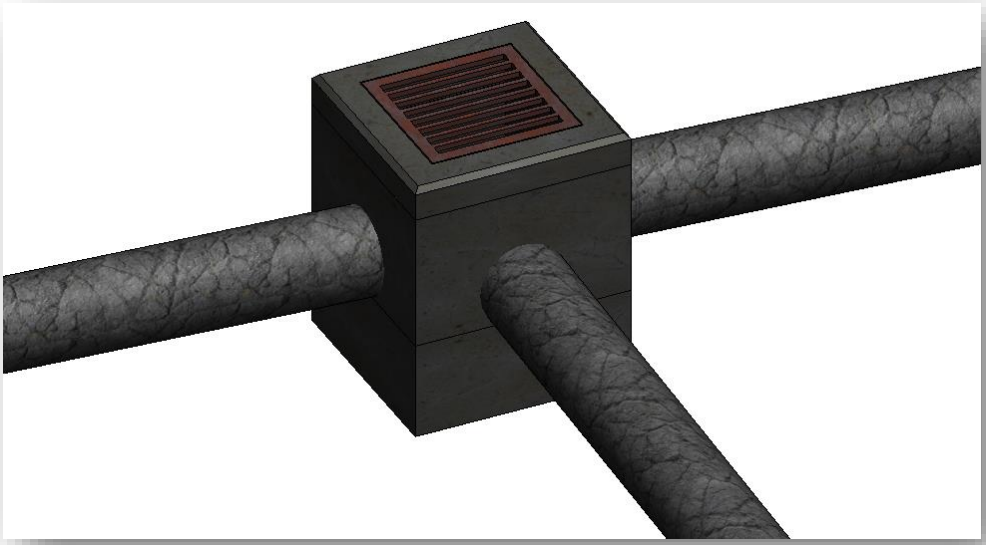
OpenRoads Survey - Existing Utilities and Storm Sewers

Overview

ODOT's field data collection process to collect the exiting drainage information has been accomplished using a variety of methods over the years. The OHDOT CADD Standards are designed to allow different field collection methods to be used to collect and process the drainage information. Support for multiple processes is intended to accommodate a variety of field data collection options. This document details various options for collecting drainage information using OpenRoads Designer with the OHDOT CADD Standards.

In order for OpenRoads to display the existing drainage information on profiles and cross sections, a 3D model of the surveyed drainage information must be generated in addition to the normal 2D survey data processing. An example of 3D drainage information is shown below.



Generating the 3D model can be accomplished by either the survey personnel or the d
esign personnel, depending on the scope of services. It should not be assumed that a 3D model of the existing drainage or other utilities is a standard Survey deliverable unless specifically scoped or agreed upon.

Bentley's Drainage and Utilities software is used to generate the 3D model of the drainage information. This information is placed in a separate drainage basemap design file, not in the survey design file. An overview of the process to extract drainage information as 3D objects is detailed in this document.

Field Survey Procedures

The process for the data collection of existing storm sewer information for modeling is summarized below:

Field Data Collection for Drainage Structures

- Shoot the storm sewer structures using the ODOT field codes for drainage structures.
- Shoot the invert of the drainage structure using the **FLINE** field code. If you are unable to shoot the invert, measure the depth and take a shot on the grate adding the depth to the rod height. The **FLINE** point is used to define the depth of the drainage structure when extracting the surveyed points to generate a 3D drainage model. If an **FLINE** point is not present, a default depth is used.

Field Data Collection for Drainage Pipes

Three potential workflows are provided for field personnel to collect the drainage pipe information. Providing three options allows the surveyor to choose the workflow that best meets field conditions and the preferred methodology.

Each option is described in this document.

Method 1: Using Mapping Codes to shoot each end of open pipes and culverts

Method 2: Using a CSV file to draw the pipes

Method 3: Using Attributes stored on the drainage points

ODOT Field Codes

ODOT's field code list provides feature codes for various storm sewer catch basins, manholes, and inlets. The complete feature code list for Survey use can be found in the OHDOT CADD Standards in the following folder:

..\OHDOT\Standards\Survey Files\Field_Codes\

The code list in Trimble and Leika formats is also available in the same folder.

This document provides additional information for the use of the drainage field codes, data collection, and survey processing procedures.

Field Codes for Drainage Structures

ODOT's field code list provides feature codes for various storm sewer catch basins, manholes, and inlets.

In the past, ODOT has used generic field codes for the data collection of storm and sanitary structures. As ODOT continues to move towards the increased use of 3D modeling, it will become increasingly important to generate surveys with storm sewer information that more accurately represents the size and location of the drainage structures found in the field. Codes for specific drainage structure types are provided in addition to the generic field codes as detained below.

Note: The Generic codes listed below were originally removed from the OHDOT CADD Standards for OpenRoads. These codes were added back to the OHDOT Standards with the August 2020 update. Either the new code, or the old generic code may be used.

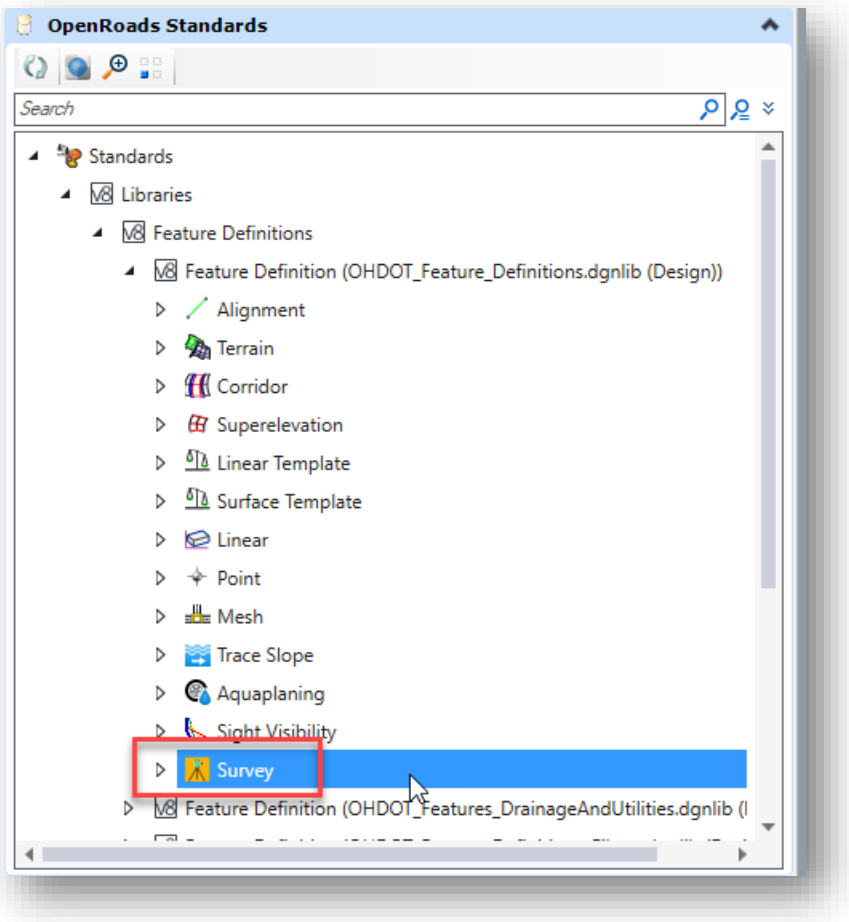
New Code	Generic Code	Description
CB-2-2B	CBS	Catch Basin No. 2-2B (Square Catch Basin) Use the code for catch basin No. 2-2A, 2-2B, 2-3, 2-4, 2-5, and 2-6
CB-3	CI	Catch Basin No. 3 (Curb Inlet) Use the code for catch basin No. 3 and 3A
CB-4		Catch Basin No. 4 Use the code for catch basin No. 4 and 4A
CB-5		Catch Basin No. 5 Use this code for catch basin No. 5, 5A, 8, and 8A.
CB-6		Catch Basin No. 6
CB-7	CBR	Catch Basin No. 7 (Round Catch Basin)
I-2-6		Median Inlet No. 2-6 Use this code for all No. 2 and 2A inlets
I-3B	MI	Median Inlet No. 3 (Median Inlet)
I-4B		Median Inlet No. 4
MH-3	STMH	This code places a cell for a Manhole No. 3 but should be used for all storm sewer manholes
MH-3-SAN	SSMH	Manhole No. 3 Use this code for all sanitary sewer manholes

The following codes are provided for the flow line at the top and bottom of drainage structures.

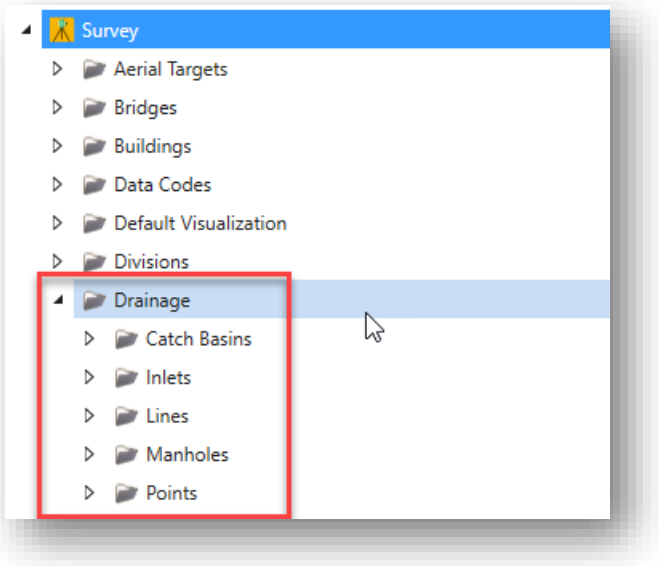
Code	Description
FLINE	Flow line at the bottom of the drainage structure
FLTOP	Low point elevation of the inlet or catch basin grate/top.

The new field codes listed above are more specific than the generic field codes; however, these codes are still somewhat generic as they do not account for the various vault sizes that may be available for each structure type. ODOT's Feature Definition library contains supplementary codes for specific structures and vault sizes that are not included in the data collector list. These supplementary codes may be used in the office to change the feature definition of specific drainage structures if needed.

The complete list of features, including the supplemental feature definitions, can be reviewed in the *Project Explorer* dialog by accessing the **OpenRoads Standards** group. To view the available **Feature Definitions** for drainage items, navigate the hierarchy as shown on the following page.

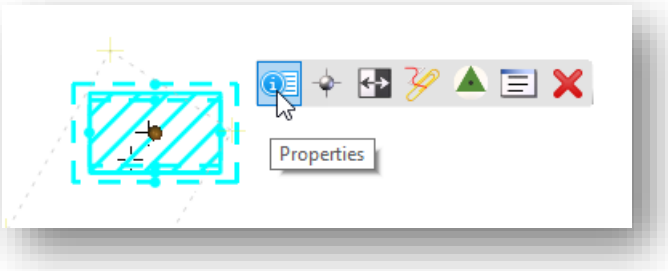


The **Survey** group contains the feature definitions for all ODOT's field codes, as well as any supplemental codes. The **Drainage** group contains all the drainage related feature definitions as shown below.

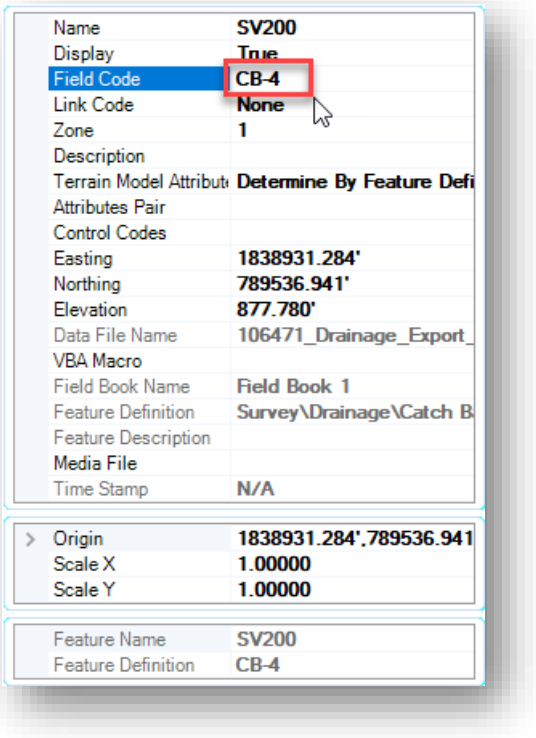


The supplemental feature types for catch basins, inlets, and manholes can be used after the data has been processed to edit a specific survey point and change its feature definition to draw the appropriate plan view cell.

To change the feature definition for a survey point to one of the supplemental field codes, select the point and choose the **Properties** icon. Key in the new **Feature Code** name



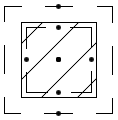
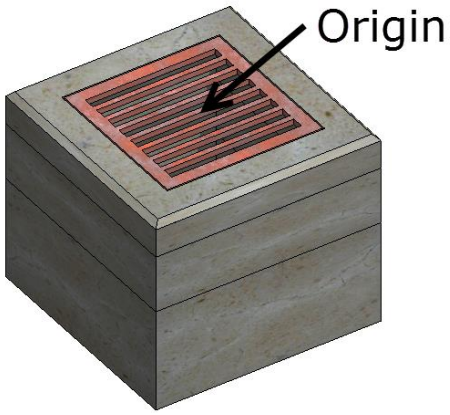
The field code **CB-4** was used in the field for this survey point.

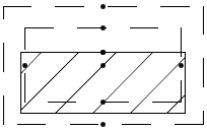
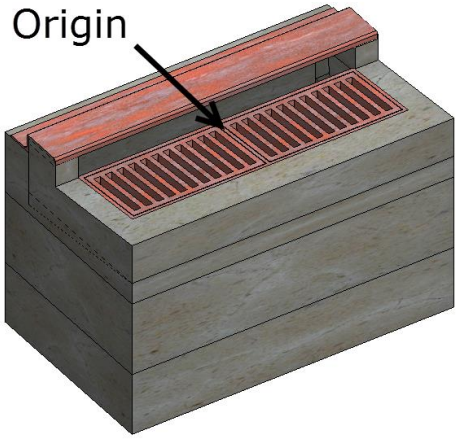


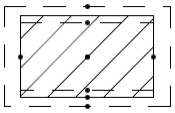
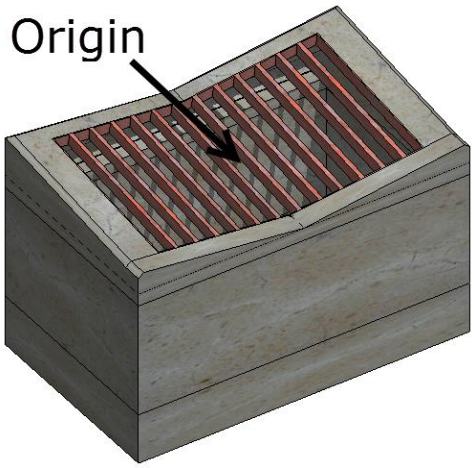
To change the **Field Code**, simply key-in the new code. The supplemental catch basin field codes can be reviewed in the *Project Explorer* dialog as shown on the previous page.

Changing the code to a different structure type results in the appropriate plan view cell being drawn for the structure.

Additional information about the drainage field codes is provided on the following pages.

Code	Description	Plan View Cell	3D View
CB-2-2B Equivalent generic code: **CBS**	Catch Basin No. 2-2B Use this code for all square catch basins with a note designating the size of the vault and whether the structure has a side inlet. **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB22B-X 	
Notes: Shoot the center of the grate. Edit the field code in the office to use one of the other square catch basin types: • CB-2-2A • CB-2-3, CB-2-3SI • CB-2-4, CB-2-4SI • CB-2-5, CB-2-5SI • CB-2-6, CB-2-6SI			

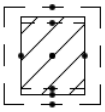
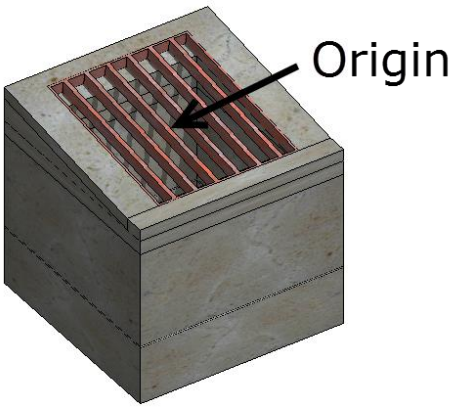
Code	Description	Plan View Cell	3D View
CB-3 Equivalent generic Code: **CI**	Curb Inlet No. 3. Also used for No. 3A which has one grate. **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB3-X 	
Notes: Shoot the low spot of the grate, at the face of curb in the center of the structure. Edit the field code in the office to use one of the other types: • CB-3A			

Code	Description	Plan View Cell	3D View
CB-4	Catch Basin No. 4 Use this code for catch basin No. 4 and 4A. The vault size varies for the 4A structures. **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB4-X 	

Notes:
Shoot the center of the grate. If the grate is slanted, take a second shot at the low point using the **FLTOP** field code.

Edit the field code in the office to use one of the CB4A types:

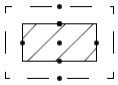
- CB-4A-42, CB-4A-48, CB-4A-54, CB-4A-60, CB-4A-66, CB-4A-72

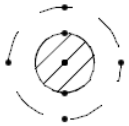
Code	Description	Plan View Cell	3D View
CB-5	Catch Basin No. 5 Use this code for catch basin No. 5, 5A, 8, and 8A. The vault size varies for the 5A and 8A structures. The 8 and 8A structures have a v-shaped grate. **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB5-X 	

Notes:
Shoot the center of the grate. If the grate is slanted, take a second shot at the low point using the **FLTOP** field code.

Edit the field code in the office to use one of the CB-5A or CB-8A types:

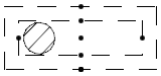
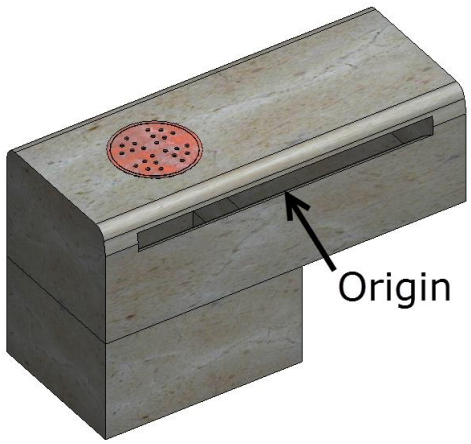
- CB-5A-42, CB-5A-48, CB-5A-54, CB-5A-60, CB-5A-66, CB-5A-72
- CB-8A-42, CB-8A-48, CB-8A-54, CB-8A-60, CB-8A-66, CB-8A-72

Code	Description	Plan View Cell	3D View
CB-6	Catch Basin No. 6 **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB6-X 	
Notes: Shoot the back of the grate.			

Code	Description	Plan View Cell	3D View
CB-7 Equivalent generic Code: **CBR**	Catch Basin No. 7 **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	CB7-X 	
Notes: Shoot the center of the grate. For domed grates, add the height of the dome (approximately 4”) to the rod height. A flat grate is used for the 3D model.			

Code	Description	Plan View Cell	3D View
FLINE	Flow line at the bottom of the drainage structure	GTM 	NA

Code	Description	Plan View Cell	3D View
FLTOP	Low point elevation of the inlet or catch basin grate/top.	GTM 	NA

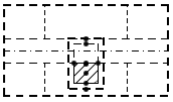
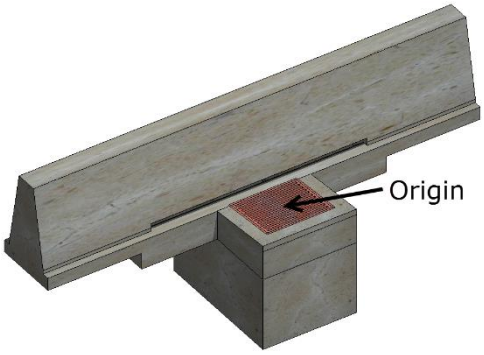
Code	Description	Plan View Cell	3D View
I-2-6	Median Inlet No. 2 **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	I26-X 	

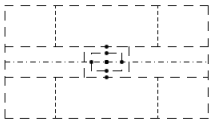
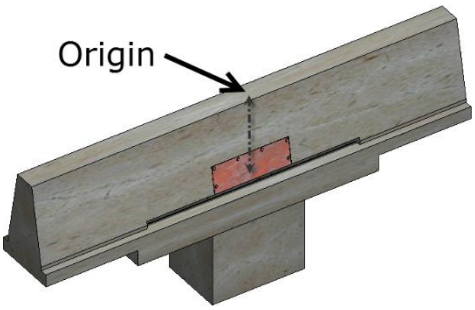
Notes:
Shoot the flow line elevation at the center of the opening. These inlets come in various sizes from 6’ to 20’ in length, in 2’ increments.

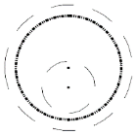
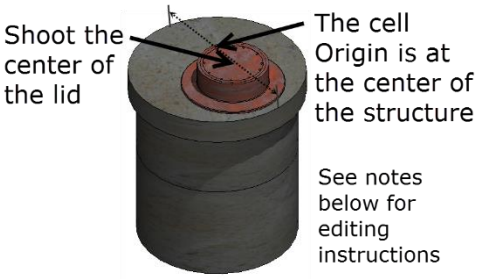
I-2 median cells are 3.0’ wide. I-2A median cells are 3’-4” wide.

Edit the field code in the office to use one of the I-2 or I-2A types:

- 1-2-6, 1-2-8, 1-2-10, 1-2-12, 1-2-14, 1-2-16, 1-2-18, 1-2-20
- 1-2A-6, 1-2A-8, 1-2A-10, 1-2A-12, 1-2A-14, 1-2A-16, 1-2A-18, 1-2A-20

Code	Description	Plan View Cell	3D View
I-3B Equivalent generic code: **MI**	Median Inlet No. 3 **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	I-3B-SS-X 	
Notes: Shoot the center of the grate.			

Code	Description	Plan View Cell	3D View
I-4B	Median Inlet No. 4 **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	I-4B-SS-X 	
Notes: Shoot the approximate center of the structure on top of the barrier. Measure the barrier height and add that value to the rod height to set the elevation for the grate.			

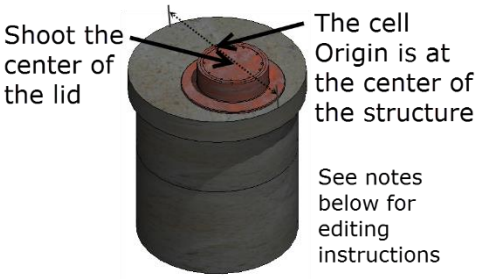
Code	Description	Plan View Cell	3D View
MH-3 Equivalent generic code: **STMH**	Storm Manhole Use this code for all storm sewer manhole types. **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	MH3-48D-X 	

Notes:
Shoot the center of the lid.

The plan view cell origin is at the center of the base, not at the center of the lid. As a result, the manhole position will be shifted in relation to the survey shot at the center of the lid. The bigger the vault, the more the shift. Take a second shot at the approximate center of the base on the surface of the ground. Code this shot using the **X2D** feature code with a note to designate this as the actual center of the structure. In the office, edit the survey point to use the Northing and Easting coordinate of the X2D shot with the elevation from the shot on the lid.

Edit the field code in the office to change the manhole type appropriately

- MH-1
- MH-2-12, etc…
- MH-3-48, etc...
- MH-4-72, etc…
- MH-5-30, etc…

Code	Description	Plan View Cell	3D View
MH-3-SAN Equivalent generic code: **SSMH**	Sanitary Manhole **Attributes:** P1, P2, P3, P4, P5, N1 Pipe attributes (P1, P2…) are entered in the following format: Dip-Size-Material-Direction N1 is used for notes.	MH1D-X-SAN 	

Notes:
Shoot the center of the lid.

The plan view cell origin is at the center of the base, not at the center of the lid. As a result, the manhole position will be shifted in relation to the survey shot at the center of the lid. The bigger the vault, the more the shift. Take a second shot at the approximate center of the base on the surface of the ground. Code this shot using the **X2D** feature code with a note to designate this as the actual center of the structure. In the office, edit the survey point to use the Northing and Easting coordinate of the X2D shot with the elevation from the shot on the lid.

Drainage Pipes and Culverts

This section documents the field codes and procedures to collect drainage pipe information.

Three potential workflows are provided for field personnel as detailed on the following pages. Providing three options allows the surveyor to choose the workflow that best meets field conditions and the preferred methodology.

- **Method 1: Using Mapping Codes to shoot each end of the pipe**
  This method is best for open pipes where both ends of the pipe can be located and a shot is taken at each end of the pipe. The mapping codes BL* (begin line) and EL* (end line) are used to connect the points to draw the linework for the drainage pipes. ODOT has added a visual basic application to the OHDOT CADD Standards with the August 2020 update that reads the SIZE attribute to automatically draw a dual-line custom line-style for pipes 12" or greater as the survey data is processed. The width of the line-style is defined by the value of the SIZE attribute. This method is not recommended for pipes connecting to a drainage structure since it requires a shot on the end of the pipe.

- **Method 2: Using a CSV file to draw the pipes**
  For those who prefer to use a spread sheet or field notes to record the drainage pipe information, the pipe information may be defined in a CSV file that is processed using an ODOT Visual Basic application after the survey information has been processed with OpenRoads Survey. The format for the CSV file is defined in this document. This method does not require the use of attributes in the data collector.

- **Method 3: Using Attributes stored on the drainage points**
  This method allows the surveyor to store information about the drainage pipes as attributes on the drainage structure point as the point is data collected in the field. These attributes define the dip, size, material, and direction of each pipe that is found in the drainage structure. Since mapping codes (BL* and EL*) are not used, graphics for the drainage pipes are not drawn when the survey information is processed with OpenRoads Survey. The pipes are drawn after the survey data has been processed using an ODOT provided Visual Basic Application.

Method 1: Open Pipes and Culverts using Mapping Codes (BL*, EL*)

The field codes listed below are available for the field collection of drainage pipes and culverts when both ends of the pipe can be located and a shot is taken on each end using the BL* and EL* mapping codes.

Note: These codes were initially removed for the OHDOT OpenRoads CADD Standards and have been restored with the August 2020 update to the standards.

Field Code	Description	Attributes	Instructions
CPP	Corrugated Plastic Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
CMP	Corrugated Metal Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
CMPA	Corrugated Metal Pipe Arch	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
CULV	Culvert	**Size** - in feet **Location** **Condition**	Shoot the ends of the culvert at the invert using the BL* and EL* mapping codes. The size is entered in rise x span format. Example: 6x10
DP	Drive Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
RCP	Reinforced Concrete Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
RCPA	Reinforced Concrete Pipe Arch	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
SMP	Smooth Metal Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18
VCP	Vitrified Clay Pipe	**Size** - in inches **Location** **Condition**	Shoot the ends of the pipe at the invert using the BL* and EL* mapping codes. For elliptical pipes, the size is entered in rise x span format. Example: 12x18

These field codes are intended to be used when both ends of the pipe can be located and a shot is taken on the invert at each end of the pipe. The BL* and EL* mapping codes are used with these field codes.

When these field codes are processed, a Visual Basic application automatically reads the Size attribute to draw the drainage pipe and to annotate the pipe information. Pipes 12” or greater are drawn at the proper width using a custom line style.

Example:

The reduced field data below represents two pipes collected using the BL* and EL* mapping codes.

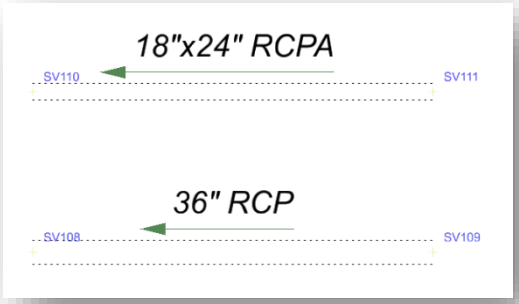
```
SV108,1080,1000,1000,RCP BL*,SIZE,36,LOCATION,INVERT,CONDITION,GOOD
SV109,1080,1050,1001,RCP EL*,SIZE,36,LOCATION,INVERT,CONDITION,GOOD
SV110,1100,1000,1000,RCPA BL*,SIZE,18x24,LOCATION,INVERT,CONDITION,GOOD
SV111,1100,1050,1001,RCPA EL*,SIZE,18x24,LOCATION,INVERT,CONDITION,GOOD
```

When the data is processed using OpenRoads Survey, the pipes are drawn and annotated as shown in the example below.

Notes:
The text size is determined by the Annotation Scale setting.

Changing the annotation scale setting does not change the length of the flow line.

The text is placed above the line in the direction of flow. This may result in text that is upside-down. Since the survey data will most likely be rotated when plan sheets are produced, there is no sense in rotating the text as it may still appear upside-down in relation to the final sheets.



Method 2: Pipes and Culverts using a CSV file

Some surveyors may prefer to collect the pipe information separately for post processing using a CSV file containing the drainage pipe information. This method can be used for pipes connecting to a drainage structure or for open drainage pipes and culverts without use of the BL* EL* mapping codes or attribute information.

After the data has been processed using OpenRoads Survey, the ODOT visual basic application **OHDOT_ExistingStormSewer.mvba** is used to read a CSV file to draw the drainage pipe information.

The various drainage structure field codes along with the codes listed below are used when data collecting the drainage pipe information in the field that will be drawn with a CSV file.

Code	Description	Plan View Cell	3D View
FDO	For Direction Only Used to show the direction of a pipe when the other end cannot be located	SVPT 	NA
PIO	Pipe Inlet/Outlet. Shoot the invert of the pipe **Attributes:** P1 If used, the attribute P1 is entered in the following format: Dip-Size-Material-Direction	SVPT 	NA
Notes: Shoot a point at each end of the pipe using the PIO field code. If one end of the pipe cannot be located, use the FDO field code to take a shot in the direction of the pipe. The BL* and EL* mapping codes should not be used with these field codes. Using this method, both ends of an open pipe should be collected using the PIO field code and later connected using an ODOT visual basic application with a CSV file.			

Using this process, the drainage pipe information is read from a CSV file and processed using an ODOT VBA Application. The CSV file format is defined below. This method can be used for open pipes (connecting two PIO shots), culverts (connecting two CULV shots), and for pipes connected to a drainage structure at one or both ends.

ODOT provides a template Excel file that can be used to collect the pipe information. The template Excel files is found in the following location:

..\OHDOT CADD\Standards\Survey Files\OHDOT_ExistingStormSewers.xlsx

The data must be exported from the Excel file to a CSV file for processing. Custom Excel files can also be used as long as the required information is saved to a CSV file in the format documented below. The first few lines of an example CSV file are shown below:

	A	B	C	D	E	F
1	First Point Name	Depth or Elevation	Size	Material	Second Point Name	Depth or Elevation
2	DR118	0	15	RCP	DR100	3.25
3	DR100	491.5	12	RCP	DR102	492.1
4	DR102	2.5	12	RCP	DR104	2.75
5	DR102	2.9	12	RCP	DR112	2.5

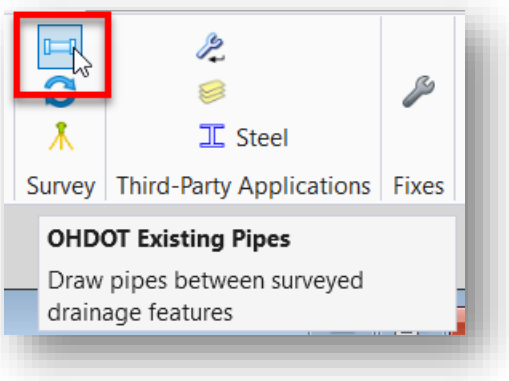
The order of the fields in the CSV file is fixed and cannot be modified. Each field is described below:

Field	Description
First Point Name	The point name for the drainage structure, PIO, or FDO point
Depth or Elevation	The measured depth to the pipe invert, or the actual elevation of the pipe invert. Notes: - If the value is greater than 200 it is assumed to be an elevation - Values less than 200 are subtracted from the First Point elevation when the CSV file is processed - Use a value of 0 for PIO and FDO points
Size	The pipe size, in inches - Use numbers only, do not append a double quote character to designate inches - Elliptical pipes are entered in rise by span format without any spaces or other characters. Example: 14x23
Material	The pipe material. Use only the abbreviations defined in the ODOT Excel file
Second Point Name	The point name for the other end of the pipe, a structure, PIO, or FDO point
Depth or Elevation	The measured depth to the pipe invert, or the actual elevation of the pipe invert. Notes: - If the value is greater than 200 it is assumed to be an elevation - Values less than 200 are subtracted from the First Point elevation when the CSV file is processed - Use a value of 0 for PIO and FDO points

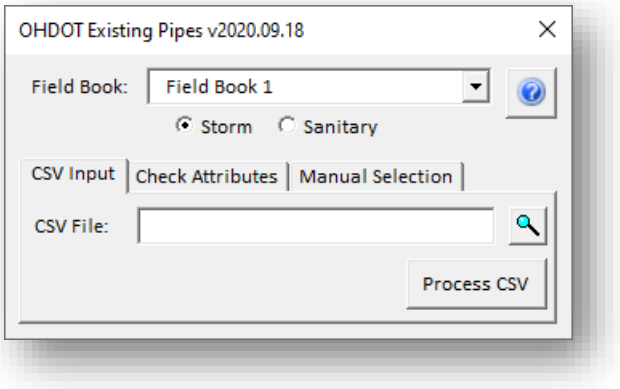
The **First Point Name** and **Second Point Name** values are the ORD Survey point number for a drainage structure, PIO, or FDO point. Pipes can be drawn between various points as listed below:

- From a drainage structure to drainage structure
- From a pipe inlet to a pipe outlet (PIO to PIO)
- From a drainage structure to a pipe outlet (PIO)
- From a drainage structure to a pipe direction shot (FDO)
- From a pipe inlet of outlet to a pipe direction shot (PIO to FDO)
- From a culvert point to a culvert point (CULV to CULV)

The **OHDOT_ExistingStormSewer.mvba** is used to process the CSV file. The application is accessed from the OHDOT WorkFlow in the Survey group as shown below.



The dialog shown below is opened.



The application requires a 3D model and must be run in the design file containing the Survey Field Book information.

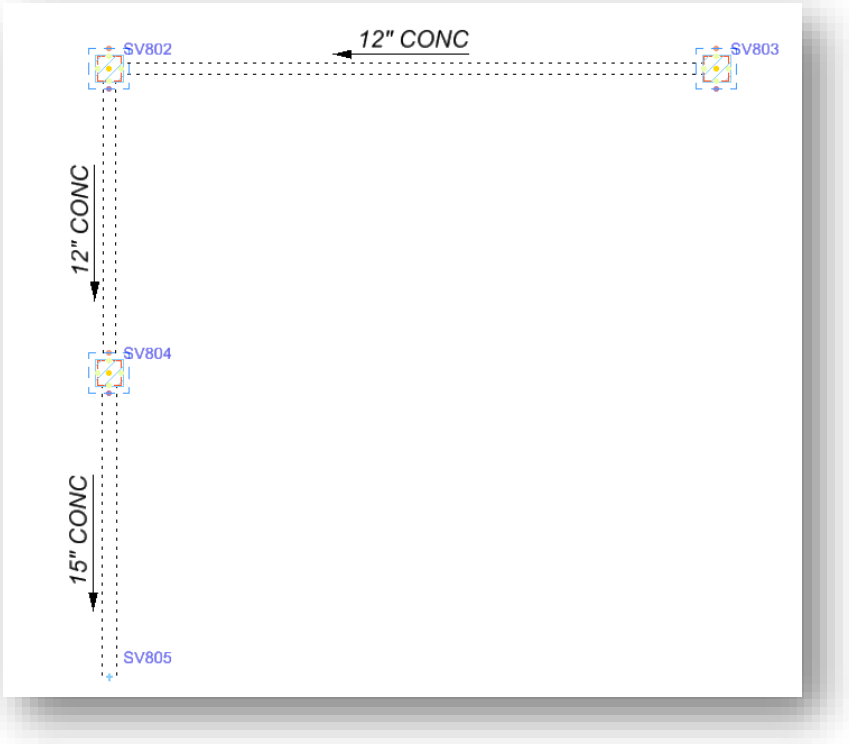
The application has three tabs:

- CSV Input
- Check Attributes
- Manual Selection

The **CSV Input** tab is used to read a CSV file containing existing pipe information and draw storm sewer and sanitary sewer pipes and culverts into the survey field book design file.

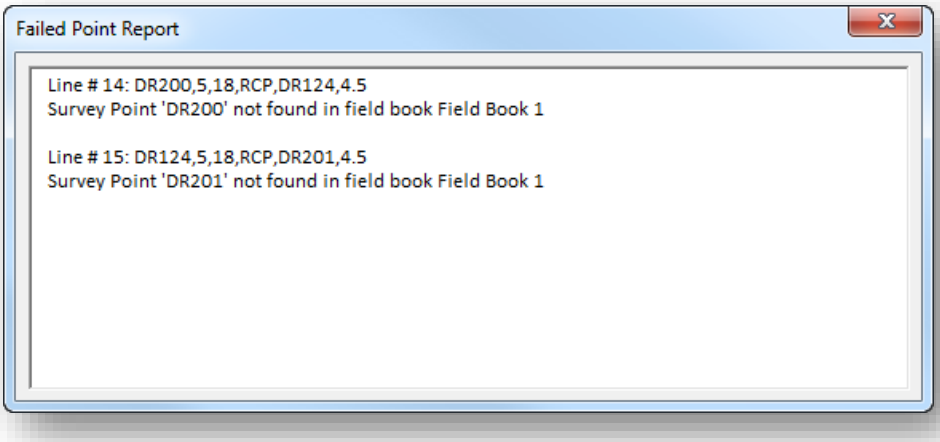
The lines that are drawn for the pipes are drawn in 3D at the correct elevations, however these lines are "flat" lines using the ODOT line styles for drainage pipes and culvers.

Select the **CSV file** and the **Field Book**. Choose the **Process File** option to initiate processing. An example of the plan graphics for the pipes drawn in the field book design file is shown below.



The pipe labels and flow arrows are placed using the active annotation scale and the active MicroStation text style. Changing the annotation scale after the CSV file has been processed will resize the text, but not the flow arrow length.

As the CSV file is processed, the selected field book is searched for survey points matching the point names defined in the CSV file. If a point in the CSV file is not found in the selected field book, it is reported in a separate dialog as shown in the example below.



The graphics in the survey basemap design file are intended for plan production purposes, not for 3D modeling. The 3D pipe information can be extracted from these graphics to generate a 3D model of the drainage features as described later in this document.

Method 3: Using Attributes Stored with the Drainage Points

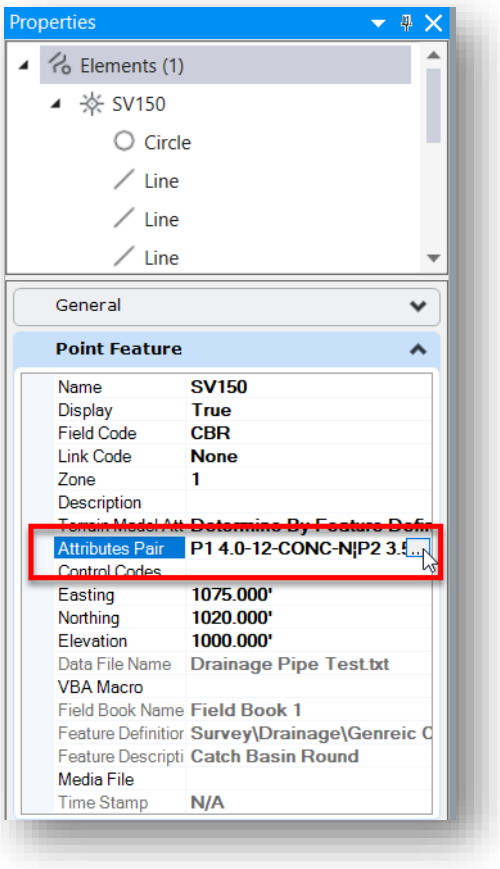
When this method is used, the surveyor enters pipe attribute information in the data collector as the drainage points are surveyed in the field. The attribute information for up to 5 pipes can be entered for each drainage structure. The attributes and the format are summarized below.

Attribute	Attribute Format	
P1	Dip-Size-Material-Direction	**Dip** = The depth from the grate to the pipe invert **Size**= The pipe size in inches. Rise by Span for elliptical pipes **Material** = The pipe material, CONC, CMP, etc. **Direction** = The approximate direction of the pipe. N, S, SE, etc. Example: 3.75-12-CONC-S
P2	Dip-Size-Material-Direction	
P3	Dip-Size-Material-Direction	
P4	Dip-Size-Material-Direction	
P5	Dip-Size-Material-Direction	
N5	Notes	Use this attribute to enter any notes

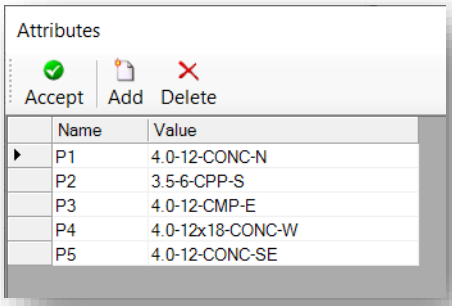
When the survey data is processed, the attribute information is stored with the drainage points. In the example below, information for 4 pipes was stored with the survey point. The attribute information is listed in the **Attributes Pair** field.

The attribute information can be edited after the survey data is processed using OpenRoads Survey tools as described below.

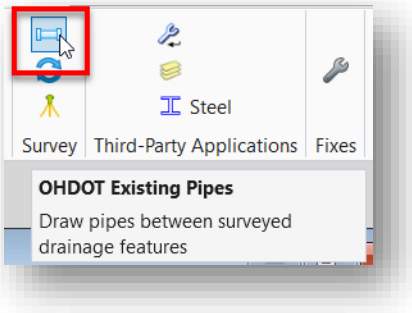
Use the MicroStation ***Element Selection*** tool to select the drainage point. The attributes can be edited by selecting the icon to the to the right of the **Attributes Pair** list as shown below.



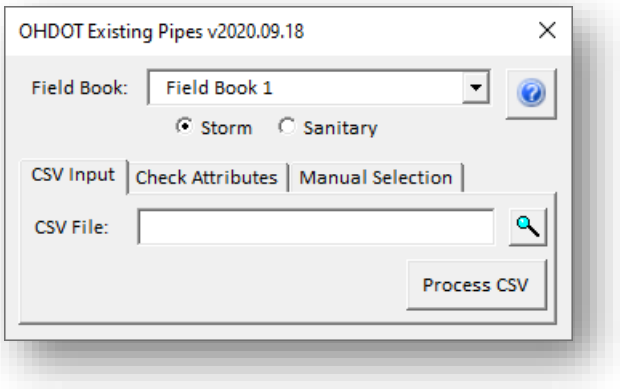
When the icon is selected, the dialog shown below is opened to allow editing or adding attributes to the selected point. Select the **Accept** button after making edits.



The **OHDOT_ExistingStormSewer.mvba** application is used to draw the pipes when attributes are used to define the pipe information. The application is accessed from the OHDOT WorkFlow in the Survey group as shown below.



The dialog shown below is opened.



The application has three tabs:

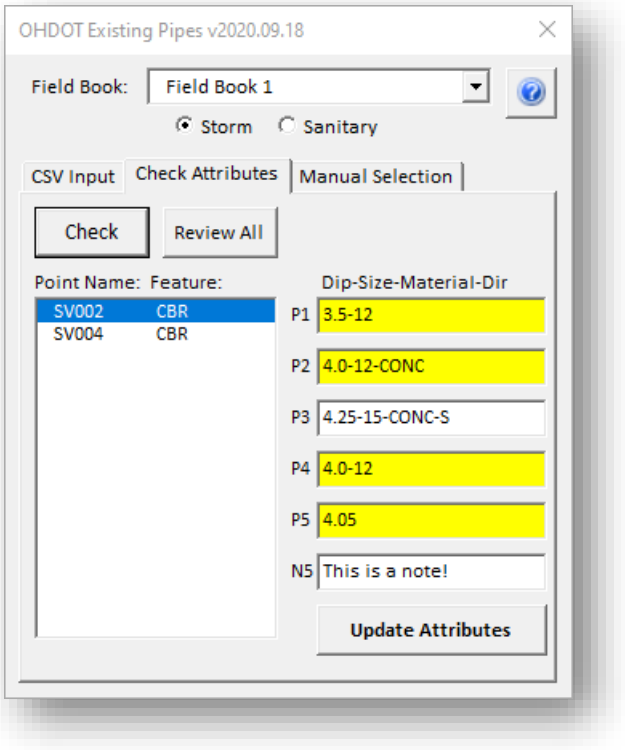
- CSV Input
- Check Attributes
- Manual Selection

The CSV Input tab was described earlier in this document. The **Check Attributes** and **Manual Selection** tabs are used when drawing the drainage pipes using attribute data.

- **Check Attributes** is used to review the OpenRoads Survey Field Book information to verify the format of the drainage attributes. This process should be run before using the **Manual Selection** functions

- **Manual Selection** is used to connect drainage pipe information by manually selecting the survey points to be connected. The attribute data is read from the survey points selected in the design file to draw the drainage pipe in the design file

When the **Check Attributes** tab is selected, the dialog appears as shown below.

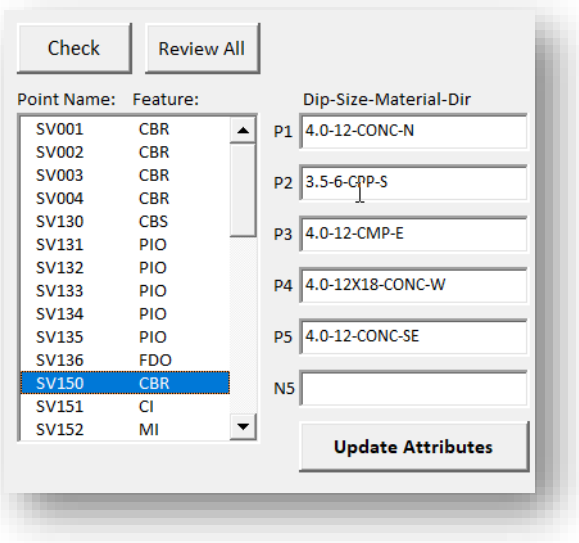


The **Check** button is used to run a check on the attribute data for the drainage points found in the selected **Field Book**. As each point is processed, the application verifies the format of the attribute data. Any points that do not meet the dip-size-material-direction formation are listed in the dialog.

The **P1**, **P2**, **P3**, **P4**, **P5**, and **N5** fields are used to correct the attribute format. Attribute fields that are incorrect are highlighted in yellow as shown at left.

Select **Update Attributes** to update the attribute data for the selected point.

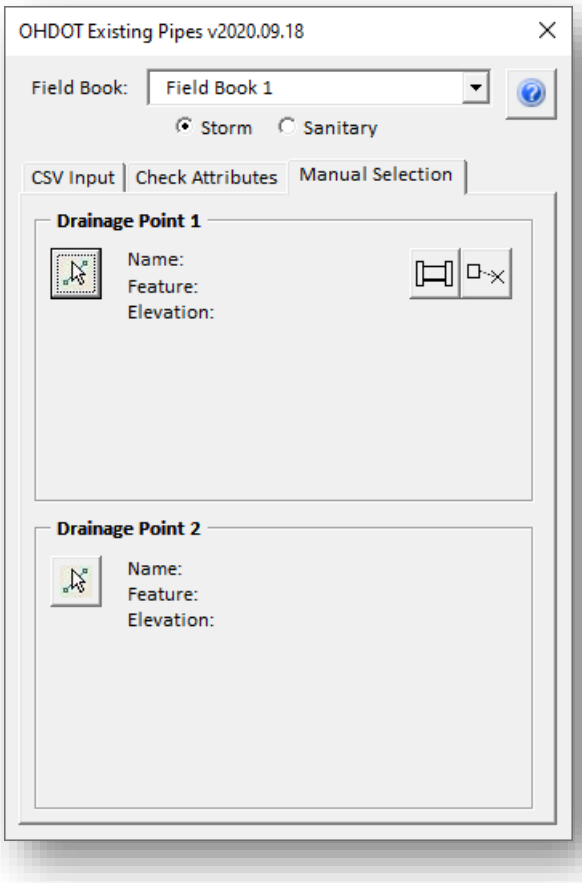
The **Review All** button is used to generate a list of all the drainage points found in the selected Field Book.



Select a point to review the attribute information.

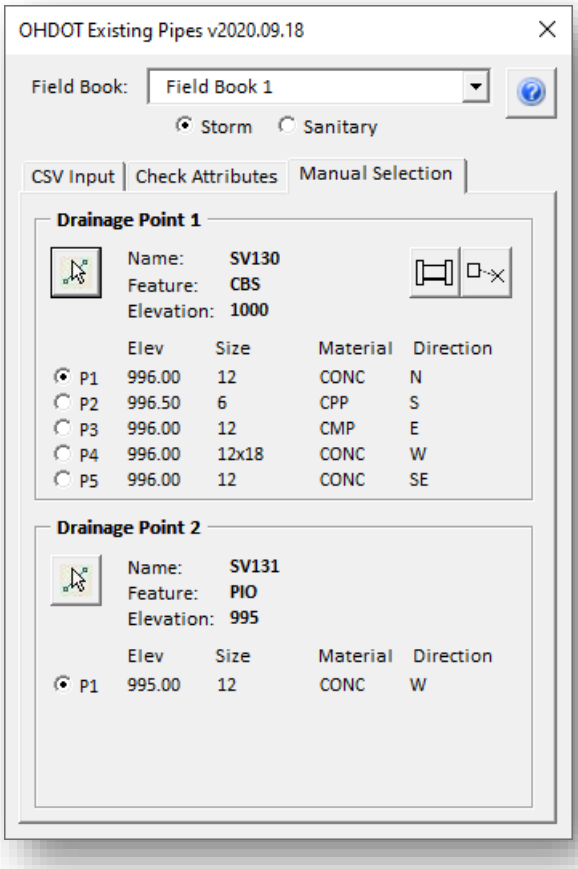
This function is useful to add attribute information to points from field notes, if desired.

When the **Manual Selection** tab is selected, the dialog appears as shown below.



Manual Selection mode is used to draw pipes and culverts by selecting two of the drainage points in the selected Field Book.

This mode is useful for projects with only a few pipes when a CSV file will not be used. Like the CSV mode, the graphics drawn for the drainage pipes are placed at the computed elevation for the end points of the pipe. The graphics are "flat" lines intended for plan production.



The **Drainage Point 1** and **Drainage Point 2** fields are used to select the points that will be used to draw a pipe or culvert. The point names must be contained in the selected **Field Book**.

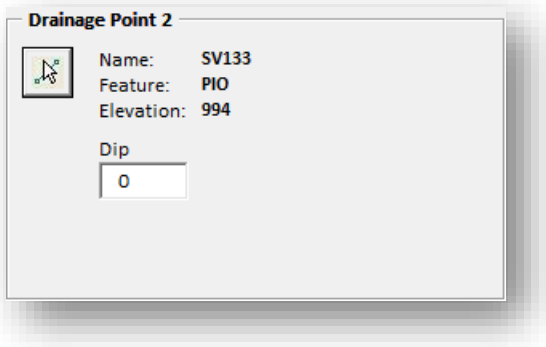
In the example at left, two points were selected that contain drainage pipe attributes.

Select this icon to draw the pipe between the selected drainage points. The pipe is drawn using the **Size** and **Material** values of the pipe selected in the **Drainage Point 1** pipe list.

Select the icon to draw a pipe from **Drainage Point 1** to a data point location. The end of the pipe is placed at the same elevation as point 1.

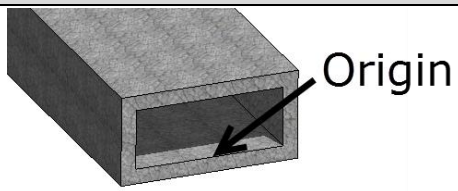
Note: The **Size** and **Material** is always annotated using the selected pipe for **Drainage Structure 1**. The application does not support labeling pipes that change size or material from one end to the other.

If the selected pipe does not have any attributes, the application allows the user to enter values for the **Dip**, as shown below.



The **Dip** value can also be entered as an elevation. Values greater than 200 are assumed to be elevations.

Field Codes for Box Culverts

Code	Description	Plan View Cell	3D View
CULV	Flow line at each end of a box culvert.	SVPT 	

Notes:
Shoot a point at each end of the culvert.

The Attributes SIZE, LOCATION, and CONDITION are available. Use these attributes when using the BL* and EL* mapping codes to draw the culvert line.

The SIZE attribute is entered in rise x span format.

The example below shows the reduced coordinate field data for a 6x10 box culvert.

```
SV124,1240,1000,1001,CULV BL*,SIZE,6x10,LOCATION,INVERT,CONDITION,POOR
SV125,1240,1050,1000,CULV EL*,SIZE,6x10,LOCATION,INVERT,CONDITION,POOR
```

The culvert graphics are drawn as shown below using a custom line style for the culvert size when the survey data is processed.

Box culverts can also be processed using the **OHDOT_ExistingStormSewers.mvba** application. The process is like processing the PIO points as described previously in this document. When processing with the visual basic application, the mapping codes BL* and EL* are not necessary.

Exercise 1. Drainage Survey Example

This exercise demonstrates the process to import survey data containing a few drainage structures, rotating the structures into place, and connecting the pipes using the OHDOT_ExistingStormSewers application to read a CSV file with the pipe information.

Note that this example is an isolated dataset containing only a few points and no other topo survey information. It is not necessary to collect the drainage information as a separate dataset. Drainage information is normally included in the same dataset as the general topo survey information. This exercise is intended to illustrate the drainage structure and pipe connection process.

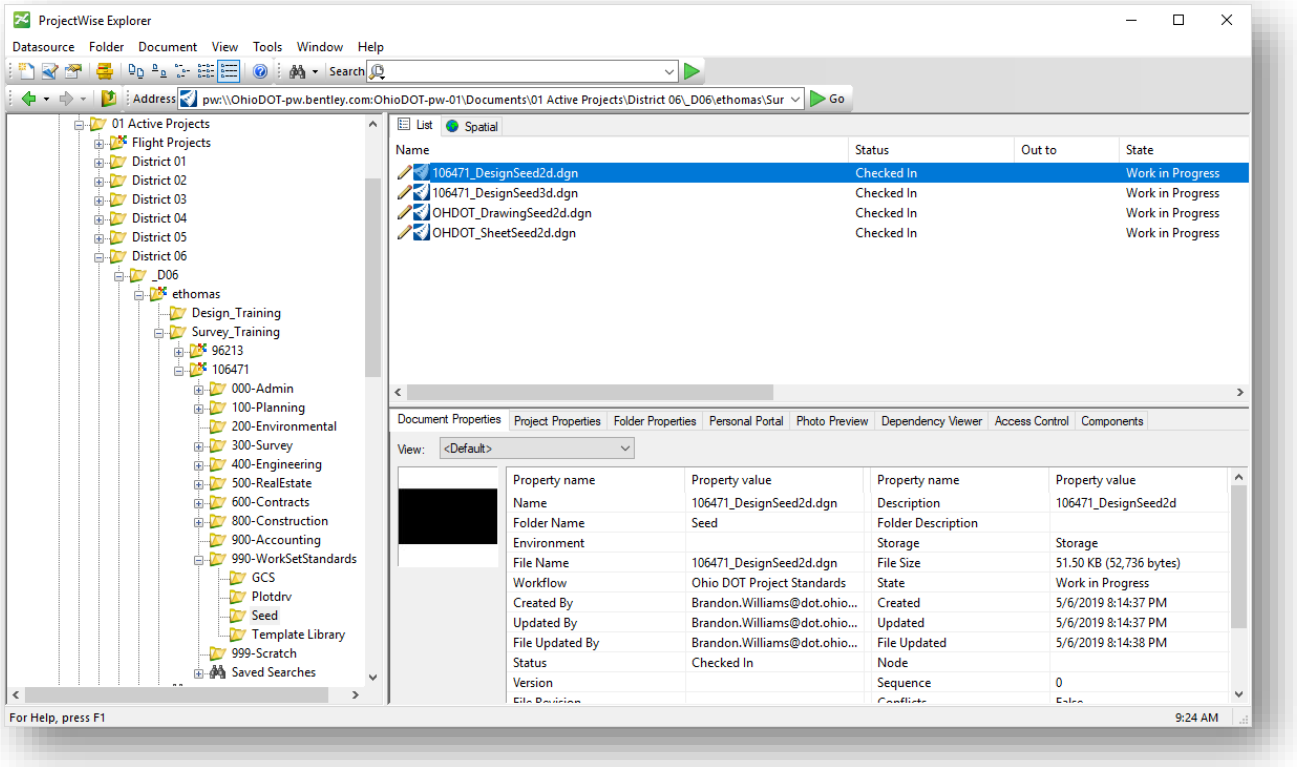
Creating the Field Book (FB) design file

For a newly created WorkSet, one of the seed files is used as the initial launching point to create new design files for the project.

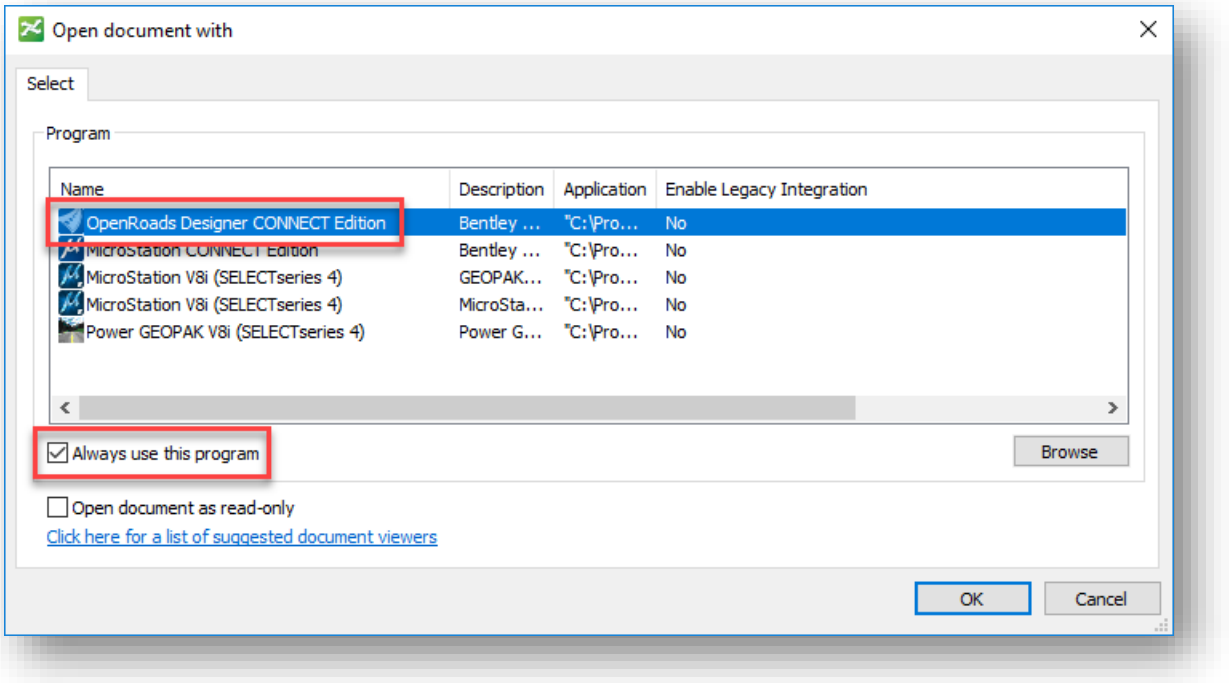
Take the following steps to open **106471_DesignSeed2d.dgn** and create a new FB design file for the project.

- Open **ProjectWise Explorer**

- Browse to the folder shown below, using your home District and your use name.



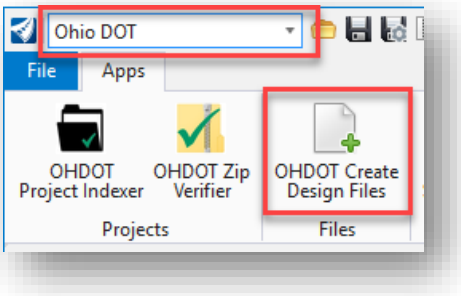
- Right-Click on the file **106471_DesignSeed2d.dgn** and choose the **Open With…** option to open the file with OpenRoads Designer CONNECT Edition. Toggle the **Always use the program** option **ON**



- Select **OK** to open the file.

- Select the **Ohio DOT** WorkFlow from the top left of the ORD interface.

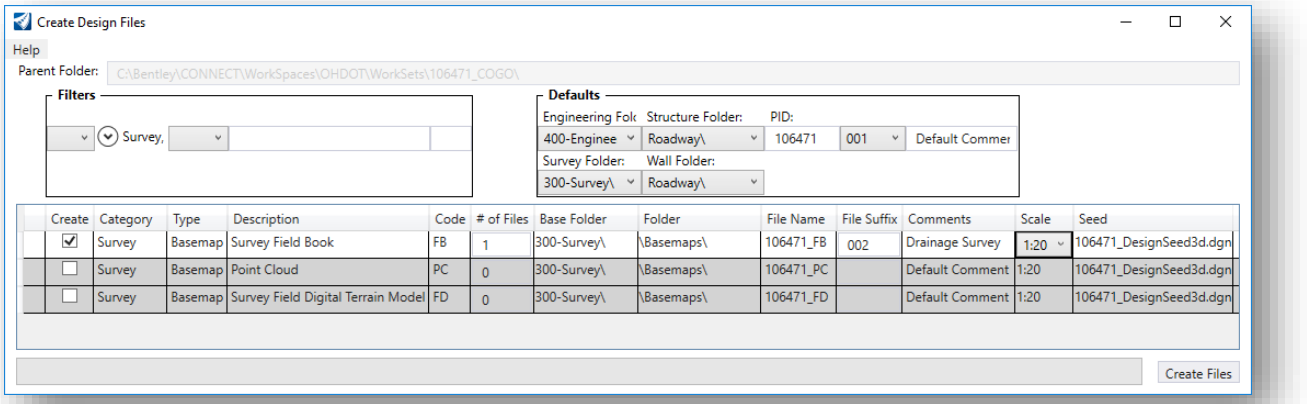
- From the **Apps** tab, select the **OHDOT Create Design Files** icon



The application is opened as shown below

- Create the following DGN file:

300-Survey\Basemaps\106471_FB002.dgn



- Open the newly created FB file

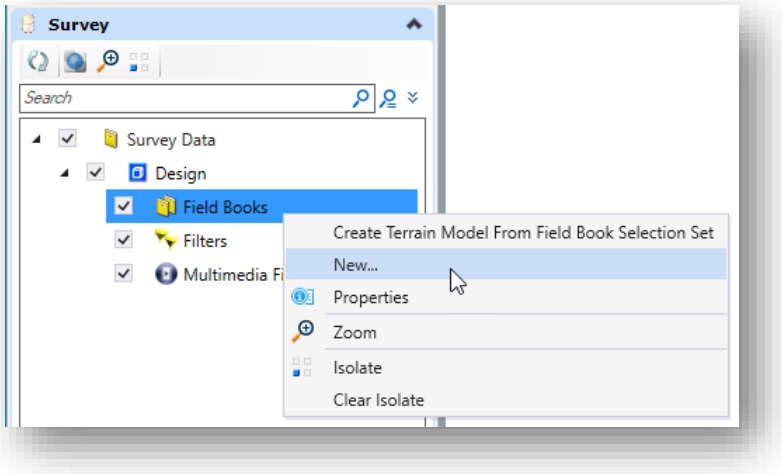
Importing Survey Data

Create a new Field Book to import the drainage information

- From the ***Explorer*** dialog, open the **Survey** group

  If the ***Explorer*** dialog is not displayed, open it by selecting **Explorer** on the **Home** tab of the **Survey** WorkFlow

- Right-click on the **Field Books** option in the ***Explorer*** dialog's **Survey** group to create a new **Field Book** as shown below.

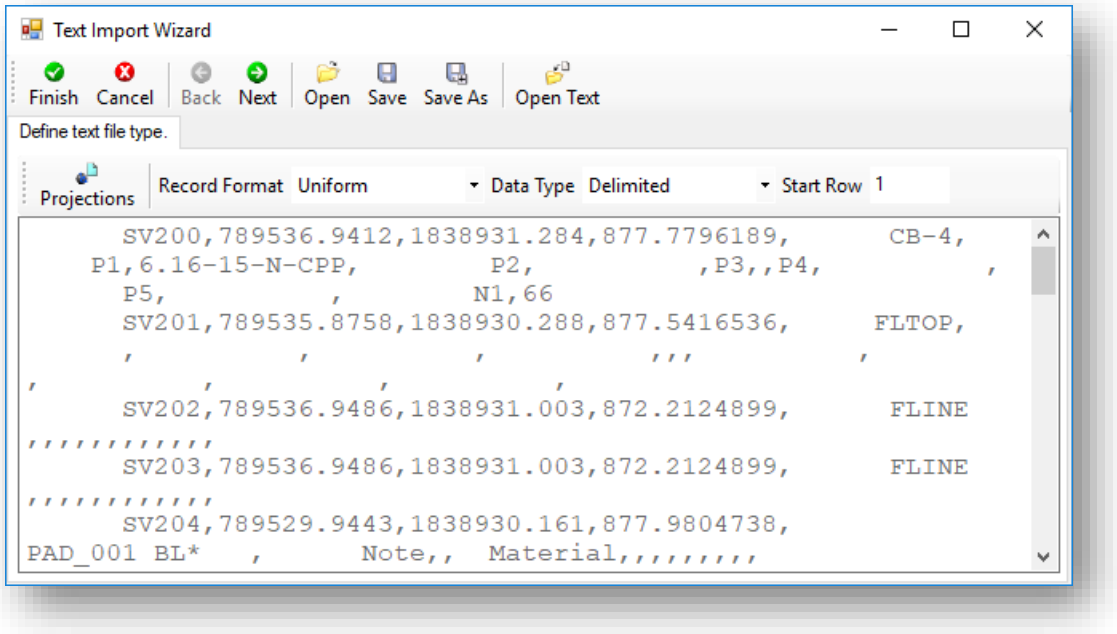


The field book is created with the default name "Field Book 1". The name can be changed by selecting the field book in the ***Explorer*** dialog and entering the new name in the ***Properties*** dialog.

- Import the drainage survey information by right-clicking on the field book name in the ***Explorer*** dialog and choosing **Import > File using Text Import Wizard**
    - Browse to the following folder to select the CSV file containing the topo survey data
      300-Survey\SurveyData\FieldData\RawData\

    - Open the file **106471_Drainage_Export_Scaled.csv**

      The ***Text Import Wizard*** dialog is opened as shown below



The **Text Import Wizard** can be used to import CSV files in a variety of formats. Users can elect to manually configure the settings or select one of ODOT's predefined formats.

ODOT provides three predefined formats for import as listed below.

OHDOT-CommaPtNEZCode.tiw

This file does not have a coordinate system defined. This file is used for projects that have a custom scale factor defined.

OHDOT-CommaPtNEZCode-OH83-2011-NF.tiw

This file is used to import CSV files that contain grid coordinates in the OH83-2011 North coordinate system.

OHDOT-CommaPtNEZCode-OH83-2011-NF.tiw

This file is used to import CSV files that contain grid coordinates in the OH83-2011 South coordinate system.

These TIW files are in the following folder within the OHDOT standards:

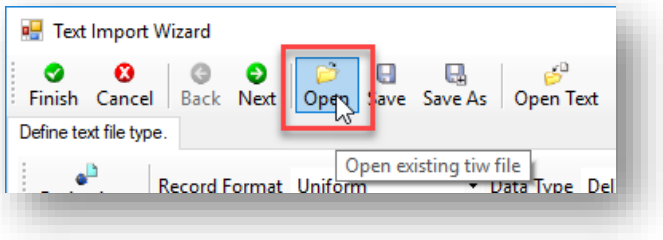
03 Standards\CADD Standards\CONNECT_Config\OHDOTCEv01\Standards\Survey Files\TIW

The files are configured for comma separated CSV files in the following format:

Column 1 Format	= Point Name
Column 2 Format	= Northing
Column 3 Format	= Easting
Column 4 Format	= Elevation
Column 5 Format	= Code
Column 6 Format	= Attribute Name
Column 7 Format	= Attribute Value
Column 8 Format	= Attribute Name
Column 9 Format	= Attribute Value
Column 10 Format	= Attribute Name
Column 11 Format	= Attribute Value
Column 12 Format	= Attribute Name
Column 13 Format	= Attribute Value
Column 14 Format	= Attribute Name
Column 15 Format	= Attribute Value
Column 16 Format	= Attribute Name
Column 17 Format	= Attribute Value

- Use the Open Existing tiw File option to select the following file from the folder listed above:

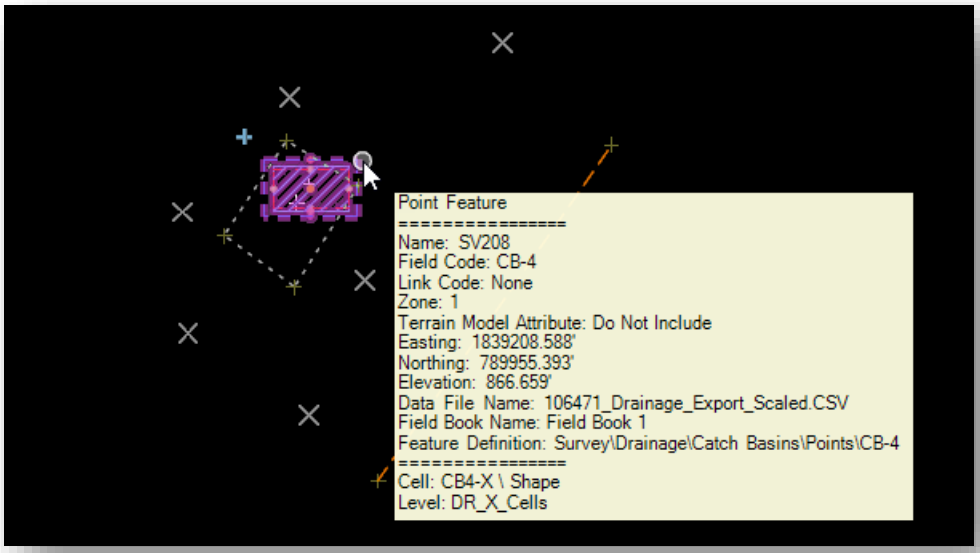
  OHDOT-CommaPtNEZCode.tiw



  The **Back** and **Next** buttons can be used to review the ***Text Import Wizard*** dialog settings prior to importing the data.

- Select **Finish** to initiate the process. The CSV file is imported into the DGN file

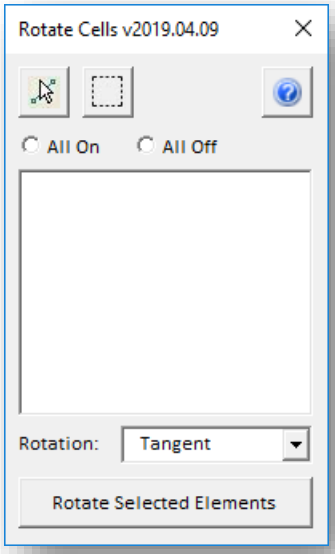
The data contains two drainage structures and a PIO (Pipe Inlet/Outlet) point. The point SV208 representing a CB-4 is shown below.



Rotating Survey Points

The concrete pad was also surveyed as shown above. The catch basin cell will be rotated to align with the concrete pad using the **OHDOT_RotateSurveySymbols.mvba** application.

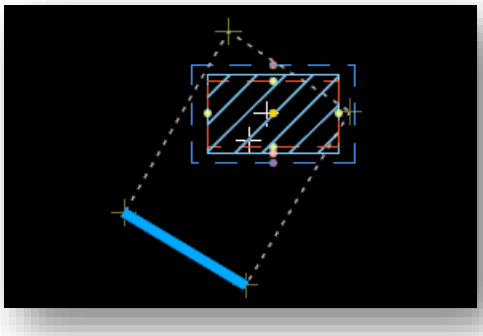
From the **OHDOT** WorkFlow, select the **OHDOT Rotate Survey Symbols** command. The dialog shown below is opened.



The application is used to rotate survey cells relative to a selected line, line string, curve, curve string, or segment of a shape. See the **Help** document for more information not presented here.

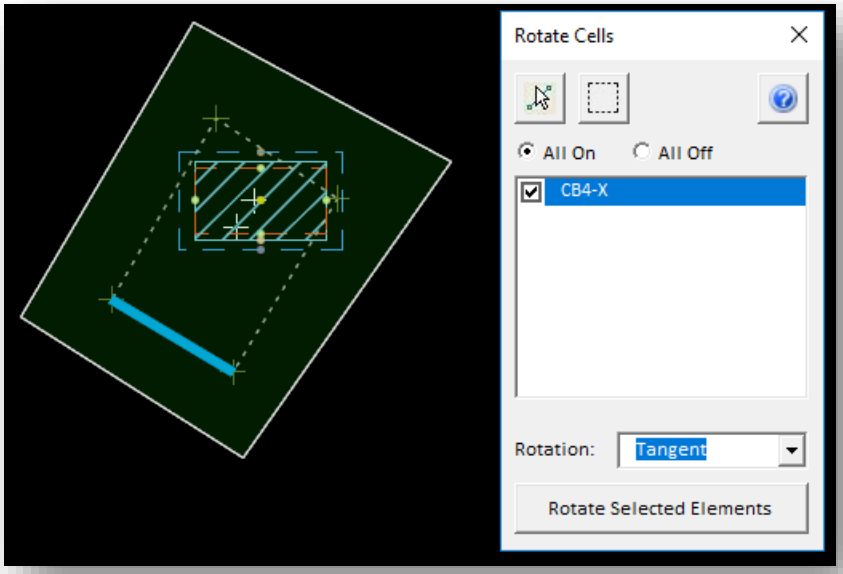
Take the following steps to rotate the catch basin cells relative to their individual concrete pads.

- Select the reference element that will be used as the baseline to rotate the cell. The opposite end of the concrete pad was selected in the example below.



- Place a fence shape around the cells that you wish to rotate. In this example, we will only rotate one cell but keep in mind that multiple cells can be rotated simultaneously by placing a fence shape around a group of cells to rotate them relative to the selected element.

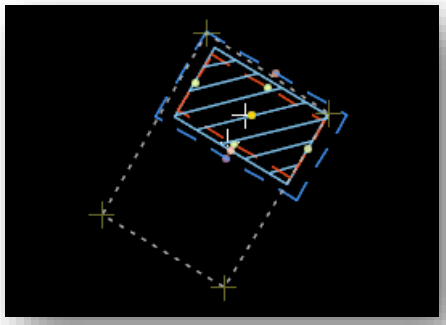
  Tip: Follow the prompts – issue a reset (right-click) to complete the fence shape placement. An example is shown below.



  All the cells found within the fence shape are listed as shown above.

- Set the **Rotation** method to **Tangent**

- Choose the **Rotate Selected Elements** button to initiate the process. The cell is rotated as shown below.

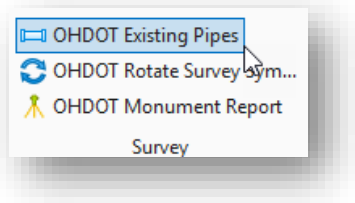


- Repeat the procedure for the other catch basin

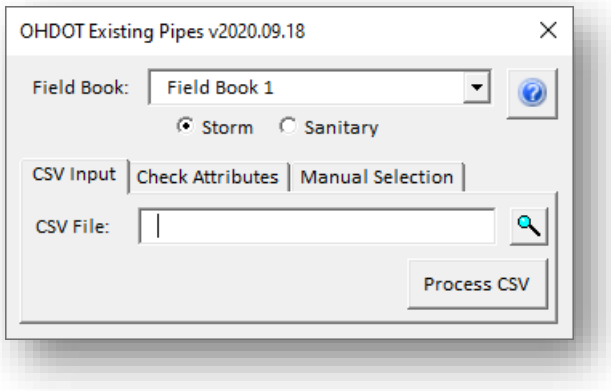
Drawing the Drainage Pipes using a CSV File

After the cells have been rotated into place the next step is to connect the pipes between the drainage structures. This is accomplished by use of the OHDOT_ExistingPipes application.

- From the OHDOT WorkFlow, select the OHDOT Existing Pipes command as shown below.



The dialog shown below is opened.



The application is used to draw storm or sanitary pipes between the drainage structures as previously detailed in this document.

The **CSV Input** tab is used to select and process the CSV file containing the connecting pipe information

Take the following steps to create and import a CSV file containing the pipe information:

- A template Excel spread sheet with the proper headings defined is available in the OHDOT CADD Standards to use a starting point to create the CSV file. Copy the XLSX file from the following location:

  03 Standards\CADD Standards\CONNECT_Config\WorkSpaces\OHDOTCEv01\Standards\Survey Files\OHDOT_ExistingStormSewers.xlsx

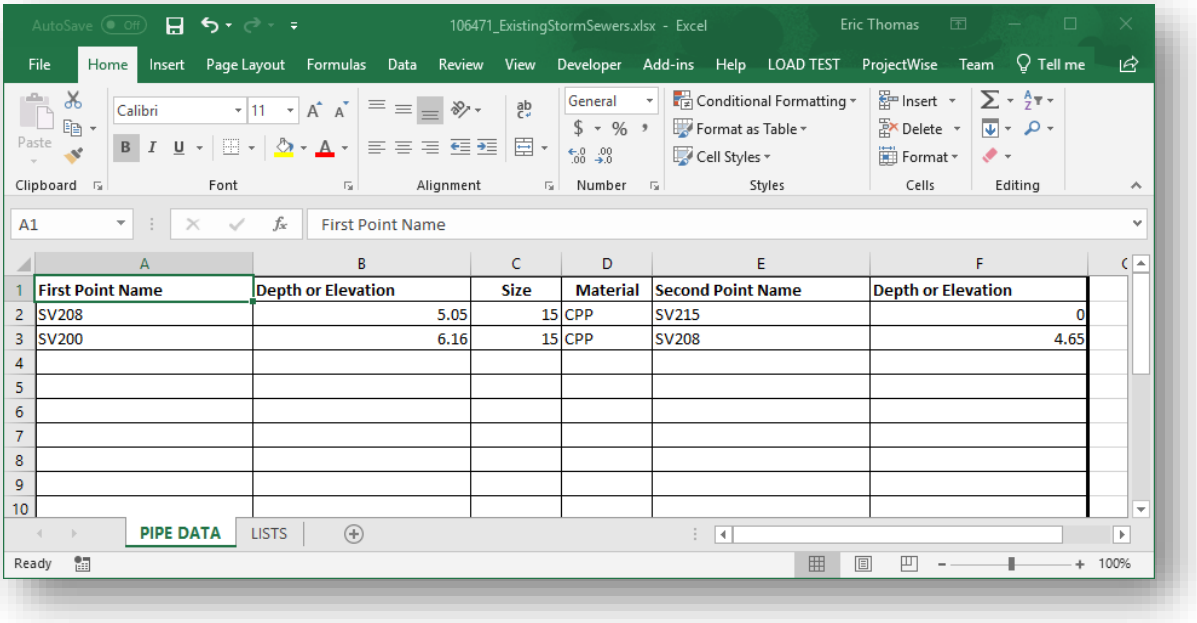
To the following folder for your project:

106471\300-Survey\SurveyData\FieldData\RawData

- Rename the file as follows:

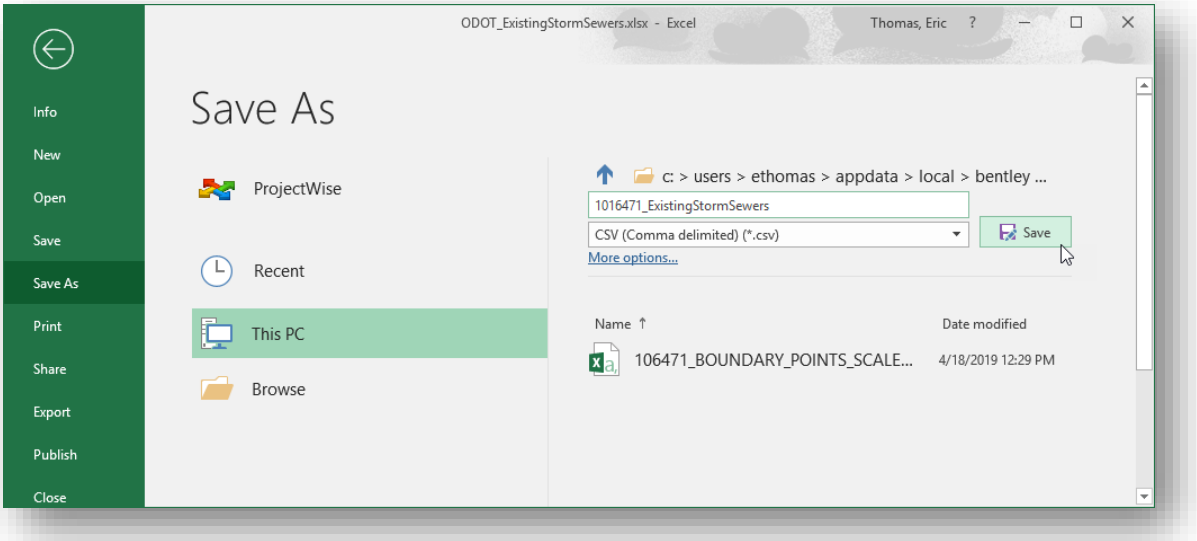
  106471_ExistingStormSewers.xlsx

- Open the file from **ProjectWise Explorer** to edit the XLSX file. Include the information for each storm sewer pipe as show below:

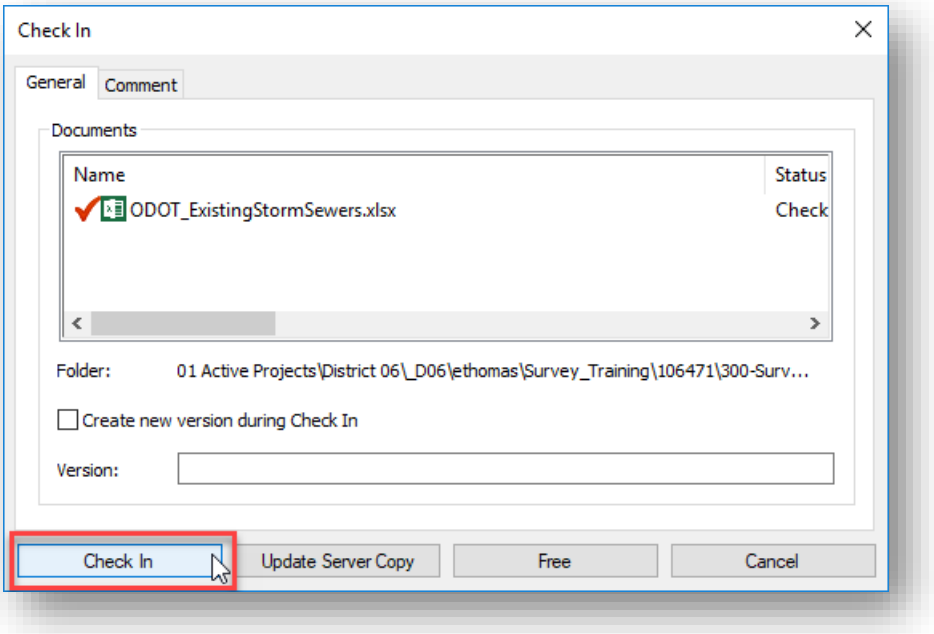


	First Point Name	Depth or Elevation	Size	Material	Second Point Name	Depth or Elevation
2	SV208	5.05	15	CPP	SV215	0
3	SV200	6.16	15	CPP	SV208	4.65

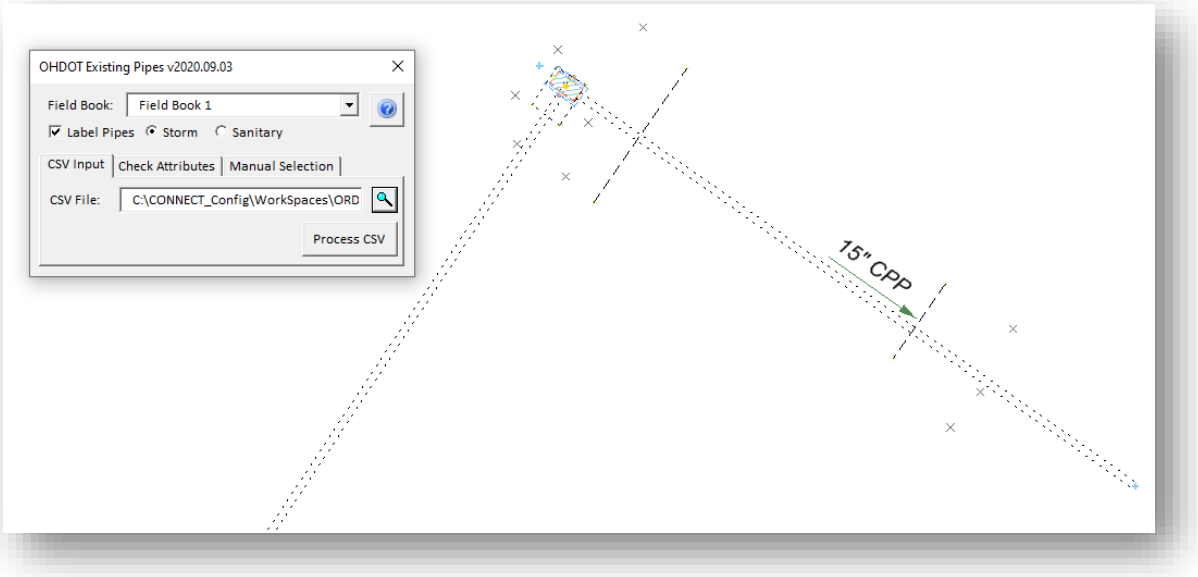
- After adding the information above, choose the **Save As…** option to save the file using the **CSV (Comma Delimited) (*.CVS)** option.



- When prompted, **Check In** the file as shown below.



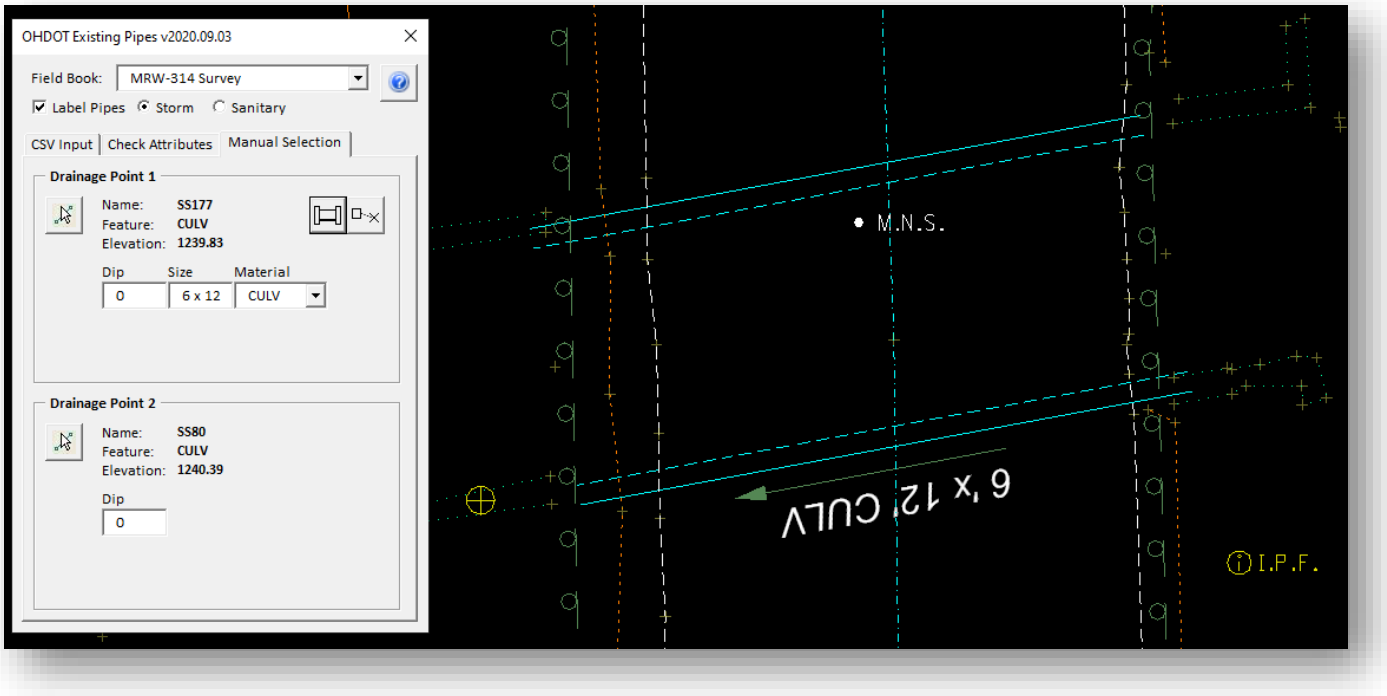
- Open the **OHDOT Existing Pipes** application
- Select the Browse button to open the following CSV file:
  300-Survey\SurveyData\FieldData\RawData\106471_ExistingStormSewers.CSV
- Select the **Process File** button. The pipes are drawn as defined in the CSV file.



- After reviewing the pipe information, close and check-in the design file.

Exercise 2: Creating a 3D Box Culvert

Box culverts are field collected using the **CULV** Code. The points are connected by use of the BL* and EL* mapping codes, or by using the ODHOT Existing Pipes application to draw the culvert lines between the surveyed points. The culvert lines can be drawn using the CSV Input process of the Manual Selection process as show in the example below.



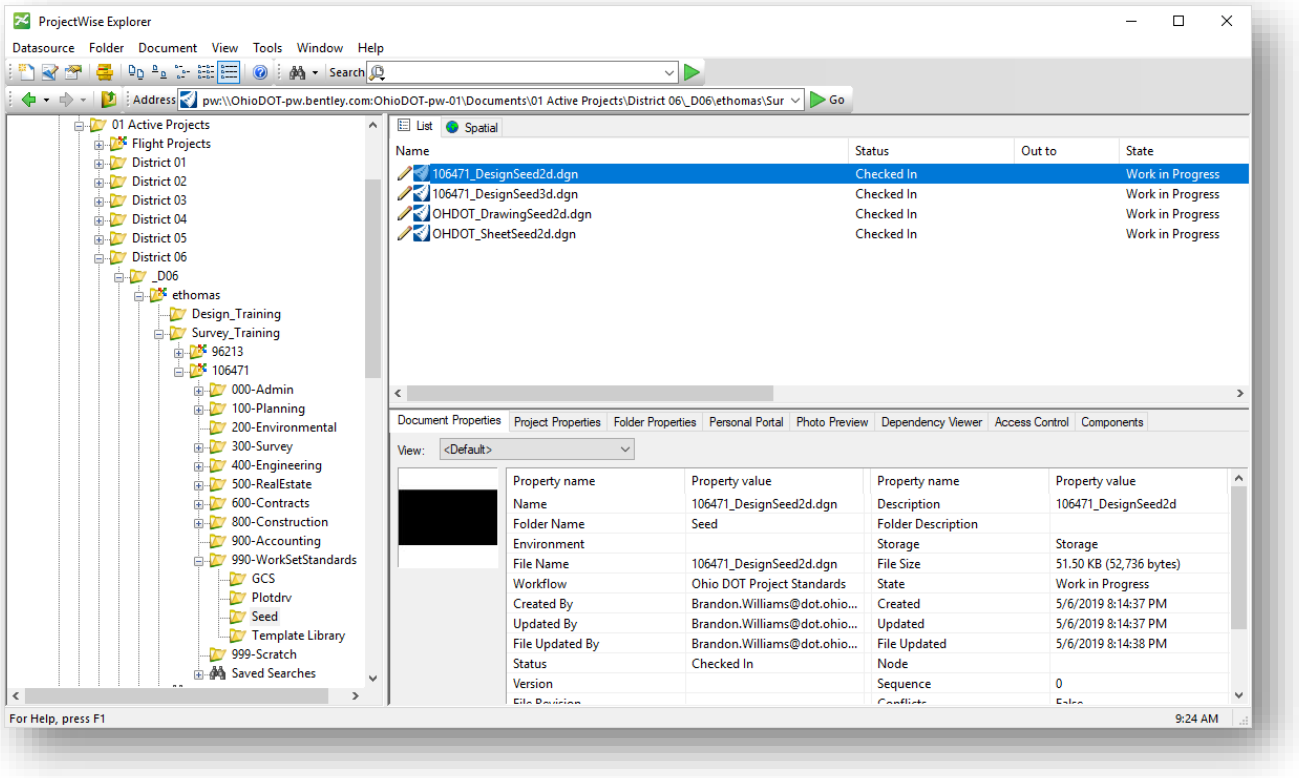
The 3D culvert information is drawn in a separate Drainage Basemap (BD) design file using the Drainage and Utilities tools.

Important - Do not use the Field Book (FB) design file for this process!
When a 3D culvert is generated, the ORD software will generate a utility database in the active file. For this reason, a separate design file is used. ODOT does not want a utility database generated in the Survey Field Book (FB) design file.

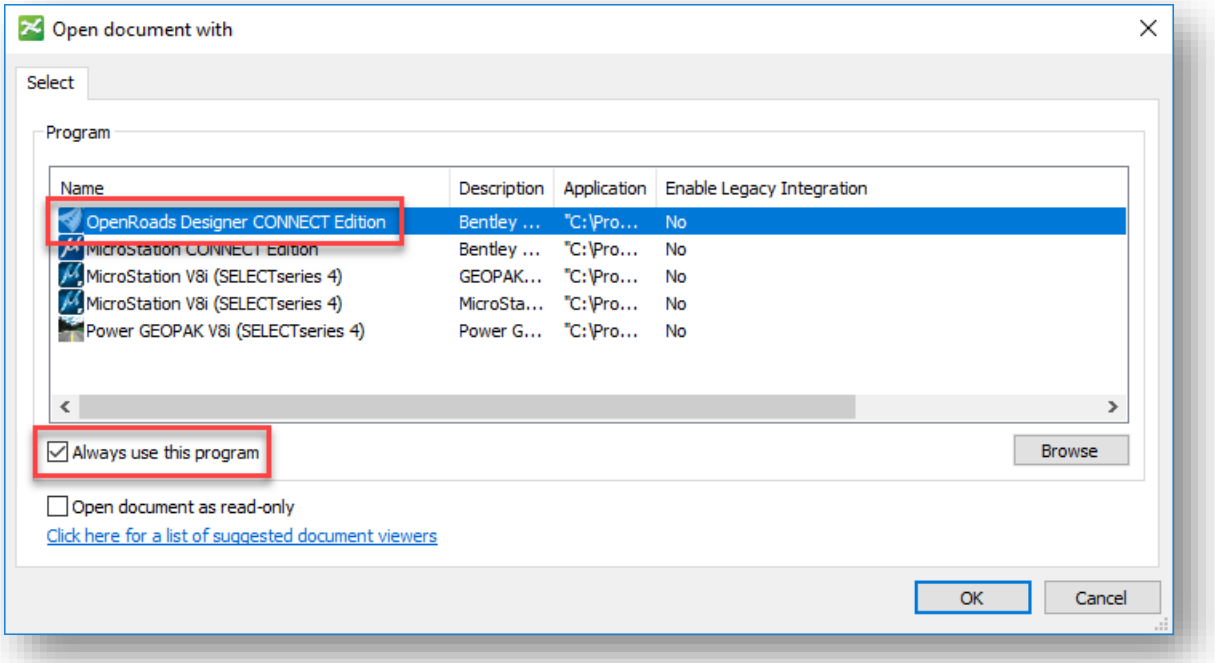
Take the following steps to create the 3D box culvert:

- Open **ProjectWise Explorer**

- Browse to the folder shown below, using your home District and your use name.

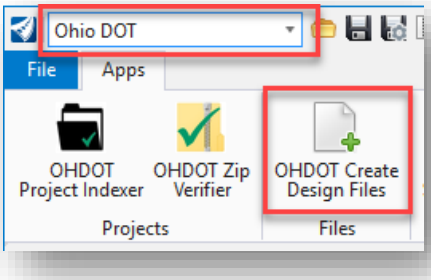


- Right-Click on the file **106471_DesignSeed2d.dgn** and choose the **Open With…** option to open the file with OpenRoads Designer CONNECT Edition. Toggle the **Always use the program** option **ON**



- Select **OK** to open the file

- Select the **Ohio DOT** WorkFlow from the top left of the ORD interface.
- From the **Apps** tab, select the **OHDOT Create Design Files** icon

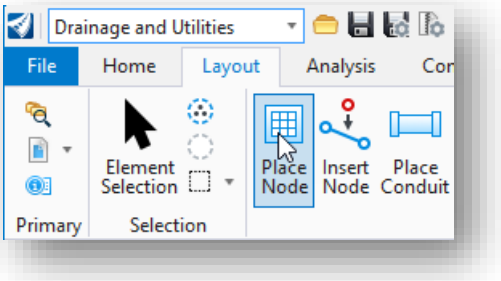


- Create the drainage basemap (BD) design file. Be sure to use the 2D seed file.
- Open the drainage basemap (BD) design file
- After creating a drainage basemap design file, attach the survey basemap as a reference file to view the culvert shots. Box culverts are surveyed using the **CULV** field code to take a shot at the invert elevation at each end of the culvert.

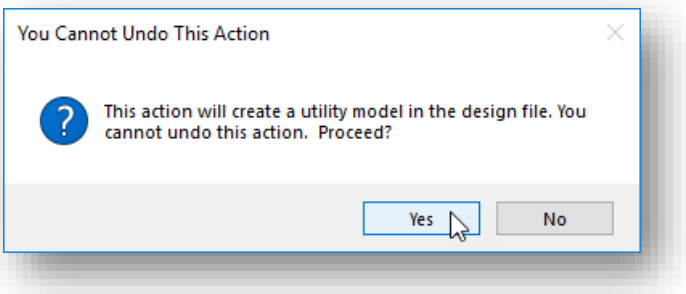
  The graphics for a box culvert is placed in a 2D model in the drainage (BD) basemap design file. The Drainage and Utilities software is used to place the box culvert in a 2D model. The software will automatically generate the 3D model for the box culvert.

Each end of the culvert must first be defined as a "**Node**" using the Drainage and Utilities software.

- From the **Drainage and Utilities** WorkFlow, select the **Place Node** command as shown below

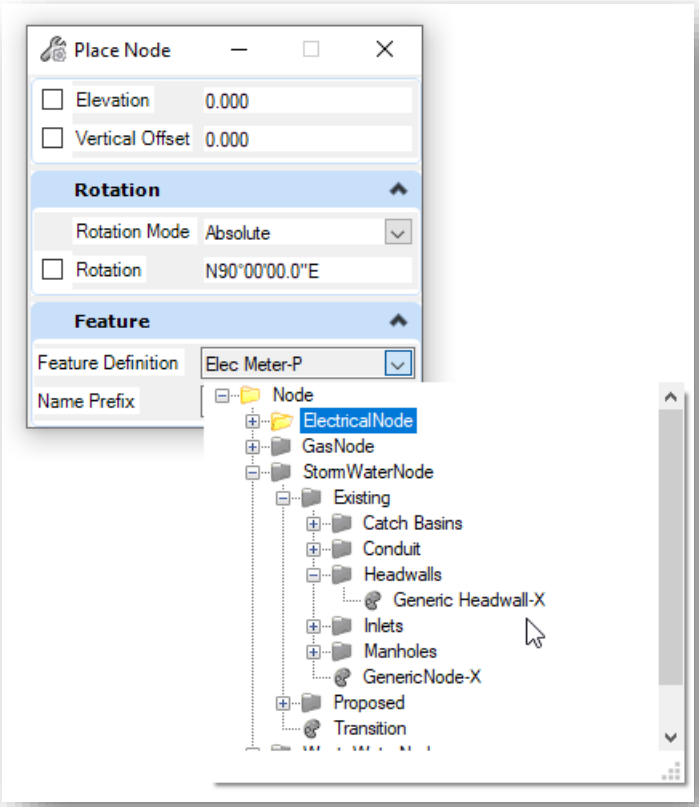


The first time the command is selected, the software will prompt whether to create a utility model in the file as shown below. Select **Yes**.

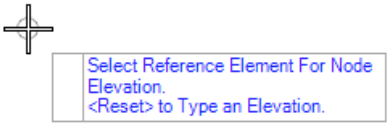


The software will go through several steps to create the utility model. When complete, you must select the **Place Node** command again.

- Box culverts are placed using the **Connect Conduit Between Nodes** command. A node must first be placed at each end of the proposed box culvert in the design file by use of the **Place Node** command. The generic headwall feature definition is used to defile the location of each end of the box culvert.



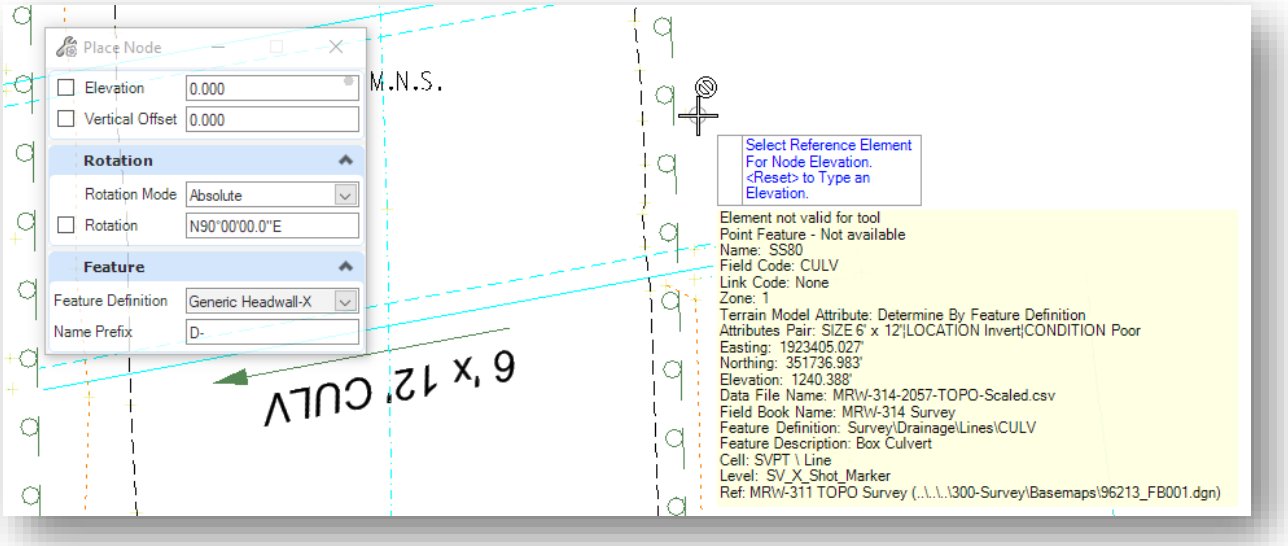
The **Elevation** is defined by selecting a Reference Element, or by keying in a value.



The CULV point cannot be selected as a reference element.

Tip: Float the cursor over the CULV point, allowing the cursor to rest on the element, to open the pop-up menu with the elevation information for the survey point as shown in the example below.

After reviewing the point elevation, right-click (reset) to key-in the elevation for the Node.



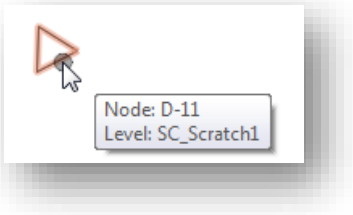
- Key-in the **Elevation** value of **1240.388**

  By default, the generic headwall feature definition has a **Name Prefix** value of **D-**. This can be changed if desired and is set to **D-1** in the example above.

- Follow the remaining prompts to place the headwall item on the CULV point.

After a Node is placed in the file, the sofware creates a 3D model in the file. This 3D model is automatically attached as a reference to the active model.

The generic headwall node is placed using a triangle symbol on the level SC_Scratch1 as shown at right. The direction of the triangle, defined by the **Rotation** parameter, is irrelevant to the flow direction of any links connected to the node.

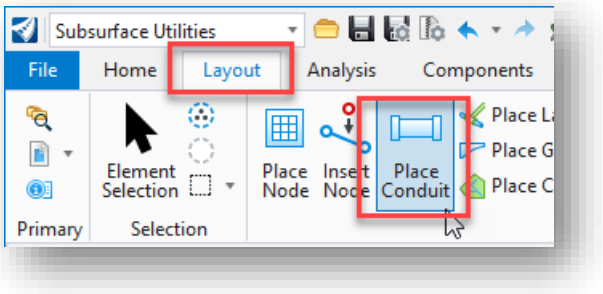


The element drawn in the active 2D model will not match the rotation of the element placed in the 3D model so it will appear that two elements were placed in the file. Only one node was placed and the second one is the 3D representaion of the node.

- Repeat the process to place a second node at the end of the culvert, using the elevation of the second CULV point.

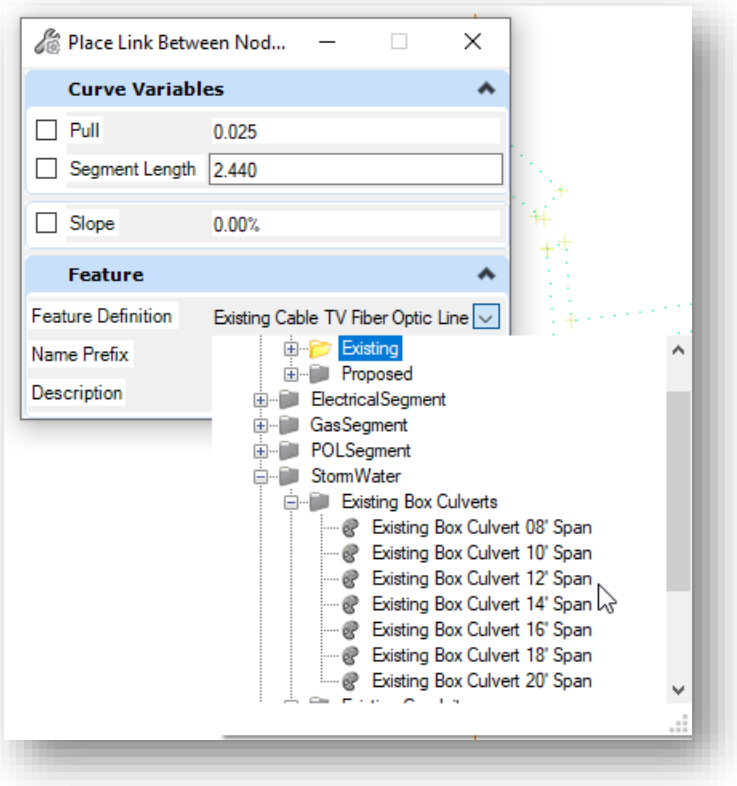
Now that each end of the culvert has been defined with a Node element the culvert can be placed. Take the following steps:

- Select the **Place Conduit** command as shown below



The survey crew entered notes for the size of the culvert as shown in the information pop-up for the CULV point on the previous page. This is a 12'x6' box culvert according to the field notes.

- Choose the **Existing Box Culvert 12' Span** feature definition as shown below

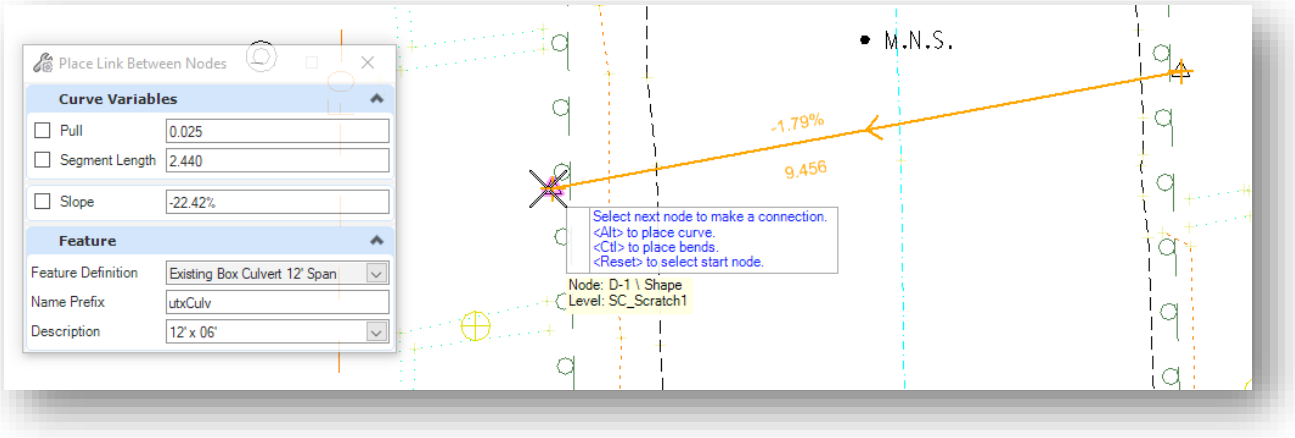


Feature definitions for existing and proposed box culverts are provided in the OHDOT CADD standards.

The span and rise for each available culvert feature is defined by the **Description** field as shown at right above.

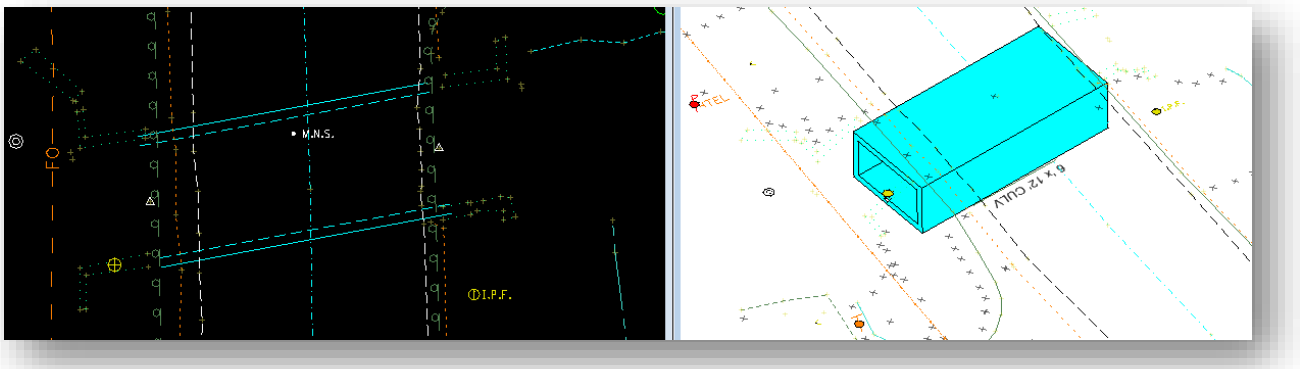
Available culvert sizes are based on the **Figure 1008-14** of the **ODOT Location and Design Manual – Volume 2, Drainage Design**.

The culvert is placed by selecting each node as shown below.

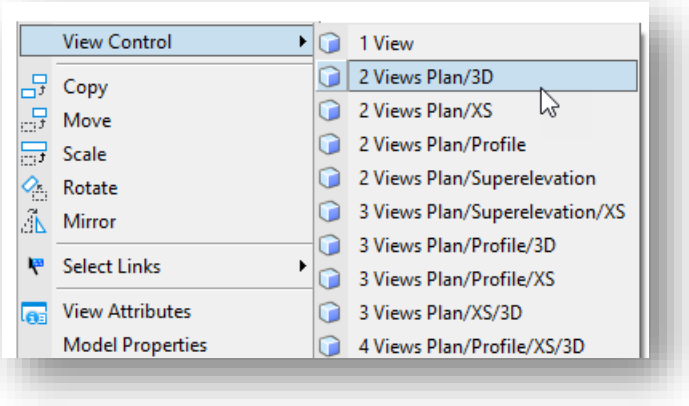


Two sets of graphics are drawn for the box culvert, one in the active 2D model and another in the 3D model.

The **Subsurface Utility** software creates a 3D model in the drainage basemap named "design-3d" containing the 3D model of the box culvert is shown at right below.



To display the 3D view, hold down the right mouse button and choose **View Control > 2 Views Plan/3D** as shown below.



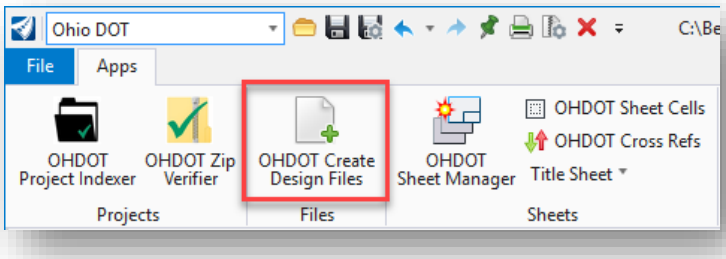
- Close and check the design file back in when complete. This concludes this exercise.

Examples: Creating a 3D Model of the Existing Utilities

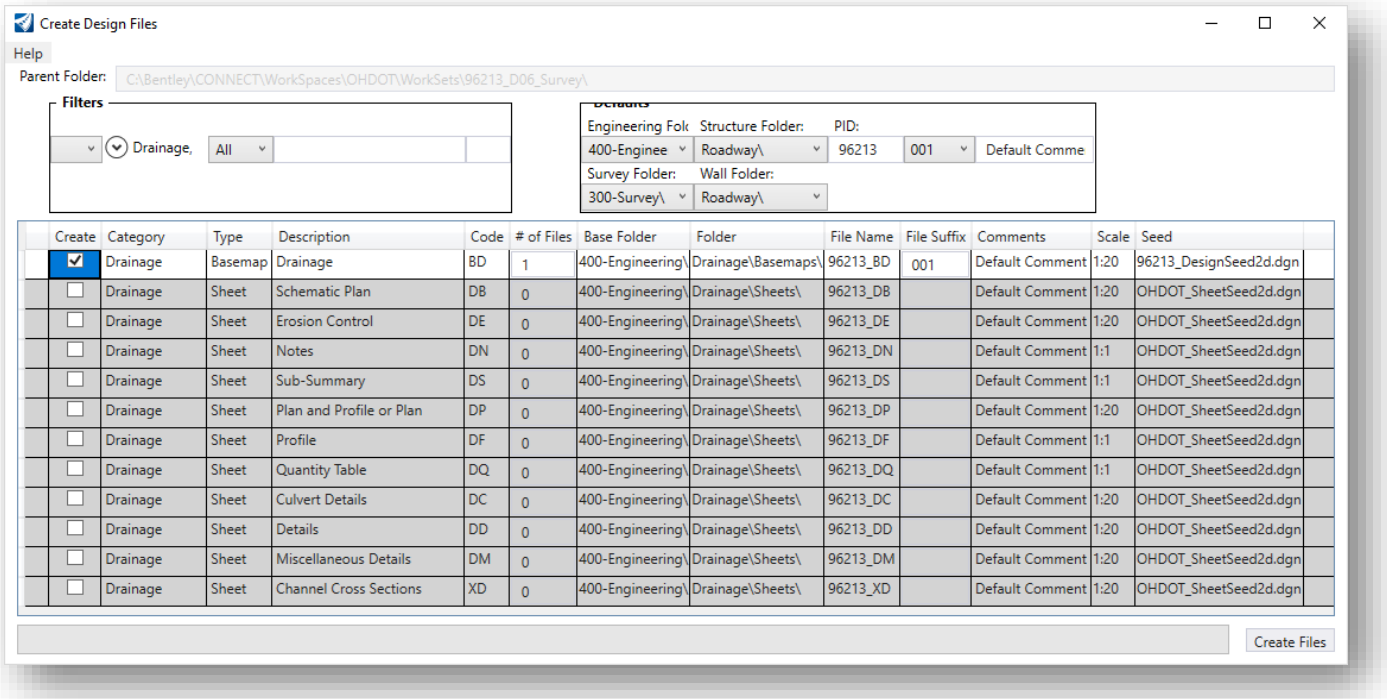
A 3D model for the existing drainage information may be need by the designers depending on the scope of the project. This 3D model is generated in a separate drainage basemap design file (BD) stored in the **400-Engineering\Drainage\Basemaps** folder.

The drainage basemap is created using the **OHDOT Create Design Files** application. The survey data is referenced to the drainage basemap. The drainage structures and the pipes are extracted from the survey file using the **Subsurface Utility** commands to generate the 3D model.

Use the **OHDOT Create Design Files** application is selected from the **OHDOT** WorkFlow as shown below.



The drainage basemap is created using the settings shown below. See the application documentation for additional information.



Create	Category	Type	Description	Code	# of Files	Base Folder	Folder	File Name	File Suffix	Comments	Scale	Seed
☑	Drainage	Basemap	Drainage	BD	1	400-Engineering\	Drainage\Basemaps\	96213_BD	001	Default Comment	1:20	96213_DesignSeed2d.dgn
☐	Drainage	Sheet	Schematic Plan	DB	0	400-Engineering\	Drainage\Sheets\	96213_DB		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Erosion Control	DE	0	400-Engineering\	Drainage\Sheets\	96213_DE		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Notes	DN	0	400-Engineering\	Drainage\Sheets\	96213_DN		Default Comment	1:1	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Sub-Summary	DS	0	400-Engineering\	Drainage\Sheets\	96213_DS		Default Comment	1:1	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Plan and Profile or Plan	DP	0	400-Engineering\	Drainage\Sheets\	96213_DP		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Profile	DF	0	400-Engineering\	Drainage\Sheets\	96213_DF		Default Comment	1:1	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Quantity Table	DQ	0	400-Engineering\	Drainage\Sheets\	96213_DQ		Default Comment	1:1	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Culvert Details	DC	0	400-Engineering\	Drainage\Sheets\	96213_DC		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Details	DD	0	400-Engineering\	Drainage\Sheets\	96213_DD		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Miscellaneous Details	DM	0	400-Engineering\	Drainage\Sheets\	96213_DM		Default Comment	1:20	OHDOT_SheetSeed2d.dgn
☐	Drainage	Sheet	Channel Cross Sections	XD	0	400-Engineering\	Drainage\Sheets\	96213_XD		Default Comment	1:20	OHDOT_SheetSeed2d.dgn

Notes:

- Use the 2D seed file to create the drainage basemap. The **Subsurface Utilities** software will generate a separate 3D model in the drainage basemap design file for the 3D drainage information
- The file is created in the **400-Engineering\Drainage\Basemaps** folder
- The two-character file code is “BD”.

Extracting the 3D Drainage Nodes

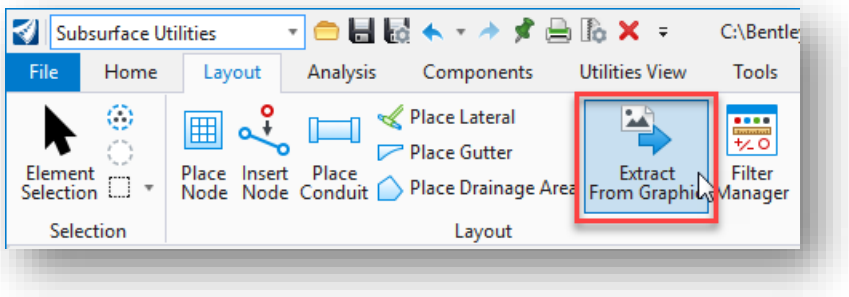
Bentley's **Subsurface Utility** tools are used to generate the 3D model of the existing drainage information. Catch basins, manholes, and inlets are referred to as a "node" by the subsurface utility software.

Take the following actions to create a 3D model of the existing drainage information. It is assumed the catch basin, manhole, and inlet cells have been rotated into place in the survey basemap before starting this process. The application **OHDOT Rotate Survey Symbols** can be used to rotate selected symbols relative to a selected curvilinear element. See the application documentation for more information.

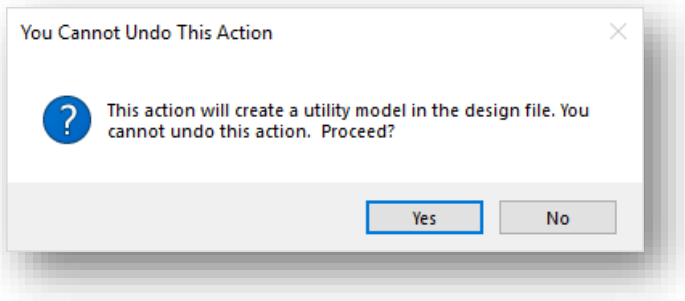
1. Open the newly created drainage basemap (BD) design file.

2. Attach the survey basemap as a reference.

3. Select the **Extract from Graphics** command, located in the **Layout** tab of the **Subsurface Utilities WorkFlow** as shown below.



Note:
If this is the first time you have selected the command, you are prompted to create a utility model. Select **Yes** to create the utility model.



After the utility model is created, you must select the **Extract from Graphics** command to initiate the process. The **Extract Utilities From Graphics** dialog is accessed as shown on the following page.

Take the following steps to extract the utility information. The options can also be selected by use of the menu prompts floating on the cursor.

1. Set the **Method** to **Utility Filter**. Several filters are provided in the OHDOT CADD Standards for individual drainage items as well as groups of items.

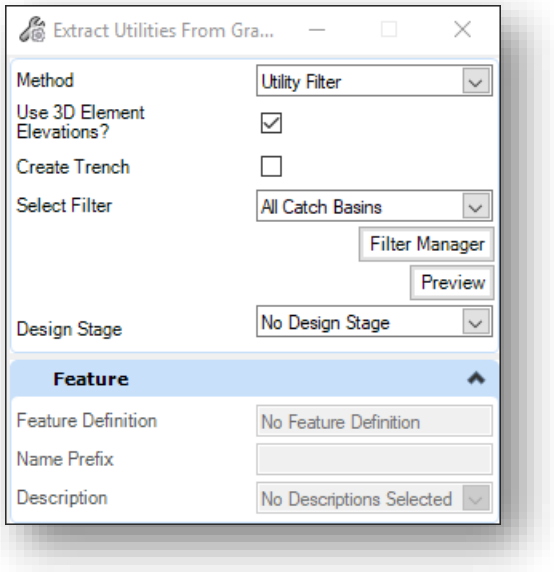
2. Use the **Select Filter** item to choose **All Catch Basins** filter. This filter is configured to extract only the drainage cells for the catch basins and not the pipes. The pipes will be extracted individually as

a separate process.

3. Toggle on the **Use 3D Element Elevations** option.

4. Accept the options as you are prompted on the cursor to initiate the extraction process.

   Note: The **Design Stage** item is not relevant to this process.

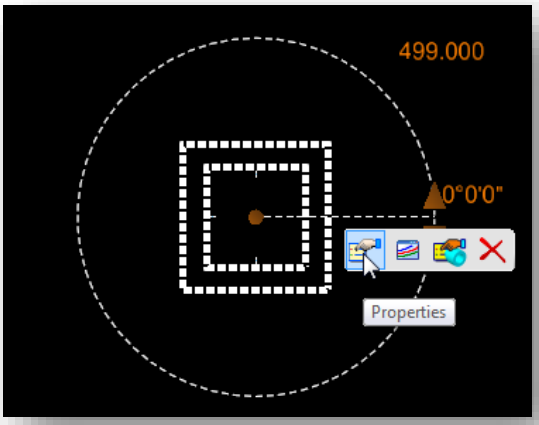


The 3D drainage structures are extracted using the elevation of the cells mapped by the Survey process. As each drainage structure is processed, the extraction process will search for a **FLINE** feature to establish the depth of the drainage structure. If a **FLINE** feature is not found, the depth is set using at a default value.

If the drainage basemap was created with a 2D seed file, which is the recommended best practice, **the Extract Utilities from Graphics** process will create a new model named **Design-3D** containing the 3D drainage structures. This new model is automatically attached as a reference to the current 2D model.

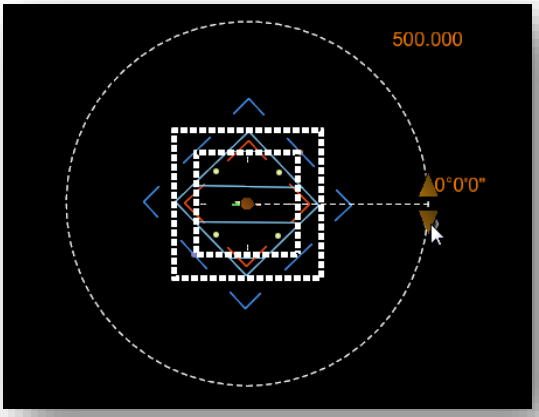
In addition to the 3D model, a 2D graphic is placed in the current 2D model for each extracted drainage structure nodes. This graphic is linked to the 3D model and can be used to make edits to the drainage structure.

In the example below, the reference file display of the survey basemap and the Design-3D model has been turned off to show the 2D graphic that is placed for one of the drainage structures.



Selecting the graphic reveals a pop-up menu that can be used to make edits to the drainage structure as well as two rules (**Node Top Elevation**, and **Node Rotation**) that can be edited by selecting the displayed text.

The extracted drainage structures do not take into account the rotation angle of the original cells and are placed at a zero degree rotation. The example at left below shows the original cell as referenced from the Survey basemap, and the 2D cell that was placed as part of the utility extraction process. It is necessary to rotate each structure manually.

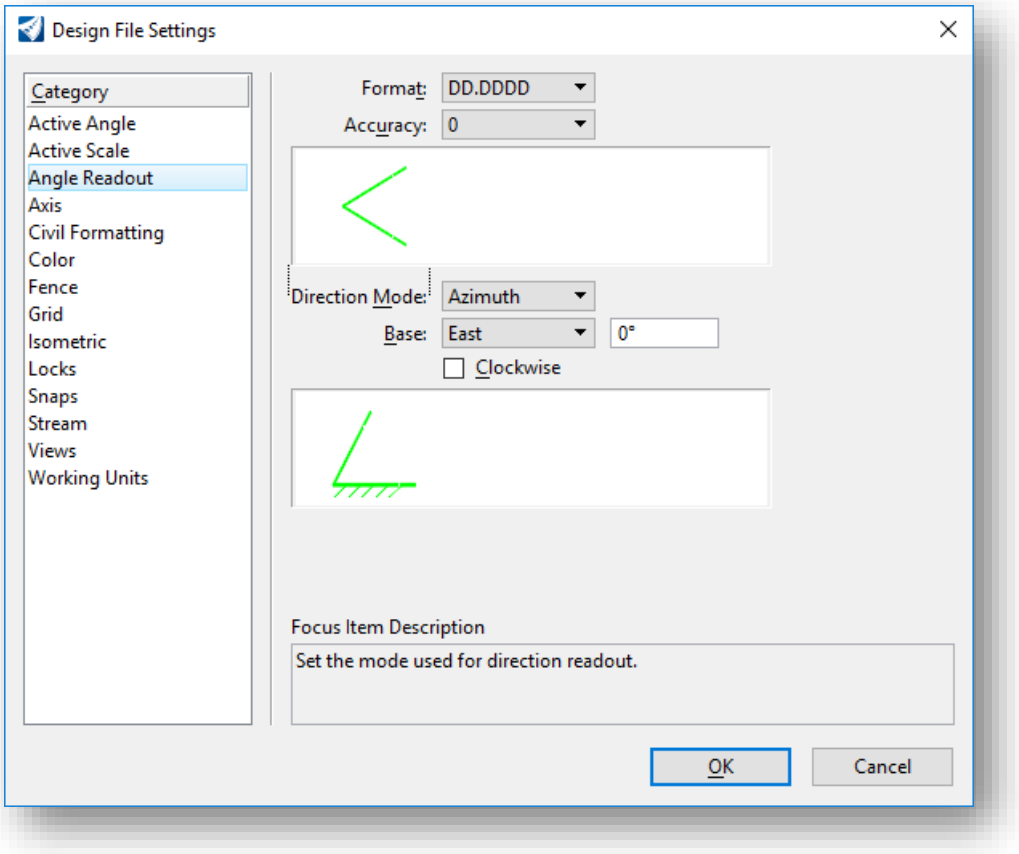


Once the 2D node is selected, parameters for the rotation of the 3D structure are displayed as shown at left. The angle can be keyed-in by selecting the angle text, or the 3D structure can be rotated by selecting one of the rotation arrows.

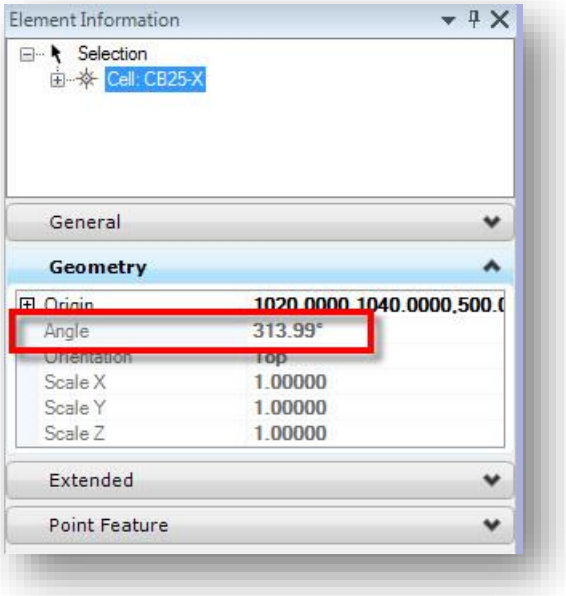
Typically, it is best to get the rotation angle of the original cell and use that value to key-in the rotation angle for the drainage node as described on the following page.

Take the following steps to key-in the rotation angle for the drainage structure:

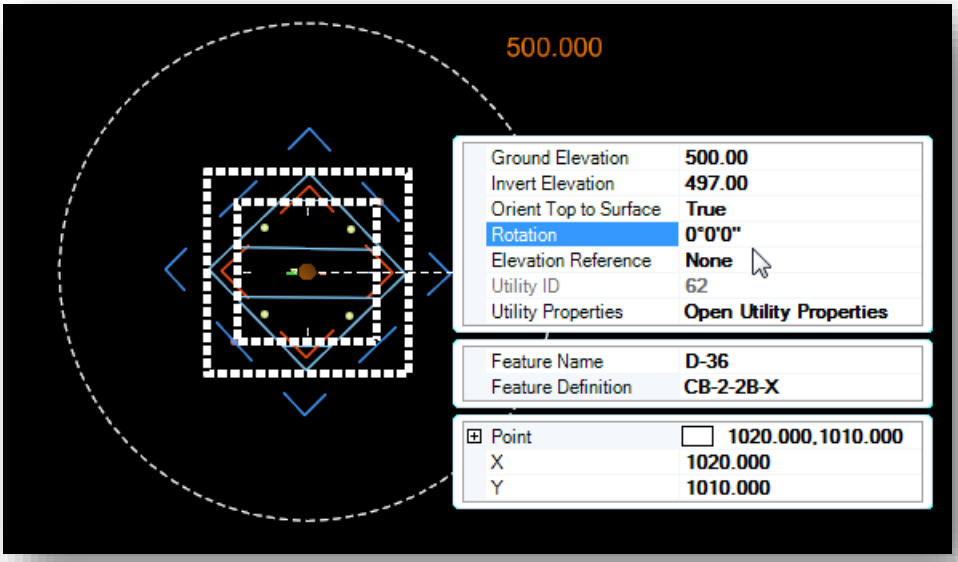
- ✓ Change the **Angle Readout** as shown below by selecting **File > Settings > File > Design File Settings**



✓ Use the MicroStation **Element Information** command to get the rotation angle of the original cell as shown below.

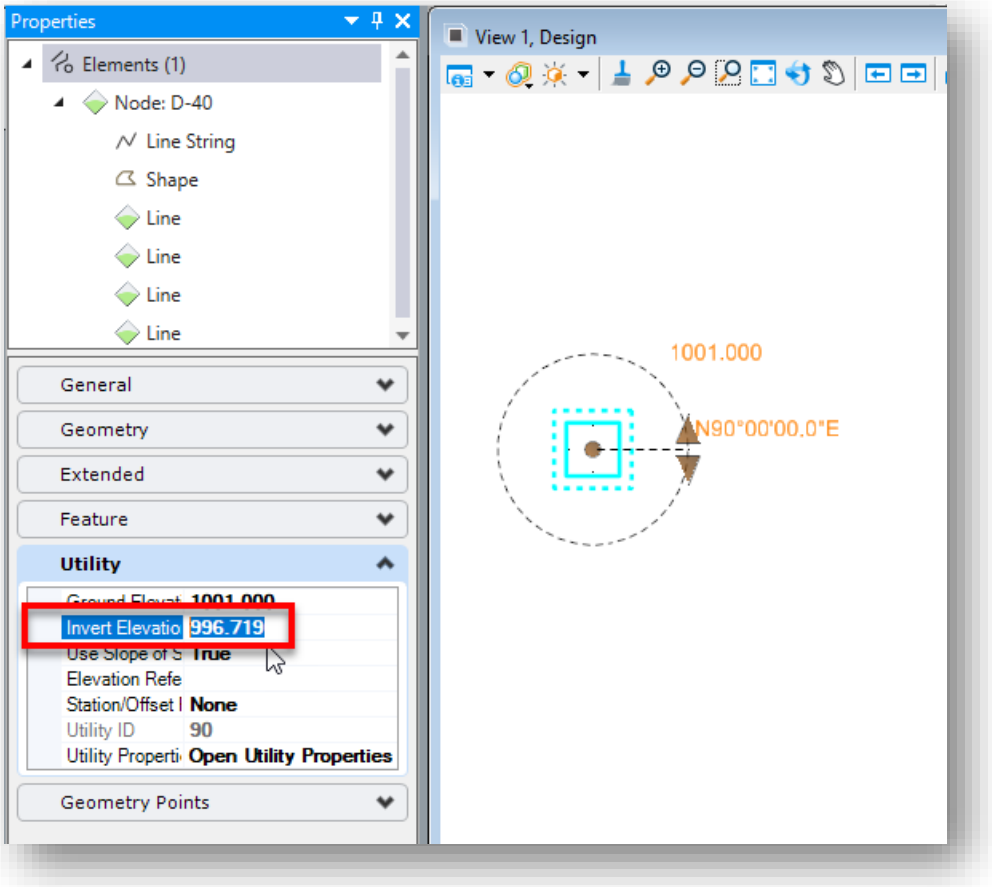


- ✓ Select the drainage node graphic and choose the **Properties** command from the pop-up menu. The **Rotation** can be modified as shown below. The graphics for the node in the 3D model are updated as changes are made to the properties.



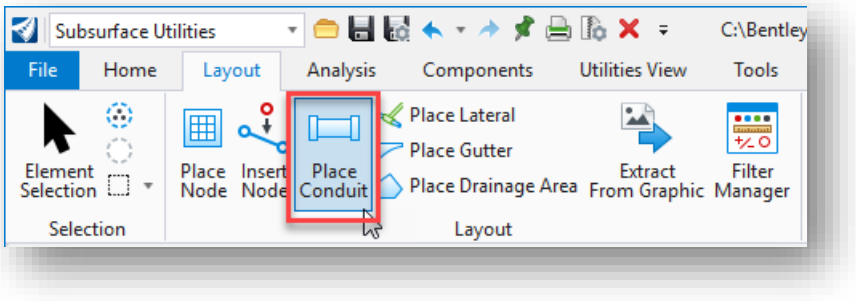
After extracting the drainage structures and rotating them into place we are ready to extract the pipes.

After extracting the graphics, it is necessary to select each structure and manually key-in the **Invert Elevation** value. An example is shown below.

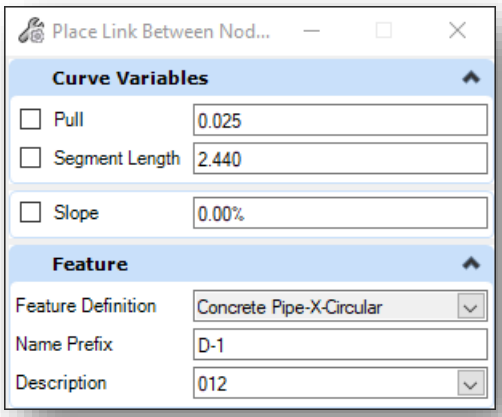


Extracting Drainage Links

The **Extract Utilities from Graphics** command could be configured to extract pipe information; however, as of this writing the current release of the software will not connect the extracted pipes to the previously extracted nodes. Even though it is more cumbersome, it is better to place each pipe manually as a "link" using the **Place Conduit** command, shown below.



The dialog shown below is opened.



General information for the command can be found by selecting **Subsurface Utility > Help > Subsurface Utilities Help** from the MicroStation pull-down menu.

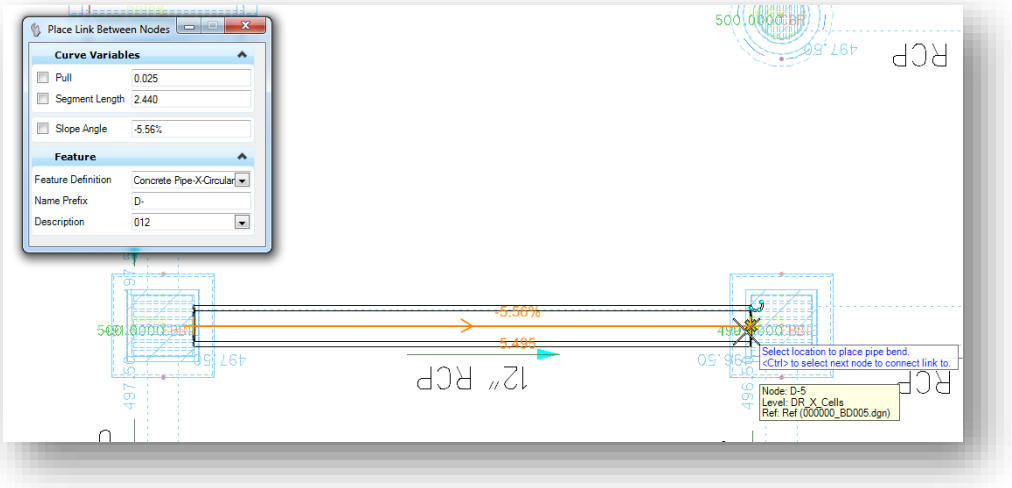
The **Feature Definition** is used to select the pipe type.

The **Description** item is used to select the pipe size.

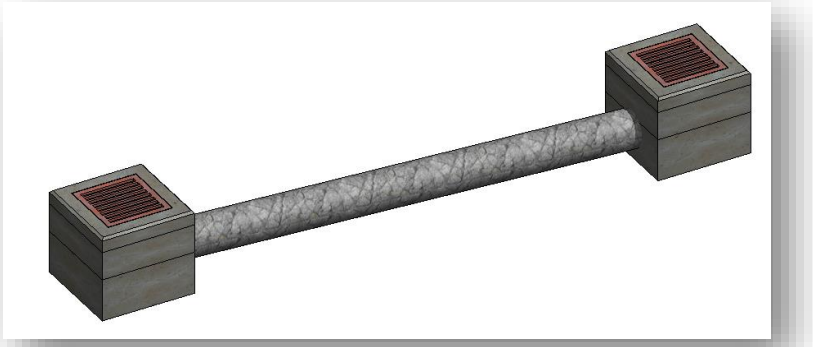
The **Name Prefix** is used to name each pipe and is incremented as you extract the pipes.

When the command is selected, you are prompted to **Select Start Node**.

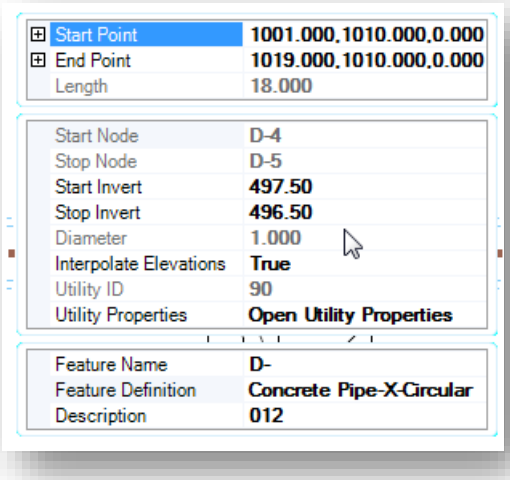
The ODOT 3D drainage items have specific connection regions on each side of rectangular structures. Circular structures have a circular connection region. When the first node is selected, the link starts from one of the connection regions. Follow the prompts to select the second node. An example is shown on the following page.



A line is placed in the current 3D model that can be used to modify he link. The extruded 3D link is placed in the 3D model as shown below.



The link is placed at the lowest elevation of the selected nodes. The elevation values can be edited by selecting the link in either the 2D or the 3D model, and then choosing the **Properties** icon from the pop-up menu.



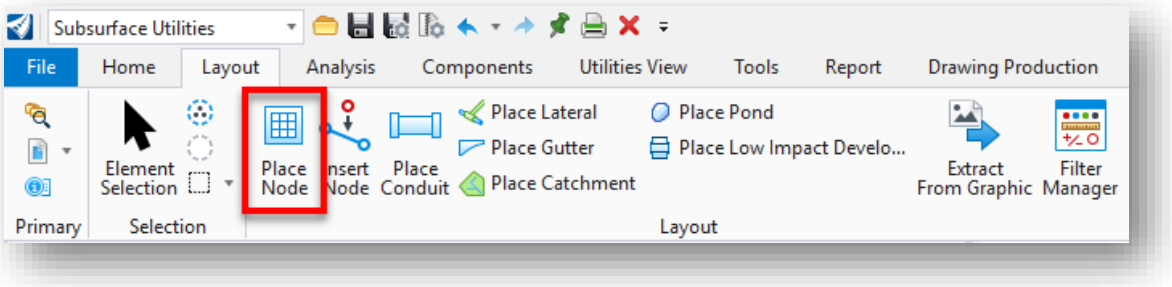
From the *Properties* menu, shown at left, the **Start Invert** and **Stop Invert** values can be edited if necessary to set the correct elevations for the pipe.

Connecting Links to FDO or PIO Points

The field codes PIO (pipe inlet or outlet) and FDO (for direction only) can both be used to designate the end of a pipe. PIO is used to designate an inlet or outlet point for an open pipe of culvert. FDO (for direction only), is used to designate the direction of a pipe when the other end cannot be located.

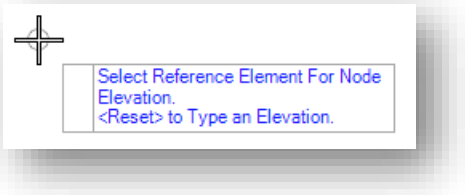
There must be a node defined at the PIO and FDO locations to place a link in the design file using the PIO and FDO points. The **Place Node** command is used to place nodes at the PIO and FDO locations.

The command is selected from the **Subsurface Utilities** WorkFlow as shown below.



Take the following steps to create nodes for the PIO and FDO points:

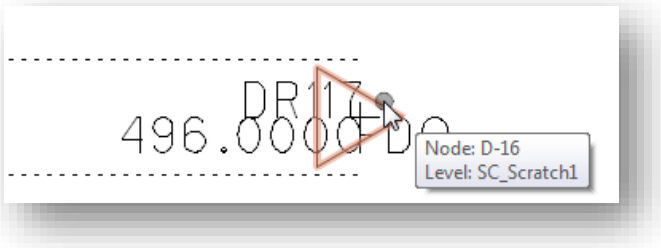
- Select the **Place Node** command
- Set the **Feature Definition** to the **Pipe Inlet or Outlet-X** item
- When prompted as shown below, issue a reset (right-click) to type in the elevation for the node



- Type in the **Elevation** for the node
- Enter a data point for the node location by snapping to the PIO or FDO point
- A triangle is placed in the 2D and the 3D models at the location of the node. The direction of the triangle is irrelevant

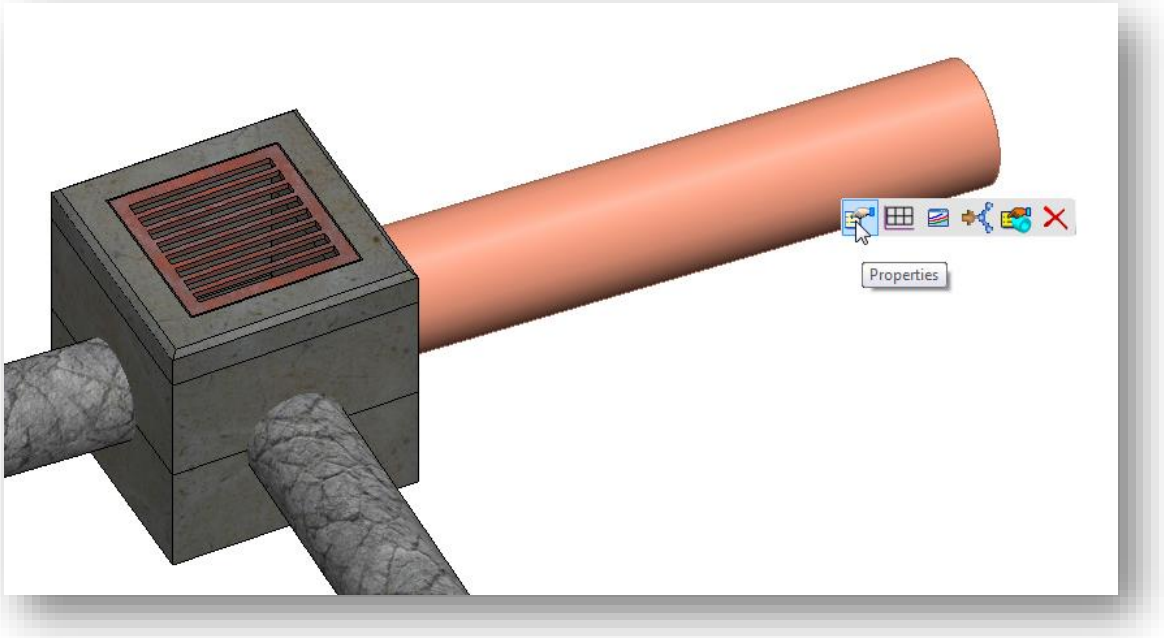
The extracted node for the PIO and FDO points is placed as a triangle at each point on the level SC_Scratch1 as shown at right.

The **Place Conduit** command described in the previous section is used to place the 3D pipes between the nodes.



Reviewing and Editing Nodes and Links

After the nodes and links have been created, it is good practice to review the values for accuracy. The parameters of the 3D drainage information can be edited by using the MicroStation **Element Selection** tool to select a node or link, and then choosing the **Properties** icon from the pop-up menu as shown below.



The parameters are shown below. Note that the invert values for a link cannot be edited if the link was extracted from graphics.

Link Properties

Start Point	1030.000,1040.000,0.000
End Point	1030.000,1030.000,0.000
Length	10.000
Start Node	D-21
Stop Node	D-20
Start Invert	499.75
Stop Invert	500.00
Diameter	1.000
Interpolate Elevations	True
Utility ID	145
Utility Properties	Open Utility Properties
Feature Name	D-1
Feature Definition	Concrete Pipe-X-Circular
Description	012

Node Properties

Origin	1020.0000,1010.0000,497
Angle	N90°0'0"E
Orientation	Top
Scale X	1.00000
Scale Y	1.00000
Scale Z	1.00000
Ground Elevation	499.00
Invert Elevation	496.00
Orient Top to Surface	True
Rotation	0°0'0"
Elevation Reference	None
Utility ID	30
Utility Properties	Open Utility Properties
Feature Name	D-4
Feature Definition	CB-2-2B-X
Point	1020.000,1010.000
X	1020.000
Y	1010.000

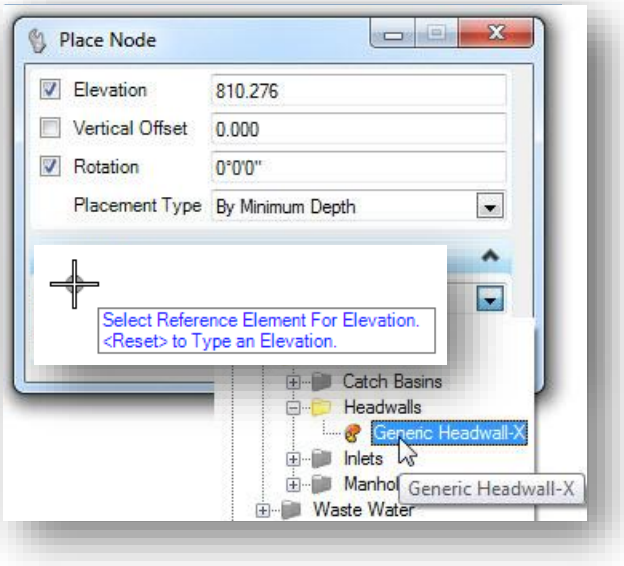
Box Culverts

The graphics for existing storm water utilities are normally placed in a 2D model in the drainage (BD) basemap design file. The **Subsurface Utility** software is used to place the box culvert in a 2D model. The software will automatically generate the 3D model for the box culvert.

After creating a drainage basemap design file, attach the survey basemap as a reference file to view the culvert shots. Box culverts are surveyed using the **CULV** field code to take a shot at the invert elevation at each end of the culvert.

Box culverts are placed as a link by the **Subsurface Utility** software by use of the **Connect Conduit Between Nodes** command. A node must first be placed at each end of the proposed box culvert in the design file by use of the **Place Node** command. The generic headwall feature definition is used to defile the location of each end of the box culvert.

Select the **Place Node** command from the task list as shown below.

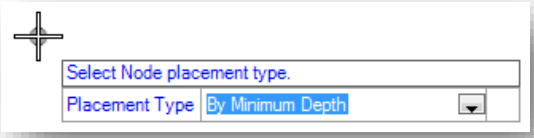


Place a node at each end of the proposed box culvert using the **Generic Headwall-X** feature definition as shown above.

The user is prompted to select a reference element for the node elevation as shown below.

Nodes can be placed at a specific elevation, or relative to the selected surface or a corridor model. Issue a **Reset** to type an elevation.

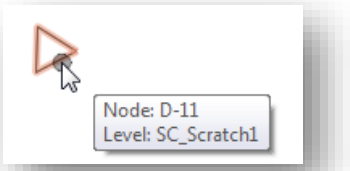
After the elevation reference is defined, the user is prompted to set the **Placement Type**.



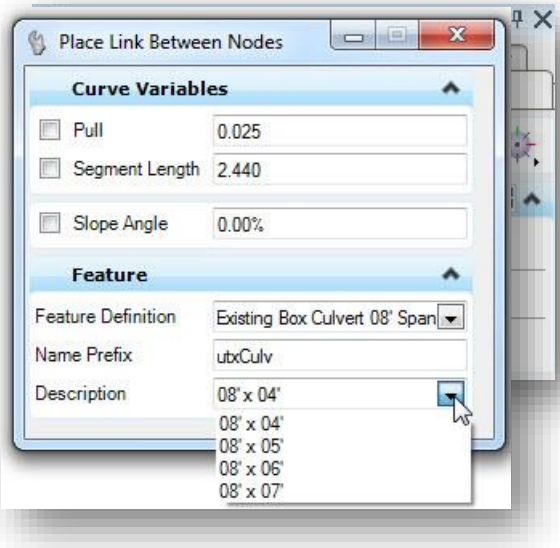
The **By Minimum Depth** option is used to set the initial depth using a default value. The invert elevation can be edited after placement if necessary.

Next the user is prompted to set the location of the node. Place the node at the location of the CULV survey point.

The generic headwall node is placed using a triangle symbol on the level SC_Scratch1 as shown at right. The direction of the triangle, defined by the **Rotation** parameter, is irrelevant to the flow direction of any links connected to the node.

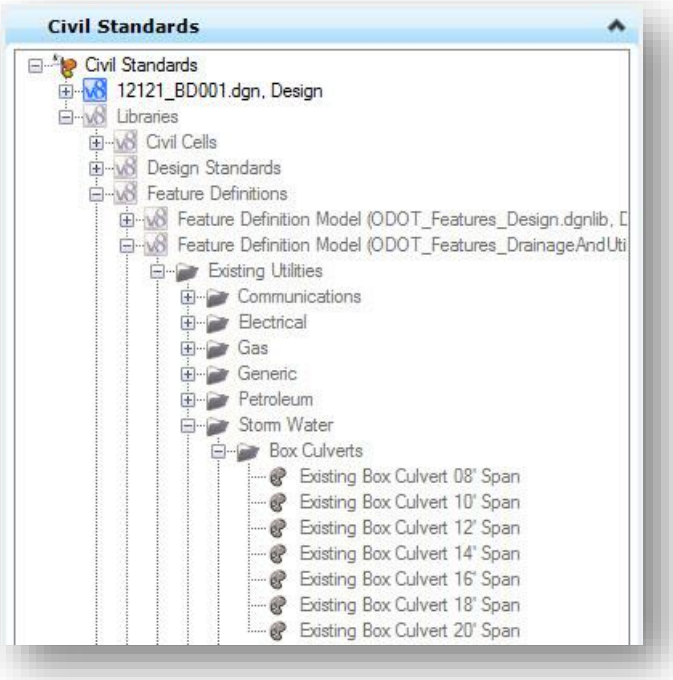


After the headwall points have been placed at each end of the culvert, the box culvert is placed using the **Connect Conduit Between Nodes** command shown below.



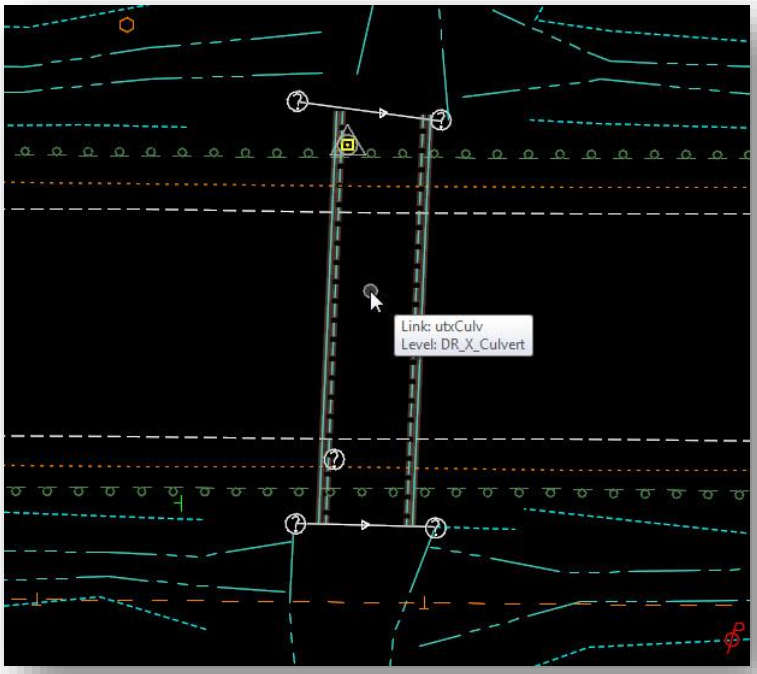
Feature definitions for existing and proposed box culverts are provided in the ODOT standards. The available features for existing box culverts are shown on the following page. The span and rise for each available culvert feature is defined by the **Description** field as shown at right above.

Available culvert sizes are based on the **Figure 1008-14** of the **ODOT Location and Design Manual – Volume 2, Drainage Design**.



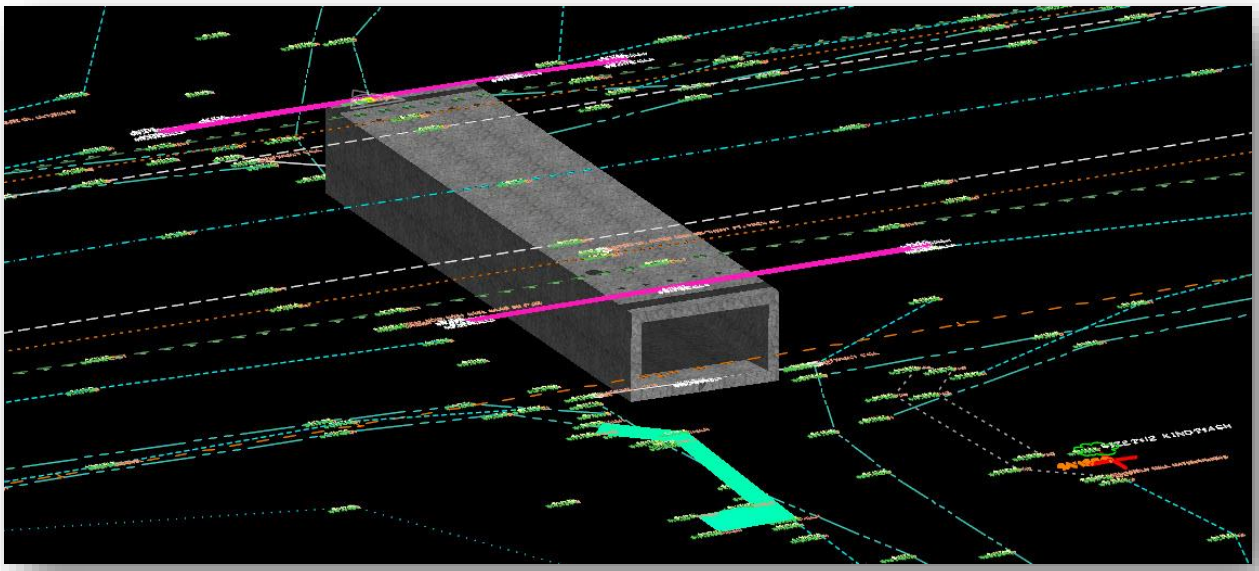
The culvert is placed by selecting each node as shown below.

Two sets of graphics are drawn for the box culvert as shown below.



The culvert is drawn as a custom line style in the 2D model as shown at left. The 2D model can be referenced back to the survey basemap (BE file) if desired, or attached as a reference by the design personnel.

The Subsurface Utility software also creates a 3D model in the drainage basemap named “design-3d” containing the 3D model of the box culvert as shown below.



OpenRoads Software Version

This document was prepared using the following software version:

OpenRoads Designer CONNECT Edition – 2020 Release 2 Update 8 – Version 10.08.01.33

Contacts

For any questions, suggestions, or problems with this document please contact the ODOT Office of CADD and Mapping Services by use of the following form on the ODOT website:

https://odot.formstack.com/forms/cadd_servicerequest