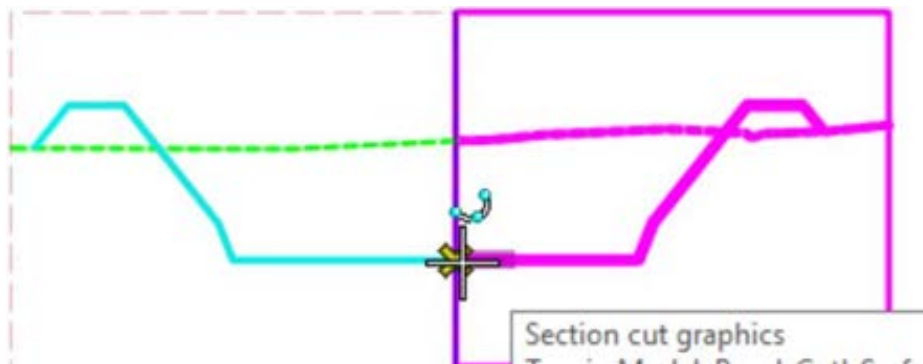


Click the **Ok** button.

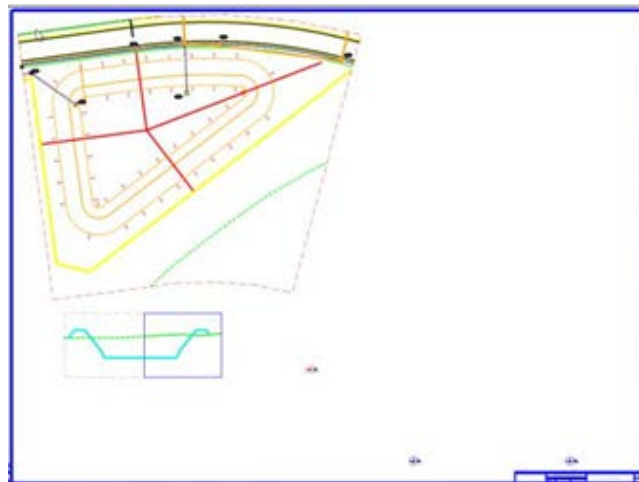
22. This will process the section and open the Pond 1 [Sheet] Model. The new section will be located as shown in the image below. It will need to be moved using the Reference file tools.



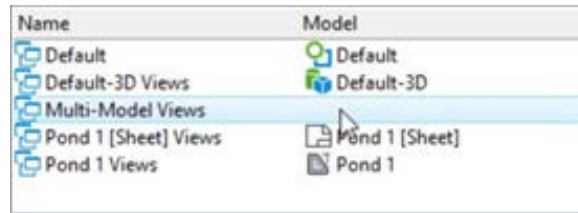
23. Click on the Home tab. Then click on the Attach Tools in the Primary group to bring up the References dialog box. Choose the newly created reference for the section and click on the Move Reference tool. Now Snap to the left end of the pond bottom of the new section and move it to align with the first section as shown in the example below.



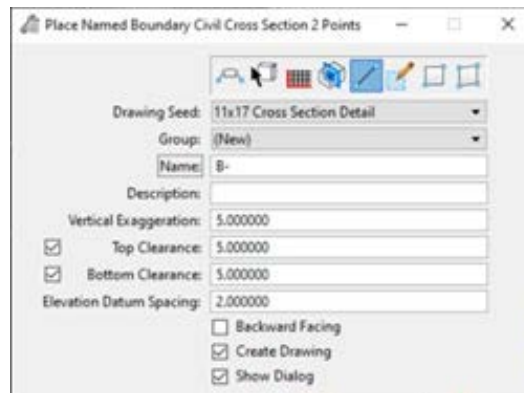
24. The Pond 1 [Sheet] should now look like this example.



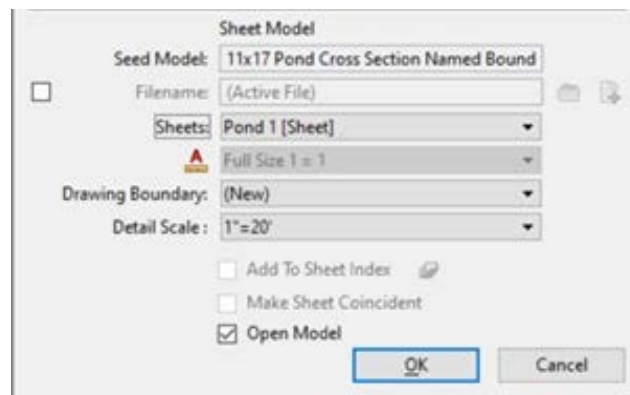
25. Change back to the Multi-Model Views View Group.



26. Switch to the Drawing Production tab and click on the Place Named Boundary tool once again to bring up the Place Named Boundary Civil Cross Section 2 Points dialog. Set all values as indicated below. In View 1 select the left most pattern line and Snap to the left end of that line. Left click (Data Point) to accept the First Point. Now Snap to the other end of the pattern line and left click (Data Point) to accept the Second Point. Left click (Data Point) in the open to finish the command.

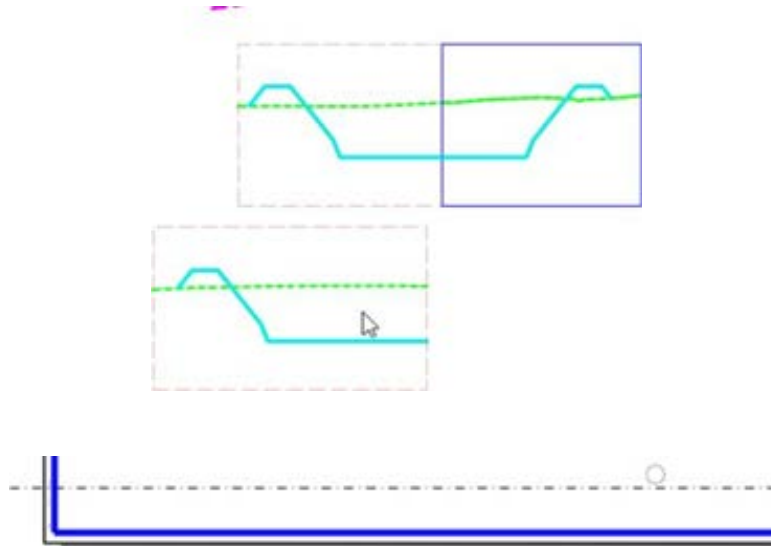


27. The Create Drawing dialog now appears. Make sure that the dropdown value for Sheets is set to Pond 1 [Sheet].



Click the **Ok** button.

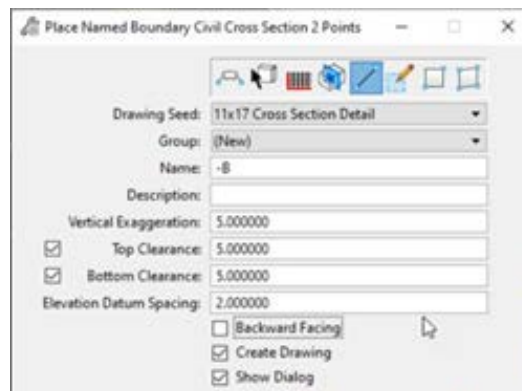
28. This will process the section and open the Pond 1 [Sheet] Model. The new section will need to be moved using the Reference file tools to the location below.

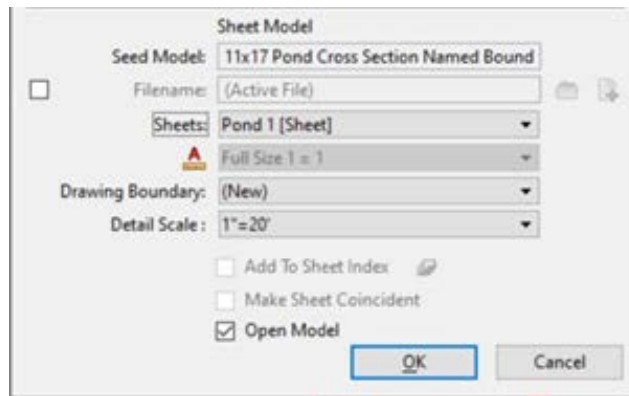


29. Change back to the Multi-Model Views View Group.

Name	Model
Default	Default
Default-3D Views	Default-3D
Multi-Model Views	
Pond 1 [Sheet] Views	Pond 1 [Sheet]
Pond 1 Views	Pond 1

30. Switch to the Drawing Production tab and click on the Place Named Boundary tool once again to bring up the Place Named Boundary Civil Cross Section dialog. Set all values as indicated below. In View 1 select the remaining pattern line and Snap to the left most end of that line. Left click (Data Point) to accept the First Point. Now Snap to the other end of the pattern line and left click (Data Point) to accept the Second Point. Left click (Data Point) in the open to finish the command.

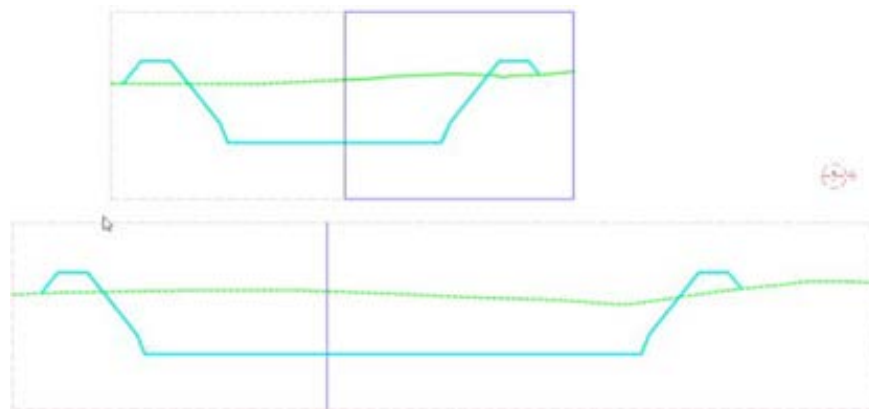




The Create Drawing dialog now appears. Make sure that the dropdown value for Sheets is set to Pond 1 [Sheet].

Click the **Ok** button.

31. This will process the section and open the Pond 1 [Sheet] Model. The new section will need to be moved using the Reference file tools to the location below. When done the Pond 1 [Sheet] Model should look like the example below.

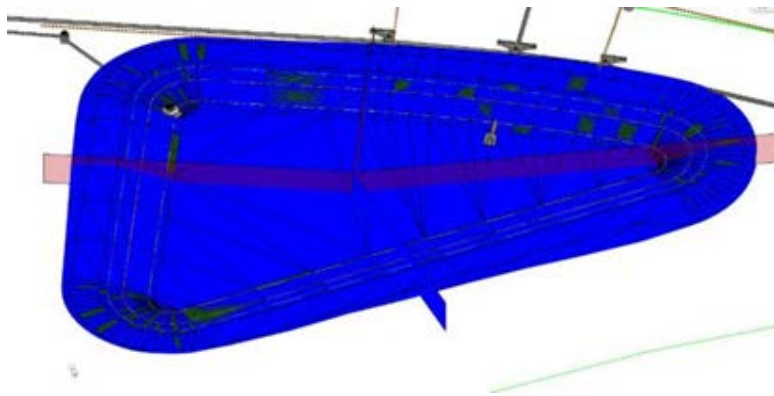


Exercise 6.3 Placing Special Details

1. Continuing in the *PDPLRD01.dgn* file, make sure that the Default-3D Views is the active View.

Name	Model
0+00.00 Views	0+00.00
0+00.1 Views	0+00.1
1+19.30 Views	1+19.30
1+60.25 Views	1+60.25
Default	Default
Default-3D Views	Default-3D
Multi-Model Views	
Pond 1 [Sheet] Views	Pond 1 [Sheet]
Pond 1 Views	Pond 1

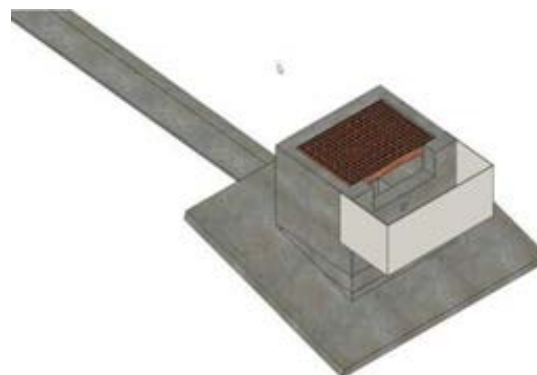
2. Using the Rotate View tool's Rotate 3D method, rotate and zoom the view until it is similar to the one below.



3. Using the OpenRoads Modeling Workflow go to the Primary Group and select the Level Display tool. This will open the Level Display dialog. Highlight the *PDPLRD01.dgn* file in the file list. Turn off all but the active level in this file. Close the dialog box. The view should look like the one below.



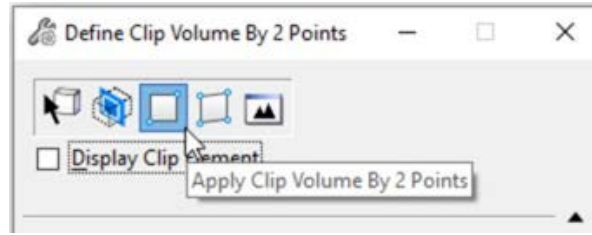
4. Now zoom in to the structure to be detailed.



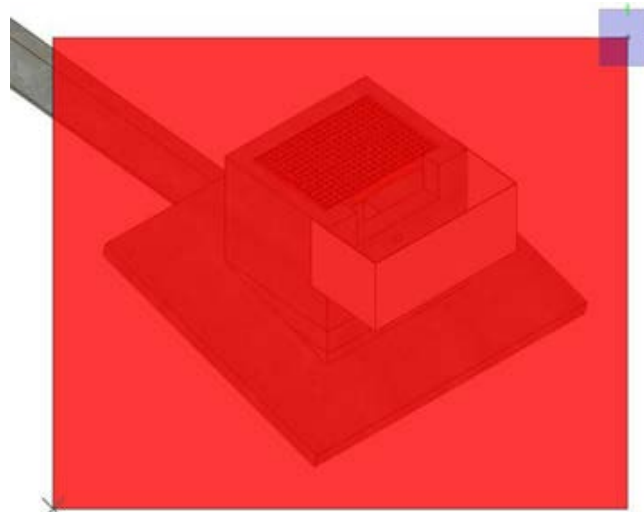
5. Change to the Drawing Production tab and select the Clip Volume tool.



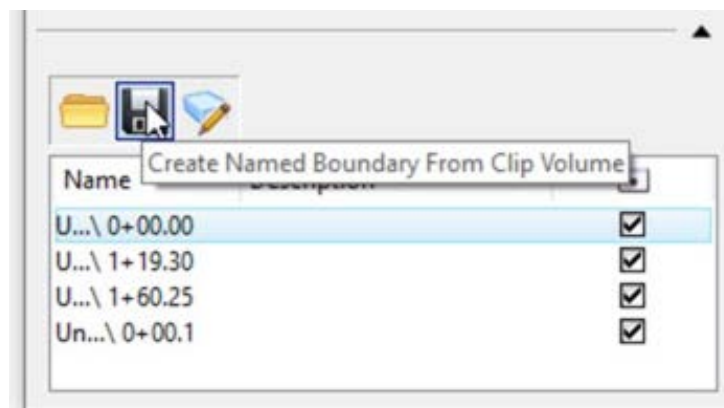
6. The Create Clip Volume dialog will display now. Select the Apply Clip Volume By 2 Points tool. Make sure the Display Clip Element checkbox is unchecked.



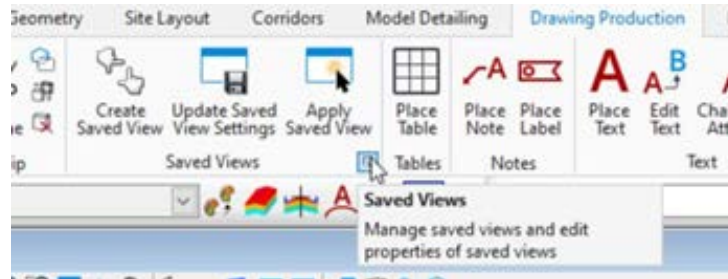
7. Left click (Data Point) in open space and drag down and left to create a Clip Volume like the example.



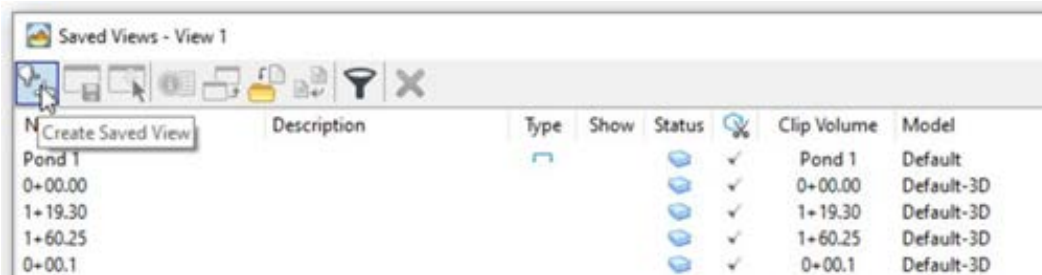
8. Now click on the icon to Create Named Boundary From Clip Volume. Name it SpecialDetail.



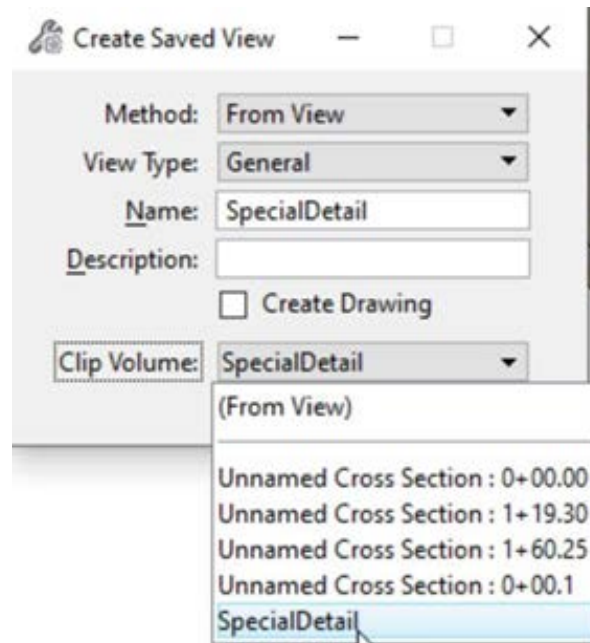
- Open the Saved Views dialog by clicking in the lower right corner of the Saved Views group of the Drawing Production tab.



- On the Saved Views dialog click the Create Saved view icon in the upper left of the dialog box.



- Set the values of the Create Saved View dialog box as follows.



- Close the dialog and change to the Pond 1 [Sheet] Views View Group. Open the References dialog from the Primary group on the Home tab. Click on the Attach Reference icon in the upper left of the dialog box. This will bring up the Attach Reference dialog. Choose the PDPLRD01.dgn file in the list and click the Open button. Set the values in the Reference Attachment Properties dialog box as follows and click the Ok button to accept.

Reference Attachment Properties for PDPLRD01.dgn

File Name: PDPLRD01.dgn
 Full Path: ...\\Worksets\\FDOT\\22049555201_CE\\Drainage\\PDPLRD01.dgn
 Model: Default-3D
 Logical Name: SpecialDetail-1
 Description: Saved View Attachment

Orientation:

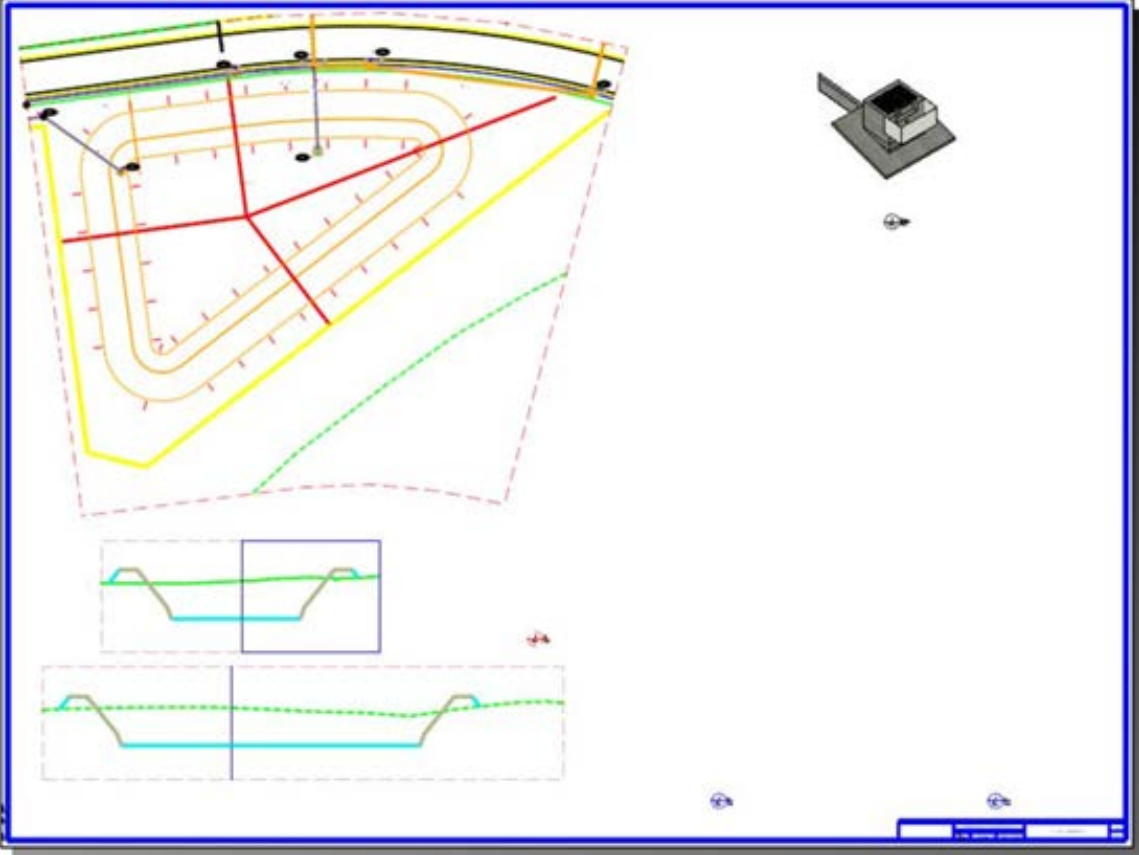
View	Description
Coincident	Aligned with Master File
Coincident - World	Global Origin aligned with Master File
Standard Views	
Saved Views	
0+00.00	
1+19.30	
1+60.25	
0+00.1	
SpecialDetail	
Named Boundaries	

Detail Scale: 3/8"=1'-0"
 Scale (Master:Ref): 1.000000000 : 32.000000000
 Named Group:
 Revision:
 Level:
 Nested Attachments: Live Nesting Nesting Depth: 1
 Display Overrides: Never
 New Level Display: Use MS_REF_NEWLEVELDISPLAY Configur
 Global LineStyle Scale: Master
 Synchronize View: All Properties
 Drawing Boundary: (New)
 Name: SpecialDetail-1
 Visible Edges: Dynamic

Toggles

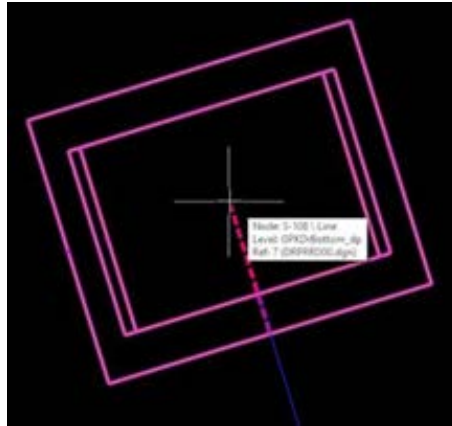
OK Cancel

13. Now place the Reference in the upper right corner of the Pond 1 [Sheet] Views. The sheet should now look like the image below.

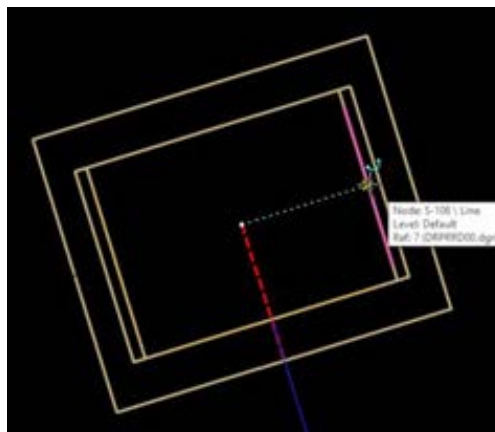


Exercise 6.4 Cutting Control Structure Sections

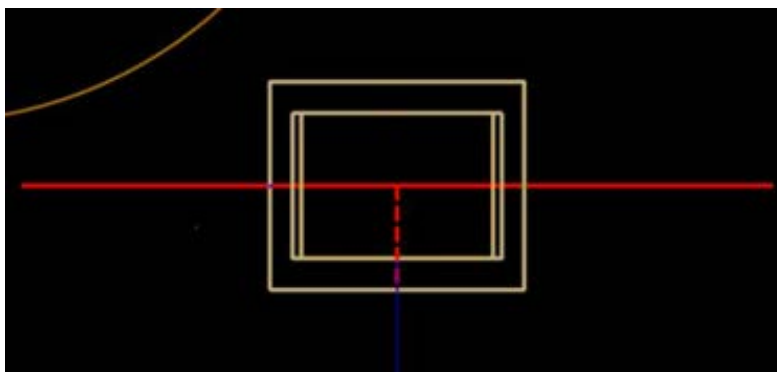
1. Continuing in the *PDPLRD01.dgn* file, switch to the Drawing Workflow. While in the Multi-Model Views View Group make View 1 active and click on the Rotate View icon. Using the 2 Points Method tentative click on the end of the red dashed line in the center of the 2D structure as shown.



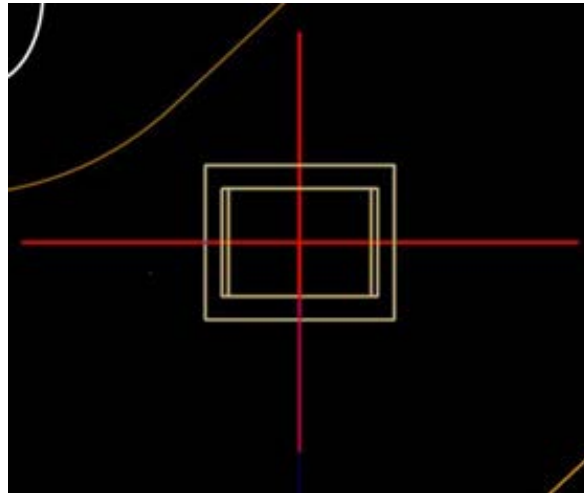
2. Now Snap to the midpoint of the tan line to the right as shown and click to complete the view rotation.



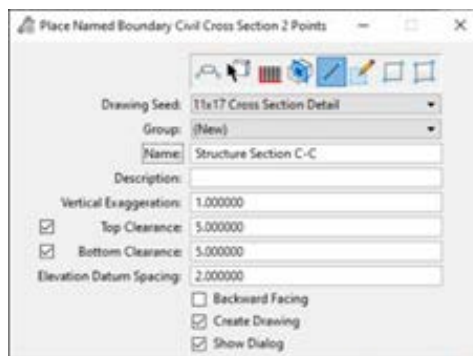
3. Using Place Line tool from the Placement group on the Home tab. Tentative click on the end of the red dashed line. Switch to the Drawing Aids tab and choose the Set Origin tool in the AccuDraw group. Move the cursor horizontally to the left and press the Enter key on the keyboard to lock the Axis of AccuDraw. Type the number 8 on the keyboard and left click (Data Point) to start drawing the pattern line. Move the cursor horizontally to the right and press the Enter key to lock the axis. Type the number 16 on the keyboard and left click (Data Point) to finish placing the pattern line.



- Once again, use the Place Line tool on the Home tab. Tentative click on the end of the red dashed line. Switch to the Drawing Aids tab and click on the Set Origin tool. Move the cursor vertically up from the end of the line and press the Enter key to lock the Axis to vertical movement. Type the number 6 and left click (Data Point) to start drawing the pattern line. Move the cursor down through the center of the 2D structure. Press the Enter key to lock the Axis to vertical movement and type the number 12. Left click (Data Point) to complete the pattern line. The structure should look like the example below.



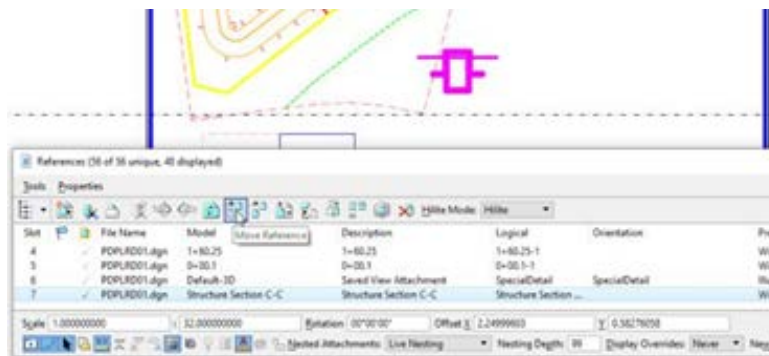
- Switch back to the OpenRoads Modeling Workflow. Use the Place Named Boundary tool to bring up the Place Named Boundary Civil Cross Section 2 Points dialog. Set the values as shown.



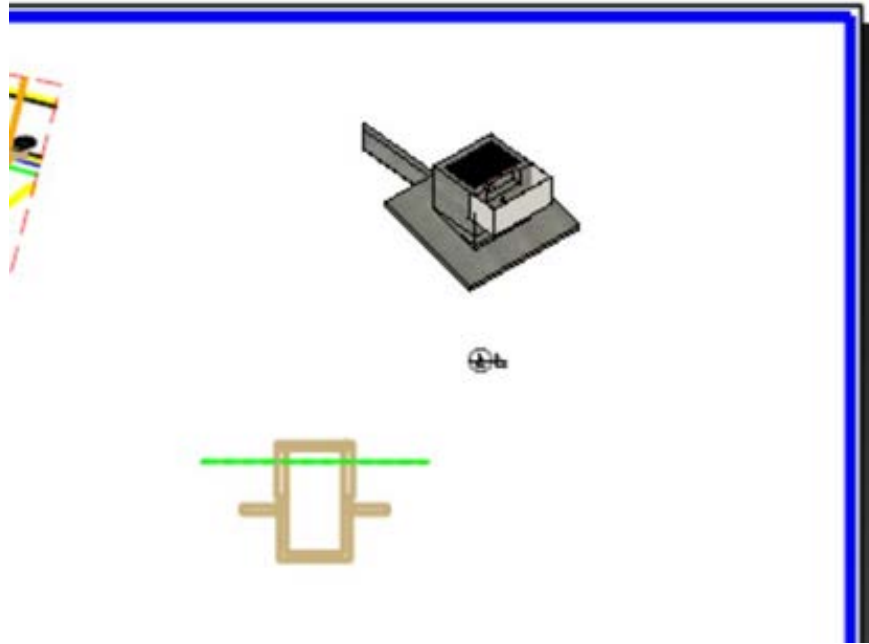
- Select the horizontal pattern line and Snap to the left end of the line. Left click (Data Point) to accept the First Point. Now Snap to the right end and left click (Data Point) to accept the Second Point. Finally left click (Data Point) in the open to bring up the Create Drawing dialog. Set the values as shown.



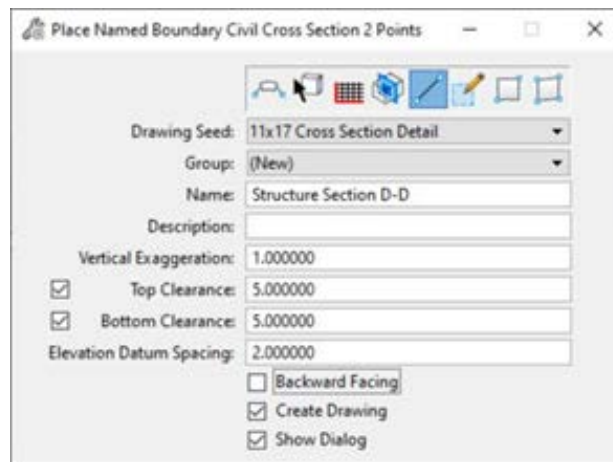
- This will process the section and open the Pond 1 [Sheet] Views Group. The new section will be located as shown in the image below. It will need to be moved using the Reference File tools.



- Using the References Move Reference Views tool, move the new section to the location just below the Special Detail in the upper right of the Pond 1 [Sheet] Views, as shown below.



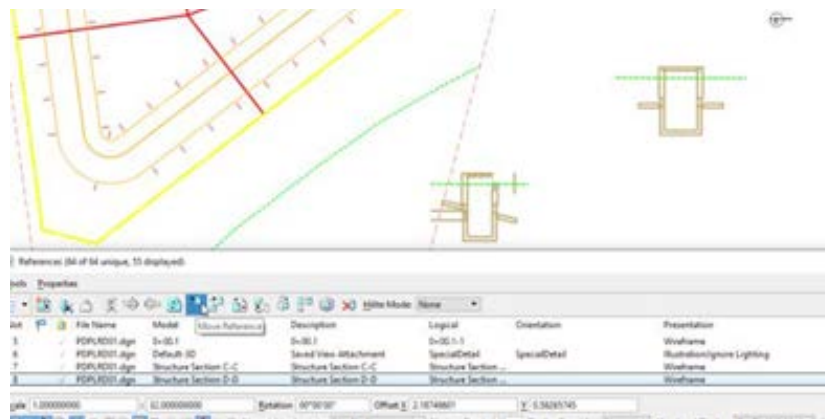
- Switch back to the Multi-Model Views View Group and make View 1 active. Use the Place Named Boundary tool to bring up the Place Named Boundary Civil Cross Section 2 Points dialog. Set the values as shown.



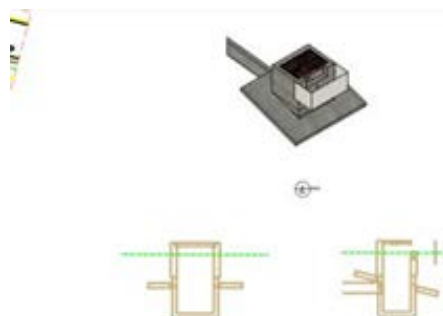
- Select the vertical pattern line and Snap to the top end of the line. Left click (Data Point) to accept the First Point. Now Snap to the bottom end and left click (Data Point) to accept the Second Point. Finally, left click (Data Point) in the open to bring up the Create Drawing dialog. Set the values as shown.



- This will process the section and open the Pond 1 [Sheet] Views Group. The new section will be located as shown in the image below. It will need to be moved using the Reference File tools.

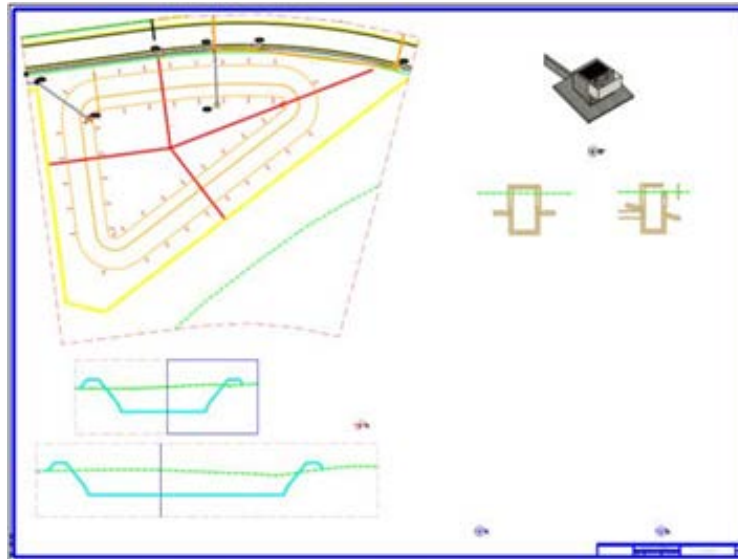


- Using the References Move Reference tool, move the new section to the location just below the Special Detail in the upper right of the Pond 1 [Sheet] Views, as shown below.



Exercise 6.5 Control Structure Form

1. Continuing in the *PDPLRD01.dgn* file, switch to the Pond 1 [Sheet] Views Group and open the FDOT tab.



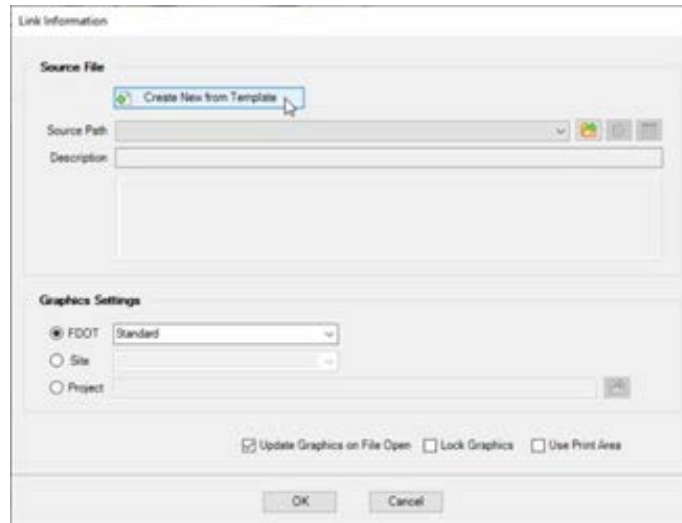
2. Click on the Linked Data Manager tool in the Actions group.



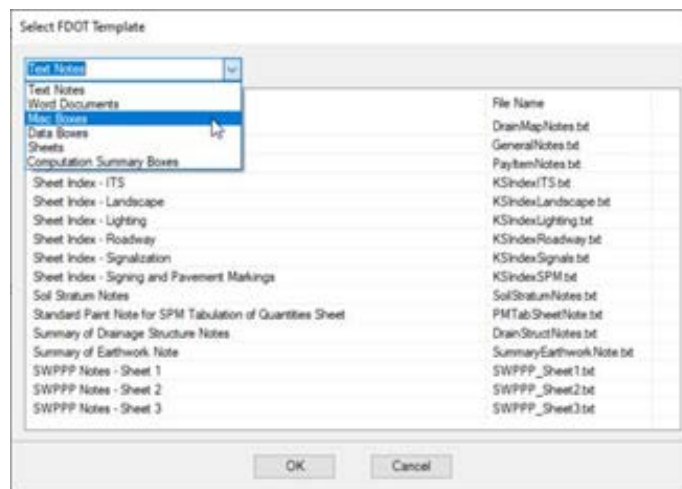
3. This will bring up the FDOT Linked Data Manager dialog. Click on the Create new link button in the upper left corner of the dialog.



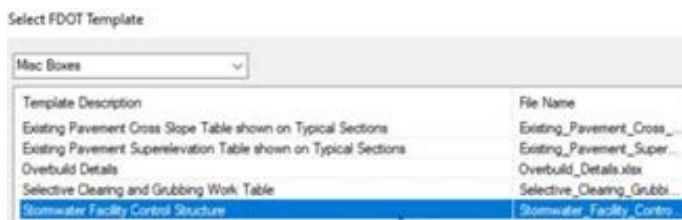
- On the Link Information dialog box click the Create New from Template button.



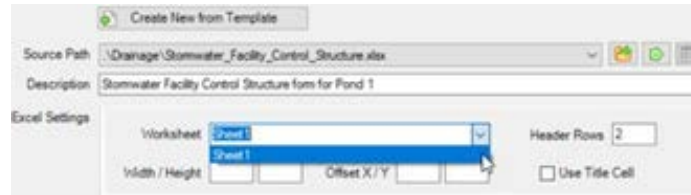
- This will open the Select FDOT Template dialog box. Click on the dropdown menu and choose Misc Boxes.



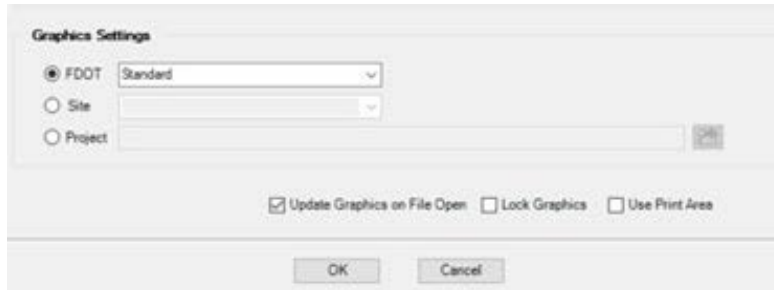
- Now select Stormwater Facility Control Structure from the list of templates and click the Ok button to save the newly created file to the Drainage directory of the current project.



7. Type Stormwater Facility Control Structure form for Pond 1 in the Description and set the Worksheet dropdown to Sheet 1.



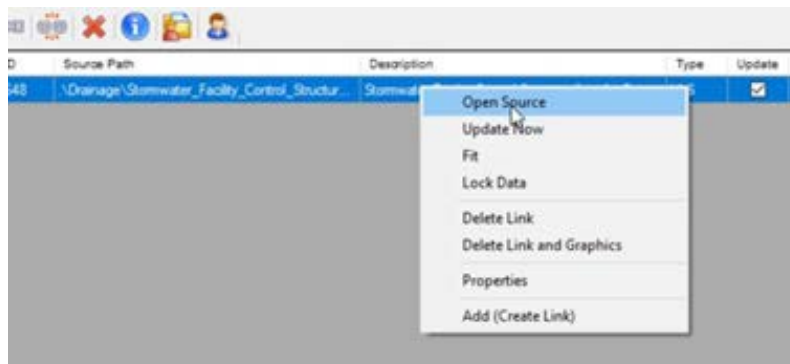
8. Set the remainder of the dialog as shown below and click the Ok button to begin placement of the Control Structure form.



9. It will take a bit of time for the program to create the new blank Excel file and then begin the process for the placement of the form in the drawing, so be patient. Eventually you will have a form attached to the cursor to be placed. Move it near the location show below and left click (Data Point) to place.



10. Back in the FDOT Linked Data Manager dialog, select and right click on the entry for the new form. Select Open Source from the list. This will open Excel and allow editing of the new blank form.



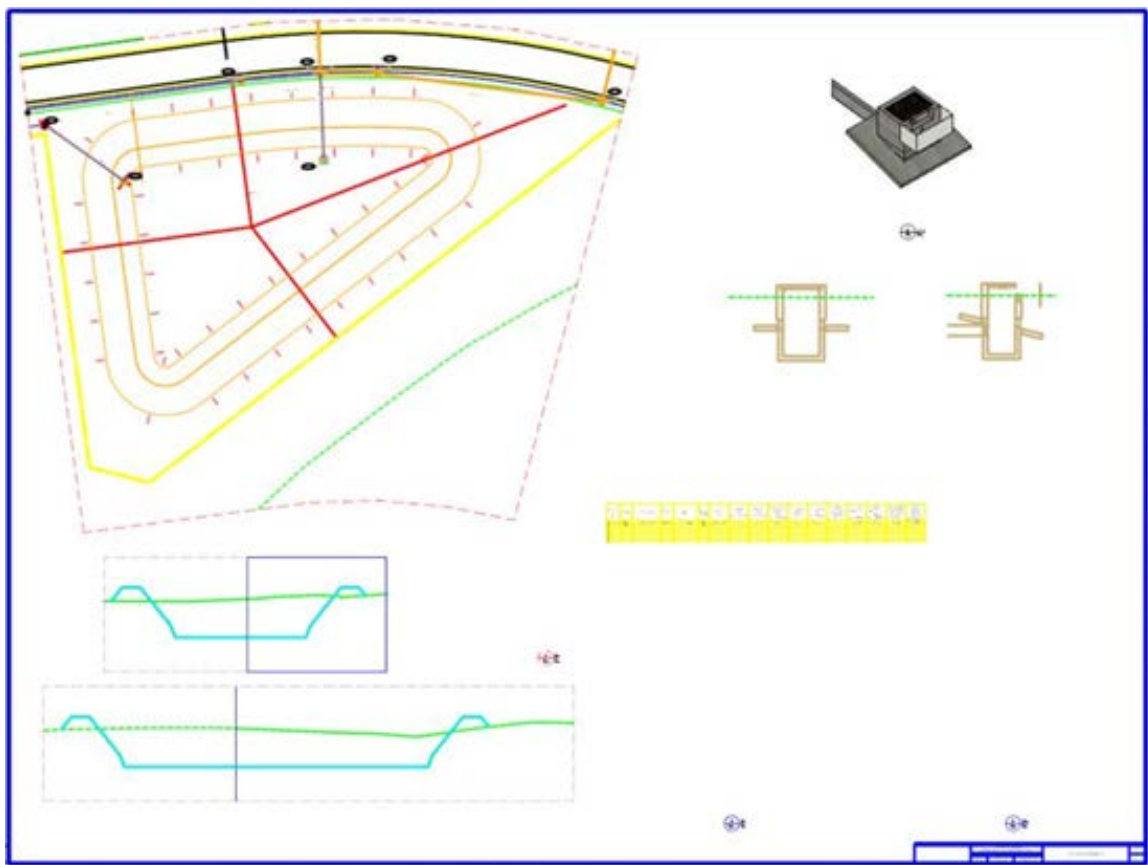
- Fill out the form and hide unused columns as shown in the example below. Once edits are made save the file and close Excel.

STRUCT NO.	SMP	STATION	OFFSET	REF	INLET TYPE	INLET NO.	GRATE EL (FT NAVD)	WEIR EL (FT NAVD)	OUTFALL PIPE EL (FT NAVD)	ORFICE DIA (INCH)	ORFICE EL (FT NAVD)	CONC DITCH FWT (FT)	TOP OF BERM EL (FT NAVD)	SWP BOTTOM EL (FT NAVD)	NORMAL WATER EL (FT NAVD)	25%RDWH EL (FT NAVD)
3.106	42	20+74.40	26.75	CL 2001	0	405.02	33.00	32.00	26.50	1.00	31.00		34.00	26.75	33.00	33.00

- Finally, right click on the new form in the FDOT Linked Data Manager and choose Update Now. This will update the placed version of the form to the latest saved version of the Excel file. Anytime a change is needed follow these steps to update the form.



- The Pond 1 [Sheet] View should now look like the following example.



7 DRAINAGE QUANTITIES

INTRODUCTION

The main focus in this chapter will be on the tools to extract quantity information from the drainage design model available in the OpenRoads Designer CONNECT Edition and FDOTConnect Workspace including:

- Item Types
- Asset Manager
- Takeoff Manager

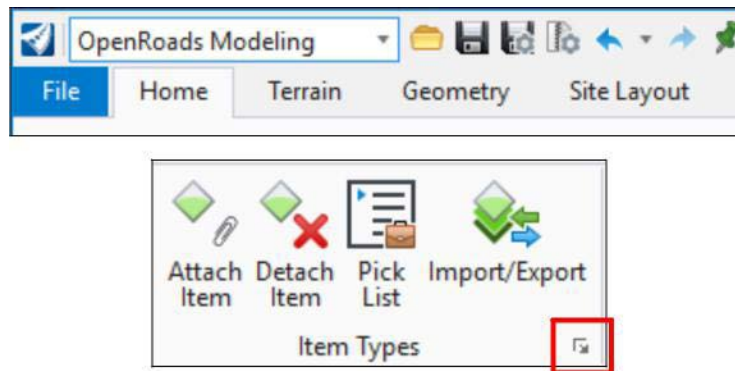
Automated quantity tools are still in development and methodologies are subject to change. Refer to the FDOTConnect Automated Quantities Workflow Course Guide for additional information.

The workflows outlined in this chapter will produce a Summary of Drainage table to be included in the Estimated Quantities Report for drainage. As described in Part 9 Chapter 902 of the FDOT Design Manual (FDM), quantities are reported with project documentation but are not included in the Roadway Plans Set.

ITEM TYPES

In the FDOTConnect Workspace, Item Types are used to apply Pay Item quantity information to drainage elements.

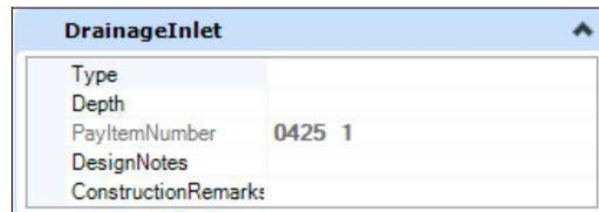
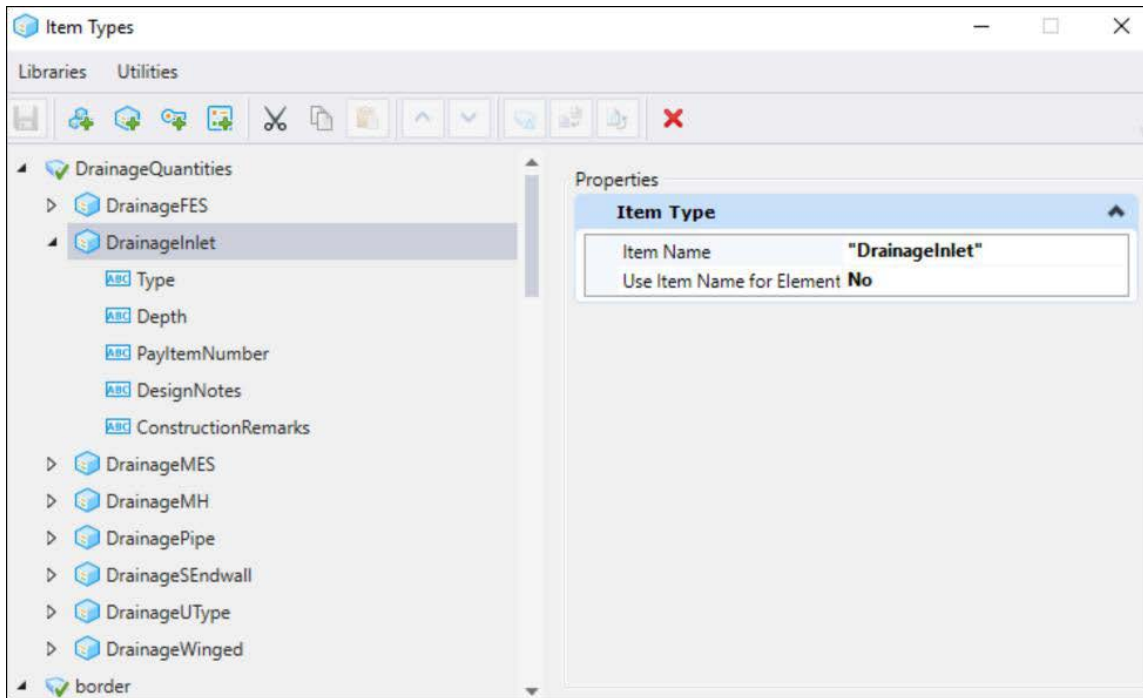
The Item Types tools can be accessed from the following path: **OpenRoads Modeling > Utilities > Item Types**.



The FDOT Drainage Item Types are based on FDOT Pay Item Number groupings in Basis of Estimates and can be viewed in the Item Types Manager, by clicking the icon in the lower right corner of the Item Types Group.

For all drainage structures, the corresponding FDOT Item Type is included with the Feature Definition, and therefore automatically attached when structures are placed. For drainage pipe, Item Types are attached after placement. In each case, the Drainage Item Types provide the framework in the properties dialog for users to select from picklists that generate the appropriate Pay Item Number.

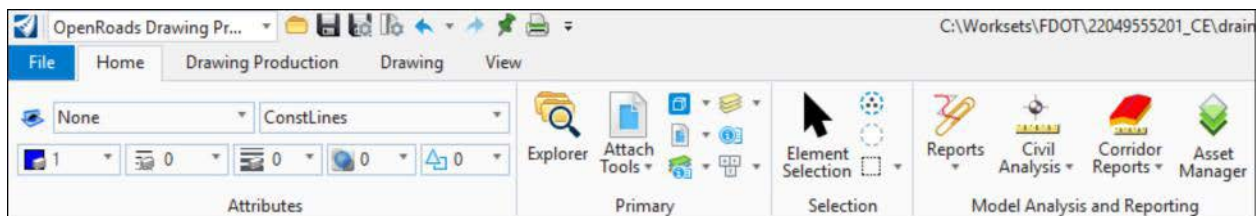
NOTE *Since Item Types are added to the drainage element properties (not Utility Properties), Pay Item information is not accessible to Flex Tables.*



ASSET MANAGER

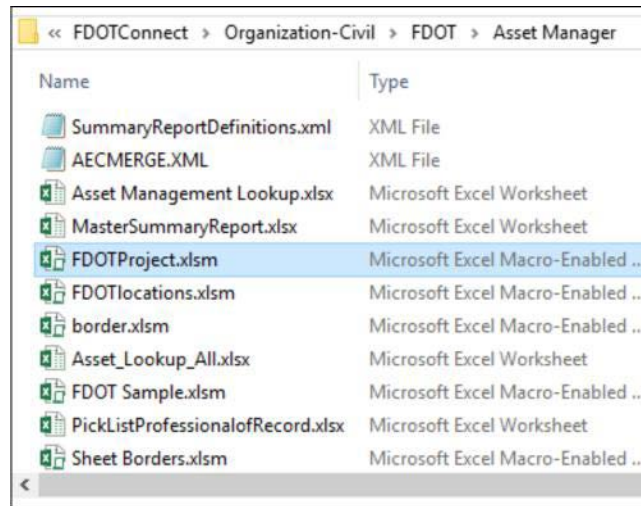
In the FDOTConnect Workspace, Asset Manager is used to assign Alignment and FPID information to elements for use by FDOT Quantity Takeoff Manager.

Asset Manager can be accessed from the following path: **OpenRoads Drawing Production > Home > Model Analysis and Reporting > Asset Manager.**



FDOT PROJECT .XLSM

For FDOTConnect Workflows, the first step in the Asset Manager workflow is to define the project alignments and/or FPID as applicable in a pre-formatted spreadsheet named FDOTProject.xlsx. Each project will have to complete the spreadsheet and save in the workset (symp/Symbology folder). The spreadsheet template may be copied from the folder location: <C:\FDOTConnect\Organization-Civil\FDOT\Asset Manager\FDOTProject.xlsx>.



The _Pick List Definitions tab has the following content:

- Row 1 is preformatted to automatically update as alignment or FPID content is added.
- Row 2 is for users to add alignment(s) from left to right, starting at cell B2.
- Row 3 is for users to add FPID(s) from left to right, starting at cell B3.

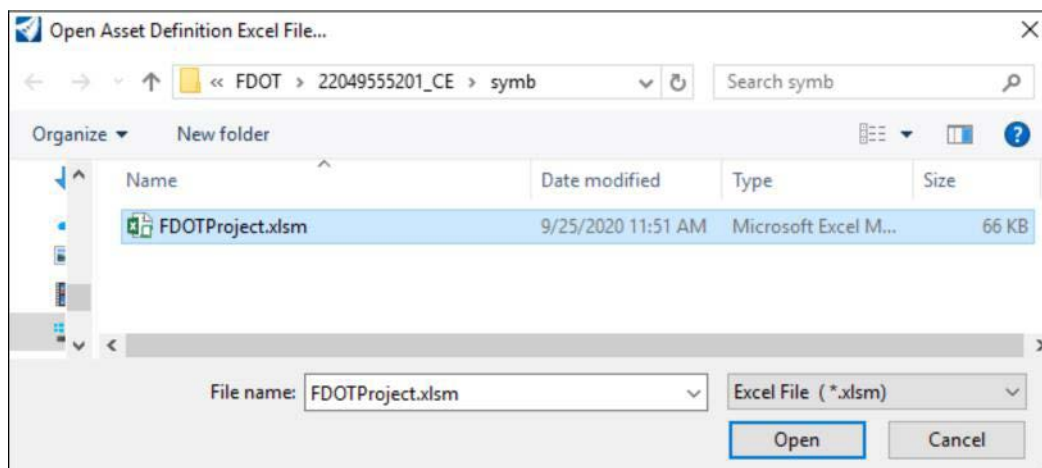
	A	B	C
1	Pick List Name	Option 1	
2	Alignment		
3	FPID		
4			

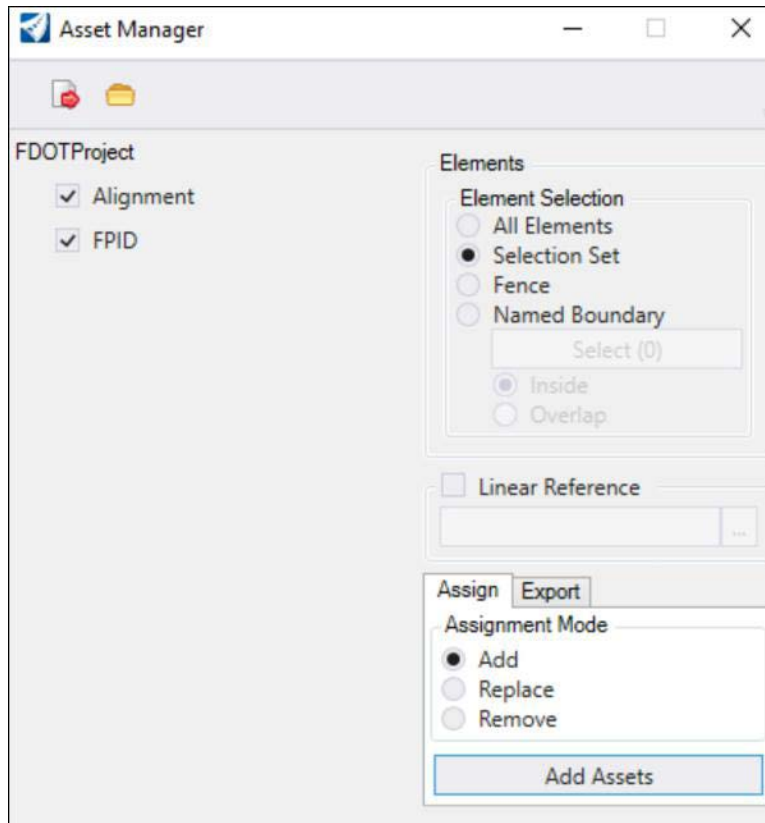
ASSET MANAGER TOOL

When activated, the two icons at the top of the Asset Manager tool are for the following:

Export empty asset definition template Open Asset Definitions File

Once the FDOTProject.xlsm spreadsheet has been completed for the project and saved to the workset directory, Asset Manager can read the alignment and FPID project information and assign to selected elements.





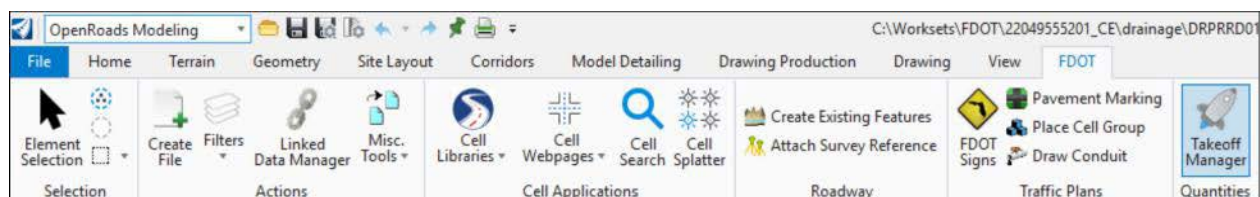
This tool can also be used to replace or remove alignment and FPID information.

FDOT QUANTITY TAKEOFF MANAGER

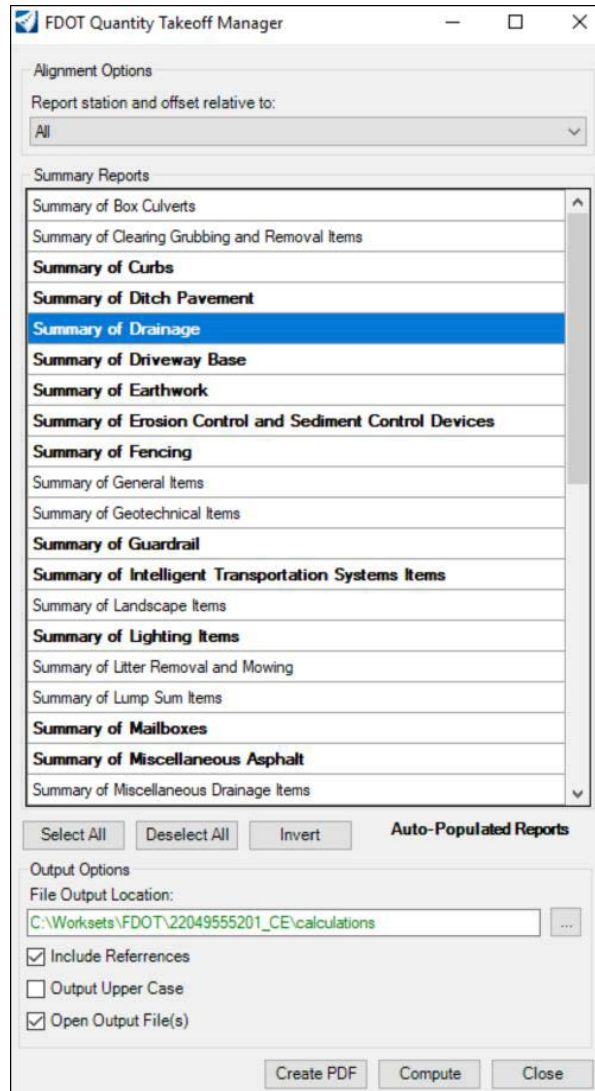
In the FDOTConnect Workspace, the Takeoff Manager is used to create the Estimated Quantities Report. The tool extracts quantity information from the drainage elements in or referenced to the model and formats the information into an auto-populated, standardized table.

NOTE *Quantity reports for all disciplines use the same standardized table, with columns hidden or displayed accordingly.*

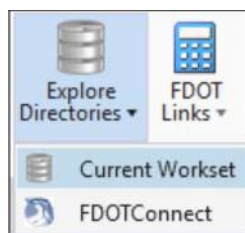
The Takeoff Manager tool can be accessed from the following path: **OPENROADS MODELING > FDOT > Quantities** .



When prompted, the tool opens with a complete list of available reports. The Summary of Drainage report is used for all Drainage Item Types.



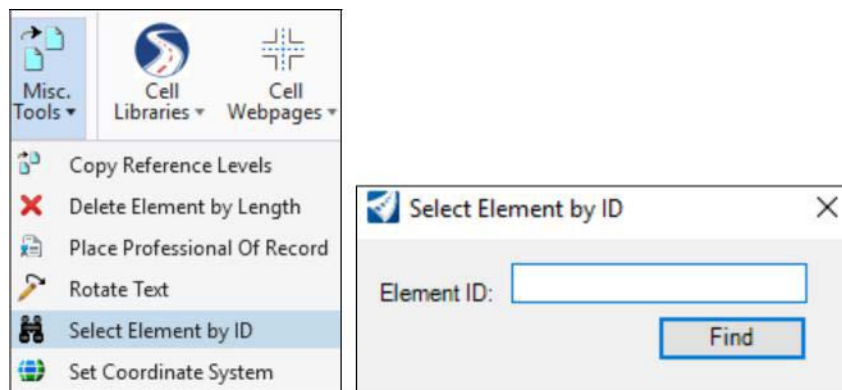
By default, the spreadsheet report is saved in the project Workset's calculations subfolder and the PDF report is saved in the project Workset's estimates subfolder. Both locations can be quickly accessed from OpenRoads with following tool: **OpenRoads Modeling > FDOT > Resources > Explore Directories > Current Workset.**



The quantity information reported in the standard table includes several ways to locate the corresponding elements in the DGN model. In addition to the drainage Structure Number and Pipe Numbers (reported in Label column), the Element ID corresponds to a unique value assigned to the properties of each individual element in the DGN.

Pay Item Number	Label	Pay Item Description	Unit of Measure	Quantity				Location				Design Notes	Construction Remarks	
				P	F	P	F	Alignment	Begin Station	End Station	Side			Element ID

The Select by Element ID tool can be accessed from the following path: **OpenRoads Modeling > FDOT > Actions > Misc. Tools > Select Element by ID.**



EXERCISES

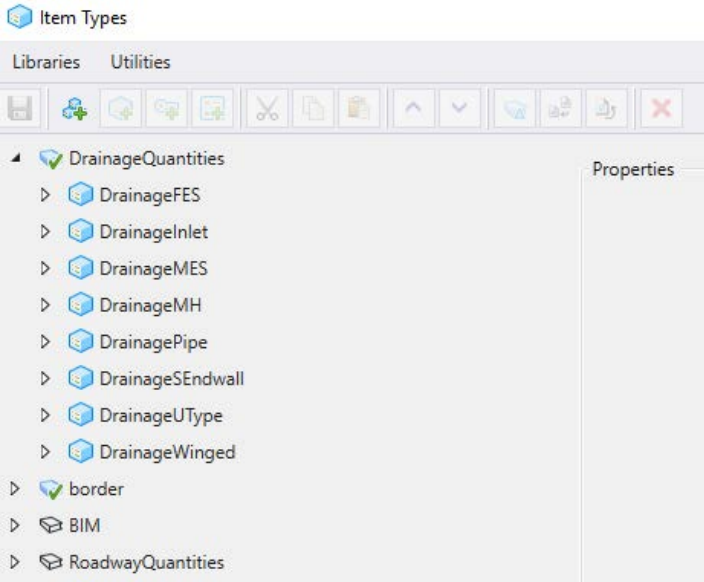
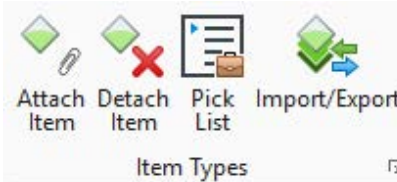
EXERCISE OVERVIEW – DRAINAGE QUANTITIES

In this chapter exercise, users will create a Summary of Drainage Report for a sample network. The network created in Chapter 2 and used in Chapters 3 & 4 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- Exercise 7.1 Explore Item Types Manager.....203
- Exercise 7.2 Generate Pay Item Numbers for sample drainage structures.....205
- Exercise 7.3 Attach Item Types to sample pipes and generate Pay Item Numbers.....206
- Exercise 7.4 Create a Selection Set.....208
- Exercise 7.5 Attach alignment information for quantities.....209
- Exercise 7.6 Use Takeoff Manager to generate Summary of Drainage table.....213
- Exercise 7.7 Explore Items in Project Explorer and delete strays.....216

Exercise 7.1 Explore Item Types Manager for Drainage

1. Open FDOTConnect, set the Workspace to “FDOT” and select the Workset – “22049555201 ”.
2. Browse to the drainage folder and open “DRPRRD01.dgn”.
3. Navigate through the following path and open Item Types Manager: **OpenRoads Modeling > Home > Item Types**.



4. Hover over Drainage Quantities and verify the following message appears:

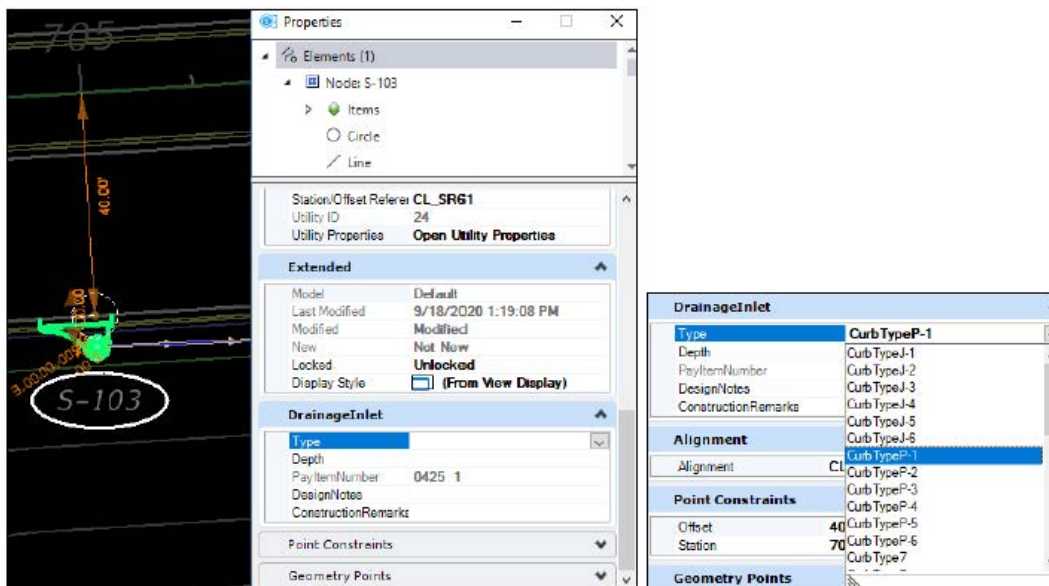
Local resource, matches library

5. Close the dialog.

NOTE *When working with Item Types in a DGN file for the first time after its been opened, sometimes the Item Types properties are blank or non-responsive within the element Properties dialog. If that happens, repeat this exercise (open Item Types Manager) to reactivate the properties.*

Exercise 7.2 Generate Pay Item Numbers for sample drainage structures

- Switch to the Default or Multi-Model Views in DRPRRD01.dgn, activate View Control, and select 1 View and zoom towards S-101, S-102, and S-103.
- Select S-103 and open the element properties (from Primary Group in any tab). Scroll down to the DrainageInlet section:
 - Click in the field next to Type to access the pulldown picklist and select CurbTypeP-1 as shown below.
 - For Depth, select LessOrEq10ft from the picklist.
 - The PayItemNumber is not editable, but will automatically be completed based on selections in a and b.
 - For DesignNotes, add "Sample notes for S-103" into the text field.
 - For ConstructionRemarks, leave this field blank.



DrainageInlet	
Type	CurbTypeP-1
Depth	LessOrEq10ft
PayItemNumber	0425 1311
DesignNotes	Sample notes for S-103
ConstructionRemarks	

- Repeat steps for S-101 and S-102 with the data shown below.

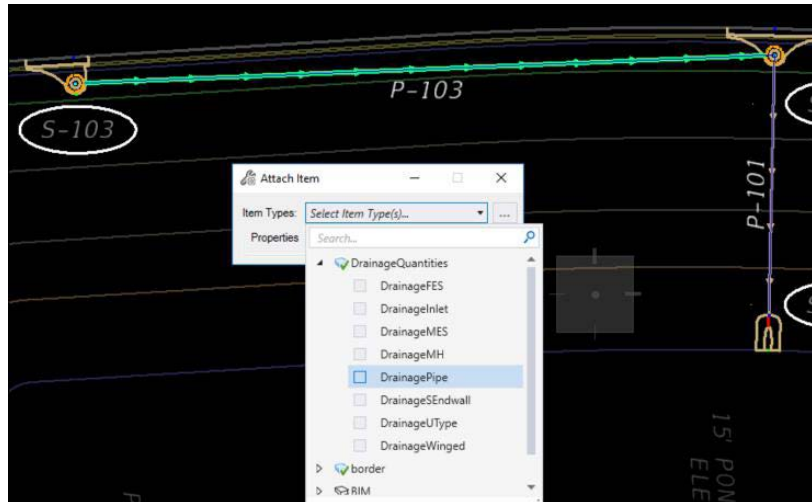
DrainageInlet	
Type	CurbTypeP-2
Depth	LessOrEq10ft
PayItemNumber	0425 1321
DesignNotes	Sample notes for S-101
ConstructionRemarks	

DrainageMES	
Application	CrossDrain
Shape	Round
Size	18
PayItemNumber	0430982125
DesignNotes	Sample Notes for S-102
ConstructionRemarks	

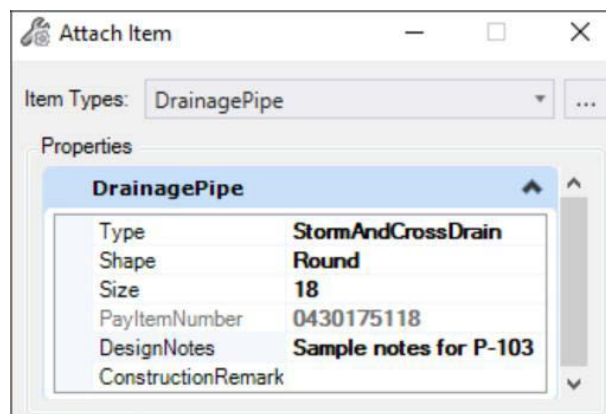
- Close properties dialog.

Exercise 7.3 *Attach Item Types to sample pipes and generate Pay Item Numbers*

1. Select P-103, open element properties and review. Note there is not yet a section for Item Types. Close the properties dialog but keep P-103 selected.
2. Navigate through the following path and select Attach Item: OPENROADS MODELING>HOME>Item Types>**Attach Item**.
3. For Item Types: select DrainageQuantities:DrainagePipe from the pulldown menu.



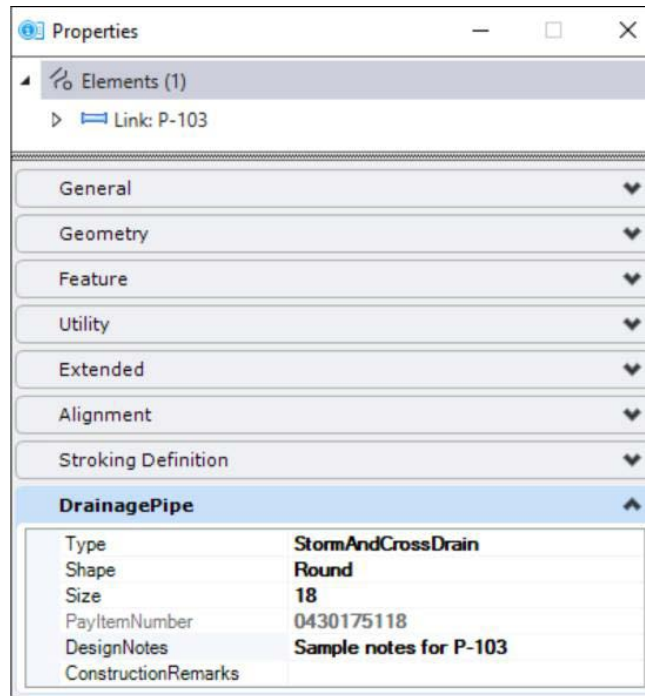
4. The Item Type property selections can be made in this dialog or later in element properties. Complete the dialog or item types properties with the following information:
 - a. Type = **StormAndCrossDrain**
 - b. Shape = **Round**
 - c. Size = **18**
 - d. PayItemNumber is not editable, but will automatically be completed based on selections in a, b, and c.
 - e. DesignNotes = "**Sample notes for P-103**"



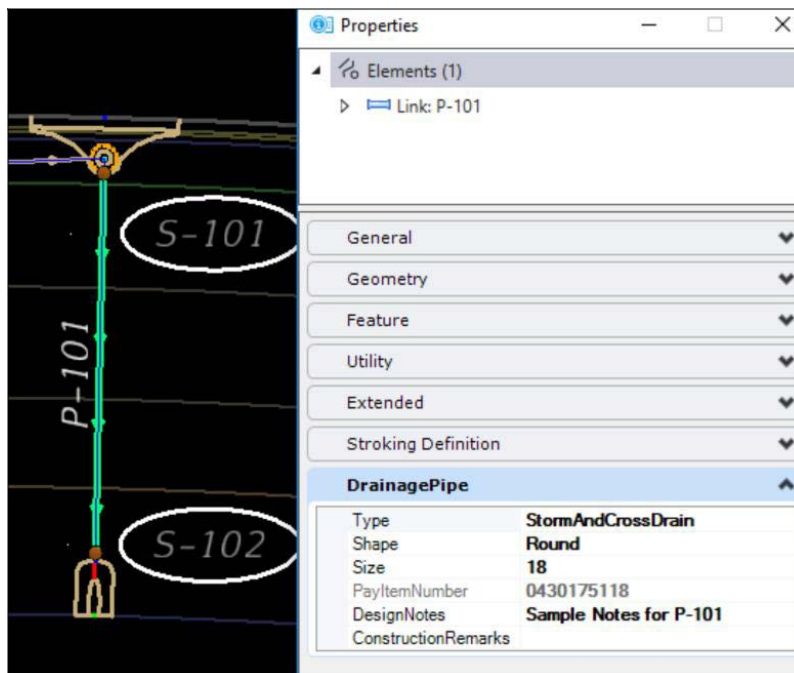
5. Left click to accept the prompt in the lower left, to apply the Attach Item settings.

Attach Item > Accept/Reject Selection

6. Reopen element properties to verify **DrainagePipe** section is complete with the Item Type properties.



7. Close the properties dialog and repeat steps 1 through 6 for P-101.

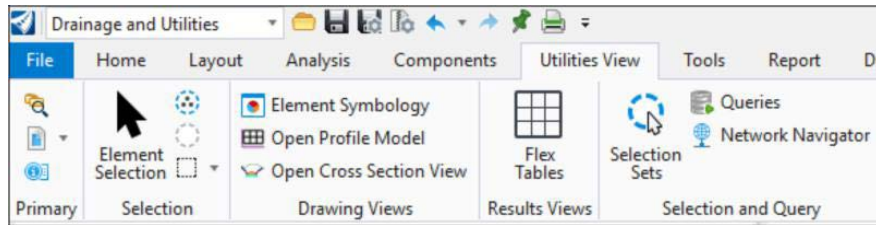


NOTE Use level display and selection sets to select and set groups with the same Item Types.

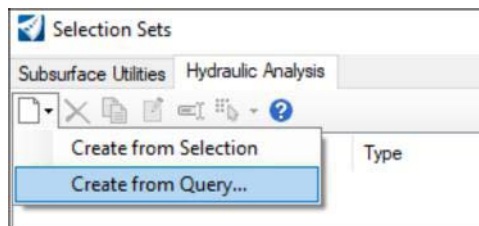
Exercise 7.4 Create a Selection Set

Selection sets are useful to quickly select groups of elements for a variety of uses. In the next exercise, the selection set allows properties to be set just once and avoids unnecessary repetition.

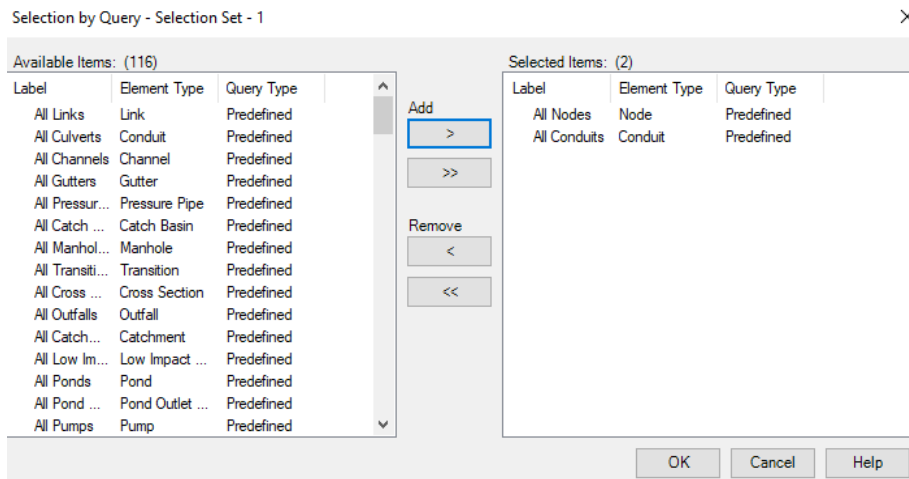
1. Navigate through the following path and select Selection Sets:**Drainage and Utilities > Utilities View > Selection and Query>Selection Sets**.



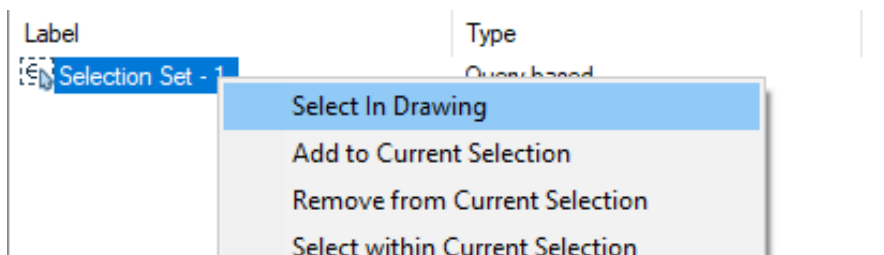
2. Click the New icon and select Create from Query.



3. From the list of Available Items, select All Nodes and All Conduits and click Add '>' and click OK to close the dialog.



4. In the Selection Sets Manager, right click the new 'Selection Set – 1' and click Select in Drawing to verify the 2 pipes and 3 drainage structures are included. Close the dialog.



Exercise 7.5 Attach alignment information for quantities

This exercise is going to generate a pick list and item type for the project alignments and assign to drainage features.

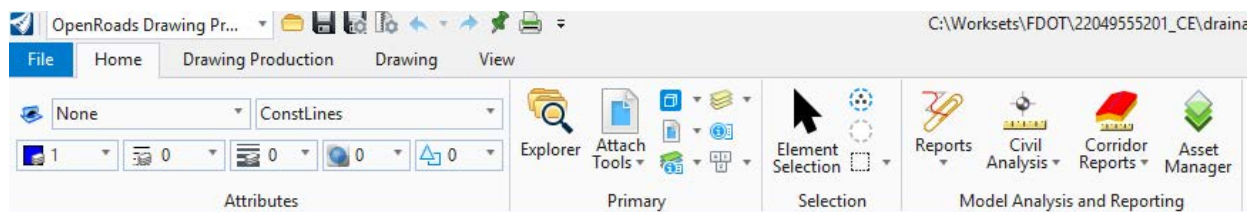
1. Outside of OpenRoads, navigate through File Explorer to the workset symb/Symbology subfolder: C:\Worksets\FDOT\22049555201\symb and locate the file FDOTProject.xlsm


NOTE *New projects created through “Create Project” will already have this file copied to the symbology folder. If already in workset folder, skip step 2.*

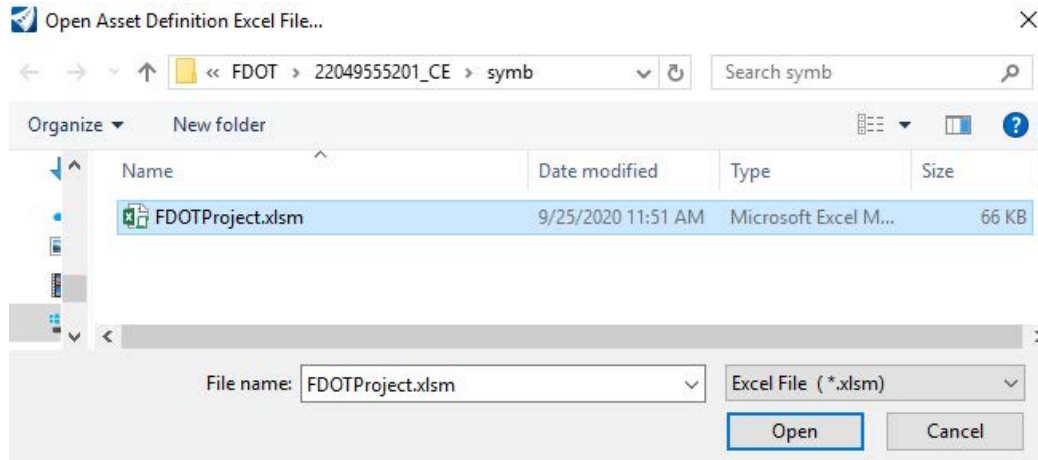
2. Navigate through File Explorer to the FDOTConnect Asset Manager resources. Workstation installations typically use the path: C:\FDOTConnect\Organization-Civil\FDOT\Asset Manager:
 - a. Find and copy the file FDOTProject.xlsm
 - b. Paste the file into the workset symb/Symbology subfolder: C:\Worksets\FDOT\22049555201\symb
3. Open the spreadsheet and in the _Pick List Definitions tab, fill in the following cells:
 - a. Cell B2 = CL_SR61
 - b. Cell B3 = US98

	A	B	C	D
1	Pick List Name	Option 1	Option 2	Option 3
2	Alignment	CL_SR61	US98	
3	FPID			
4				

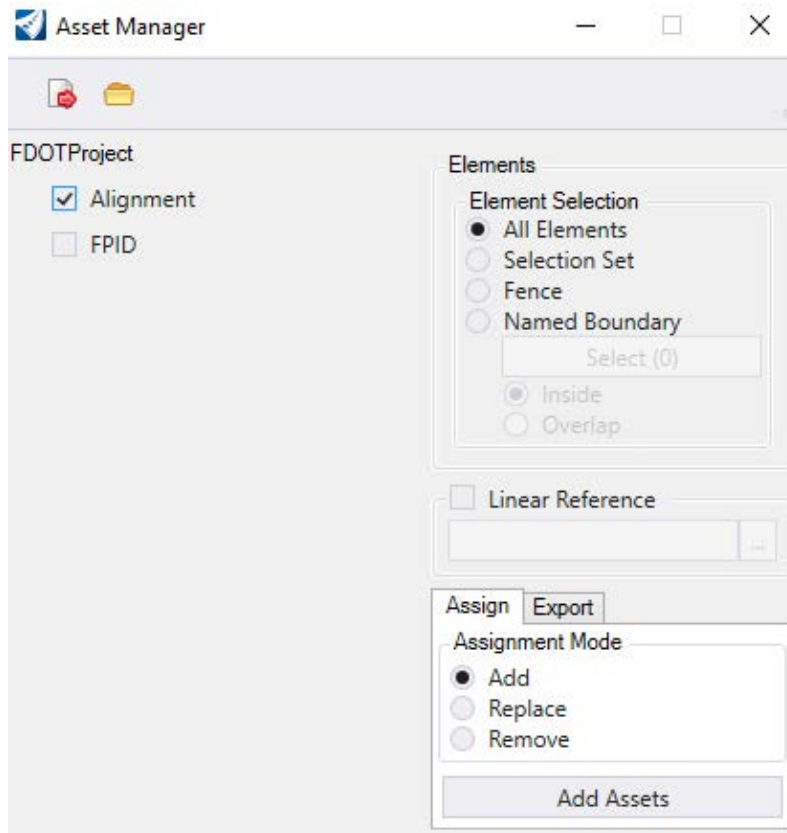
- c. Save and close FDOTProject.xlsm
4. Back in OpenRoads, navigate through the following path and open Asset Manager: OPENROADS DRAWING PRODUCTION>HOME>Model Analysis and Reporting> Asset Manager.



5. From Asset Manager, select the  icon to Open Asset Definitions File and select FDOTProject.xlsm.



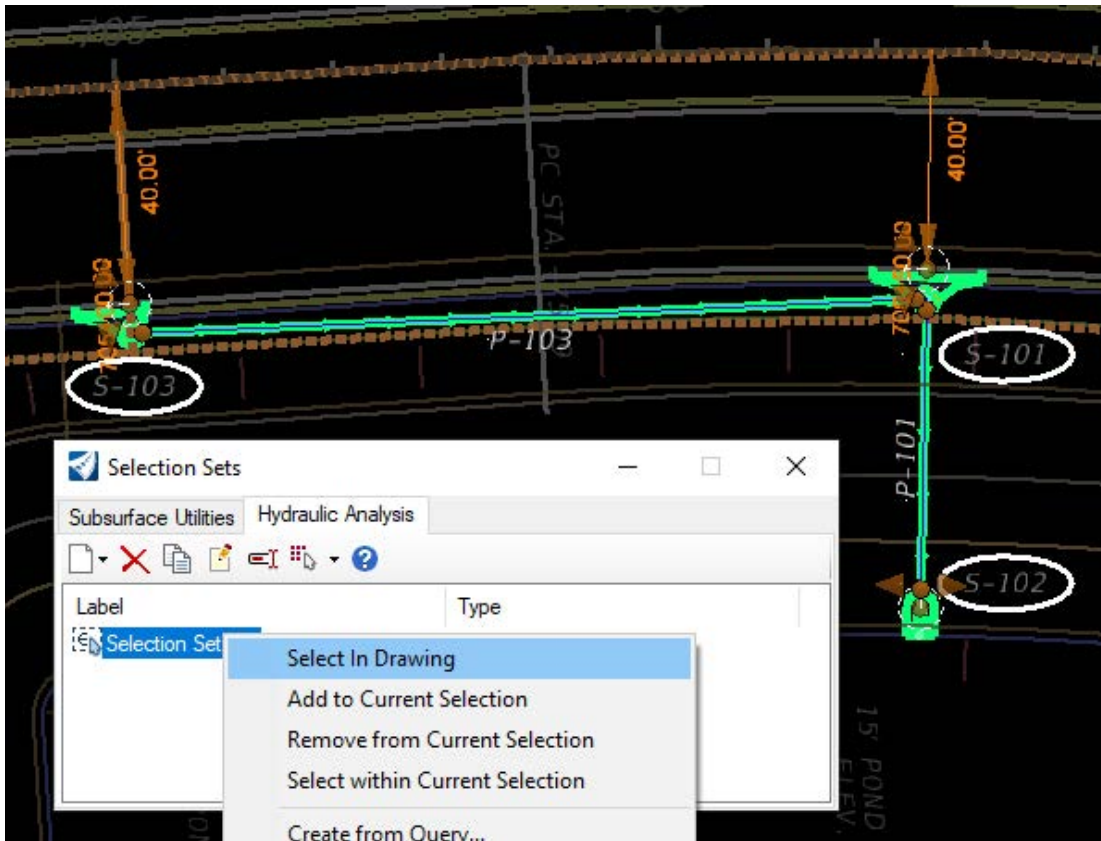
- a. Check the box for Alignment.



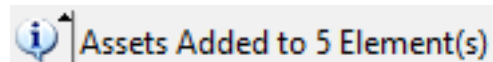
NOTE Typically, FPID should not be attached unless the project has multiple funding sources (sequencing).

- b. In the Elements section of the tool, change setting from All Elements to Selection Set.

- c. From the path: **Drainage and Utilities** > **Utilities View** > **Selection and Query** > **Selection Sets**, open Select Sets Manager, and right click Selection Set – 1, and choose Select in Drawing.

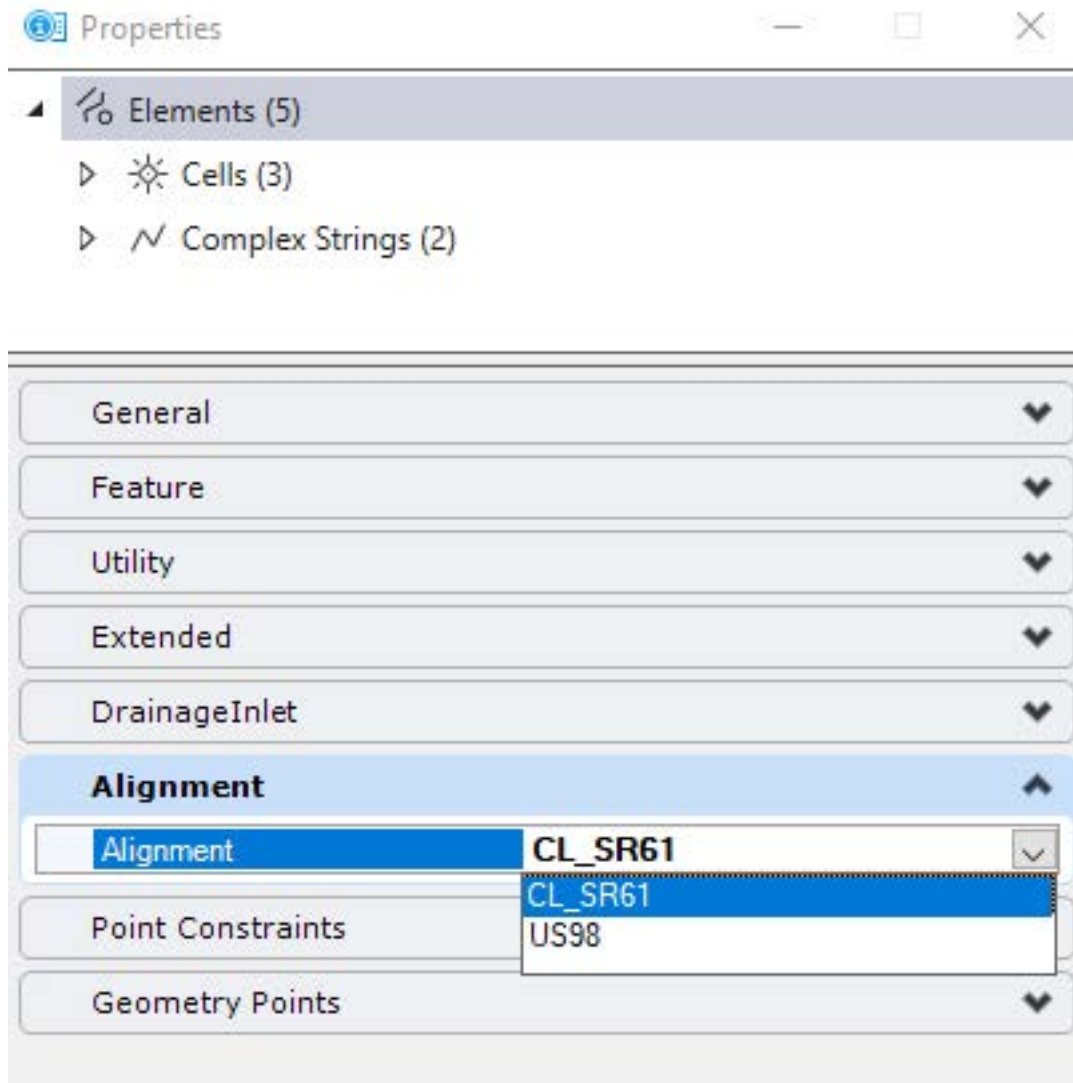


- d. In the Asset Manager window, under the Assign Tab, click **Add Assets**.
- e. Verify successful attachment from messages at the bottom of the OpenRoads window.



- f. Close the Asset Manager tool

6. With the selection set still active, open properties and set the alignment CL_SR61 for all elements.



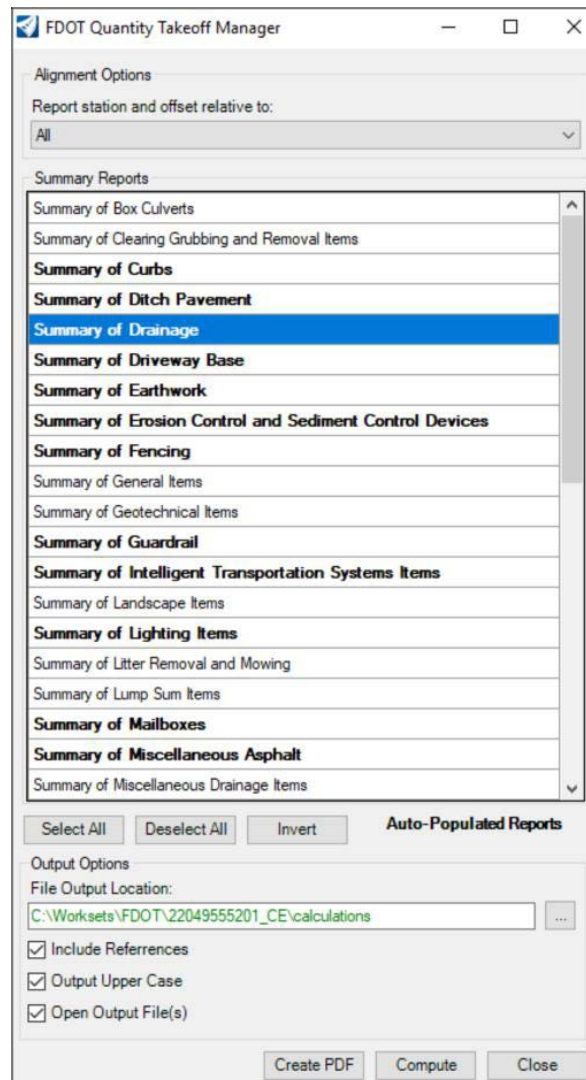
Exercise 7.6 Use Takeoff Manager to generate Summary of Drainage table

Once Pay Item Numbers are generated and alignments assigned, the Takeoff Manager is ready to run.

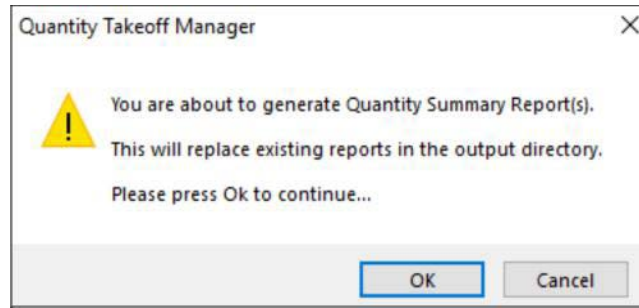
1. Open the FDOT Quantities Takeoff Manager from the path: **OpenRoads Modeling > FDOT > Quantities**.



- a. Open the pulldown menu for 'Report station and offset relative to:' and verify the relevant project alignments are recognized. Keep 'All' as the selected option.
- b. Check the boxes for Include References, Output Upper Case, and Open Output File(s).
- c. Click Compute.



- d. Select OK to the following prompts.



NOTE Any previous tables with the same file name and location will be replaced when OK is clicked in the prompt shown above. Ensure no valuable information will be lost by renaming or relocating files as needed.



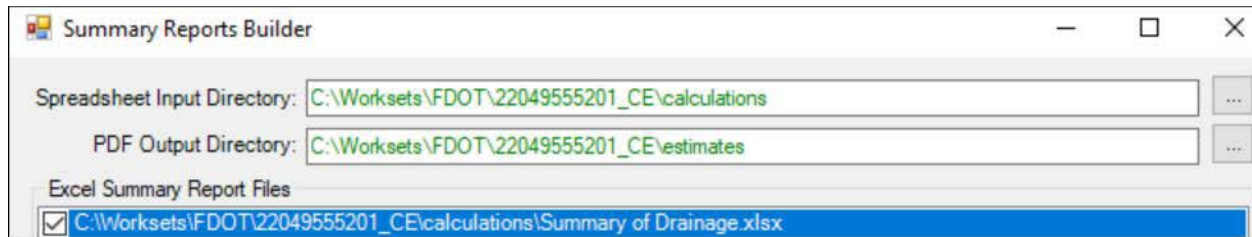
2. Review the new Excel sheet Summary of Drainage.xlsx and close when complete.

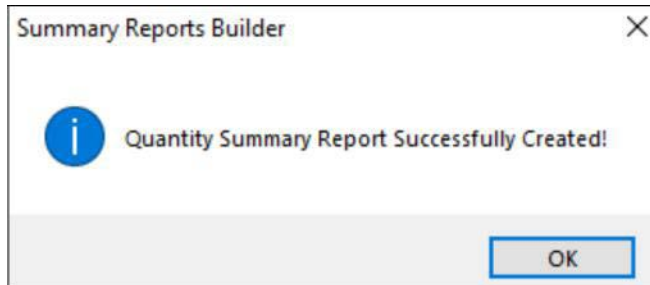
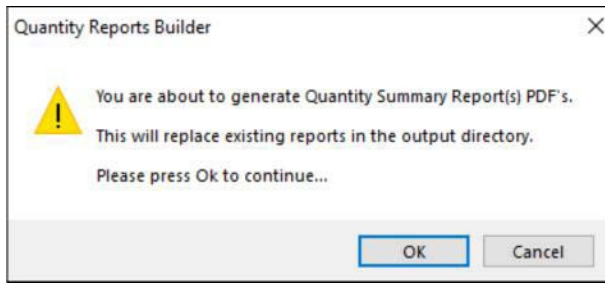
Pay Item Number	Label	Pay Item Description	Unit of Measure	Quantity				Location				Design Notes	Construction Remarks	
				P	F	P	F	Alignment	Begin Station	End Station	Side			
0425 1311	S-102	INLETS, CURB, TYPE P-1, <10'	EA	1		1		CL SR61	705+00.00	705+00.00	RT	4581	SAMPLE NOTES FOR S-103	
0425 1321	S-101	INLETS, CURB, TYPE P-2, <10'	EA	1		1		CL SR61	706+50.00	706+50.00	RT	3046	SAMPLE NOTES FOR S-101	
0430175118	P-103	PIPE CULVERT, OPTIONAL MATERIAL ROUND, 18"/CD	LF	142.08		193.37		CL SR61	705+02.00	706+47.89	RT	4992	SAMPLE NOTES FOR P-103	
	P-101			51.29				CL SR61	706+50.02	706+50.09	RT	3657	SAMPLE NOTES FOR P-101	
0430982125	S-102	MITERED END SECTION, OPTIONAL ROUND, 18" CD	EA	1		1		CL SR61	706+50.09	706+50.09	RT	3222	SAMPLE NOTES FOR S-102	

3. Back in the FDOT Quantity Takeoff manger Tool, click Create PDF.

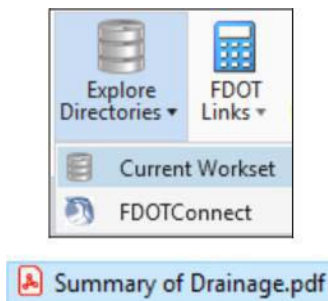
NOTE Summary of Drainage PDFs may be useful for QC purposes, but must be delivered within the complete Estimated Quantity Report generated by the Prime/EOR.

4. In the following prompt, check the box for Summary of Drainage, select Convert and OK to the following prompts:





5. Navigate through the following path to open the estimates subfolder and the Summary of Drainage pdf:
OpenRoads Modeling > FDOT > Resources > Explore Directories > Current Workset.

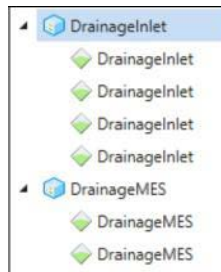


Exercise 7.7 Explore Items in Project Explorer and delete strays

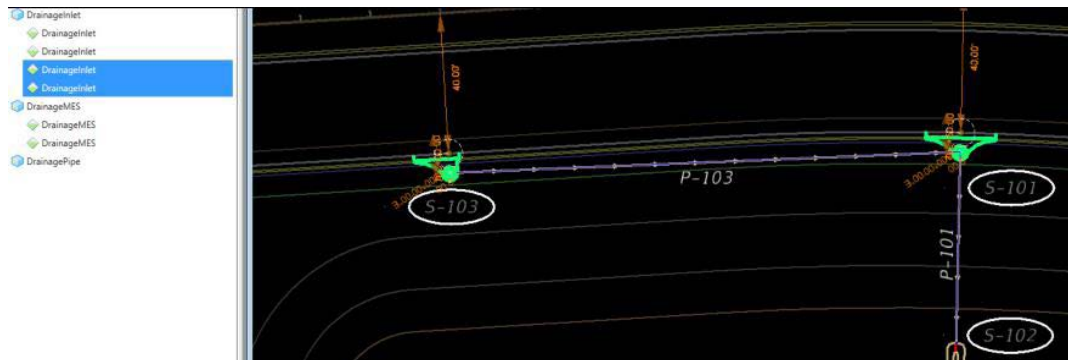
FDOT methodologies are subject to change as further Bentley refinements are implemented with OpenRoads updates.

NOTE *Warning: the process described in this exercise may significantly slow performance and require restart if using Version 10.08.*

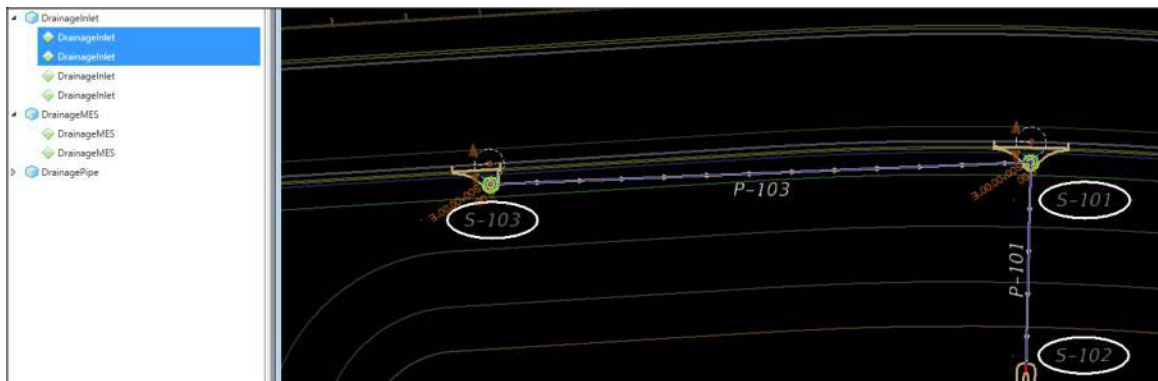
1. If not already docked and open, click F11 to Toggle Project Explorer, or use following path and navigate to Items:**Drainage and Utilities** > **Home** > **Primary** > **Explorer** > **Items**. Expand the sections for DrainageInlet and Drainage MES:



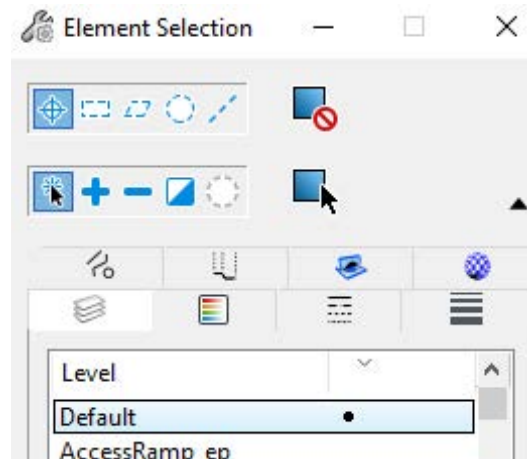
- a. Note the intended total of drainage structures is Drainage Inlets (2: S-101 and S-103) and MES (1: S-102), but the total in the Items sections is double.
- b. Scroll through the list and the corresponding selected element in the DGN will be highlighted.
- c. Find the items corresponding to the Drainage Inlets where the whole structure is highlighted.



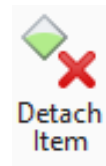
2. Find and select the items that do not highlight the entire structure, but just the connection regions. These will be deleted in the next steps.



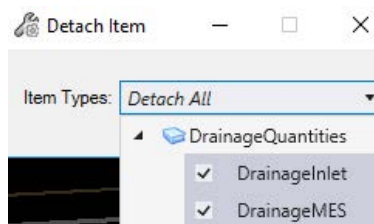
- d. Typically, these stray lines are placed on the level Default. Use the level filter in the Element Selection tool to select all the elements on Default. It is OK if more than just the stray items are selected in this process.



3. Keeping the selection from Step 3, open Detach Item from the path: **OpenRoads Modeling > Home > Item Types > Detach Item**.




4. The options of Items attached to the selection are listed. Check boxes for DrainageInlet and DrainageMES.

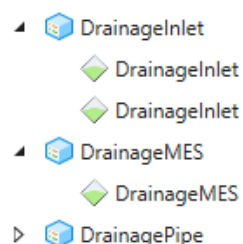


- a. Left click to accept the prompt in the lower left to attach:

Detach Item > Accept/Reject Selection

- b. The message at lower left confirms successful attach:  **Detached 3 item(s).**

- c. Also, to confirm, the Item Tab in Project Explorer now correctly shows 3 item types attached to drainage structures:



8 DRAINAGE DOCUMENTATION

INTRODUCTION

The focus in this chapter will be on the tools available in OpenRoads Designer CONNECT Edition to fulfill FDOT Drainage Manual 3.13.1 drainage documentation requirements. For additional guidance on storm drain calculations and documentation, see FDOT Drainage Design Guide Chapter 6. The Drainage Workflows for FDOTConnect aim to provide the required information but are presented in a new format.

In OpenRoads Designer CONNECT Edition, reports and tables are an effective way to organize and convey the drainage model database information and calculations. The FDOT Drainage Workflows for OpenRoads Designer accomplish drainage documentation primarily through a combination of reports and flex tables available in the FDOTConnect Workspace.

As discussed in FDM 916, large format sheets can accommodate a combination of multiple model views and tables. For drainage documentation of storm drain networks, the workflows described in this chapter also pair relevant tables with depictions of the storm drain network. For purposes of this course guide, this will be referred to as the FDOT storm drain documentation sheet. The general steps of adding tables to sheets shown in Chapter 4 also apply here: 1) export table to Excel, and 2) place table in sheets.

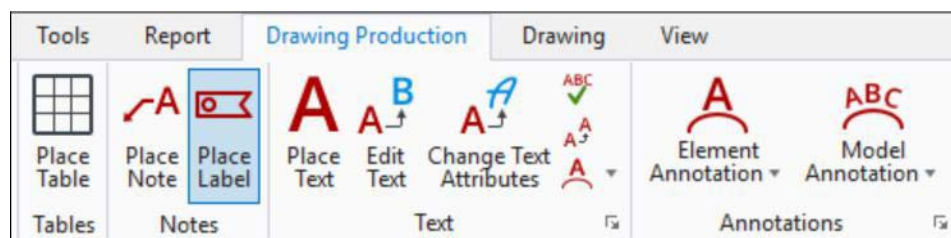
The drainage documentation tools and features discussed in this chapter are:

- Place Label
- Hydraulic Model Properties
- Reports
 - Hydraulic Model Inventory
 - Calculation Summary
- Tables
 - OpenRoads Tables
 - FDOT Flex Tables
- Place Table

PLACE LABEL

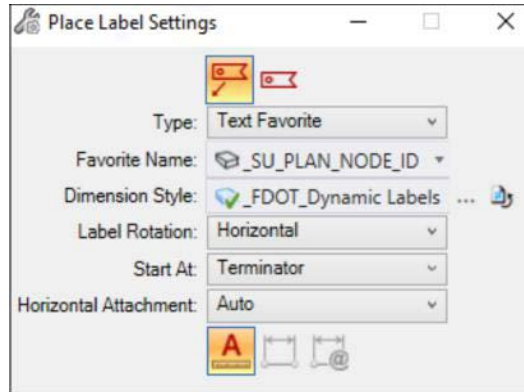
For FDM 903 Drainage Map and/or the FDOT storm drain documentation sheet, the Place Label tool with text favorites can be used to add drainage area information to plan view. For additional guidance on the Place Label tool, see Chapter 4 of this course guide.

The Place Label tool is used in the FDOT Drainage Plans Production Workflow to manually add dynamic labels for plan view and can be accessed from the path: **Drainage and Utilities > Drawing Production > Notes > Place Label**.



NOTE Labels are placed on the active level. Make sure the correct level is active before using the Place Label tool. It is recommended that drainage area labels use the level *TextDetails* so that other plans that attach the drainage file as a reference can isolate which labels are displayed.

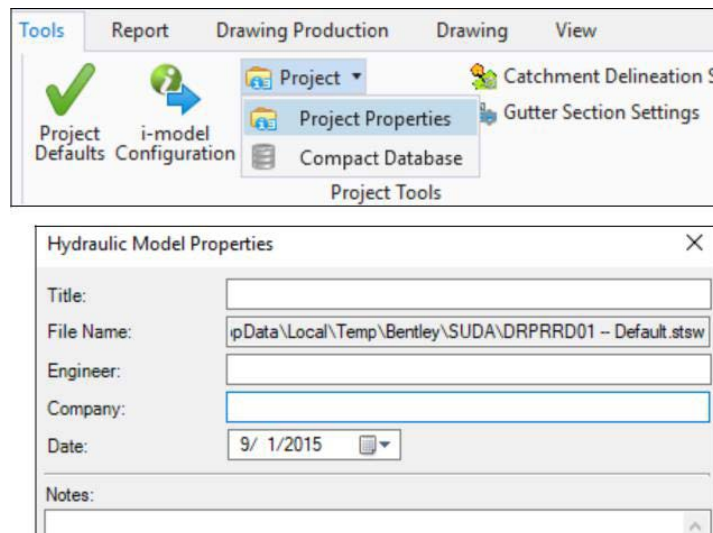
The Favorite Name: ‘_DU_PLAN_NODE_ID’ also works to add the label for the catchment (drainage area) ID.



HYDRAULIC MODEL PROPERTIES

In the OpenRoads Designer CONNECT Edition, Hydraulic Model Properties is a tool available to document designer information and model notes. This information can be included in a report, exported to Excel, and placed in the FDOT storm drain documentation sheet.

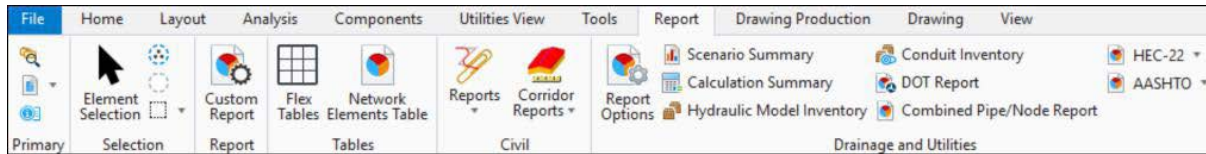
The Hydraulic Model Properties dialog can be accessed from the following path: **Drainage and Utilities > Tools > Project Tools > Project > Project Properties.**



REPORTS

In OpenRoads Designer CONNECT Edition, a variety of predefined Reports are included with the installation. Additionally, Custom Report is a tool to build a report based on a variety of model input and results. Reports can be exported to several different formats, including Excel. In the FDOT Drainage Documentation Workflow, some of the required drainage documentation can be accessed from Reports.

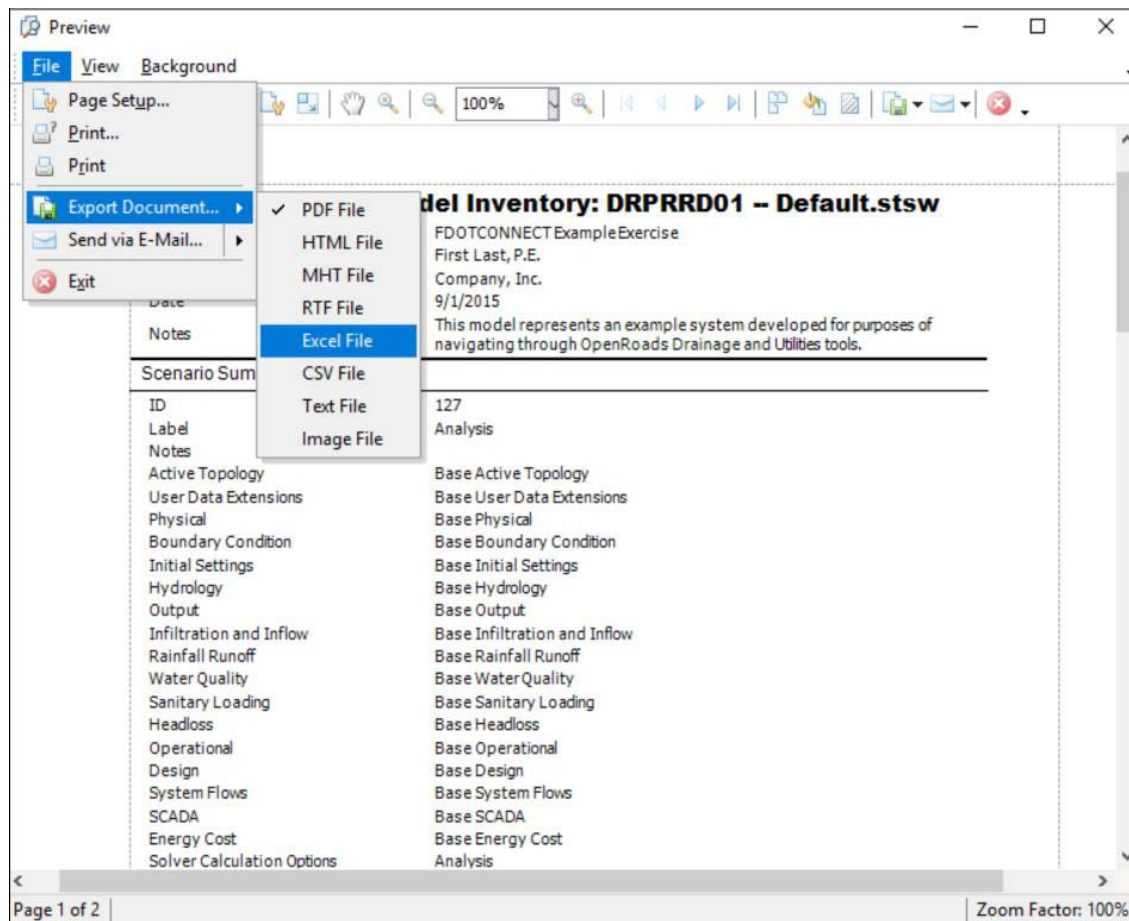
Reports can be accessed from the following path: **Drainage and Utilities > Report > Drainage and Utilities.**



Some of the predefined Drainage and Utilities reports open a Flex Table and others open a Report 'Preview'. The Report 'Preview' types cannot be formatted with OpenRoads tools. However, both types may be exported for further formatting as needed.

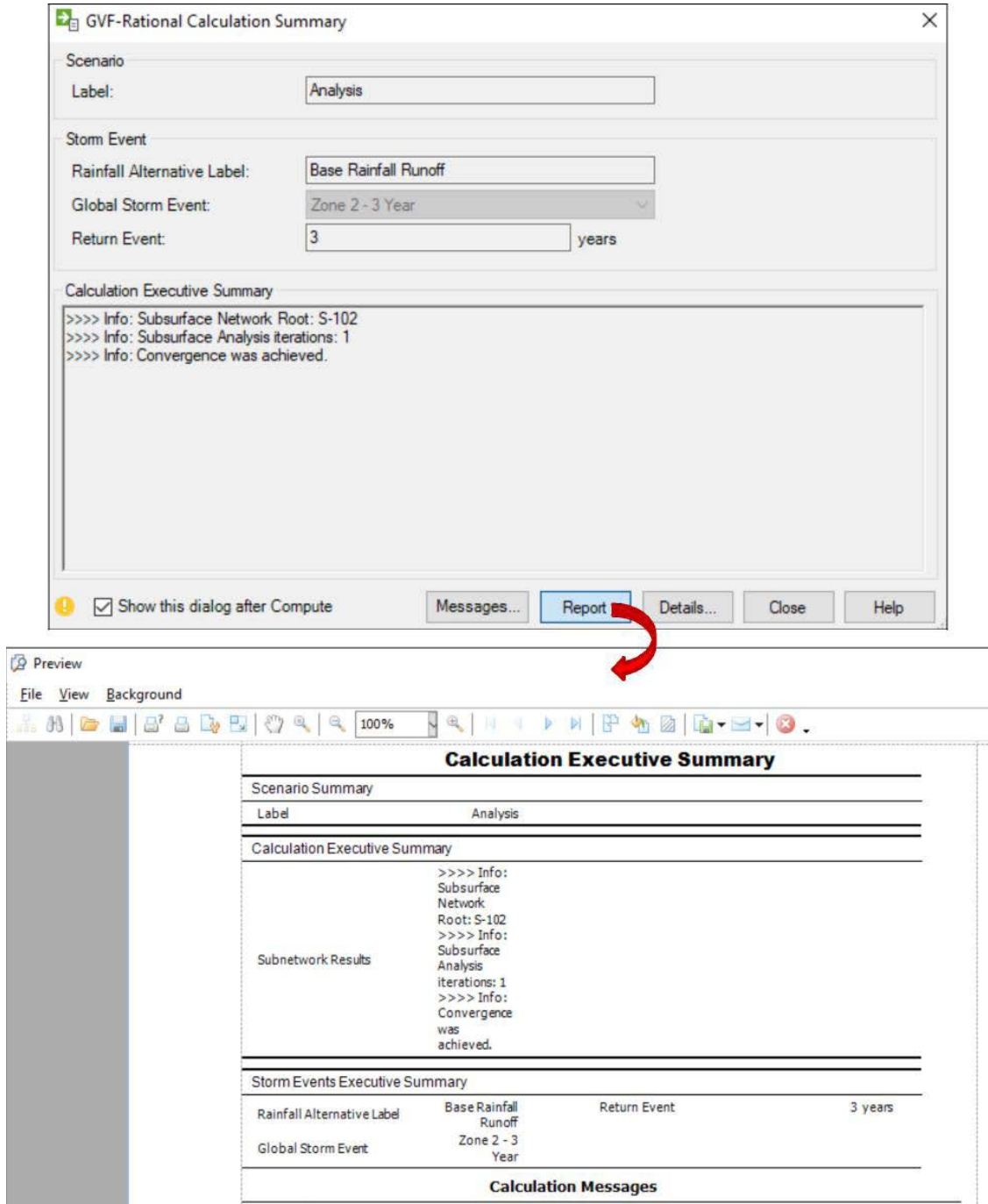
HYDRAULIC MODEL INVENTORY:

An example of a predefined Report 'Preview' that can be useful for FDOT drainage documentation is the Hydraulic Model Inventory. The contents include Hydraulic Model Properties, an abbreviated Scenario Summary, and the Network Inventory. The Scenario Summary section shows the type of computation and Alternatives selected.



CALCULATION SUMMARY:

This report includes a summary of the calculations performed on the model and warning messages. When activated from the menu, or following a computation, the GVF -Rational Calculation Summary Window opens. The 'Report' button at the bottom will generate a Calculation Executive Summary.



If the 'Details...' button is selected, a second window, 'Calculation Detailed Summary' will open with tabs for various drainage feature types. The 'Report' button generates a Calculation Detailed Summary Report.

Calculation Detailed Summary

Calculation Options | Catchment Summary | Link Summary | Node Summary | Inlet Summary | Pond Summary

General
 Maximum Network Traversals: 5
 Flow Convergence Test: 0.00100

Inlets
 Neglect Side Flow?
 Neglect Gutter Cross Slope For Side Flow?
 Active Components for Combination Inlets In Sag: Grate and Curb
 Active Components for Combination Inlets on Grade: Grate and Curb

Hydraulics and Hydrology
 Flow Profile Method: Backwater Analysis
 Number of Flow Profile Steps: 5
 Hydraulic Grade Convergence Test: 0.00 ft
 Average Velocity Method: Actual Uniform Flow Velocity
 Minimum Structure Headloss: 0.00 ft
 Minimum Time of Concentration: 10.000 min

Report Close Help

Preview
 File View Background

100%

Calculation Detailed Summary

Element Details			
ID	126	Notes	
Label	Analysis		
Hydraulic Summary			
Flow Profile Method	Backwater Analysis	Average Velocity Method	Actual Uniform Flow Velocity
Number of Flow Profile Steps	5	Minimum Structure Headloss	0.00 ft
Hydraulic Grade Convergence Test	0.00 ft	Minimum Time of Concentration	10.000 min
Inlets			
Neglect Side Flow?	False	Active Components for Combination Inlets In Sag	Grate and Curb
Neglect Gutter Cross Slope For Side Flow?	True	Active Components for Combination Inlets on Grade	Grate and Curb

TABLES

Tables are needed to supplement the documentation provided by the OpenRoads predefined reports. Since any table in OpenRoads can be exported or copy/pasted to Excel for documentation purposes, there is a wide variety of tables and information to choose from. Typical applications of both OpenRoads Tables and FDOT Flex Tables are discussed in the following sections.

OPENROADS TABLES:

Although some of the predefined OpenRoads summary reports include a list of which Alternatives were selected for use in the computation settings, designers may choose to document further details as needed.

For example, if minor losses are calculated, the Headloss Alternative table may be exported for a concise summary of methodology and loss coefficients selections.

The screenshot shows a software window titled "Headloss : Base Headloss (DRPRRD01 -- Default.stsw)". It contains a table with columns: ID, Label, Headloss Method, HEC-22 Benching Method, Absolute Headloss (ft), Headloss Coefficient (Downstream), Headloss Coefficient (Upstream), Headloss Coefficient (Standard), AASHTO Shaping Method, and Flow-Headloss Curve. Two rows are visible: 438 S-101 and 450 S-103. A context menu is open over the table with "Copy With Headers" selected. A red arrow points from this menu to a "Preview" window below.

The "Preview" window shows a report titled "15: Base Headloss (Catch Basin Headloss)". It contains a table with the same columns as the main window, but with additional columns for "Headloss Method", "HEC-22 Benching Method", "Headloss Coefficient (Downstream)", and "Headloss Coefficient (Upstream)". The data rows are:

*	ID	Label	Headloss Method	HEC-22 Benching Method	Absolute Headloss (ft)	Headloss Coefficient (Downstream)	Headloss Coefficient (Upstream)	Headloss Coefficient (Standard)	AASHTO Shaping Method	Flow-Headloss Curve
True	438	S-101	Standard	<None>				0.00000	<None>	<None>
True	450	S-103	Standard	<None>				0.00000	<None>	<None>

Another example of additional supporting details is the Rainfall Runoff Alternative. If the Report icon is selected, a report Preview will generate that includes the maximum (10 minute) storm intensity based on FDOT IDF curves.

The screenshot shows a software window titled "Rainfall Runoff : Base Rainfall Runoff (DRPRRD01 -- Default.sts...)". It contains a form with the following fields:

- Global Rainfall: Manhole, Outfall, Catchment, Pond, Wet Well
- Storm Events:
 - Alternative: Base Rainfall Runoff
 - Global Storm Event: Zone 2 - 3 Year
 - Source: Orphan (local)
 - Return Event: 3
 - Intensity (Average): (N/A) in/h
 - Depth: (N/A) in
 - Duration (Modified Rational): 0.000 min
- Legend:
 - = Base data
 - = Local data
 - = Inherited data

Preview

File View Background

100%

Base Rainfall Runoff

Global Rainfall			
Alternative	Base Rainfall Runoff	Depth	(N/A) in
Global Storm Event	Zone 2 - 3 Year	Duration (Modified Rational)	0.000 min
Source	Orphan (local)	Maximum Storm Intensity	7.596 in/h
Return Event	3	Climate Adjustment Type	None
Intensity (Average)	(N/A) in/h	Climate Adjustment	0.0 %

Global Storm Events

Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Ba Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4 4 in/hr Absolute Intensity (Spread Only)	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000		

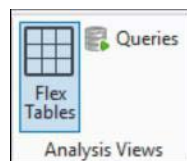
Copy
Copy With Headers
Paste

GLOBAL STORM EVENTS

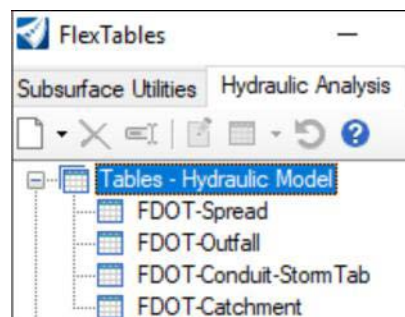
Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0	0	7.596	0	None	0
4 in/hr Absolute Intensity	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0	0	4.000	0	None	0

FDOT FLEX TABLES:

Where feasible, FDOT Flex Tables have been developed to resemble familiar documentation formats shown in the FDOT Drainage Manual and FDOT Drainage Design Guide. These tables can be accessed from the Flex Table Manager at the path: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables.**



The FDOT drainage documentation flex tables are located in the Hydraulic Analysis Tab:



FDOT-SPREAD:

The FDOT-Spread flex table is comparable to FDOT Drainage Design Guide Table 6.3-1 and documents to spread and inlet capacity analysis.

SPREAD CALCULATIONS												
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Inlet	Inlet Drainage Area (acres)	Inlet C	Total Inlet Intensity (in/h)	Total Rational Flow to Inlet (cfs)	Road Cross Slope (%)	Gutter Cross Slope (%)	Longitudinal Slope (Inlet) (%)	Manning's n (Inlet)
	Depth (Gutter) (in)	Spread / Top Width (ft)	Maximum Spread (ft)	Inlet Location	Capture Efficiency (Calculated) (%)	Intercepted Rational Flow (cfs)	Bypassed Rational Flow (cfs)	Bypassed Additional Carryover Flow (cfs)	Bypass Target			

FDOT-OUTFALL

The FDOT-Outfall flex table is a supplement to the FDOT-Conduit-StormTab table that documents the tailwater conditions used in the hydraulic calculations.

OUTFALL CONDITIONS													
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	Notes

FDOT-CONDUIT-STORMTAB

The FDOT-Conduit-StormTab flex table is comparable to FDOT Drainage Manual Figure 3-2: Storm Drain Tabulation Form and documents the results of hydrologic and hydraulic calculations for storm drain systems.

STORM DRAIN TABULATION															
Label	-Node- Upstream Downstream	Length (Unified) (ft)	Upstream Inlet Area (acres)	System Drainage Area (acres)	System CA (acres)	System Flow Time (min)	Time (Pipe Flow) (min)	System Intensity (in/h)	System Additional Flow (cfs)	System Rational Flow (cfs)	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	HGL Clearance (ft)	-HGL- Upstream Downstream (ft)	
	-Invert (Conduit)- Upstream Downstream (ft)	Headloss (ft)	Fall Inverts (ft)	Number of Barrels	Size (Display)	Rise (Unified) (ft)	Span (ft)	Manning's n	Friction Slope (%)	Slope (Calculated) (%)	Minimum Slope (%)	Velocity (ft/s)	Physical Velocity (ft/s)	Capacity (Full Flow) (cfs)	Notes

FDOT-CATCHMENT

DRAINAGE AREAS TABULATION						
Label	Area Defined By	Subareas <Count>	Subareas	Area (Unified) (acres)	Catchment CA (acres)	Composite C

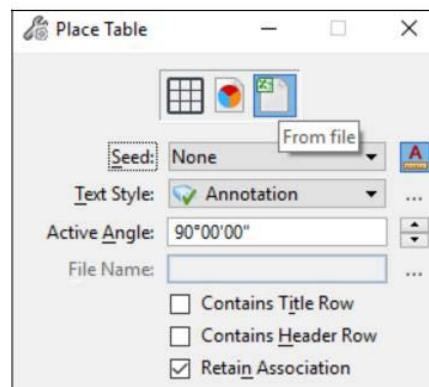
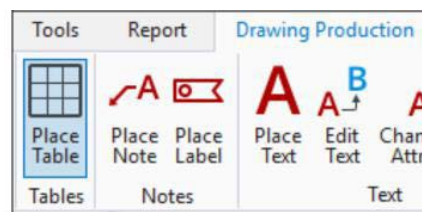
The individual subareas flex tables can also be accessed and exported to Excel through the ellipses shown in the 'Subareas' column of the FDOT-Catchment flex table.

	Label	Area Defined By	Subareas <Count>	Subareas	Area (Unified) (acres)	Catchment CA (acres)	Composite_C
446: DR-101	DR-101	Multiple Subareas	2	Collection: 2 items	0.334	0.270	0.81000
452: DR-103	DR-103	Multiple Subareas	2	<Collection: 2 items>	0.225	0.182	0.81000
459: DR-999	DR-999	Single Area	0	<Collection: 0 items>	0.073	0.070	0.95000

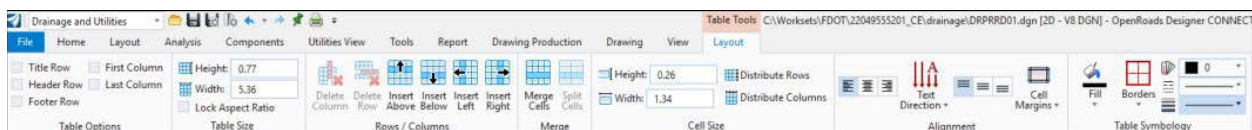
Subareas - DR-101 (Catchment)			
Area / Total Area (%)	Area (acres)	Surface Description	Runoff Coefficient
80.0	0.267	Pavement	0.95000
20.0	0.067	Grass	0.25000

PLACE TABLES

Once the appropriate reports and tables have been exported to Excel, the Place Table tool can be used to add these to the FDOT storm drain documentation sheet(s). This tool is accessed from the path: **Drainage and Utilities > Drawing Production > Tables > Place Table**.



When a placed table is selected, the Table Tools Layout Tab appears with multiple editing and formatting options.



EXERCISES

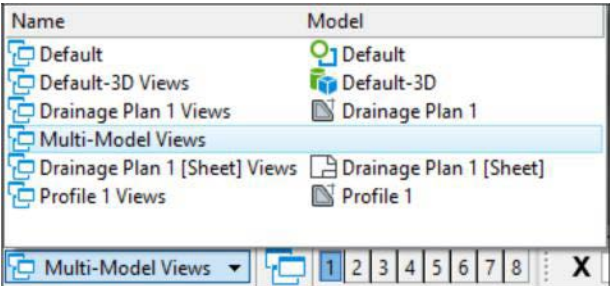
EXERCISE OVERVIEW – DRAINAGE DOCUMENTATION

In this chapter’s exercises, users will locate & export various OpenRoads reports and tables to Excel. A new FDOT storm drain documentation sheet will be created and populated with the exported tables. The scenarios and network set up in Chapter 2 and used in Chapters 3-5 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

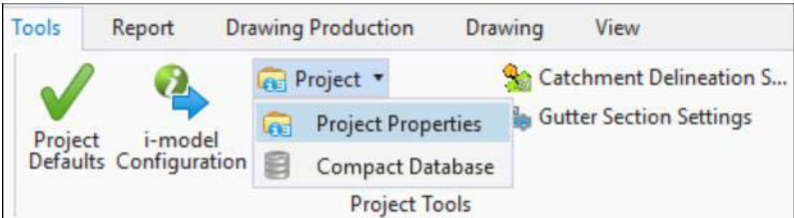
- Exercise 8.1 Complete the Hydraulic Model Properties.....227
- Exercise 8.2 Compute Center: Review Properties and Run Analysis Scenario (Zone 2 – 3 Year).....229
- Exercise 8.3 Export a Hydraulic Model Inventory Report to Excel.....232
- Exercise 8.4 Copy/Paste Global Storm Events data to Excel.....235
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Exercise 8.1 Complete the Hydraulic Model Properties

1. Open FDOTConnect, set the Workspace to “FDOT” and select the Workset – **22049555201**.
2. Browse to the drainage folder and open “**DRPRRD01.dgn**” and use Manage View Groups (see lower left of OpenRoads window) to set Active View Groups to Default or Multi-Model Views.



3. Navigate through the following path and select the Project Properties icon: **Drainage and Utilities > Tools > Project Tools > Project > Project Properties**.



4. In the Hydraulic Model Properties window, complete the text fields with the following information:
 - a. Title: **FDOTConnect Example Exercise**
 - b. Engineer: **First Last, P.E.**
 - c. Company: **Company, Inc.**
 - d. Date: **1/1/2021**
 - e. Notes:

This model represents an example system developed for purposes of navigating through OpenRoadsDrainage and Utilities tools.

Checked by: ##

Checked date: ##

Hydraulic Model Properties

Title: FDOTCONNECT Example Exercise

File Name: C:\Users\ashepard\AppData\Local\Temp\Bentley\SUDA\DRP

Engineer: First Last, P.E.

Company: Company, Inc.

Date: 1/ 1/2021

Notes:

This model represents an example system developed for purposes of navigating through OpenRoads Drainage and Utilities tools.

Checked by: ##

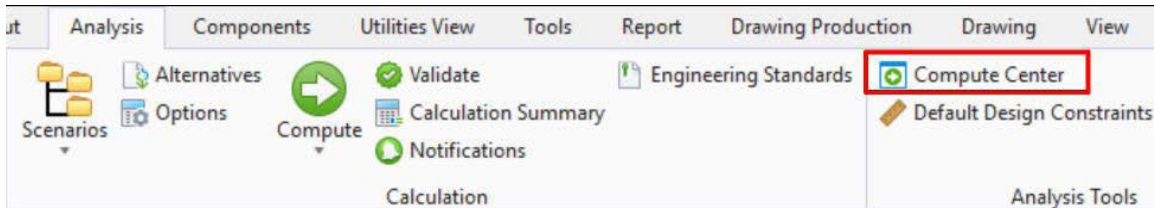
Checked date: ##


5. Select **OK** to accept the updates and close the Hydraulic Model Properties window.

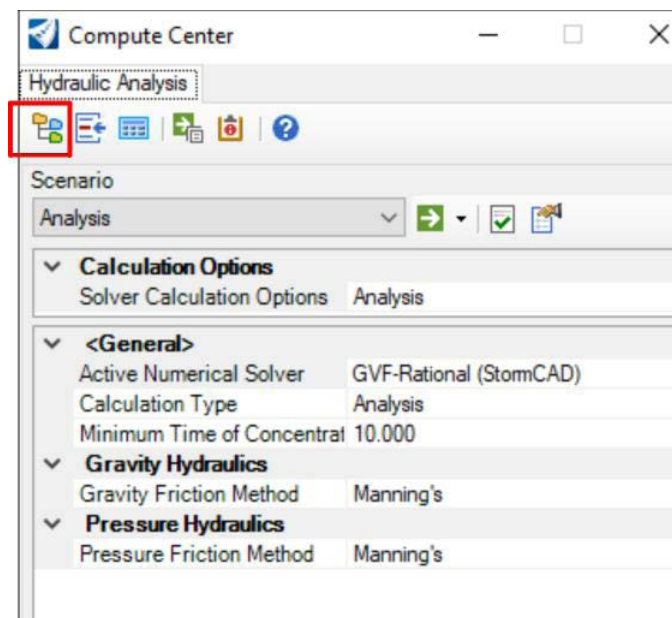
Exercise 8.2 Compute Center: Review Properties and Run Analysis Scenario (Zone 2 – 3 Year)

This exercise revisits the Compute Center, ways to review the scenario before computation, and rainfall properties to be included in drainage documentation.

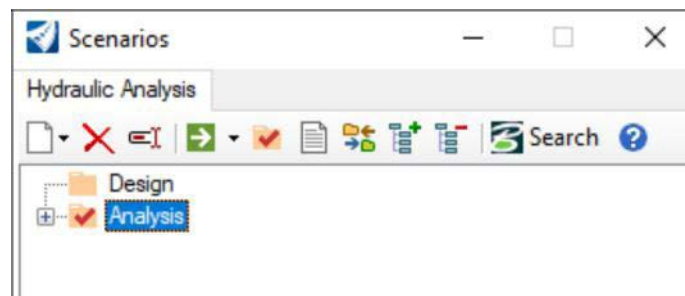
1. Navigate through the following path and open the Compute Center: **Drainage and Utilities > Analysis > Analysis Tools > Compute Center**.



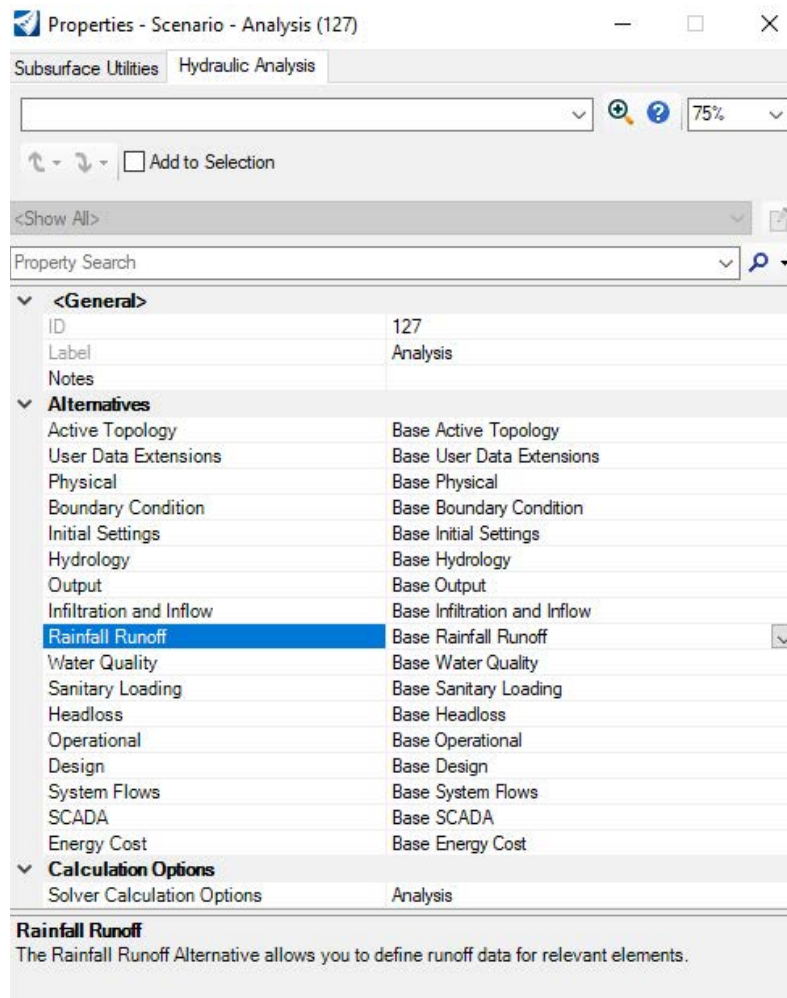
2. The active scenario, shown in the pull-down menu, is Analysis.
 - a. To review the Alternatives selections for the Analysis scenario, select the  Scenarios icon.




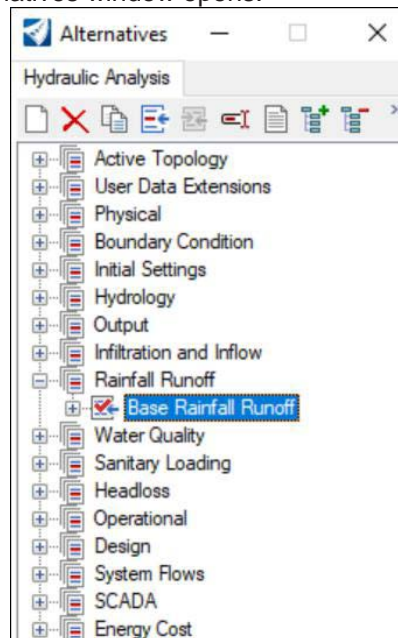
- b. From the Scenarios Manager window, double-click Analysis to open Properties.



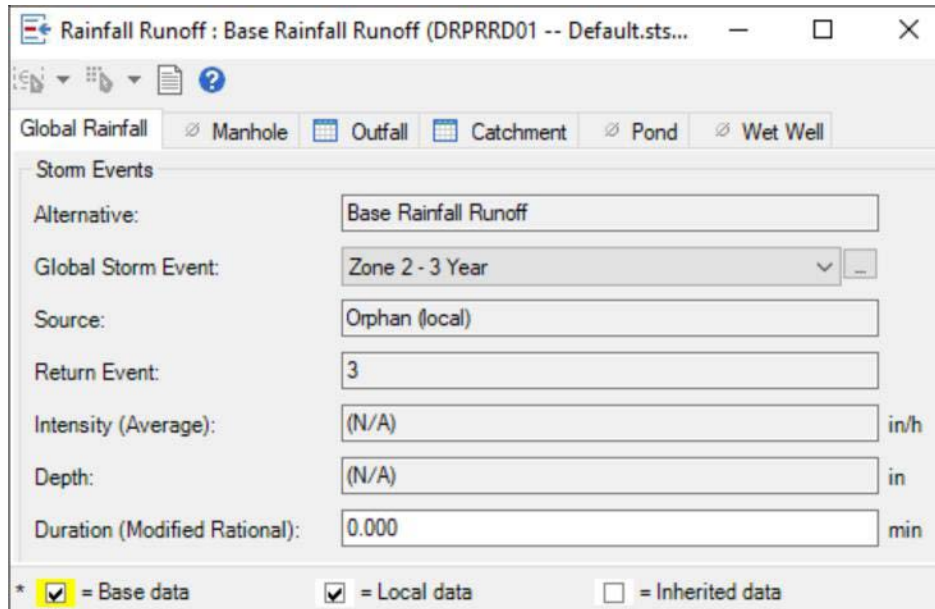
- c. In Properties, note the Rainfall Runoff Alternative is set to Base Rainfall Runoff.



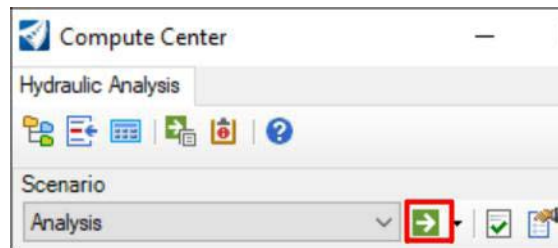
- d. To view or edit details of Base Rainfall Runoff, select the  Alternatives icon from Compute Center. The following Alternatives window opens:



- e. Double-click Base Rainfall Runoff in the Alternatives window to open the editor shown below. Note, the Global Storm Event selected is Zone 2 – 3 Year.

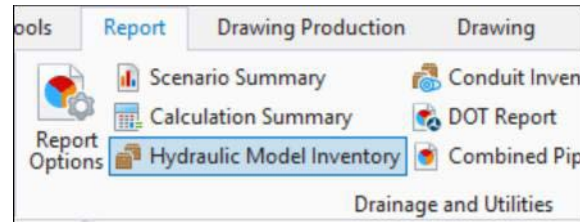


- f. Close the editor, Alternatives, and Scenario Properties windows. From Compute Center, select the icon to Compute Scenario. After computation is complete, close all open dialogs.



Exercise 8.3 Export a Hydraulic Model Inventory Report to Excel

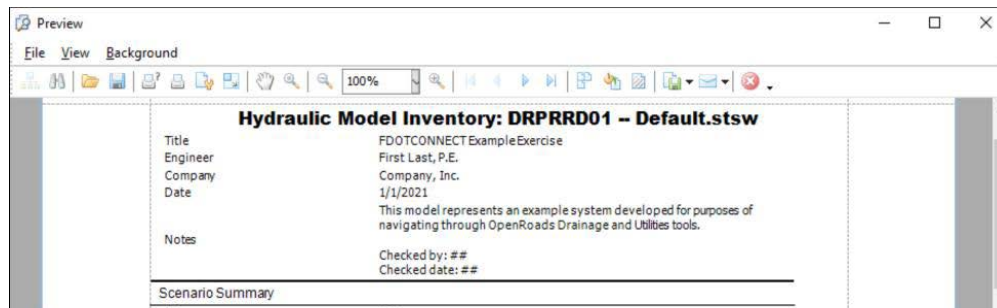
1. Navigate through the following path and open the Hydraulic Model Inventory report: Drainage and Utilities > REPORT > Drainage and Utilities > Hydraulic Model Inventory.



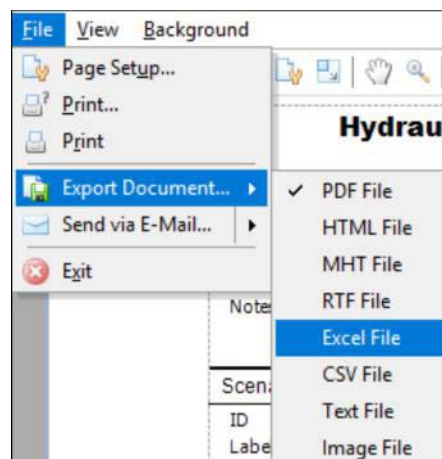
- a. The following window will appear while the report is being generated.



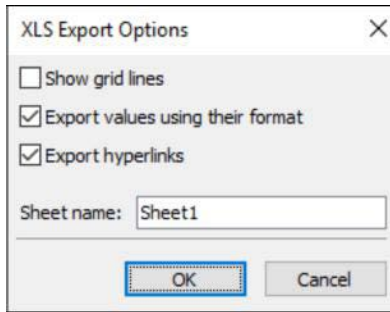
- b. The Hydraulic Model Inventory information entered in Exercise 6.1 is automatically included in the report preview.



2. From the Preview menus, select File: Export Document: Excel File.



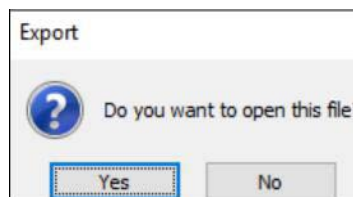
- a. Select **OK** to the following prompt:



- b. **Save** the .xls in the example workset folder, drainage: eng_data subfolder.



- c. Select **Yes** in the following prompt to open the file:



1. In Excel, review the report contents. In addition to Hydraulic Model Inventory information, a Scenario Summary, Network Inventory, and Circle Inventory populate the report.
2. For the purposes of this example, the only information to be placed into the sample storm drain documentation sheet are the Hydraulic Model Inventory and Scenario Summary.
 - a. Use the tools in Excel to delete rows as shown below

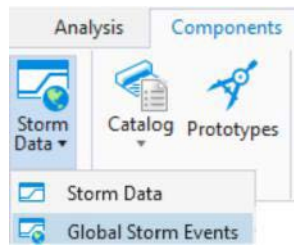
	C	D	F	G	H	J	K	L	M	N	O	Q	
1	Hydraulic Model Inventory: DRPRRD01 -- Default.stsw												
2	Title	FDOTCONNECT Example Exercise											
3	Engineer	First Last, P.E.											
4	Company	Company, Inc.											
5	Date	1/1/2021											
	Notes	This model represents an example system developed for purposes of navigating through OpenRoads Drainage and Utilities tools.											
6		Checked by: ## Checked date: ##											
8	Scenario Summary												
11	ID	127											
12	Label	Analysis											
13	Notes												
14	Active Topology	Base Active Topology											
15	User Data Extensions	Base User Data Extensions											
16	Physical	Base Physical											
17	Boundary Condition	Base Boundary Condition											
18	Initial Settings	Base Initial Settings											
19	Hydrology	Base Hydrology											
20	Output	Base Output											
21	Infiltration and Inflow	Base Infiltration and Inflow											
22	Rainfall Runoff	Base Rainfall Runoff											
23	Water Quality	Base Water Quality											
24	Sanitary Loading	Base Sanitary Loading											
25	Headloss	Base Headloss											
26	Operational	Base Operational											
27	Design	Base Design											
28	System Flows	Base System Flows											
29	SCADA	Base SCADA											
30	Energy Cost	Base Energy Cost											
31	Solver Calculation Options	Analysis											
34													
35	DRPRRD01 -- Default.stsw	Bentley Systems, Inc. Haestad Methods Solution Center							Drainage and Utilities				
36	10/29/2020	27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666							[10.08.01.33] Page 1 of 1				
38													

- b. Save and close the Excel file.

Exercise 8.4 Copy/Paste Global Storm Events data to Excel

This exercise revisits the Global Storm Events, which can be used for drainage documentation. This table shows all events selected for use by Rainfall Runoff Alternative(s). The model in this exercise contains two rainfall events:

- The Zone 2 – 3 Year event is selected for the Base Rainfall Runoff Alternative in the Analysis Scenario.
 - The 4 in/hr Absolute Intensity – 0 Year event is selected for the 4in/hr Absolute Intensity (Spread Only) Rainfall Runoff Alternative in the 4 in/hr Absolute Intensity (Spread Only) Scenario.
1. In OpenRoads, navigate through the following path and open Global Storm Events: **Drainage and Utilities > Components > Common > Storm Data > Global Storm Events**.



2. Using the mouse, click and drag from left to right to select the table contents. Left click and select **Copy with Headers** from the prompt that opens, as shown below.

Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4 in/hr Absolute Intensity (Spread Only)	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000		

A context menu is open over the table with the following options: Copy, Copy With Headers (highlighted), and Paste.

3. Minimize OpenRoads and open Excel.
 - a. Paste the clipboard contents into a new or blank workbook.

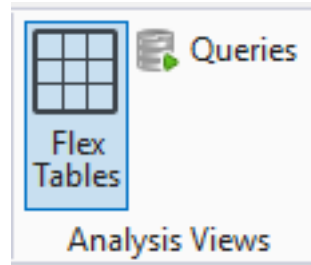
The screenshot shows an Excel spreadsheet with the following data:

Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4 in/hr Absolute Intensity (Spread Only)	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000		

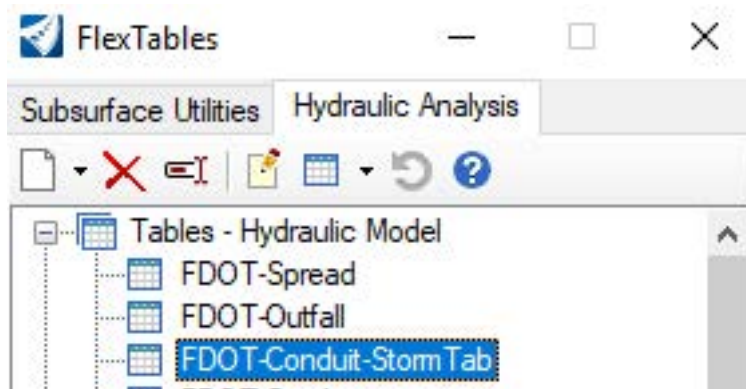
- b. Format the table to FDOT font and insert a row at the top for the table title as shown below.


Exercise 8.5 Export FDOT Flex Tables to Excel

1. In OpenRoads, navigate through the following path and open Flex Tables: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables**:



2. From the Hydraulic Analysis tab, select the FDOT-Conduit-StormTab table and double-click to open.



- a. Select the  Export to File... icon from the upper left of the FlexTable window.

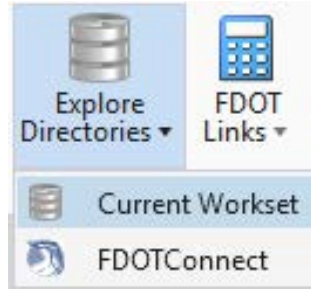
Label	-Node- pstrear winstre	engtl inifict (ft)	strea Inlet Area (acres)	System Drainage Area (acres)	ystem CA (acres)	System Flow Time (min)	Time (Pipe Flow) (min)	ystem tensil (in/h)	ystem ditor Flow (cfs)	ystem ations Flow (cfs)	strea uctua radia (ft)	evatio nroun Start (ft)	HGL saran (ft)	-HGL- ystrea vinstre	-Invert onduct pstrear winstre	adior: (ft)	Fall vert: (ft)	umbe of arrel: (ft)	Size isplay	Rise inifict (ft)	Span (ft)	anning n	ricitor Slope (%)	Slope iculate (%)	linimun Slope (%)	alocit (ft/s)	ysic alocit (ft/s)	apac (Full Flow (cfs)
444: P-101	P-101	S-101	5...	0.334	0.96	0.452	13...	0.247	5...	0.00	1.66	0.00	30.85	2.84	28.01	25.20	0.01	0...	1 18 ...	1.50	0...	0.012	0.021	0.353	0.151	0.94	3.82	6.7
444: P-101		S-102												28.00	25.00													
454: P-103	P-103	S-103	1...	0.225	0.22	0.182	10...	0.402	6...	0.00	1.12	0.00	31.40	3.37	28.03	26.50	0.01	1...	1 18 ...	1.50	0...	0.012	0.010	0.887	0.151	0.63	6.06	10.7
454: P-103		S-101												28.01	25.20													

- b. Save as type: Comma Delimited File (*.csv), with the File Name: FDOT-Conduit-StormTab.csv.



- c. Close the Flex Table.

3. Navigate through the following path to quickly open the workset drainage folder: **OPENROADS MODELING > FDOT > Resources > Explore Directories > Current Workset**.



4. Open the FDOT-Conduit-StormTab.csv file in Excel and update formatting with the following:

- a. Select from cells A1 to AD5
- b. Add borders (Home: Font: Borders: All Borders)
- c. Change font to FDOT
- d. Adjust units for significant digits and reshape column widths as needed
- e. Add title row and input **“STORM DRAIN TABULATION FORM”**

STORM DRAIN TABULATION FORM															
Label	-Node- Upstream Downstream	Length (Unified) (ft)	Upstream Inlet Area (acres)	System Drainage Area (acres)	System CA (acres)	System Flow Time (min)	Time (Pipe Flow) (min)	System Intensity (in/h)	System Additional Flow (cfs)	System Rational Flow (cfs)	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	HGL Clearance (ft)	-HGL- Upstream Downstream (ft)	-Invert (Conduit)- Upstream Downstream (ft)
P-101	S-101	56.70	0.33	0.56	0.45	13.9	0.25	5.39	0.00	1.66	0.00	30.85	2.84	28.01	25.20
	S-102													28.00	25.00
P-103	S-103	146.08	0.23	0.22	0.18	10.0	0.40	6.09	0.00	1.12	0.00	31.40	3.37	28.03	26.50
	S-101													28.01	25.20

5. Save as .xlsx and close Excel.
6. Repeat Steps 1 through 5 for FDOT-Outfall and FDOT-Catchment Flex Tables.

OUTFALL CONDITIONS															
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	Notes		
S-102	CL SR61	706+50	102.19	27.21	25	User Defined Tailwater	<None>	28.00	0.452	14.86	5.25	2.39			

	A	B	C	D	E	F	G
1	DRAINAGE AREAS TABULATION						
2	<i>Label</i>	<i>Area Defined By</i>	<i>Subareas <Count></i>	<i>Subareas</i>	<i>Area (Unified) (acres)</i>	<i>Catchment CA (acres)</i>	<i>Composite C</i>
3	DR-101	Multiple Subareas	2	<Collection: 2 items>	0.334	0.27	0.81
4	DR-103	Multiple Subareas	2	<Collection: 2 items>	0.225	0.182	0.81

- In OpenRoads, from the FDOT-Catchment Flex Table, open tables for each Subarea Collection by clicking the ellipse.

FlexTable: FDOT-Catchment (Current Time: 0.000 min) (DRPRRD01 -- Default.stsw)

	Label	Area Defined By	Subareas <Count>	Subareas	Area (Unified) (acres)	Catchment CA (acres)	Composite_C
446: DR-101	DR-101	Multiple Subareas	2	<Collection: 2 items> ...	0.334	0.270	0.81000
452: DR-103	DR-103	Multiple Subareas	2	<Collection: 2 items>	0.225	0.182	0.81000

2 of 2 elements displayed

- Follow methodology from Exercise 6.4 to copy/paste table data and format in Excel.

	Area / Total Area (%)	Area (acres)	Surface Description	Runoff Coefficient
1	80.0	0.267	Pavement	0.95000
2	20.0	0.067	Grass	0.25000

Copy
Copy With Headers
Paste

- Save As Subareas_DR-101.xlsx and SubAreas_DR-103.xlsx respectively:

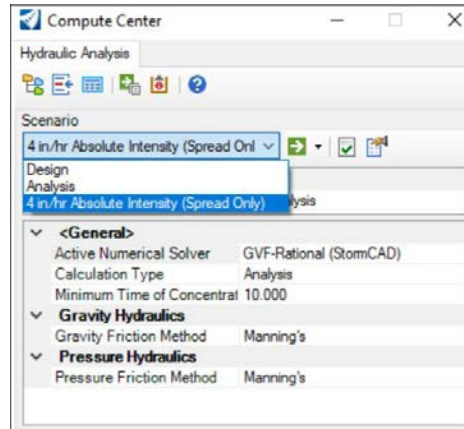
	A	B	C	D
1	SUBAREAS - CATCHMENT (DR-101)			
2	<i>Area / Total Area (%)</i>	<i>Area (acres)</i>	<i>Surface Description</i>	<i>Runoff Coefficient</i>
3	80	0.267	Pavement	0.95
4	20	0.067	Grass	0.25

	A	B	C	D
1	SUBAREAS - CATCHMENT (DR-103)			
2	<i>Area / Total Area (%)</i>	<i>Area (acres)</i>	<i>Surface Description</i>	<i>Runoff Coefficient</i>
3	80	0.180	Pavement	0.95
4	20	0.045	Grass	0.25

- Save and close all Excel files.

Exercise 8.6 Compute Center: Run 4 in/hr Absolute Intensity (Spread Only) Scenario

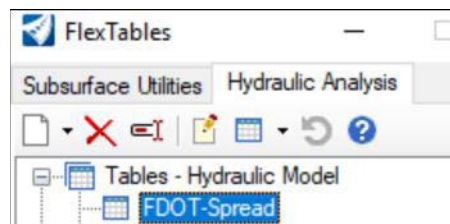
1. In OpenRoads, navigate through the following path and open the Compute Center: **Drainage and Utilities > Analysis > Analysis Tools > Compute Center**.
2. From the Scenario pull-down, select 4 in/hr Absolute Intensity (Spread Only) and compute.



3. Once computation is complete, close the Compute Center and Calculation Summary.

Exercise 8.7 Export FDOT-Spread Flex Table to Excel

1. In OpenRoads, navigate through the following path and open Flex Tables: **Drainage and Utilities > Analysis > Analysis Views > Flex Tables**.
2. From the Hydraulic Analysis tab, select the **FDOT-Conduit-StormTab** table and double-click to open.



- a. Select the  **Export to File...** icon from the upper left of the FlexTable window.

Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Inlet	Inlet Drainage Area (acres)	Inlet C	
438: S-101	S-101	CL_SR61	706+50	40.000	Curb Inlet Type	0.334	0.81000
450: S-103	S-103	CL_SR61	705+00	40.000	Curb Inlet Type	0.225	0.81000

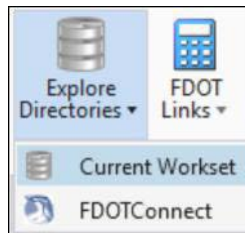
2 of 2 elements displayed

- b. Save as type: Comma Delimited File (*.csv), with the File Name: FDOT-Spread.csv.



- c. Close the Flex Table.

3. Navigate through the following path to quickly open the workset drainage folder: **OPENROADS MODELING > FDOT > Resources > Explore Directories > Current Workset.**



4. Open the FDOT-Spread.csv file in Excel and update formatting with the following:

Label	Baseline Feature	Baseline Station	Baseline Offset	Inlet	Inlet Drainage Area	Inlet C	Total Inlet Intensity	Total Rational Flow to Inlet	Road Cross Slope	Gutter Cross Slope	Longitudinal Slope	Manning's n	Depth	Spread / Top Width	Maximum Spread	Inlet Local	Capture Efficiency	Intercepted Rational Flow	Rational Flow	Bypassed Rational Flow	Bypassed Addition	Carryover Flow	Bypass Target
S-101	CL_SR61	706+50	40	Curb Inlet	0.334	0.81	4	1.09	2				6.329	3.454	14	In Sag	100	1.09	0	0	0	<None>	
S-103	CL_SR61	705+00	40	Curb Inlet	0.225	0.81	4	0.73	2		0.502	0.016	1.753	7.304	14	On Grade	100	0.73	0	0	0	S-101	

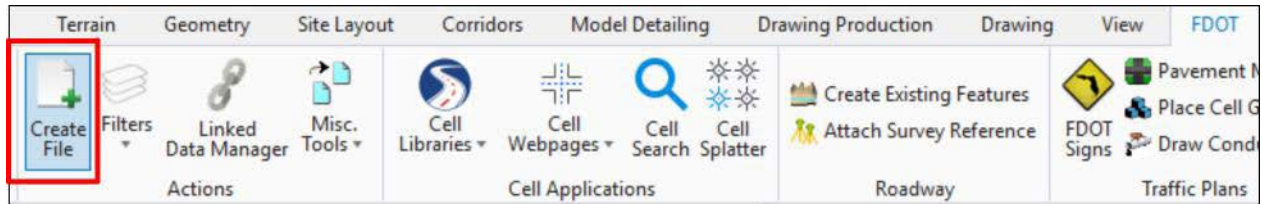
- Select from cells A1 to V3
 - Add borders (Home: Font: Borders: All Borders)
 - Change font to FDOT
- Adjust units for significant digits and reshape column widths as needed
- Add title row and input **"SPREAD CALCULATIONS"**

SPREAD CALCULATIONS																					
Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Inlet	Inlet Drainage Area (acres)	Inlet C	Total Inlet Intensity (in/h)	Total Rational Flow to Inlet (cfs)	Road Cross Slope (%)	Gutter Cross Slope (%)	Longitudinal Slope (Inlet) (%)	Manning's n (Inlet)	Depth (Gutter) (in)	Spread / Top Width (ft)							
S-101	CL_SR61	706+50	40	Curb Inlet Type 2	0.33	0.81	4.0	1.09	2.00				6.3	3.45							
S-103	CL_SR61	705+00	40	Curb Inlet Type 1	0.23	0.81	4.0	0.73	2.00		0.502	0.016	1.8	7.30							

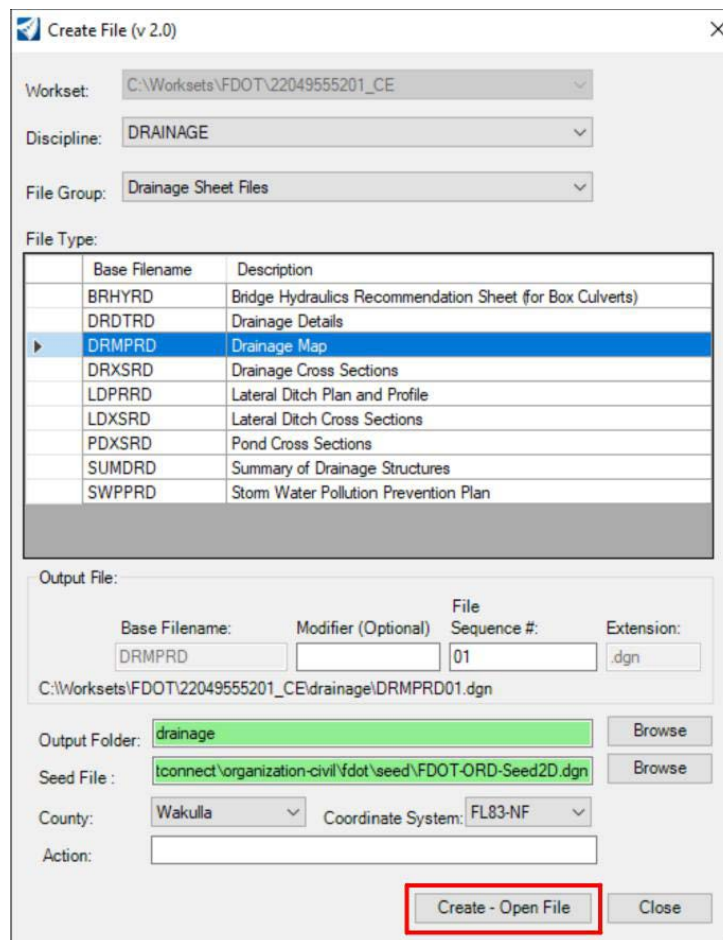
- Save as .xlsx and close Excel.
- Save *DRPRRD01.dgn* and close OpenRoads.

Exercise 8.8 Create FDOT storm drain documentation sheet and place labels

1. Reopen OpenRoads Designer and locate “_Blankfile.dgn” at the root of the workset folder structure. Select this file and then select “OPEN” to open it.
2. Navigate through the path to Create File, **OpenRoads Modeling > FDOT > Actions > Create File** and complete selections as follows:

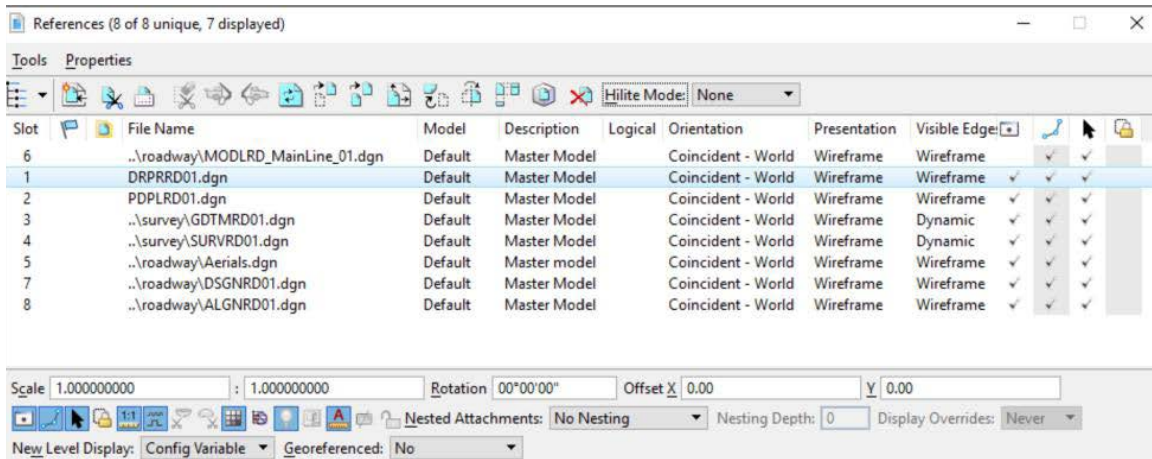


- Discipline = “**DRAINAGE**”
- File Group = “**Drainage Sheet Files**”
- File Type = “**DRMPRD**”
- File Sequence # = “**01**”
- County = “Wakulla” (Coordinate System = FL83-NF)

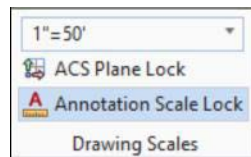


3. Select **Create – Open File** and **Close** after the new file is open.

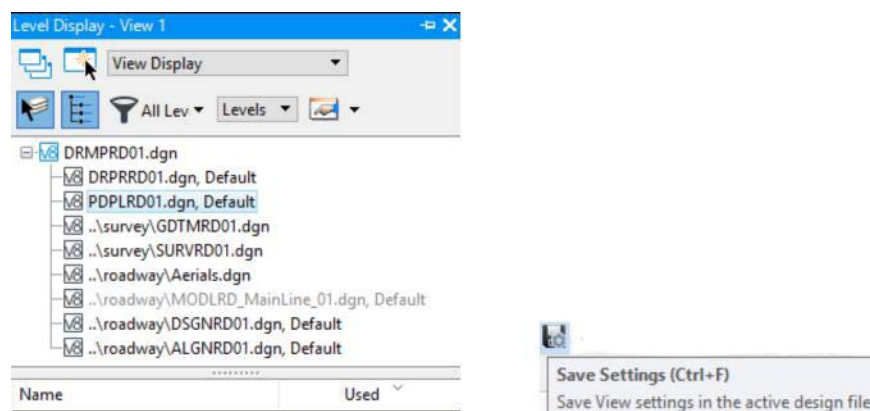
4. Navigate through the following path to open the References dialog and attach the files listed below: Drainage and Utilities > HOME>PRIMARY>Attach Tools> References>Tools>**Attach**
 - a. Survey folder: *GDTMRD01.dgn*
 - b. Drainage folder: *PDPLRD01.dgn, DRPRRD01.dgn*
 - c. Roadway folder: *ALGNRD01.dgn, MODLRD_MainLine01.dgn, DSGNRD01.dgn, Aerials.dgn*



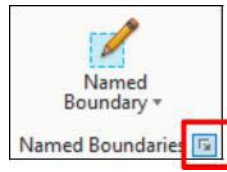
5. Set Annotation Scale to 1" = 50' from the path: **Drainage and Utilities > Drawing > Drawing Scales.**



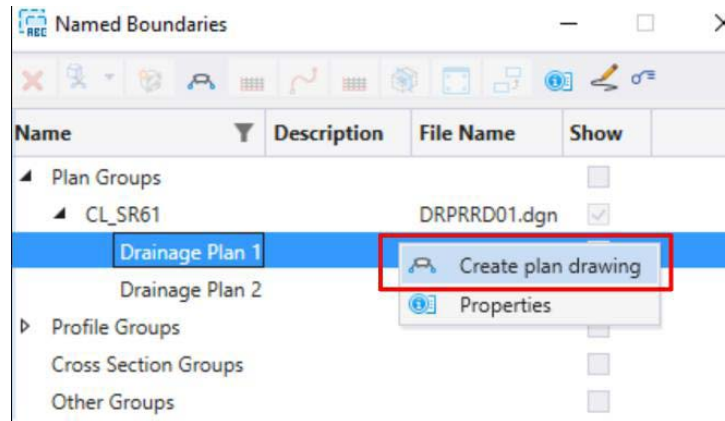
6. Turn off levels from Reference files as needed and save settings.
 - a. Examples of undesired levels include the model handles and labels in the *PDPLRD01.dgn*.



7. The new sheet created in this exercise will use existing named boundaries created in Chapter 4 exercises in the *DRPRRD01.dgn* file. From the following path, open Named Boundaries Manger: **Drainage and Utilities > Drawing Production > Named Boundaries**.



8. Expand the Named Boundaries to Plan Groups: CL_SR61: Drainage Plan 1. Right click on Drainage Plan 1 and select **Create plan drawing**.



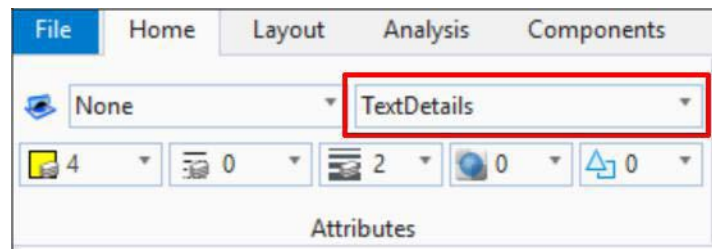
- a. This action creates two new models in this DGN, Drainage Plan 1 Views and [Sheet] Views.

Name	Model
Default	Default
Drainage Plan 1 [Sheet] Views	Drainage Plan 1 [Sheet]
Drainage Plan 1 Views	Drainage Plan 1

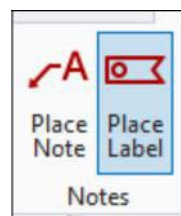
Drainage Plan 1 [She] 1 2 3 4 5 6 7 8



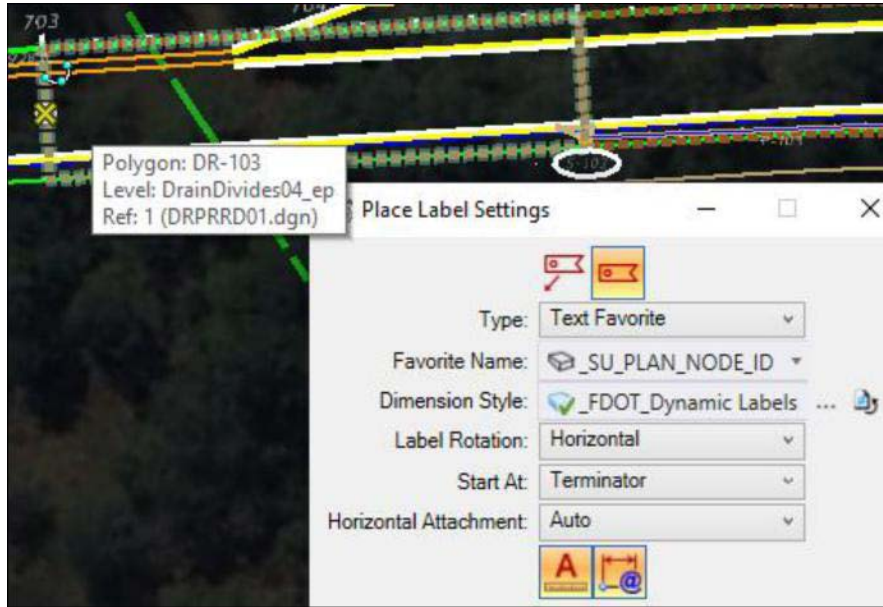
- Switch back to the Default model and set active level to TextDetails.



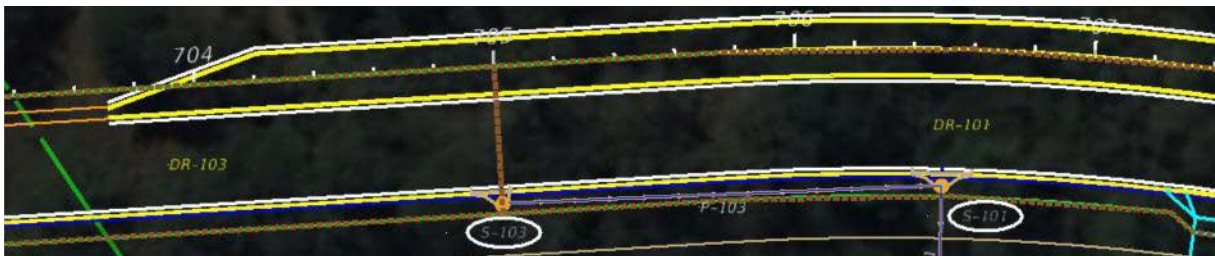
- Open the Place Label tool from the path: **Drainage and Utilities > Drawing Production > Notes > Place Label.**



- a. Update settings for Text Favorite: `_SU_PLAN_NODE_ID` and select one of the drainage areas as shown below:



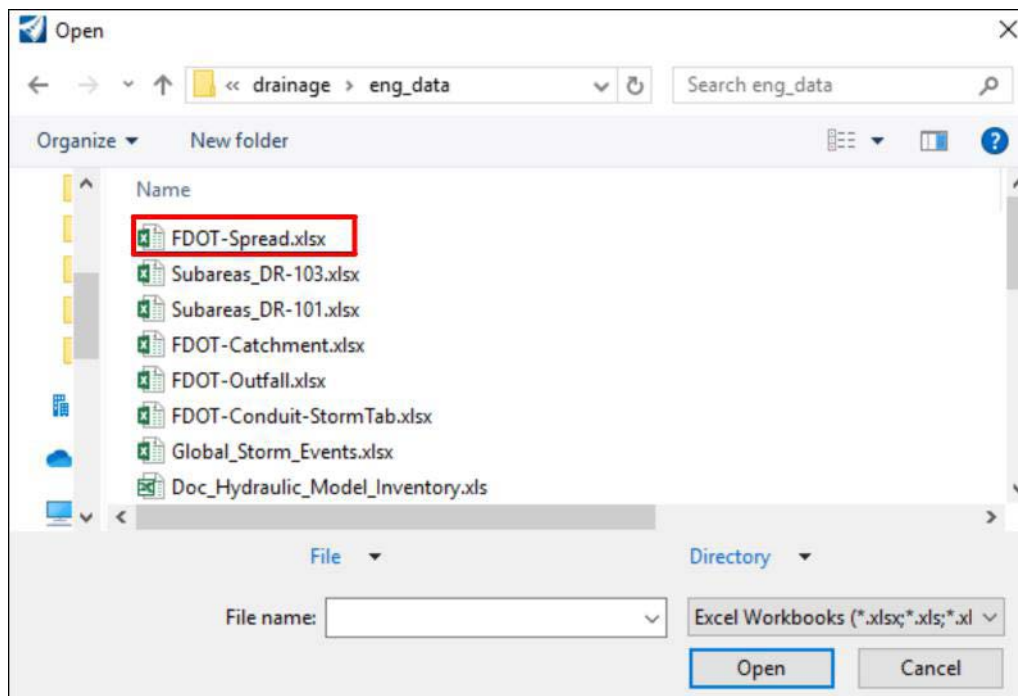
- b. Left click in the center of the area to accept placement. Repeat for second drainage area:



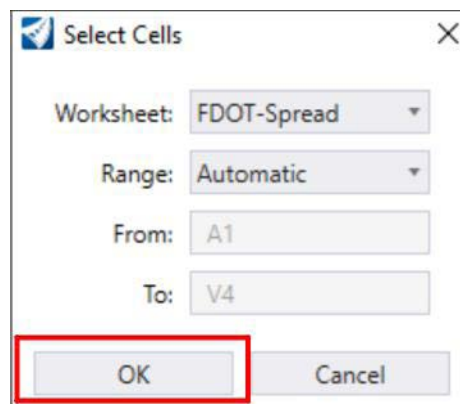
Exercise 8.9 Place Tables, from Excel, in FDOT Storm Drain Documentation Sheet

This exercise will place the drainage documentation tables generated in Exercises 6.1 through 6.7 into the sheet created in Exercise 6.8.

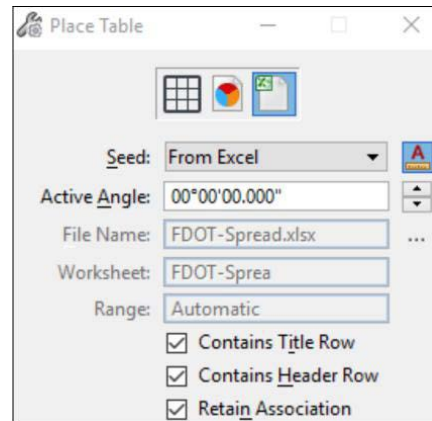
1. In *DRMPRD01.dgn*, switch to the Drainage Plan 1 [Sheet] Views Model and navigate through the path to open **Place Table > Drainage and Utilities > Drawing Production > Tables > Place Table**.
 - a. Select the icon for **From file**.
 - b. Select the ellipse next to File Name and locate the drainage/eng_data folder, where tables were saved in earlier exercises.



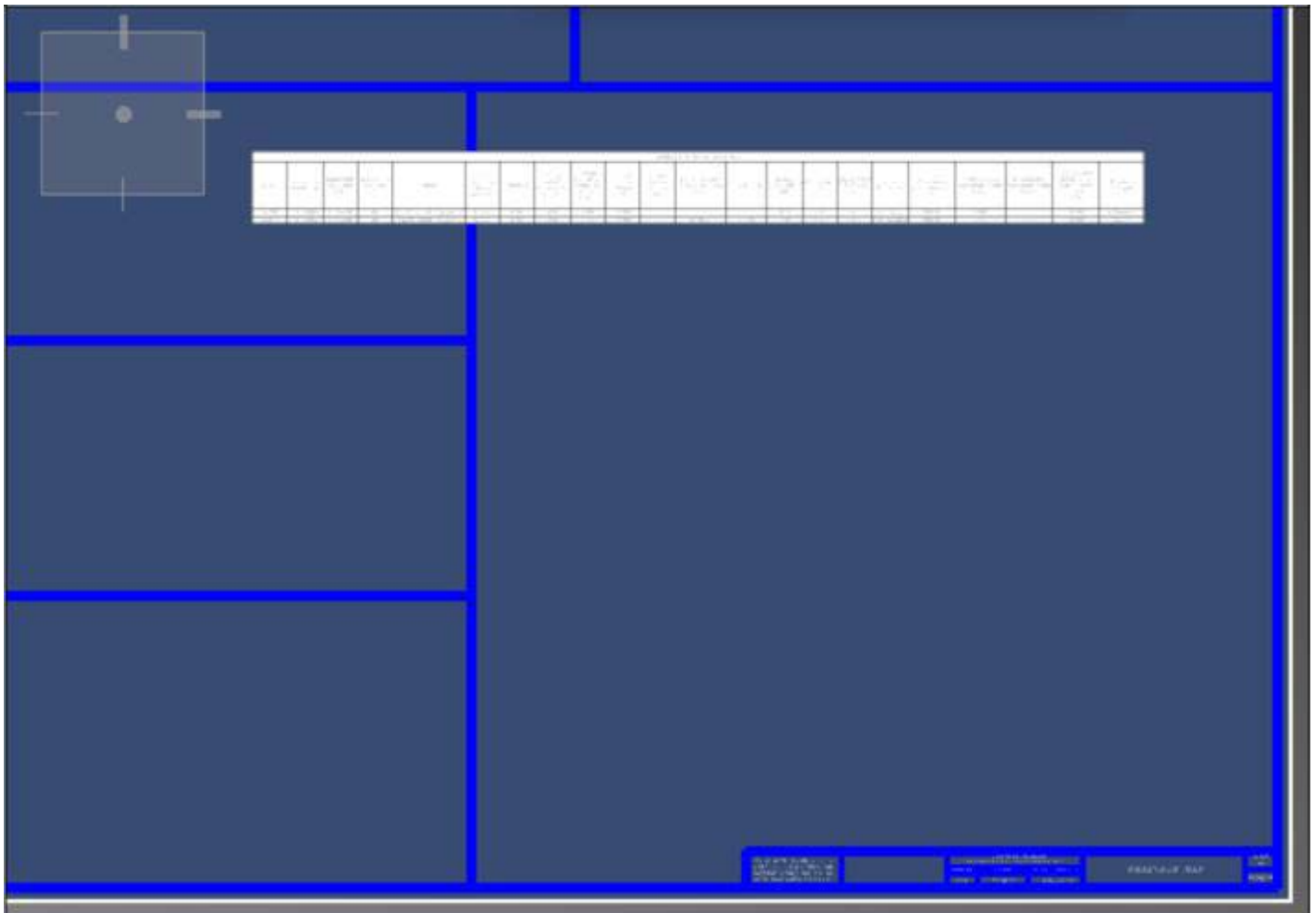
- c. Choose the file *FDOT-Spread.xlsx* and select OK to the prompt shown below:



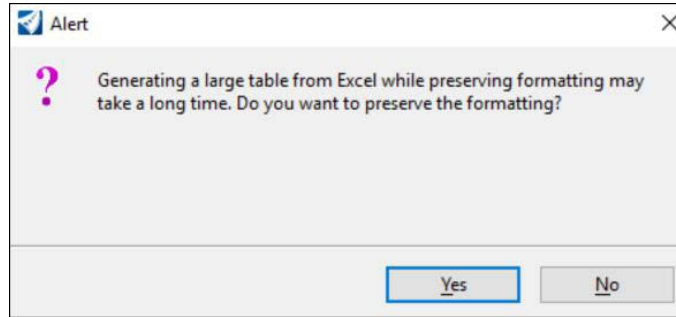
- d. The completed settings for the Place Table tool are shown below:



- e. Once the table has finished generating, use the cursor to choose the table location. Left click to accept and place.



2. Repeat Step 1 for the remaining drainage documentation tables.
 - a. Note, some larger Excel tables may generate the following alert. For this example, select Yes.



3. Move tables and organize as needed to best fit the sheet. The following tables are presented on this example:
 - a. STORM DRAIN TABULATION FORM
 - b. OUTFALL CONDITIONS
 - c. SPREAD CALCULATIONS
 - d. DRAINAGE AREA TABULATIONS
 - e. SUBAREA CATCHMENTS
 - f. HYDRAULIC MODEL INVENTORY
 - g. GLOBAL STORM ANALYSIS

STORM DRAIN TABULATION FORM																							
Label	Node - Description (ft)	Height (ft)	System Type (ft)	System Material (ft)	System CA (ft)	System Flow (ft)	Time to Travel (min)	System Inflow (ft)	System Outflow (ft)	System Retention (ft)	System Flow (ft)	Elevation to invert (ft)	MS Change (ft)	MSL to invert (ft)	MSL to invert (ft)	Headloss (ft)	Flow (ft)	Flow (ft)	Flow (ft)	Flow (ft)	Flow (ft)	Flow (ft)	Notes
0-001	0-001	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
0-002	0-002	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
0-003	0-003	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
0-004	0-004	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

OUTFALL CONDITIONS												
Label	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Notes
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	

SPREAD CALCULATIONS															
Label	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)	Baseline Point (ft)
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

DRAINAGE AREA TABULATION														
Label	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

SUBAREA CATCHMENT (0-001)														
Area / Total Area (%)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

SUBAREA CATCHMENT (0-002)														
Area / Total Area (%)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

Hydraulic Model Inventory: DPRR001 - Default.stw														
Item	Description	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

GLOBAL STORM ANALYSIS														
Area	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)	Area (ft ²)
0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001	0-001

9 ADVANCED TOPICS

UNDER DEVELOPMENT:

Basic workflows for FDOT Storm Drain design are detailed in Chapters 1-6. Advanced topics, such as those listed below are under development to provide additional guidance and considerations for OpenRoads Designer modeling capabilities.

- Culverts and Cross Drain Analysis
- Ditches
- Pond Design (time varying / dynamic conditions)
- Utility Conflicts Matrix
- Show Gutter Flow Tool
- Importing existing Geopak Drainage or ASAD networks.

Submit requests or topic suggestions to cadd.support@dot.state.fl.us

10 FREQUENTLY ASKED QUESTIONS

DGNLIB

HYDRAULIC SEED DATA

Q: What was the basis of hydraulic property input used to populate the FDOT resources?

A: Hydraulic input is comparable to GEOPAK drainage and verified vs. standard plans. Where applicable catalog notes are available to clarify input.

Q: How were the new resources validated? Does the new software run calculations accurately?

A: Validation models were prepared to compare results from OpenRoads with FDOT Drainage Design Guide examples.

FEATURE DEFINITIONS

Q: What should I do if I want to change the structure type or Feature Definition?

A: If the Feature Definition is changed from the pulldown menu in the element Properties, the Symbology Properties will automatically update. However, the Hydraulic Properties are automatically assigned only once, at first placement and will not automatically update to the new Feature Definition. However, the Hydraulic Properties can be edited to match the correct structure in the Utility Properties dialog.

Q: All the structures have centered tops and bottoms. What do I need to do to get an eccentric configuration?

A: Recommendation is to keep models with delivered features. We anticipate future enhancements from Bentley will allow for these configurations to be more easily modified.

Q: If I make a custom Feature Definition for a J-Bottom structure in a design file, can I reuse it for other design files or other projects to avoid?

A: Create a new DGNLib and copy in the custom Feature Definition(s). Save the new DGNLib in the <C:\FDOTConnect\Workspaces\FDOT\Standards\Dgnlib\Feature Definitions> folder.

DGN

Q: Can more than one person work in a design file at a time?

A: No, however design files with drainage models can be referenced into other DGNs.

MODEL

Q: Do I need StormCAD activated?

A: No, as long as networks contain less than 100 nodes. Also, separate network(s) can be included in separate dgns.

Q: How are drainage designers notified of model changes that affect drainage placement rules?

A: No apparent software official notification. We recommend having designers provide a quality control on the drainage items.

LAYOUT

NODES

Q: What is the Define Catchment checkbox for, and what should I know before using it?

A: We recommend using other tools available, or other COTS products to assist in delineating boundaries. Note, the Bentley Define Catchment tool appears to increase the amount of information the software needs to process and may increase processing times. Also, since the areas automatically update, any manual edits will not 'hold'. If the terrains are simple and the automatic drainage area does not require further tweaks, this could be an efficient way to set catchments.

CONDUIT

Q: Why are there different Feature Definition Categories for pipes, Drainage Pipes and Culverts? What's the difference?

A: The only difference between these two types of conduit is that the 'Is Culvert' property is set to 'True'. This is necessary to run culver or cross drain calculations, especially when overtopping analysis is required.

Q: Is there an option to set barrel spacing?

A: Currently no. This function is pending further enhancement from Bentley in upcoming releases.

CATCHMENTS

Q: Why do the drainage areas not work with curves?

A: This is an observed Bentley defect. If a closed shape includes curved elements, the Place Catchment tool converts the shape into chords.

Q: Why is the automated weighted C value function gone?

A: This has been reported to Bentley, and pending enhancement in a future release.

Q: Is there a recommended work-around to avoid manually calculating percent land cover or weighted C values?

A: Since OpenRoads does handle multiple catchments to a single node, a possible workaround using land cover shapes for grass or pavement, etc. is to break up drainage divides by land cover.

COMPUTE

SCENARIOS

INPUT

Q: How do I compute with Minor Losses?

A: The default set up provided in FDOT DGNLib is the Standard loss method where a user-defined loss coefficient is used to calculate the head loss based on the velocity head of the exit conduit. This input is provided at each structure and can be managed either in element properties or Headloss Alternatives. For further reference, see 'Junction Headloss Methods' in Bentley Help.

AUTOMATED DESIGN

Q: Can I use automated design for drainage networks?

A: Yes, but recommend reviewing The Drainage and Utilities 'Design Priorities' . These may result in a different design than that of following FDOT Drainage Design Guide. For example, "Pipe Capacity Should Be Greater Than the Discharge" could result in larger or deeper pipes than necessary to meet 1' HGL clearance. FDOT recommendation is to design systems using Analysis scenarios.

Q: Surcharging: tracing HGL from downstream to upstream, why does the HGL increase along the pipe – to above the upstream structure elevation, but resets to the upstream structure top for the next upstream pipe?

A: StormCAD solver is not meant for undersized systems, but rather is intended to design systems not to flood. See communities wiki link below: https://communities.bentley.com/products/hydraulics_hydrology/w/hydraulics_and_hydrology_wiki/11166/why-is-the-hgl-reset-to-rim-elevation-for-flooded-structures

Q: Can automated design avoid utility conflicts automatically?

A: Not directly, however you can use view utility conflicts with the Conflict Resolution tool.

PLANS PREPARATION

ANNOTATION

Q: How automated are the labeling and annotation tools?

A: The integrity of dynamic labels using Place Note and Place Label are maintained since they're based on the properties of the labeled element. If properties change, the labels change.

PROFILE RUNS

Q: Can I present lateral pipes in profiles and cross sections?

A: Yes, using the 3D Cut tool, all 3D elements through the model will be shown. The 3D cut elements shown can be turned off by level as needed.

DOCUMENTATION

Q: Is there a VBA script to run or format the StormTabs?

A: No, the StormTab Flex Table may be exported for use in design documentation. Formatting may be performed within the Bentley Report Tool or in external programs such as Excel.

Under Development

Caution synchronize drawing.

Explanation of FDOT design priorities vs. Drainage & Utilities

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Drainage Design & 3-D Modeling