Chapter 3

Inlets

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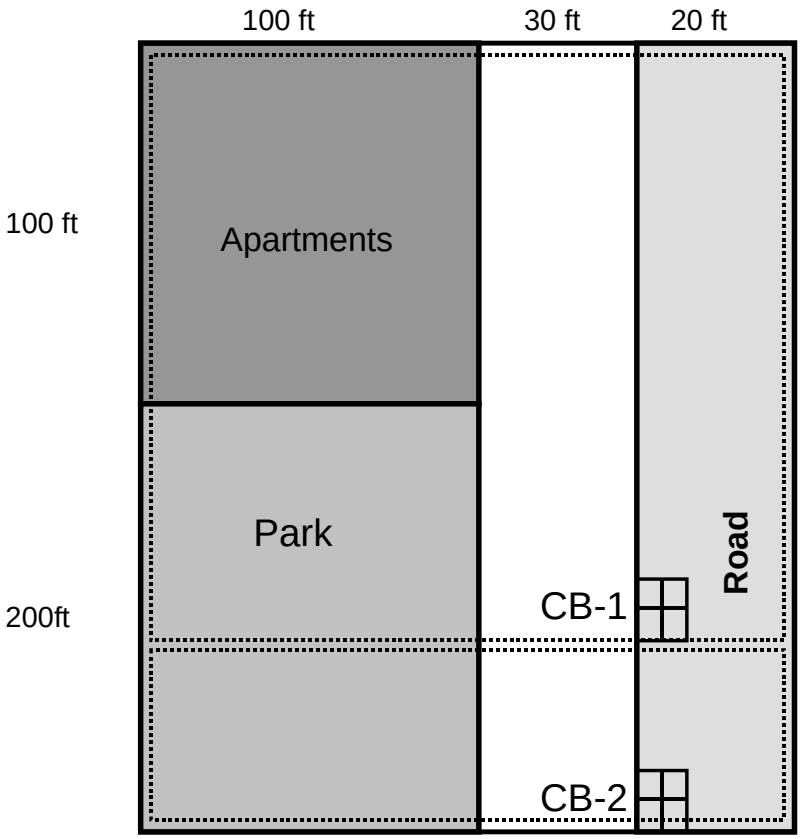
3.1 Objectives

Create and place stormwater inlets and associated drainage areas in GEOPAK Drainage

3.2 Overview

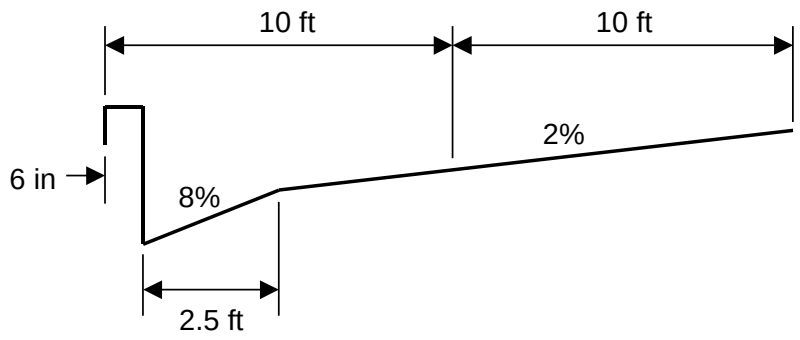
Establish inlets to collect run off from the drainage area that we created in Chapter 2. We will need to place 2 inlets in order to satisfy the ponded width (spread), ponded depth, and interception criteria. If we recall from Chapter 1 that there must be a 1 to 1 relationship between inlets and drainage areas, so the overall drainage area will have to be subdivided and each of these subareas will be associated with an individual inlet.

The first inlet (CB–1) is a 2'x2' curved vane grate and will be located 80 feet from the downstream end of the drainage area. The second inlet (CB–2) is a 2'x2' combo curved vane grate and curb opening and will be located at the downstream end of the drainage area. The typical spread section and vertical alignment of the roadway are shown in the figures on the next page.

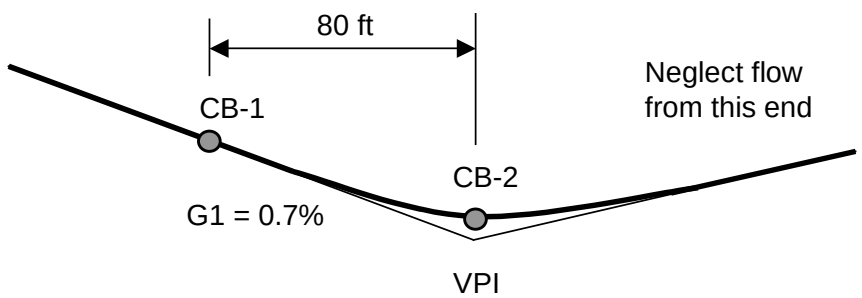


Inlet Label	Inlet Type	Tc (min)	Elevation (ft)
CB-1	2x2 CV Grate on Grade	5	100
CB-2	2x2 Combo CV Grate	6	99.5

Typical Spread Section



Vertical Alignment



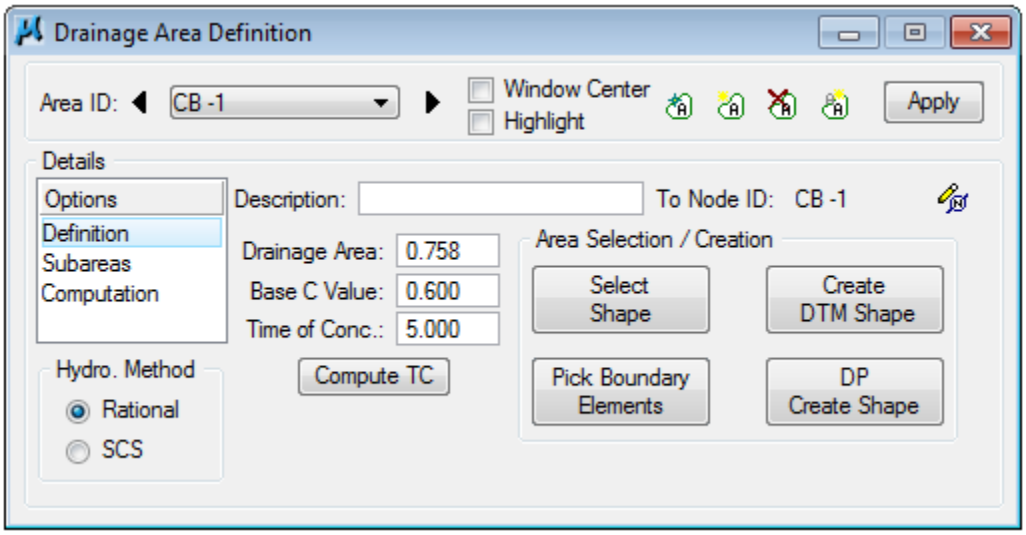
3.3 Define Subareas

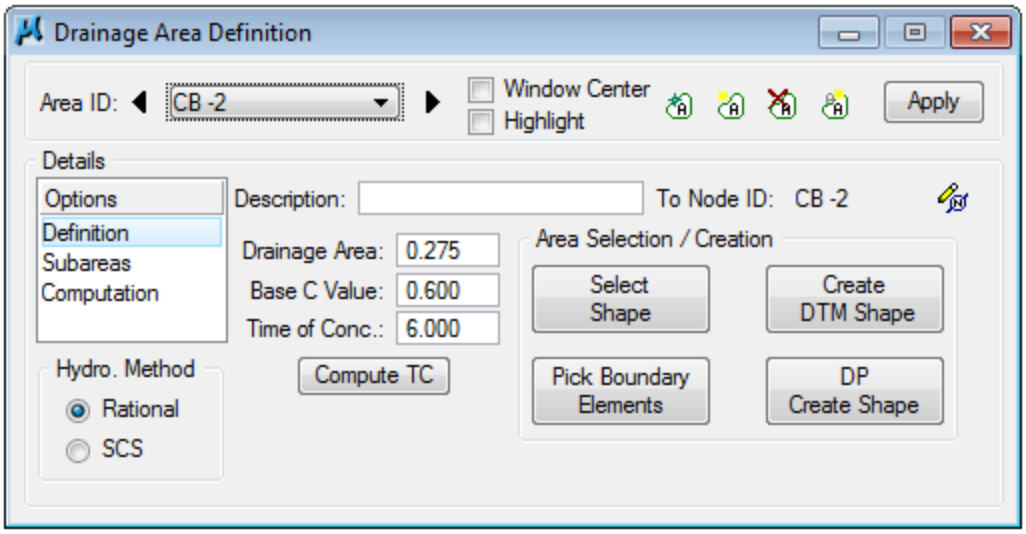
1. Create MicroStation shapes for subareas CB-1 and CB-2 as defined in the illustration in 3-1. Area CB-1 is 150 ft wide and 220 ft long and area CB-2 is 150 ft wide and 80 ft long.

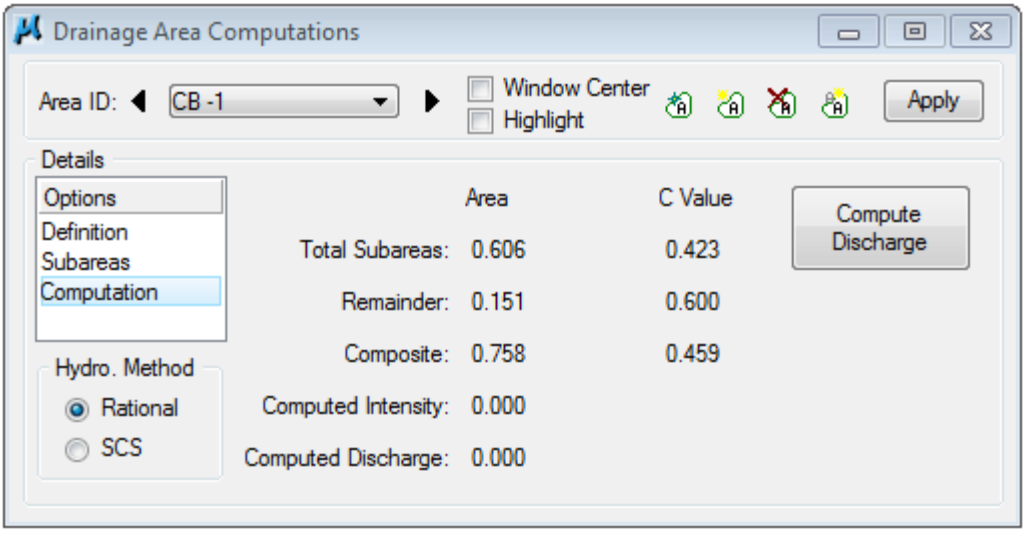
2. Use the Drainage menu Component >Area >Add option to add each of the two drainage areas. Be sure to add the Base C Value and Time of Concentration for each drainage area and use the Delineate Subareas button to include the land uses previously defined. The Time of Concentration for CB-1 should be set to 5.0 and set to 6.0 for CB-2.

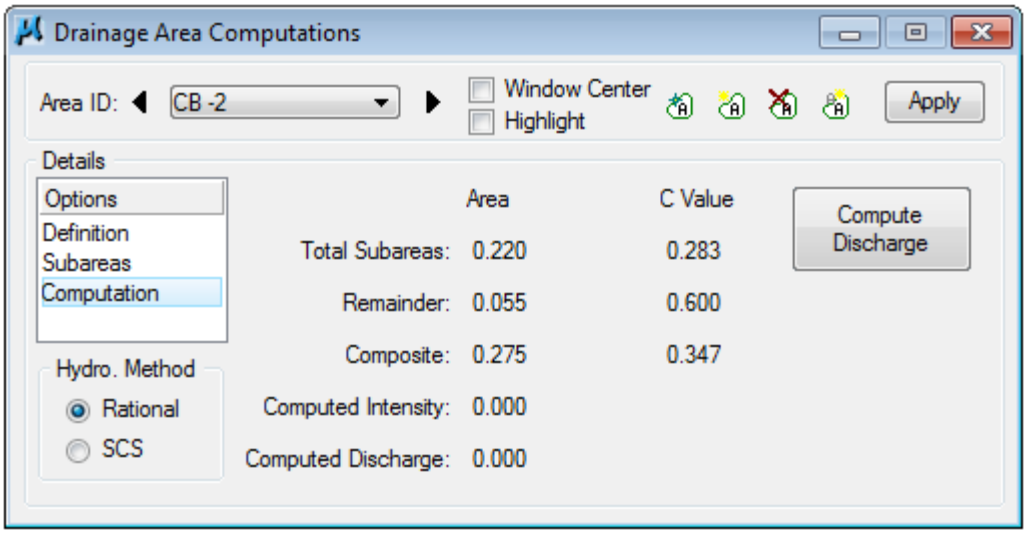
Make sure that you click the **Apply** button when you complete your inputs for both drainage areas to store the values.

Base C Value *The runoff coefficient (C value) for the drainage area. If subareas are to be delineated within the Area, this value will be applied to all subareas which have no associated land use.*




Drainage Area Definition
Area ID: CB -2
Window Center
Highlight
Apply
Details
Options
Definition
Subareas
Computation
Description:
To Node ID: CB -2
Drainage Area: 0.275
Base C Value: 0.600
Time of Conc.: 6.000
Compute TC
Area Selection / Creation
Select Shape
Create DTM Shape
Pick Boundary Elements
DP Create Shape
Hydro. Method
Rational
SCS

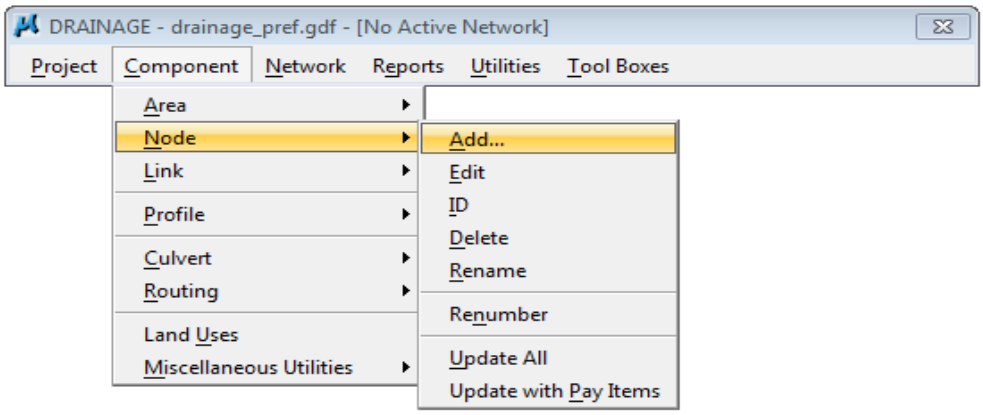

Drainage Area Computations
Area ID: CB -1
Window Center
Highlight
Apply
Details
Options
Definition
Subareas
Computation
Area
C Value
Total Subareas: 0.606 0.423
Remainder: 0.151 0.600
Composite: 0.758 0.459
Computed Intensity: 0.000
Computed Discharge: 0.000
Compute Discharge
Hydro. Method
Rational
SCS


Drainage Area Computations
Area ID: CB -2
Window Center
Highlight
Apply
Details
Options
Definition
Subareas
Computation
Area
C Value
Total Subareas: 0.220 0.283
Remainder: 0.055 0.600
Composite: 0.275 0.347
Computed Intensity: 0.000
Computed Discharge: 0.000
Compute Discharge
Hydro. Method
Rational
SCS

3.4 Define an inlet on grade

1. Go to Component >Node >Add . The node ID should appear as CB –1.

This is important to note because drainage areas and inlets are associated by name only. In other words, the discharge from drainage area CB-1 will flow into inlet CB-1. Because of this you may want to give inlet CB-1 a description like “Inlet for sub-area 1”.



Use the following information to create CB-1

Properties Option

Node Type: Grate

Profile: **On Grade** (Note that the hydraulic computations are different for inlets on grade and inlets at sags so it is important to select the proper profile.)

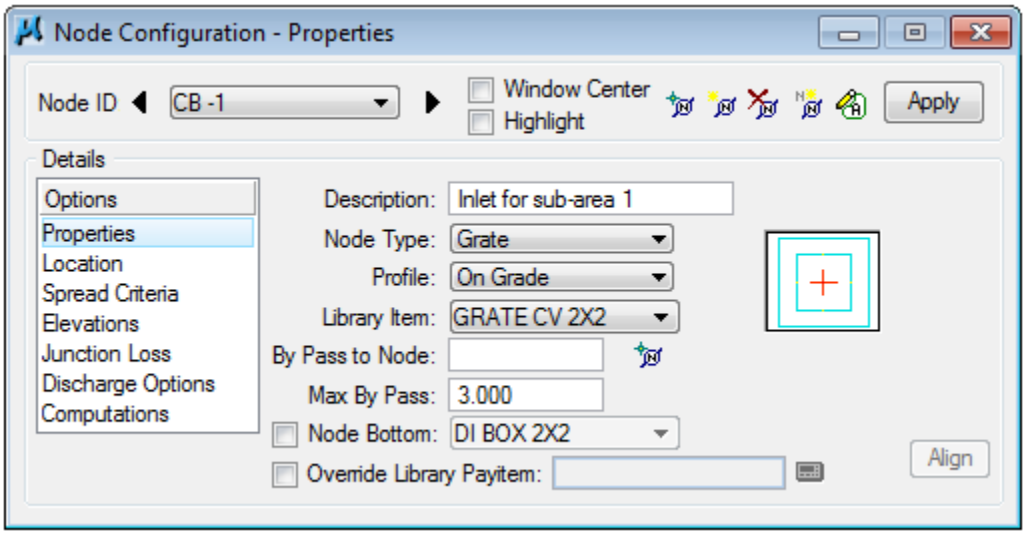
Library Item: Select **GRATE CV 2x2** for a 2’ x 2’ Curved Vane Grate

By Pass to Node allows us to identify the downstream inlet that will collect any runoff that is not caught at CB-1. This can be accomplished by selecting the ID button and then selecting either the label or cell for the downstream inlet. Alternately we can type in the node ID. We will complete this step after placing CB-2.

Max By Pass does not enter into any hydraulic computations, and is just used for querying the system. This will be discussed later in the course.

Node Bottom won’t be used at this time.

Override Library Payitem enables the user to select an inlet item other than the one specified from the defined drainage library. We will not use this option.


Node Configuration - Properties
Node ID
CB -1
Window Center
Highlight
Apply
Details
Options
Properties
Location
Spread Criteria
Elevations
Junction Loss
Discharge Options
Computations
Description:
Inlet for sub-area 1
Node Type:
Grate
Profile:
On Grade
Library Item:
GRATE CV 2X2
By Pass to Node:
Max By Pass:
3.000
Node Bottom:
DI BOX 2X2
Override Library Payitem:
Align

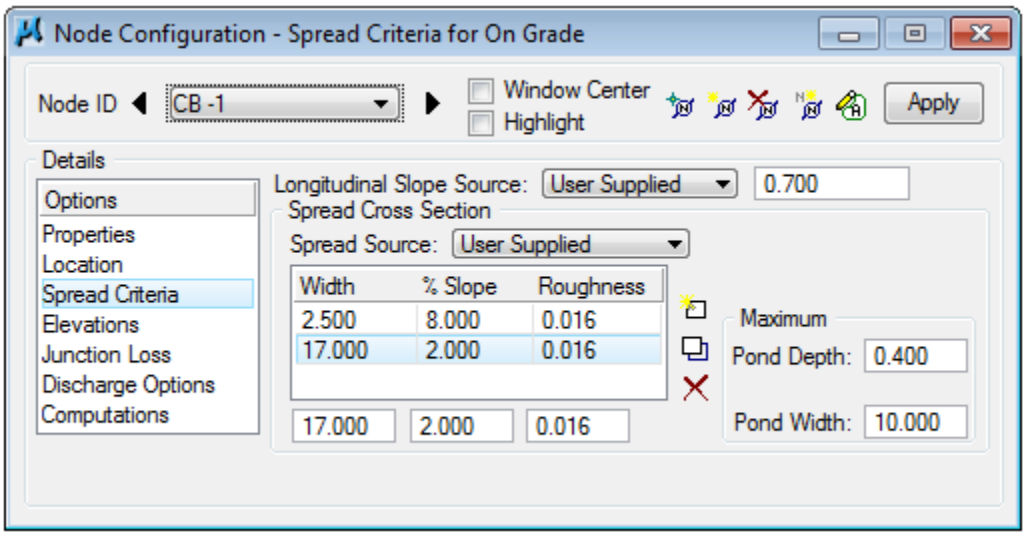
Spread Criteria Options

Longitudinal Slope Source: This is the actual grade along the vertical curve and not necessarily the tangent grade G1 or G2. For this example set the option to User Supplied and enter **0.7**

Spread Source: Enter the cross section of the roadway beginning at the curb face and working towards the crown of the roadway. For this example set the option to User Supplied

Max Ponded Depth is the maximum depth of water that can pond at the inlet. The ponded depth does not affect inlets at grade but does enter into the calculations for inlets at sags. Since we are using a 6" curb height, the maximum ponded depth is **0.4** ft.

Max Ponded Width is how much water will pond on the spread cross-section measured from the curb face. For this example enter **10** ft.



Elevations Options

Elevation Source: User Supplied - 100

Node Elevation Option: Same as Source

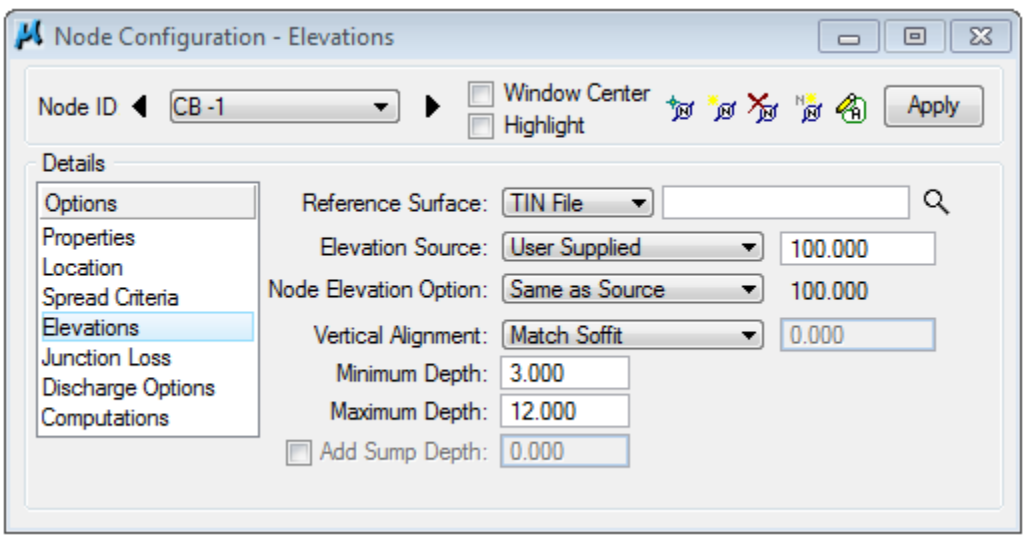
The next 3 settings deal with establishing pipe elevations

Vertical Alignment Preference: Match Soffit (top inside surface of the pipe)

Minimum Depth for this example is **3** ft. This is the upper limits of the design envelope, the soffit of the pipe cannot be placed above this line.

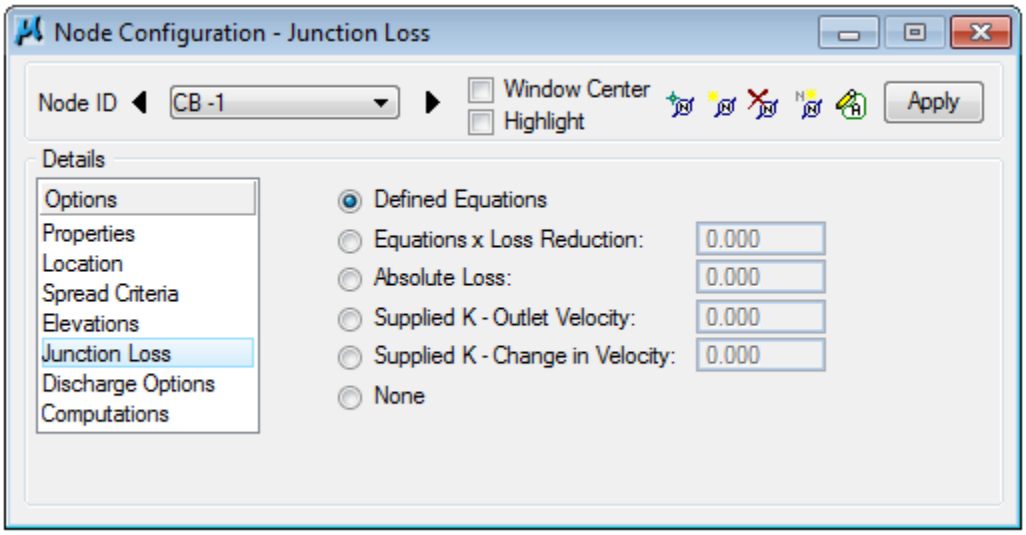
Maximum Depth for this example is **12** ft. This is the lower limit of the design envelope; the invert of the pipe cannot be placed below this line.

The design envelope created by the Minimum and Maximum Depth values are used by GEOPAK Drainage to set the absolute top and absolute bottom elevations for pipes to enter and exit the node. Additional information provided in the Chapter 3 Reference material.



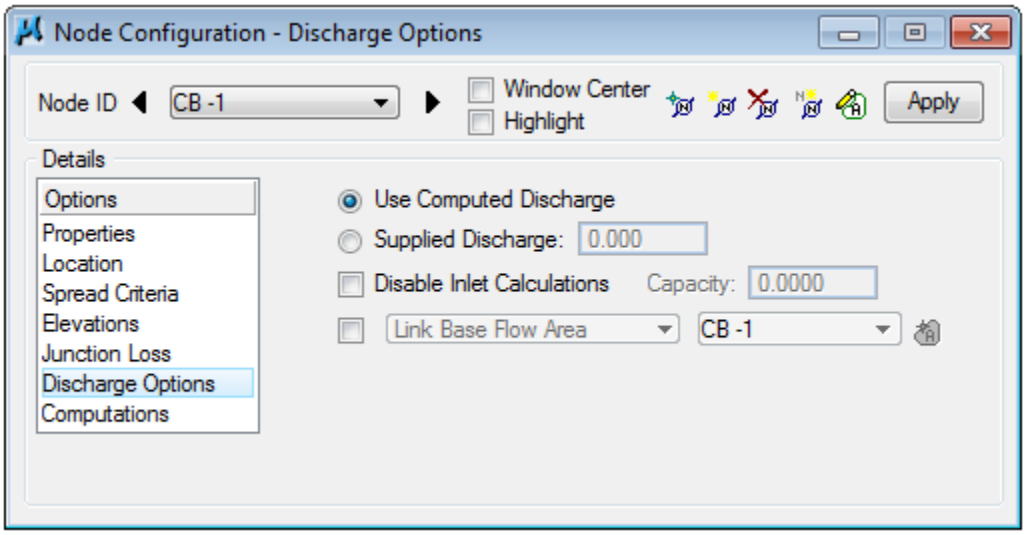
Junction Loss Options

Select Defined Equations



Discharge Options

Use Computed Discharge will associate drainage area CB-1 to inlet CB-1. Alternately you can specify a discharge.
Disable Inlet Calculations Capacity: When this toggle is not active, GEOPAK utilizes the inlet capacity calculations. To override these calculations, the user may activate the toggle and provide the desired capacity.
Link Base Flow Area/Discharge: When not activated, the drainage area identified for the node is utilized for calculations. When this toggle is activated, additional drainage areas may be defined. The area can be identified graphically by pressing the ID button and selecting the MicroStation shape or may be manually entered in the key-in field. Note the area is included in the pipe, but is not included in the inlet spread calculations.
A discharge amount may be specified as well by choosing that option from the drop-down box and inputing



Location Options

We are not utilizing data from Geopak Road in this example.

1. Set the Align setting to Tangent to Element

2. **Select the MS Alignment Element button**

3. **Data point on the rectangle that represents the roadway.**

Make sure AccuDraw is running

4. **Select the Station DP button and snap (single middle mouse click) to the lower right hand corner of the roadway. *Do not left-click to accept the snap!***

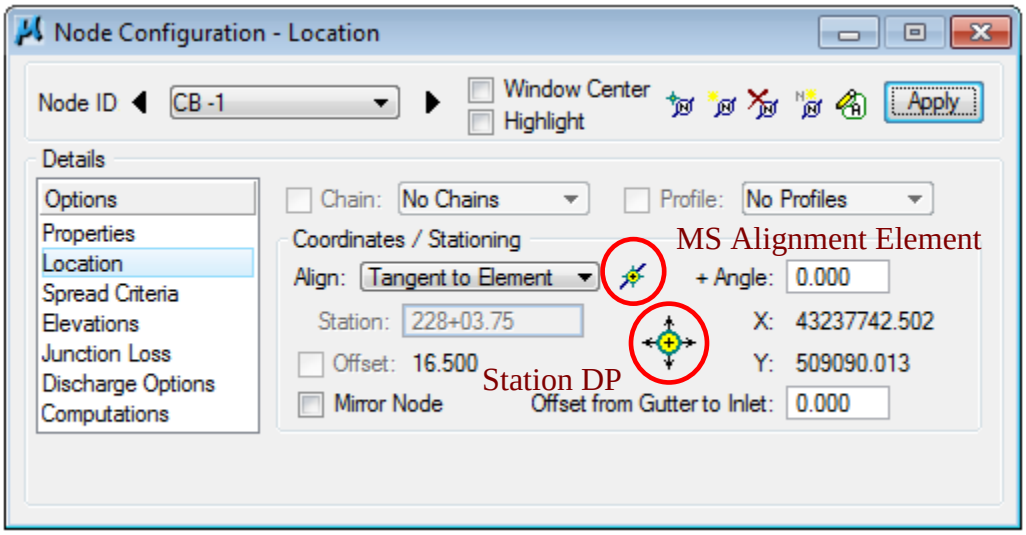
5. **Select the letter O on the keyboard to set the origin.**

6. **Move the mouse in the negative X direction, enter 18.5**
   (20' pavement width, then subtract 6" curb and ½ the grate width)

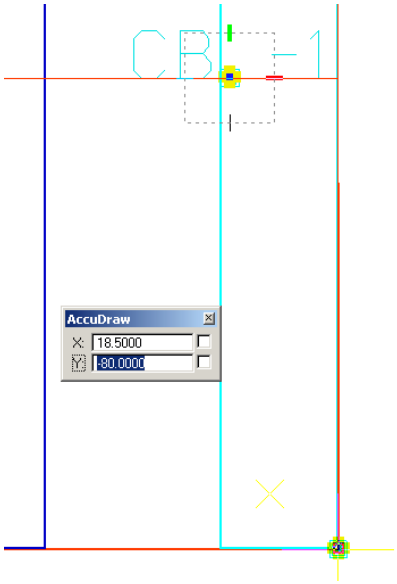
7. **Move the mouse in the positive Y direction, enter 80, and data point to accept.**

8. **Finally select the Apply button.**

The inlet is now saved to the *.gdf file, any changes to the inlet will now be updates.



After you are finished CB-1 should appear in this location:

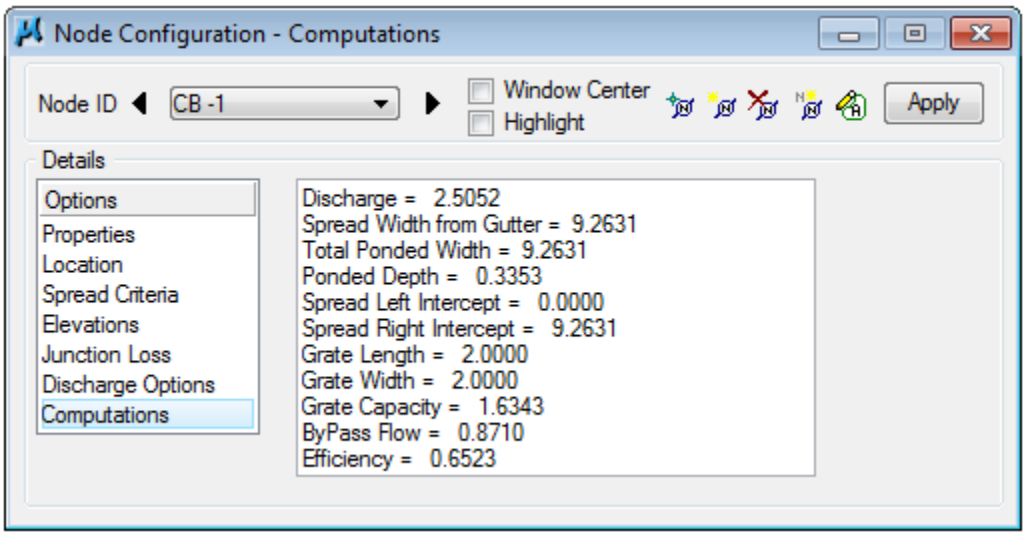


Computations Options

The Computations Option will show all the information pertaining to the new inlet based on the area associated with it.

In this example we can see that the Spread Width is 9.2631, which is less than the 10' that was allowed. The ponded depth is .3353, which is less than the .4' that was allowed. There is some bypass flow indicating that some flow is going to need to be intercepted downstream of this inlet.

We can see from these computations that this inlet already meets the criteria that we set for our roadway. However, if this inlet had not worked we would need to consider what steps we could take to fix any issues that came up. With this being the first inlet in our drainage project, the fix could be as simple as just establishing the rest of the system to see if it relieves the issues, but if the computations produced values that fell too far outside of our needs we may want to consider a larger inlet.



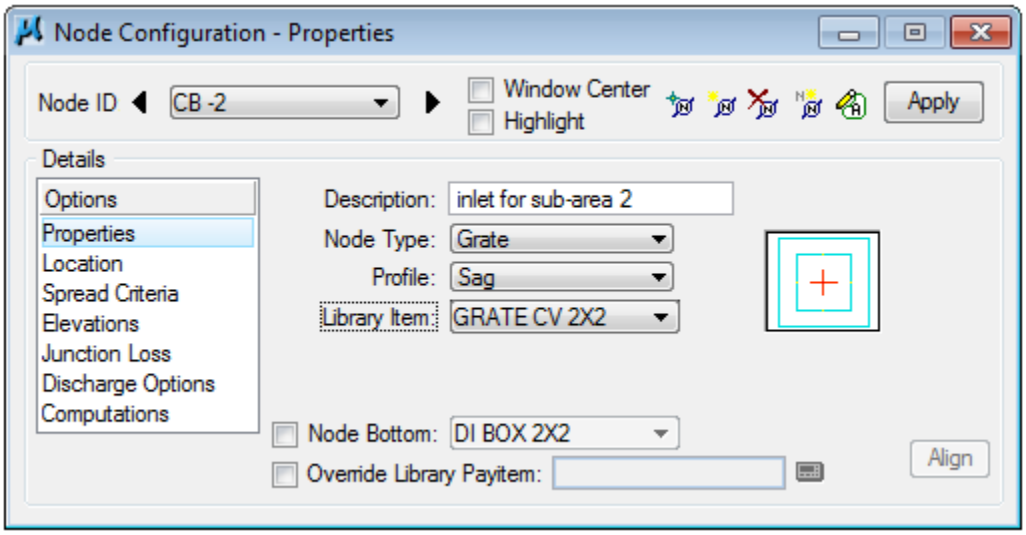
Make sure you have clicked the **Apply** button to save your work to CB-1 before moving on to creating CB-2!

3.5 Define an inlet at a sag location

Add inlet CB-2 at the sag location.

Properties Options

Use the options shown below in the dialog screenshot



Location Options

1. Set the Align setting to Tangent to Element

2. Select the MS Alignment Element button

3. Data point on the rectangle that represents the roadway.

Make sure AccuDraw is running

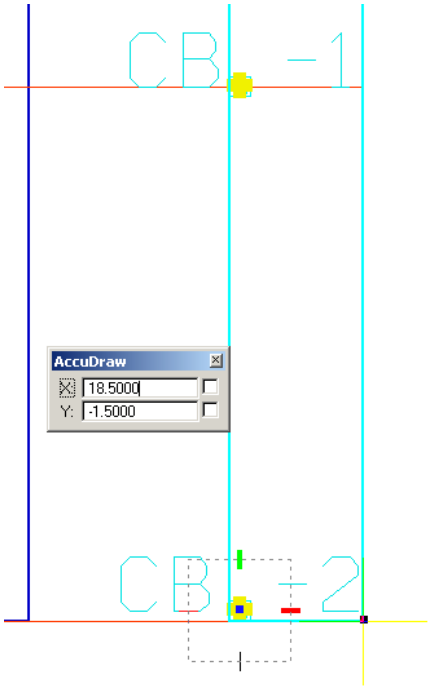
4. Select the Station DP button and snap (single middle mouse click) to the lower right hand corner of the roadway. *Do not left-click to accept the snap!*

5. Select the letter O on the keyboard to set the origin.

6. Move the mouse in the negative X direction, enter 18.5
(20' pavement width, then subtract 6" curb and ½ the grate width)

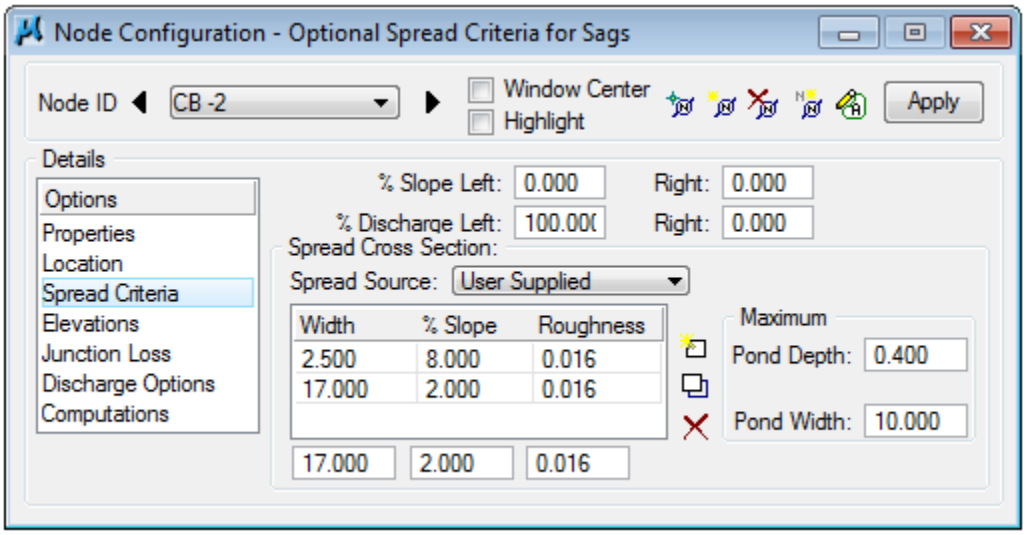
7. Move the mouse in the positive Y direction, enter 1.5, and data point to accept.

8. Finally select the Apply button.



Spread Criteria Options

Enter 0.0 for the slope left & right, and 100% of the discharge approaching from the left. We are neglecting flow from the right hand side. A low point will always have flow approaching from both sides, the right side was neglected for simplicity.



Elevations Options

Enter the elevation as **99.5**

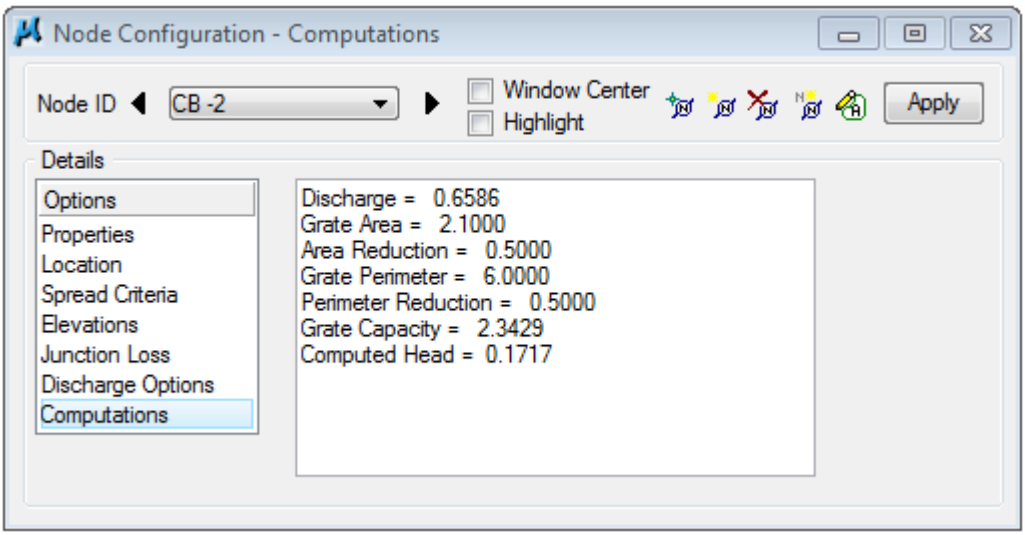
Discharge Options

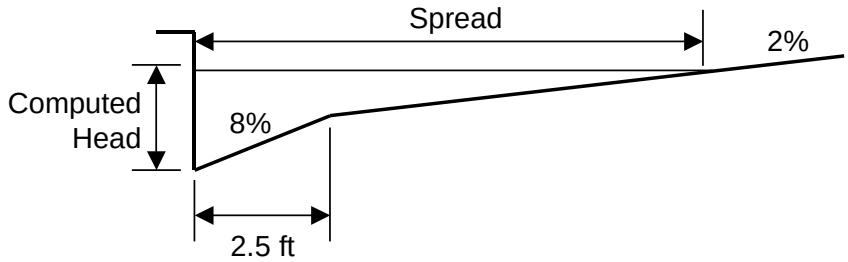
Remain the same

Computation Options

The spread used by MoDOT for design purposes at sag inlets is not contained in the computations window. You can compute the spread using simple geometry by taking the computed head (depth of flow in the gutter) and applying it to the spread section.

Spread can be generated using the Report Builder which is not covered in this class
.

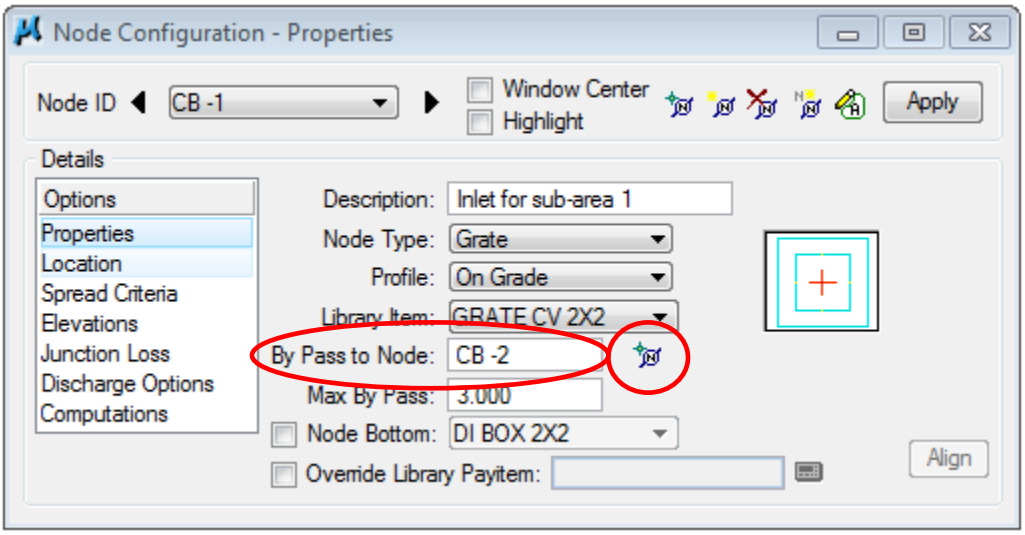
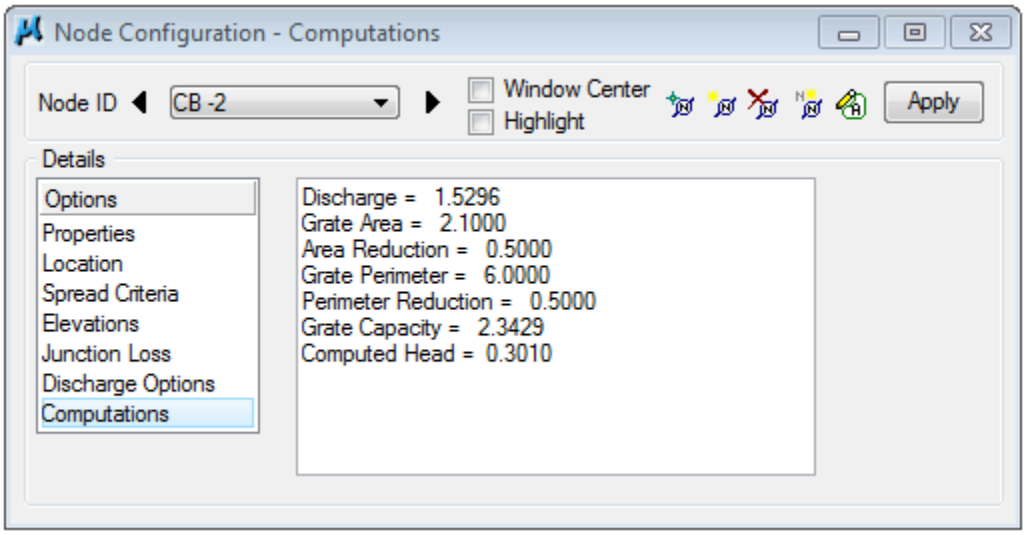




Set By Pass Flow

Now that we have a downstream inlet we can set it up to catch the water that isn't collected by our upstream inlet. To catch that flow, and make sure it is intercepted by the next inlet:

- Open the previous instance, in this case, CB – 1
- Click on the **Properties** Option
- Select the **ID By Pass Node** tool next to **By Pass to Node**
- Using the left mouse button, select the inlet downstream, in this case, **CB –2**



- Now open the CB – 2 and look at the computations again