

## 5. Storm Drainage Nodes

This exercise shows the user how to create surface drainage components for storm drainage. The user will add drainage areas, inlets, and outlets as necessary for proper roadway drainage design. Unless designing for the interstate, TDOT typically uses a 10-yr storm to design (See Appendix J).

Typically, each segment of the roadway drainage system will have an outlet to a side ditch, natural river or stream, or an adjacent storm drainage system. Possibilities of these outlets should be considered when determining catch basin locations.

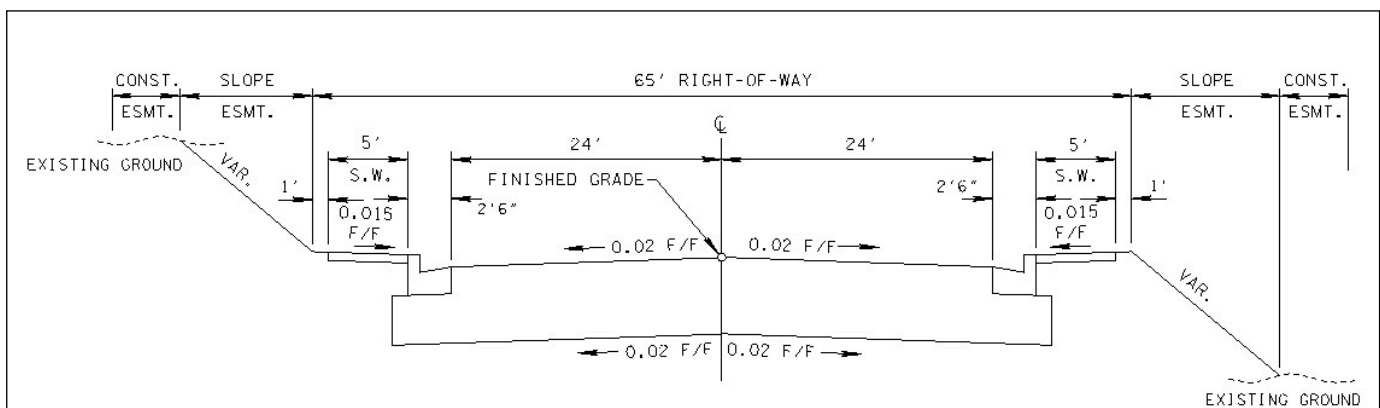
Initial locations for catch basins (inlets) should be based on the following criteria:

- 1.) At all low points (sag points) in the gutter grade or low points behind curbs, shoulders or sidewalks
- 2.) At the location down grade from the highpoint of a vertical curve where the spread is equal to the allowable spread
- 3.) At areas where off-site flow will flow across the top of curbs
- 4.) Upstream of median breaks, entrance/exit ramp gores, cross walks, street intersections, and bridges
- 5.) At side streets upgrade from the intersection
- 6.) At least every 400 feet (required for maintenance)

Once these primary locations are determined, adjustments or additions can be made to ensure that a safe travel way is maintained.

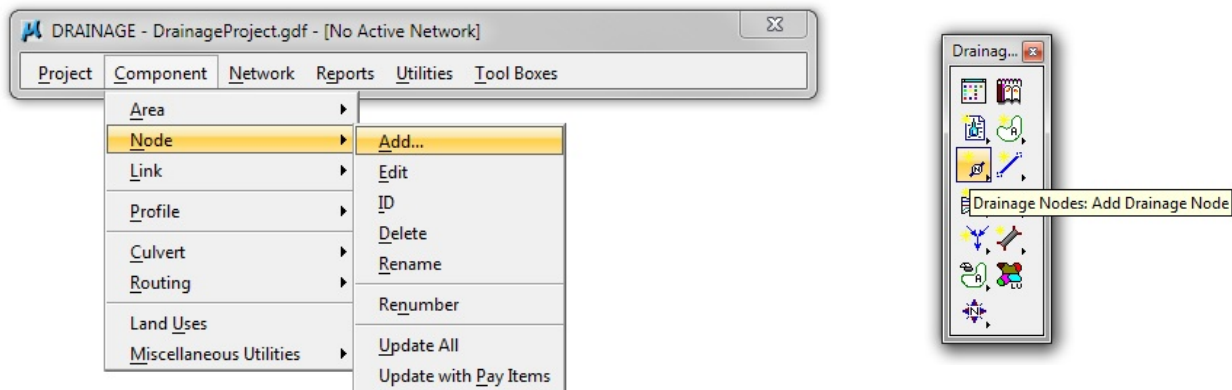
### 5.1 Design Drainage Node CB – 1

- a) Determine the location of the Proposed Inlet. The proposed roadway is 4 lanes with no shoulders and a 6" non-mountable curb with curb and grate inlets.

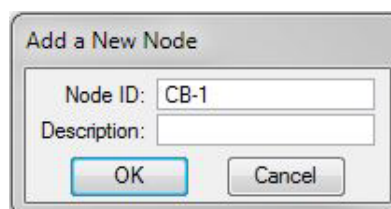


We will assume for this project that the curb and gutter begins at 0+00.00. We have also determined that our maximum allowable spread is 8.0 feet (See [TDOT Drainage Manual Chapter 7](#) Section 7.03.3.7). Using sound engineering judgment we will assume our first inlet to be at Station **4+00.00** Offset **-26.00**.

- b) From the Drainage Main Menu Bar, select **Component > Node > Add** OR from the Main Toolbar, select **Add Drainage Node**.



- c) Type in **CB-1** for the node ID. Leave the Description blank. Click OK. Over the next several steps, we will progress through the Node Configuration until everything has been set successfully.



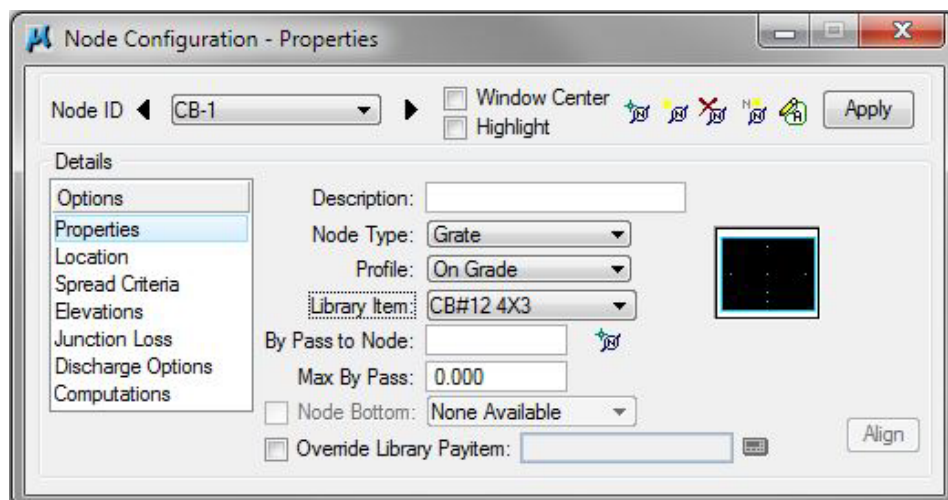
- d) **Properties >** With the Node Id set to CB-1, set the properties as shown below:

**Node Type:** Grate

**Profile:** On Grade

**Library Item:** **CB #12 4X3**

(See Standard Drawing D-CB-12S for details.)



## Exercise 5

**NOTE:** This project calls for a 6" nonmountable curb and gutter inlet. A type 12 catch basin is used since it is the most common for this type of gutter. The 4X3 is chosen because it requires the least amount of depth for the type 12's. It is common practice to choose the smallest catch basin at the beginning of the system. Refer to the TDOT GEOPAK Drainage Nodes shown in Appendix A to see other sizes and types of nodes.

- e) **Location** > Describe the inlet's location in the design file as shown below:

**Reference Chain:** CL

**Profile:** DESIGNCL

**Align:** Tangent to Chain

**Angle:** 0.00


**Station:** 4+00.00

**Offset:** -26.00

The screenshot shows the 'Node Configuration - Location' dialog box. At the top, 'Node ID' is set to 'CB-1'. There are checkboxes for 'Window Center' and 'Highlight'. Below this is a 'Details' section with a list of options: 'Options', 'Properties', 'Location' (selected), 'Spread Criteria', 'Elevations', 'Junction Loss', 'Discharge Options', and 'Computations'. The 'Chain' is set to 'CL' and 'Profile' is 'DESIGNCL'. Under 'Coordinates / Stationing', 'Align' is 'Tangent to Chain', 'Angle' is '0.000', 'Station' is '4+00.00', 'Offset' is '-26.000', and 'Offset from Gutter to Inlet' is '0.000'. There is a 'Station DP' button with a crosshair icon, which is highlighted. An 'Apply' button is at the top right.

### NOTES:

Once the location options are set, hit enter on your keyboard or data in one of the fields to add the catch basin. The angle of the catch basin is automatically set to match the centerline.

If a line or some other MicroStation element is located at the desired station and offset, the **Station DP**  button can be used. If Station DP is active and the location is set, **DO NOT** move out of the dialog because the station range will change. Hit enter on your keyboard or data in one of the fields to add the catch basin.

## Other Align Options:

**Tangent to Chain:** Allows independent station and offset while matching a specified chain's angle.

**Tangent to Element:** Allows independent station and offset while matching an elements angle.

**Tangent on Element:** Allows independent station (within limits of the element) while matching elements offset and angle. (Mirror Node is often required when using this option)

**At Point:** Allows independent station, offset and angle.

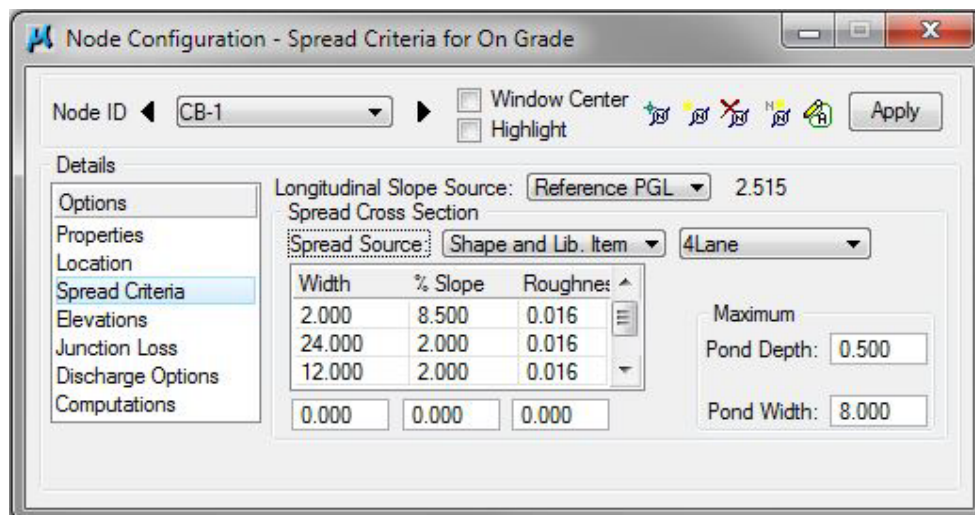
- f) **Spread Criteria** > Describe the roadway cross sectional characteristics directly in front of the inlet. These values will be utilized to calculate inlet capacity and resulting by-pass flow. Turn ON the display for the reference file: **DVSR1SEshapes.dgn** and choose the following options:

**Longitudinal Slope Source:** Reference PGL

**Spread Source:** Shape & Lib. Item - 4Lane

**Max Pond Depth:** 0.50 feet

**Max Pond Width:** 8.00 feet



Change Spread Source back to User Supplied to remove extra links created by the combination of the Shape and Library Item. The 24' link is defined in the library item but is not required since we have superelevation shapes for the pavement area, one shape for each 12' lane. **Delete the item with 24 for the width, and change the last item width from 11.993 to 12 and slope percent from 2.001 to 2.**

- g) **Spread Criteria** > In the previous step, we set the spread section using a combination of the project's superelevation shapes and a standard drainage library spread section to illustrate that if a final TIN file has not yet been made, other methods could be used. The recommended method is to use a final TIN file which should represent the roadway accurately at any given inlet location.

Change the **Spread Source** to Reference TIN.



## Exercise 5

- h) **Elevation** > Assign the inlet vertical elevation and vertical pipe alignment options. The **Reference Surface: Tin File** should already be set.

**Reference Surface:** TIN File - final.tin

**Elevation Source:** Reference TIN

**Node Elevation Option:** Same as Source

**Vertical Alignment:** Min. Fixed Drop, 0.17

**Minimum Depth:** 2.38 feet (See first note at top of next page)

**Maximum Depth:** 20.00 feet

Node Configuration - Elevations

Node ID: CB-1

Window Center: ☐ Highlight: ☐

Details:

- Options
- Properties
- Location
- Spread Criteria
- Elevations**
- Junction Loss
- Discharge Options
- Computations

Reference Surface: TIN File final.tin

Elevation Source: Reference TIN 880.196

Node Elevation Option: Same as Source 880.196

Vertical Alignment: Min. Fixed Drop 0.170

Minimum Depth: 2.380

Maximum Depth: 20.000

Add Sump Depth: ☐ 0.000

Apply

### NOTES:

Refer to the [TDOT GEOPAK Drainage Nodes](#) listing in Appendix A of this manual or online for **Minimum Depth**, **Maximum Depth** and **Min. Fixed Drop** or **Drop Across Bottom of Structure** values for a given catch basin type and pipe size.

In Node Configuration, Minimum Depth refers to the Minimum Depth of Cover. It does not refer to the minimum depth of the catch basin. Both numbers are provided as shown below in a segment of the table taken from Appendix A.

Drainage Node Name	Node Description	Cell Name	Drop Across Bottom of Structure	Max. Depth	Pipe Sizes			
					15		18	
					Min. Depth	Min. Depth of Cover	Min. Depth	Min. Depth of Cover
Type: Grate								
CB#10 32"X26"	Lowered 6-30 Curb & Grate Inlet	CB32X26S	0.12	5.00			3.74	2.12
CB#10 4X3	6" NonMount. Curb & Grate Inlet	CB4X3S	0.17	20.00			3.88	2.21
CB#10 4' DIA	6" NonMount Curb & Grate Inlet	CB4DIAS	0.17	20.00			3.88	2.21
CB#10 4X4	6" NonMount. Curb & Grate Inlet	CB4X4S	0.17	28.00			3.88	2.21
CB#12 32"X32"	6" NonMount. Curb & Grate Inlet	CB32X32	0.12	4.58			3.74	2.12
CB#12 4X3	6" NonMount. Curb & Grate Inlet	CB4X3	0.17	20.00			3.88	2.21

**NOTES:**

In the TDOT GEOPAK Drainage Nodes table in Appendix A “**Minimum Depth of Cover = Minimum Depth - Pipe Size - Drop Across Bottom of Structure**” for catch basins with both inlet and outlet pipes. To determine Minimum Depth of Cover for catch basins with an outlet only: add **Drop Across Bottom of Structure** to **Minimum Depth of Cover**. The first catch basin in the system is considered an outlet only because there are no other pipes (inlets) coming into it.

For the initial design, use the value given under the 18 in. pipe size. **If larger pipes are designed, reset the Minimum Depth of Cover to the value for the pipe designed on and re-design the network.** Steps for this procedure are given in chapter 9 on **Drainage Navigator /Querying**.

**Catch Basins – Inlet and Outlet:**

Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

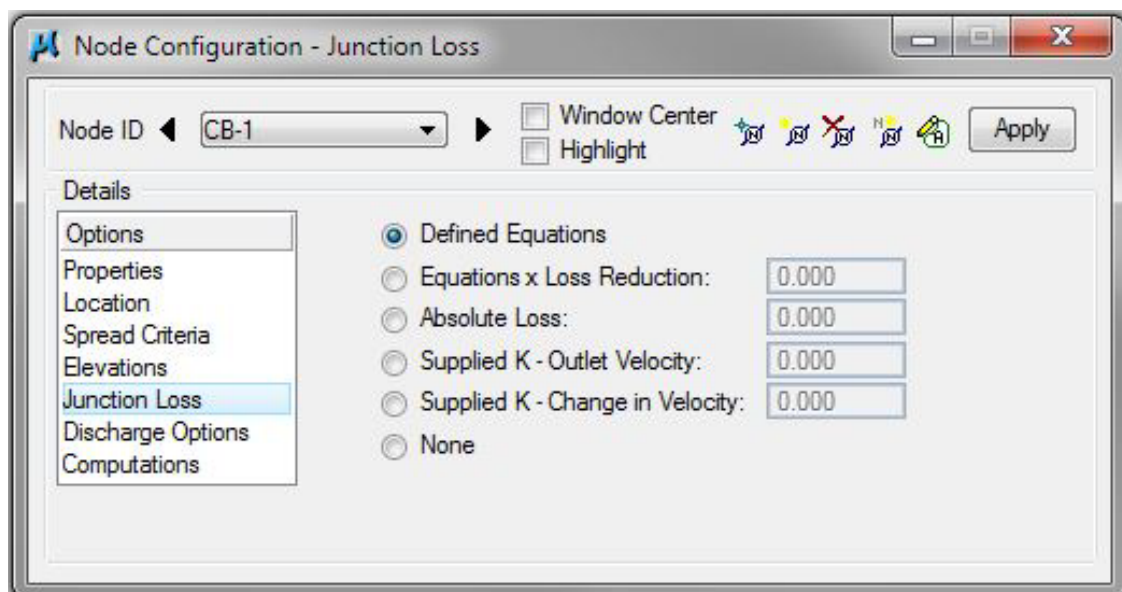
$$\text{CB\#12 4x3: } 3.88' - 18''/12 - 0.17' = 2.21'$$

**Catch Basins – Outlet Only:**

Drop Across Bottom of Structure + Min. Depth of Cover = Minimum Depth

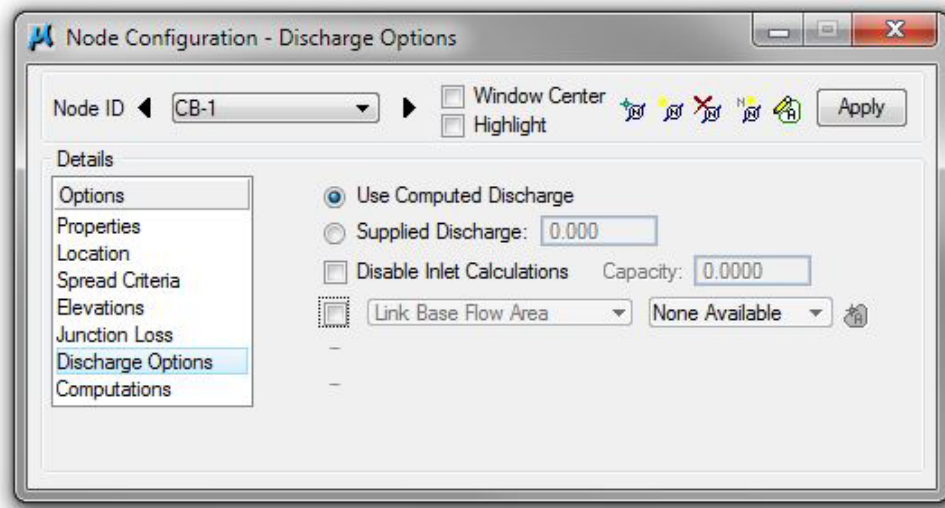
$$\text{CB\#12 4x3: } 0.17' + 2.21' = 2.38'$$

- i) **Junction Losses** > Set to Use **Defined Equations** (This defaults to the project preference settings that were set in Exercise 1):



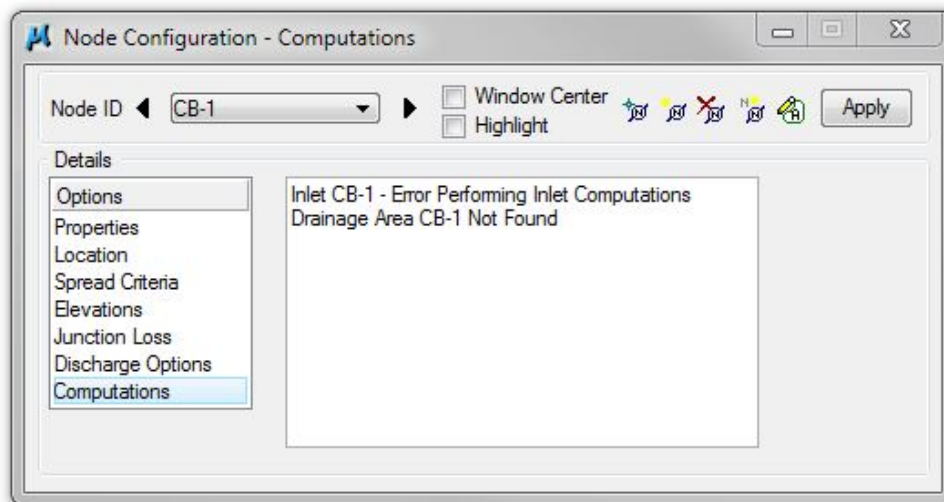
## Exercise 5

- j) **Discharge Options** > Specify the source of the discharge contributing to this inlet.  
Toggle **Use Computed Discharge**:



- k) **Computations** > Verify the inlet's hydraulic computations:

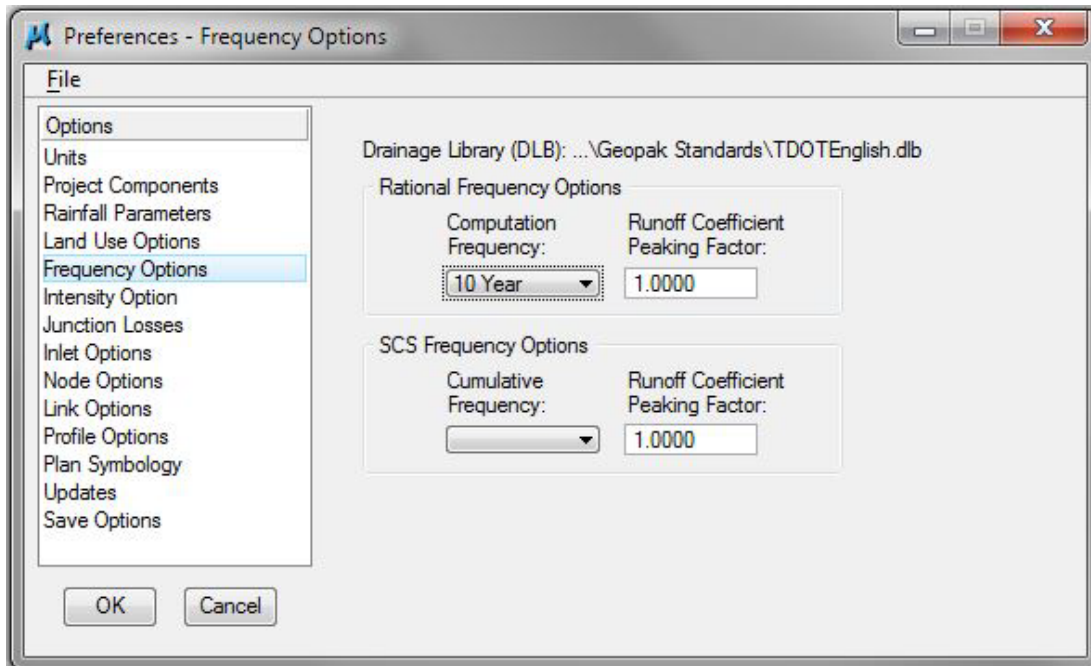
**NOTE:** The Drainage Area for this node hasn't been added; therefore, the computations for the node can't be completed until a discharge is known.



- l) Add this Node to the project by pressing the **Apply** button.

## 5.2 Delineate Drainage Area CB – 1

- a) According to the [TDOT Drainage Manual Chapter 4](#) Table 4-1 (see Appendix J) *Hydrologic Design Criteria*, the drainage area for CB-1 should be calculated for a 10 year frequency. Select **Project>Preferences** and **change the Frequency Options to the 10 Year Storm**. Click the **OK** button to accept the new preference settings.

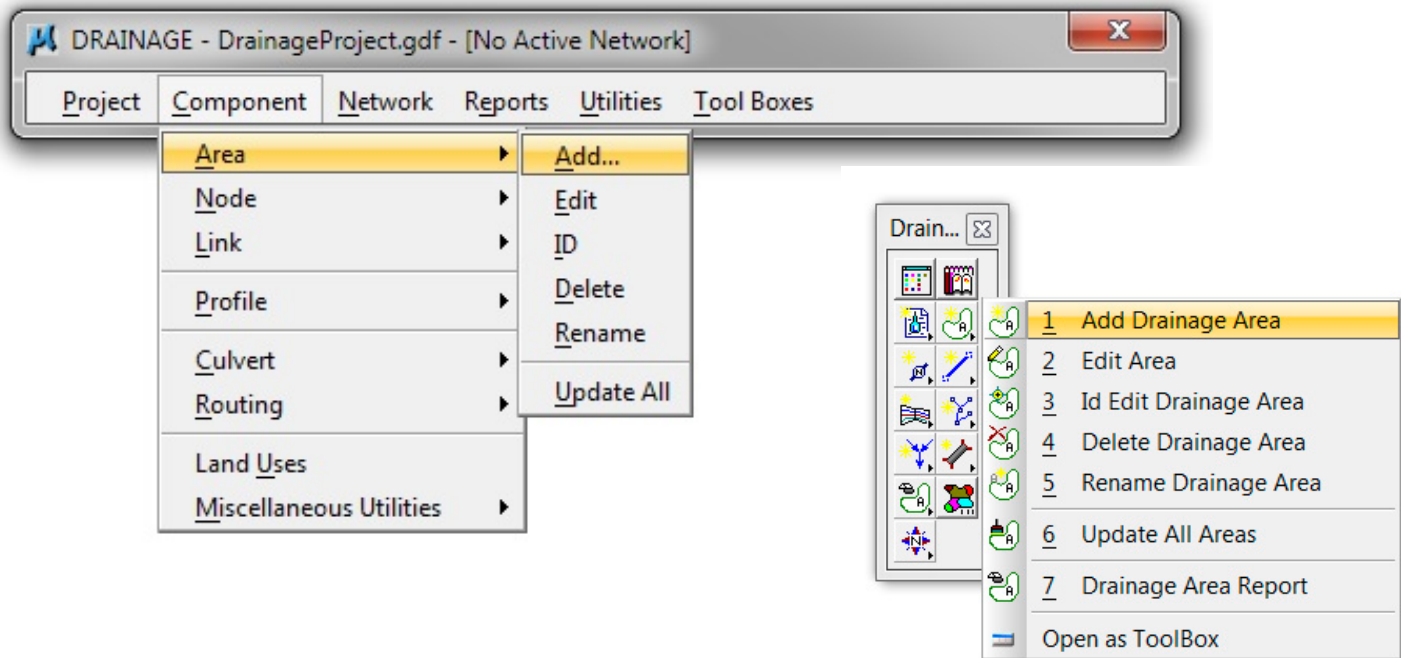


- b) From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**.

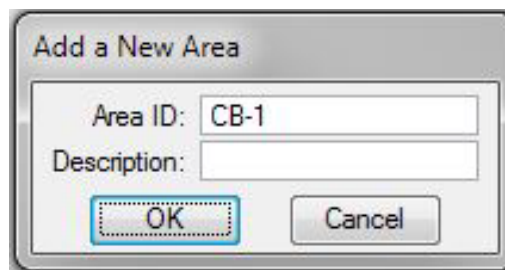


**NOTE:** If you have closed the Node Configuration Dialog you may create a new Drainage Area by going to the Drainage Main Menu Bar, and selecting **Component > Area > Add** OR from the Main Toolbar and selecting **Add Drainage Area**.

## Exercise 5

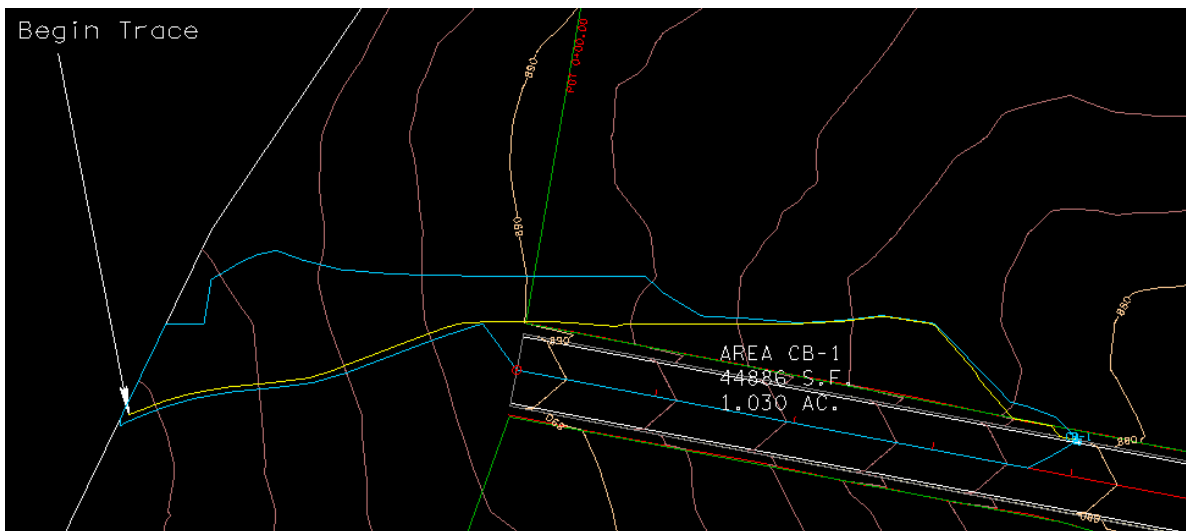


The following Add a New Area dialog box will pop up. Click **OK**.



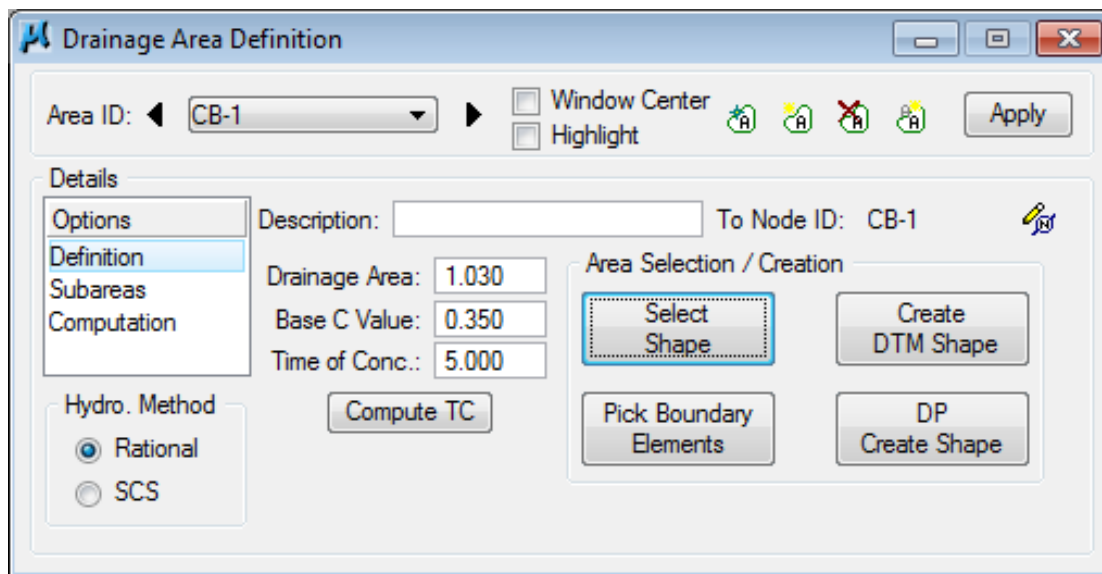
- c) Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 1. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-1.

Delineate Drainage Area:



- d) Define Drainage Area:

**Use Select Shape to identify the drainage area.** Our Base C Value was set previously in the culvert exercise.



Drainage Area Definition

Area ID: CB-1

Window Center ☐ Highlight ☐

Apply

Details

Options

Definition

Subareas

Computation

Description: To Node ID: CB-1

Drainage Area: 1.030

Base C Value: 0.350

Time of Conc.: 5.000

Compute TC

Area Selection / Creation

Select Shape

Create DTM Shape

Pick Boundary Elements

DP Create Shape

Hydro. Method

☒ Rational

☐ SCS

This Base C Value should be set to the most common land use item within your project area then only the remaining areas would need land use shapes developed for them.



## Exercise 5

e) Calculate Time of Concentration:

Drainage Area ID: CB-1  
TIN File: final.tin  
Define Path: Trace, ID - Segments  
☒ **Sheet Flow**  
Method: FHA Length: 300.000  
n Value: 0.400 Slope: 2.918  
☒ **Shallow Flow**  
Inter. K: 0.491 Length: 100.000  
Slope: 2.655  
☒ **Concentrated Flow**  
Method: Continuity Length: 410.569  
Velocity: 5.000  
Accum. Distance: 810.569  
Accum. Avg. Slope: 2.535  
**Tc= 31.361**  
Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
18.93	2.29	2.29	Sheet
15.01	2.98	2.59	Sheet
17.94	2.55	2.58	Sheet
9.82	2.80	2.61	Sheet
22.50	2.56	2.60	Sheet
6.92	2.78	2.61	Sheet
25.39	2.90	2.68	Sheet
3.41	2.81	2.68	Sheet
12.19	3.65	2.77	Sheet
12.96	3.85	2.87	Sheet
5.61	3.14	2.88	Sheet
19.52	3.07	2.90	Sheet
14.81	3.10	2.92	Sheet
10.26	3.14	2.93	Sheet

Distance: 18.930 Slope: 2.290 Adjust Flow  
Max Sheet Flow Distance: 300.000  
Max Shallow Flow Distance: 100.000  
Apply

Note that the n value for the sheet flow and the Inter. K value for the shallow flow has changed and will remain the same throughout this exercise unless noted.

**Sheet Flow** – When water flows at a depth of 0.1 feet (1.2 inches) or less

**Shallow Flow** – Sheet flow usually becomes shallow flow and flows at a depth above 0.1 feet (1.2 inches)

**Concentrated Flow** – Water flowing in a ditch, gutter, channel, or other drainage structure

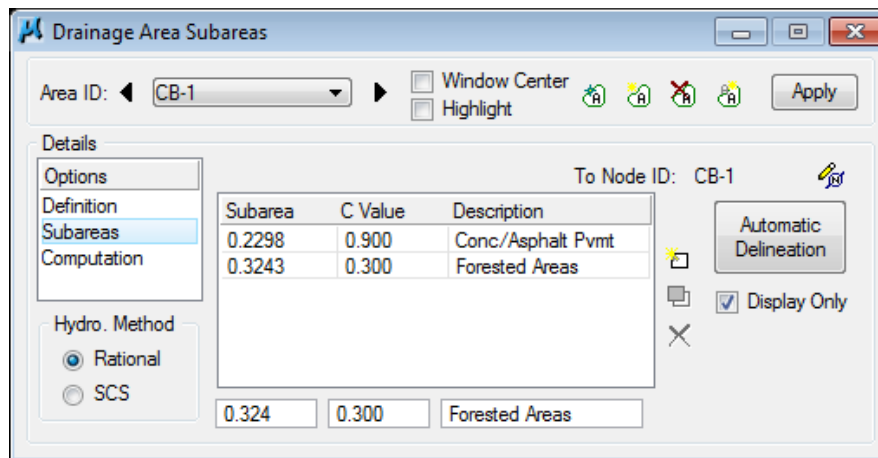
The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

Area ID: CB-1  
Window Center Highlight  
Apply

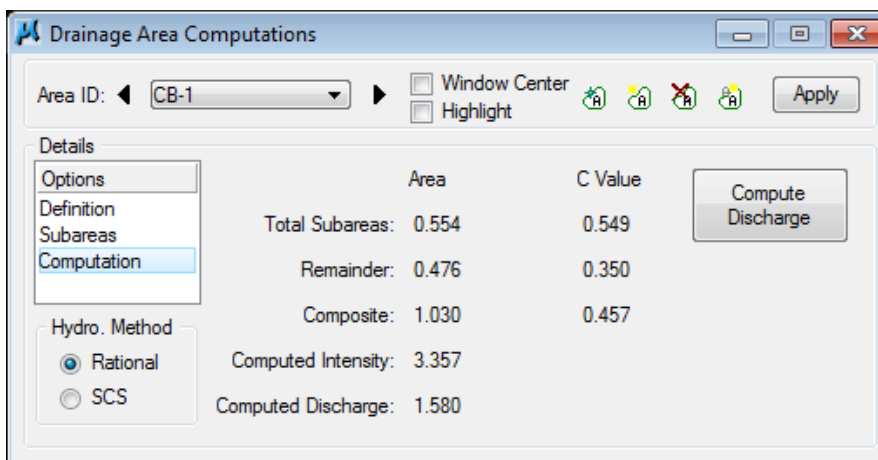
**Details**

Options Definition Subareas Computation  
Description: To Node ID: CB-1  
Drainage Area: 1.030  
Base C Value: 0.350  
Time of Conc.: 31.347  
Hydro. Method: ☒ Rational ☐ SCS  
Compute TC  
Area Selection / Creation: Select Shape Create DTM Shape Pick Boundary Elements DP Create Shape

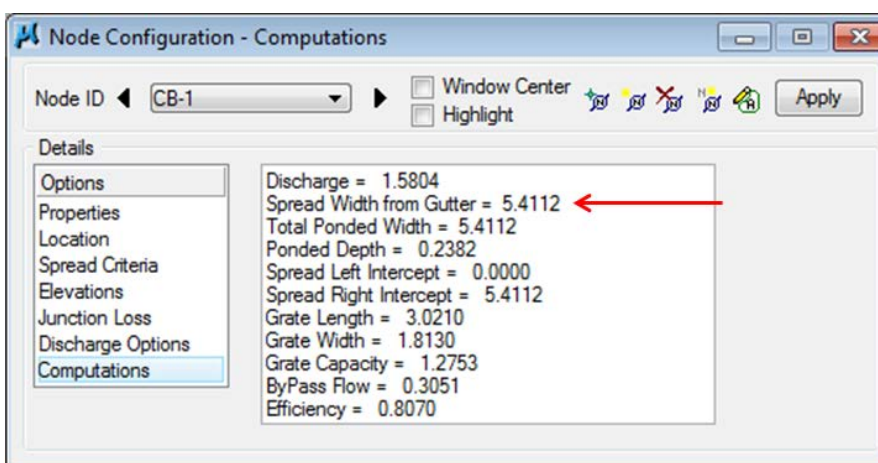
f) Delineate Subareas utilizing the Land Use DGN:



g) Compute Discharge and Apply:



h) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

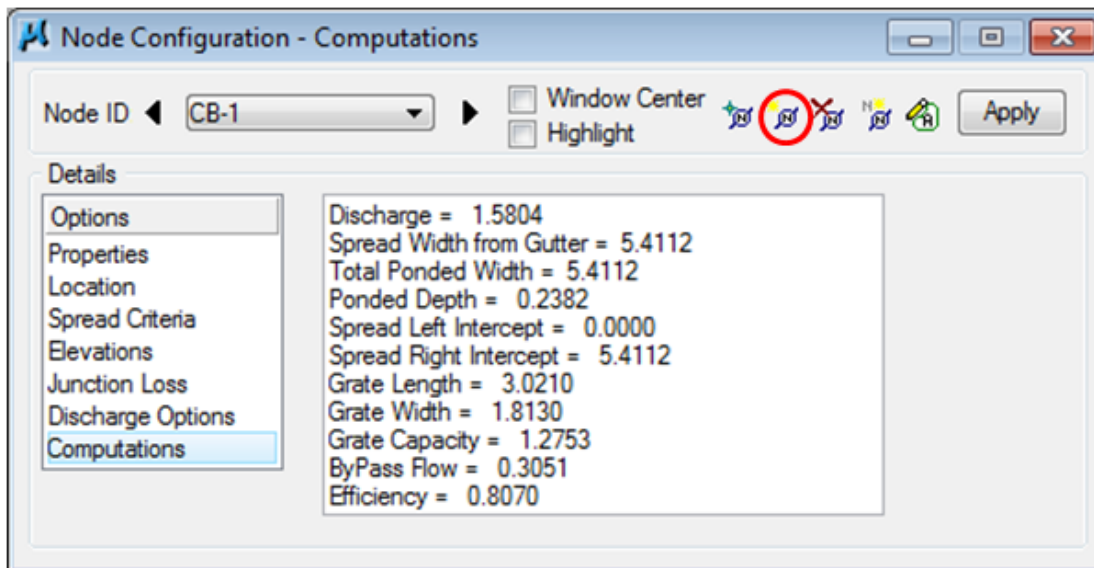
## 5.3 Design Inlet CB – 2

It has been determined that another standard **CB#12 4X3** will be used.

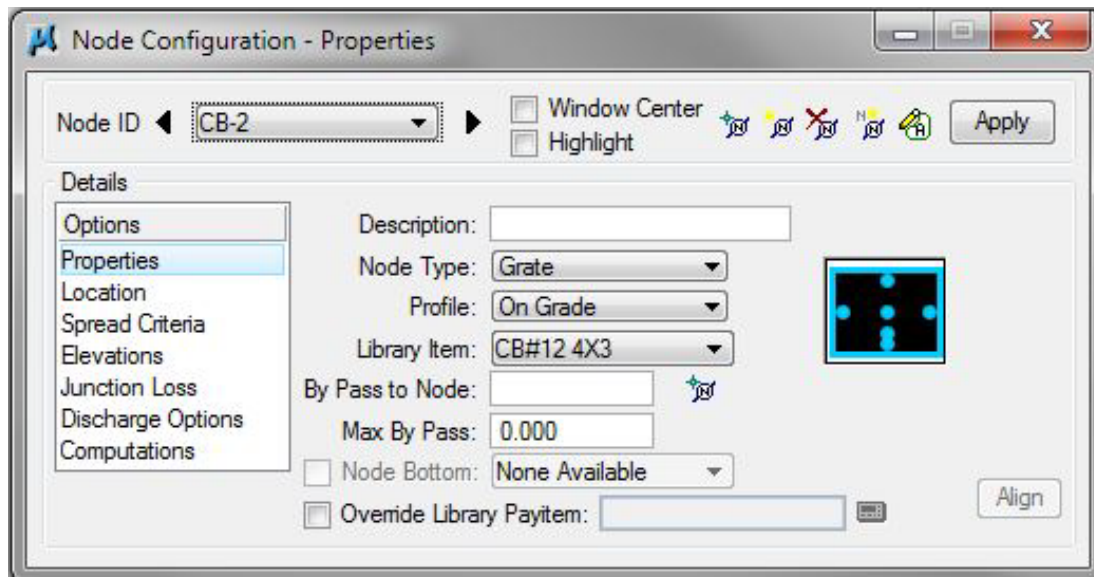
See Standard Drawing D-CB-12S for details.

CB- 2 will be at nearly the same location as CB-1 but will be on the right side of the road. Many of the parameters will be defaulted to those used to place CB-1.

- Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog.



- Click **OK** to add CB-2. CB-2 will automatically take the place of CB-1 in the Node Configuration dialog which is already open.
- Properties >** Verify the Node Properties are defaulted from the previous Node (CB-1) such that no user-input is required for this similar curb inlet.



- d) **Location** > All Reference information is defaulted from the previous Node (CB-1) such that only the **station,+ Angle (OR Mirror Node but NOT both)** and the **Offset** needs to be changed. Change the

**Station:** 3+70

**Angle:** \*180 (or toggle on Mirror Node)

**Offset:** 26.00

\*(180 for Right side, 0 for the Left), (Mirror Node ON for the Right, OFF for the Left)

Node Configuration - Location

Node ID ◀ CB-2 ▶ ☐ Window Center ☐ Highlight Apply

Details

- Options
- Properties
- Location
- Spread Criteria
- Elevations
- Junction Loss
- Discharge Options
- Computations

☒ Chain: CL ☒ Profile: DESIGNCL

Coordinates / Stationing

Align: Tangent to Chain + Angle: 180.000

Station: 3+70.00 X: 2941.569

☒ Offset: 26.000 Y: 3169.465

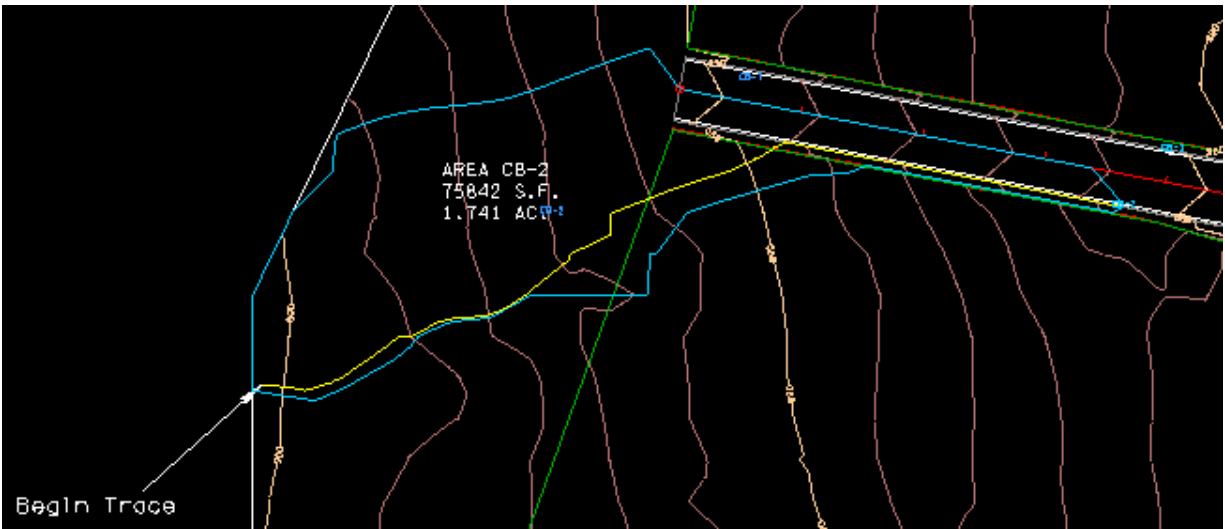
☐ Mirror Node Offset from Gutter to Inlet: 0.000

- e) Click **Apply** to include this node in the Drainage Project.

## 5.4 Delineate Drainage Area CB – 2

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-2** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 2. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-2 and turn off DA\_CB-1.

Delineate Drainage Area:



- Define Drainage Area:



d) Calculate Time of Concentration:

Drainage Area ID: CB-2

TIN File: final.tin

Define Path: Trace, ID - Segments

☒ **Sheet Flow**  
 Method: FHA Length: 300.000  
 n Value: 0.400 Slope: 2.358

☒ **Shallow Flow**  
 Length: 100.000  
 Inter. K: 0.491 Slope: 2.180

☒ **Concentrated Flow**  
 Method: Continuity Length: 367.535  
 Velocity: 5.000

Accum. Distance: 767.535  
 Accum. Avg. Slope: 2.550

**Tc= 33.535** Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
24.80	2.96	2.96	Sheet
10.43	1.49	2.52	Sheet
22.85	2.69	2.59	Sheet
2.83	1.50	2.54	Sheet
6.19	0.98	2.39	Sheet
40.86	1.09	1.90	Sheet
15.79	2.04	1.92	Sheet
10.21	1.59	1.89	Sheet
24.02	2.25	1.95	Sheet
11.20	1.29	1.90	Sheet
17.22	4.13	2.11	Sheet
15.07	4.49	2.29	Sheet
11.65	1.66	2.25	Sheet
20.32	3.22	2.34	Sheet

Distance: 24.800 Slope: 2.960 Adjust Flow

Max Sheet Flow Distance: 300.000  
 Max Shallow Flow Distance: 100.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

Max. Sheet and Max. Shallow Flow Distance values should be the same.

e) Delineate Subareas utilizing the Land Use DGN:

Area ID: CB-2

☐ Window Center ☐ Highlight Apply

**Details**

Options: Definition, Subareas, Computation

To Node ID: CB-2

Subarea	C Value	Description
0.2136	0.900	Conc./Asphalt Pvmnt
0.1746	0.300	Forested Areas

Automatic Delineation

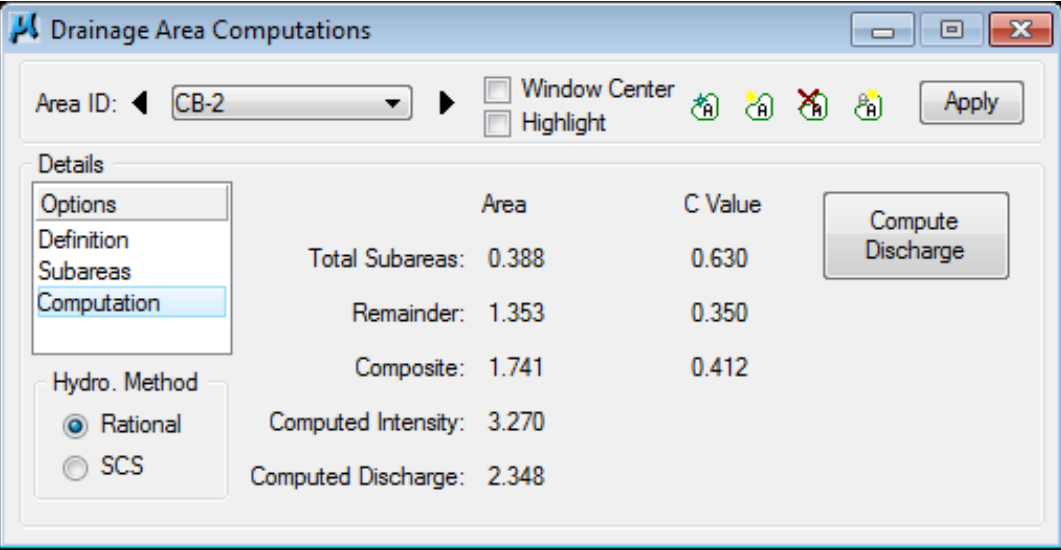
☒ Display Only

Hydro. Method: ☒ Rational ☐ SCS

0.175 0.300 Forested Areas



## f) Compute Discharge and Apply:

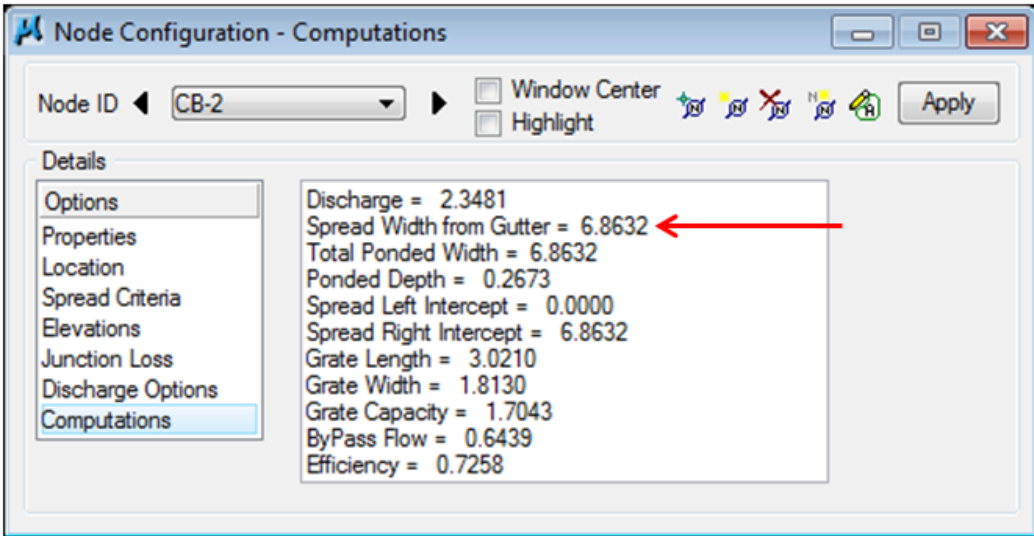


The **Drainage Area Computations** dialog box shows the following details:

- Area ID:** CB-2
- Window Center:** ☐ (disabled)
- Highlight:** ☐ (disabled)
- Details:**
  - Options:** Definition, Subareas, **Computation** (selected)
  - Hydro. Method:**
    - ☒ Rational
    - ☐ SCS
- Area and C Value:**

	Area	C Value
Total Subareas:	0.388	0.630
Remainder:	1.353	0.350
Composite:	1.741	0.412
- Computed Intensity:** 3.270
- Computed Discharge:** 2.348
- Buttons:** Compute Discharge, Apply

## g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

- Node ID:** CB-2
- Window Center:** ☐ (disabled)
- Highlight:** ☐ (disabled)
- Details:**
  - Options:** Properties, Location, Spread Criteria, Elevations, Junction Loss, Discharge Options, **Computations** (selected)
- Computed Values:**
  - Discharge = 2.3481
  - Spread Width from Gutter = 6.8632 (indicated by a red arrow)
  - Total Ponded Width = 6.8632
  - Ponded Depth = 0.2673
  - Spread Left Intercept = 0.0000
  - Spread Right Intercept = 6.8632
  - Grate Length = 3.0210
  - Grate Width = 1.8130
  - Grate Capacity = 1.7043
  - ByPass Flow = 0.6439
  - Efficiency = 0.7258
- Buttons:** Apply

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

## 5.5 Design Inlet CB – 3

It has been determined that another standard **CB#12 4X3** will be used.

See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog.

Click **OK** to set the name CB-3

**Properties >** Verify the Node Properties are defaulted from the previous Node such that no user-input is required:

The dialog box is titled "Node Configuration - Properties". It features a "Node ID" dropdown set to "CB-3". On the right, there are checkboxes for "Window Center" and "Highlight", along with several small icons and an "Apply" button. A "Details" sidebar on the left lists "Options", "Properties", "Location", "Spread Criteria", "Elevations", "Junction Loss", "Discharge Options", and "Computations". The main area contains the following fields: "Description:" (empty), "Node Type:" (Grate), "Profile:" (On Grade), "Library Item:" (CB#12 4X3), "By Pass to Node:" (empty), "Max By Pass:" (0.000), "Node Bottom:" (None Available), and "Override Library Payitem:" (empty). A small square icon representing a grate is shown to the right of the "Library Item" field. An "Align" button is located at the bottom right.

- b) **Location >** All Reference information is defaulted from the previous Node (CB-2) such that only the **Angle**, **Station** and the **Offset** needs to be changed. After a few iterations it was determined that CB-3 should be placed at Station 6+20.00:

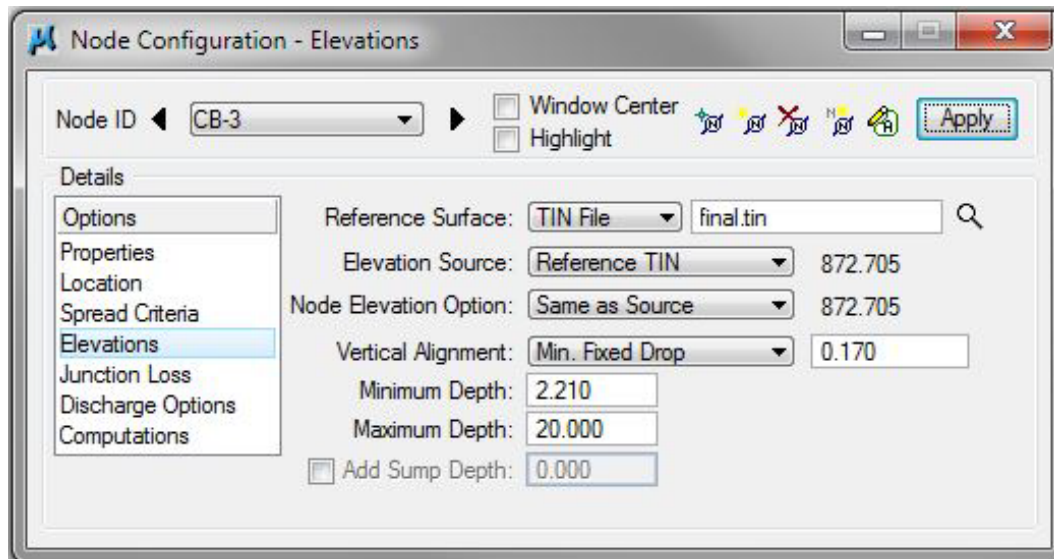
The dialog box is titled "Node Configuration - Location". It has the same "Node ID" dropdown set to "CB-3" and "Window Center"/"Highlight" checkboxes as the previous dialog. The "Details" sidebar is the same. The main area contains: "Chain:" (CL), "Profile:" (DESIGNCL), "Coordinates / Stationing" section with "Align:" (Tangent to Chain), "+ Angle:" (0.000), "Station:" (6+20.00), "Offset:" (-26.000), "Mirror Node" (unchecked), and "Offset from Gutter to Inlet:" (0.000). A small icon showing a node with a crosshair and a circle is located between the "Station" and "Offset" fields. The "X" and "Y" coordinates are displayed as 3196.887 and 3173.550 respectively. An "Apply" button is at the top right.

## Exercise 5

c) **Elevation** > Reset Minimum Depth for a node with both inlet and outlet pipes.

**Minimum Depth:** 2.21 FT

**NOTE:** SEE Appendix H – Storm sewer sketch, inlet and outlet on the right.



d) Click the **Apply** button to include this node in the Drainage Project.

### Catch Basins – Inlet and Outlet:

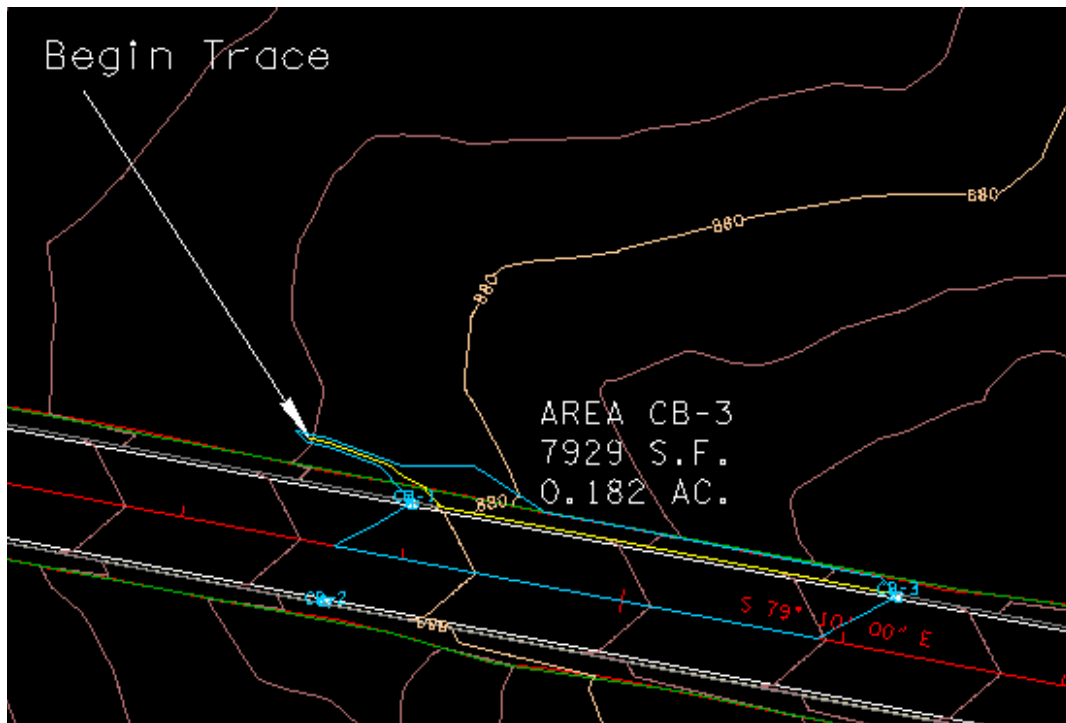
Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

$$\text{CB\#12 4x3: } 3.88' - 18''/12 - .17' = 2.21'$$

## 5.6 Delineate Drainage Area CB – 3

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-3** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 3. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-3 and turn off DA\_CB-2.

Delineate Drainage Area:



- Define Drainage Area:

Drainage Area Definition

Area ID: ◀ CB-3 ▶ ☐ Window Center ☐ Highlight

Details

Options  
Definition  
Subareas  
Computation

Description: To Node ID: CB-3

Drainage Area: 0.182  
Base C Value: 0.350  
Time of Conc.: 5.000

Hydro. Method  
☒ Rational  
☐ SCS

Compute TC

Area Selection / Creation

## Exercise 5

d) Calculate Time of Concentration:

**Time of Concentration**

Drainage Area ID: CB-3  
 TIN File: final.tin

Define Path  
 Trace ID - Segments

☒ **Sheet Flow**  
 Method: FHA Length: 35.000  
 n Value: 0.400 Slope: 1.283

☒ **Shallow Flow**  
 Length: 35.000  
 Inter. K: 0.491 Slope: 4.975

☒ **Concentrated Flow**  
 Method: Continuity Length: 205.750  
 Velocity: 5.000

Accum. Distance: 275.750  
 Accum. Avg. Slope: 2.671

**Tc= 9.150** Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
9.38	1.70	1.70	Sheet
25.62	1.13	1.28	Sheet
3.40	1.13	1.27	Shallow
2.47	1.43	1.28	Shallow
2.18	1.36	1.28	Shallow
1.81	1.85	1.31	Shallow
1.02	1.85	1.32	Shallow
0.96	2.24	1.34	Shallow
7.70	2.24	1.46	Shallow
3.02	2.24	1.50	Shallow
0.00	53.36	1.50	Shallow
0.96	50.07	2.30	Shallow
0.00	50.06	2.30	Shallow
0.01	3.21	2.30	Shallow

Distance: 9.380 Slope: 1.700 Adjust Flow

Max Sheet Flow Distance: 35.000  
 Max Shallow Flow Distance: 35.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

The maximum length for sheet flow and shallow flow has changed and will vary depending upon the drainage area. For this area, set Max. Sheet Flow and Max. Shallow Flow to 35.

e) Delineate Subareas utilizing the Land Use DGN:

**Drainage Area Subareas**

Area ID: CB-3

☐ Window Center ☐ Highlight

**Details**

Subarea	C Value	Description
0.1312	0.900	Conc./Asphalt Pvmnt
0.0183	0.300	Forested Areas

To Node ID: CB-3

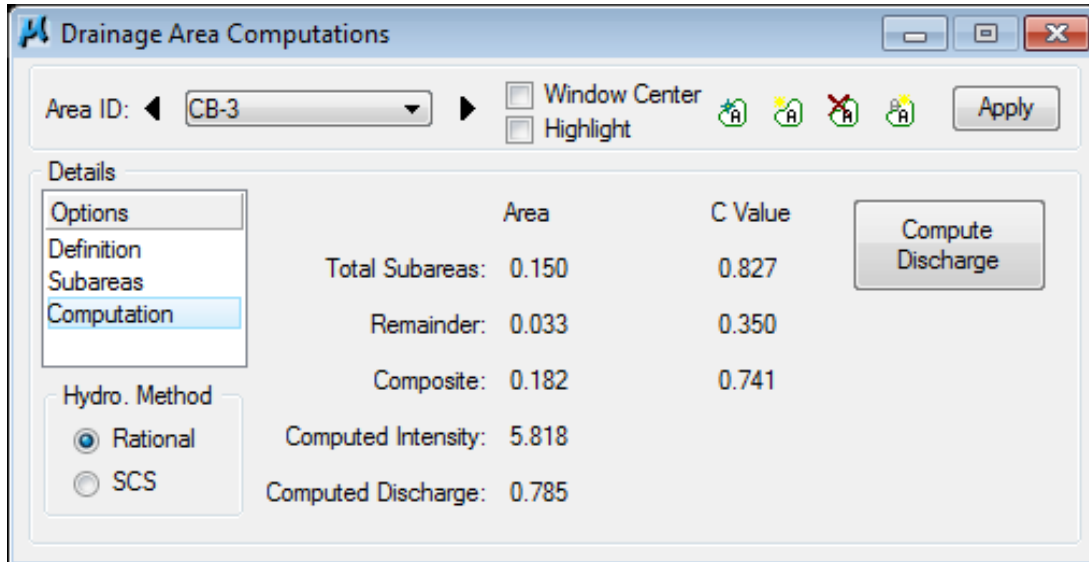
Automatic Delineation

☒ Display Only

Hydro. Method  
☒ Rational  
☐ SCS

0.018 0.300 Forested Areas

f) **Compute Discharge and Apply:**

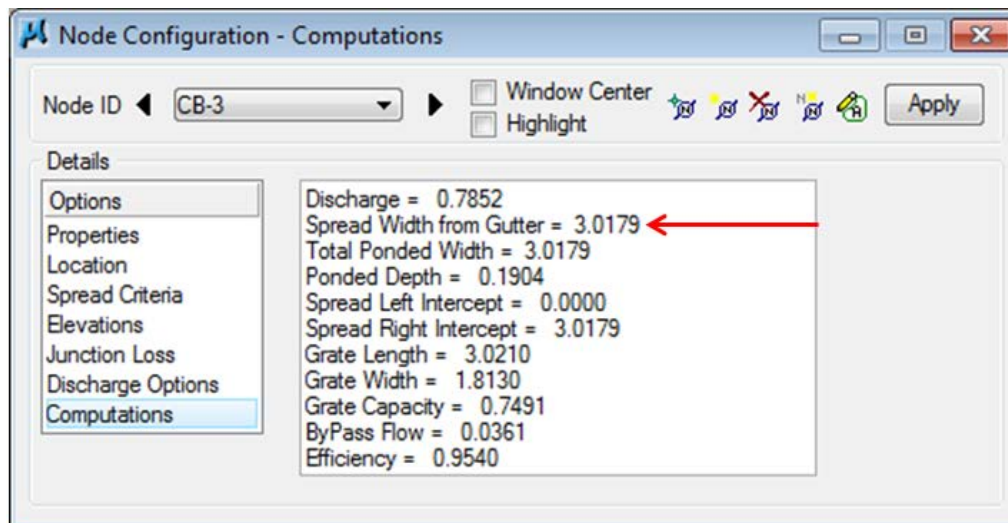


The **Drainage Area Computations** dialog box shows the following details:

- Area ID:** CB-3
- Window Center:** ☐ (disabled)
- Highlight:** ☐ (disabled)
- Details:**
  - Options:**
    - Definition
    - Subareas
    - Computation** (selected)
  - Hydro. Method:**
    - ☒ Rational
    - ☐ SCS
- Area and C Value:**

	Area	C Value
Total Subareas:	0.150	0.827
Remainder:	0.033	0.350
Composite:	0.182	0.741
Computed Intensity:	5.818	
Computed Discharge:	0.785	
- Buttons:** **Compute Discharge** (disabled), **Apply** (disabled)

g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

- Node ID:** CB-3
- Window Center:** ☐ (disabled)
- Highlight:** ☐ (disabled)
- Details:**
  - Options:**
    - Options
    - Properties** (selected)
    - Location
    - Spread Criteria
    - Elevations
    - Junction Loss
    - Discharge Options
    - Computations** (disabled)
- Computed Values:**
  - Discharge = 0.7852
  - Spread Width from Gutter = 3.0179 (highlighted with a red arrow)
  - Total Ponded Width = 3.0179
  - Ponded Depth = 0.1904
  - Spread Left Intercept = 0.0000
  - Spread Right Intercept = 3.0179
  - Grate Length = 3.0210
  - Grate Width = 1.8130
  - Grate Capacity = 0.7491
  - ByPass Flow = 0.0361
  - Efficiency = 0.9540
- Buttons:** **Apply** (disabled)

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.



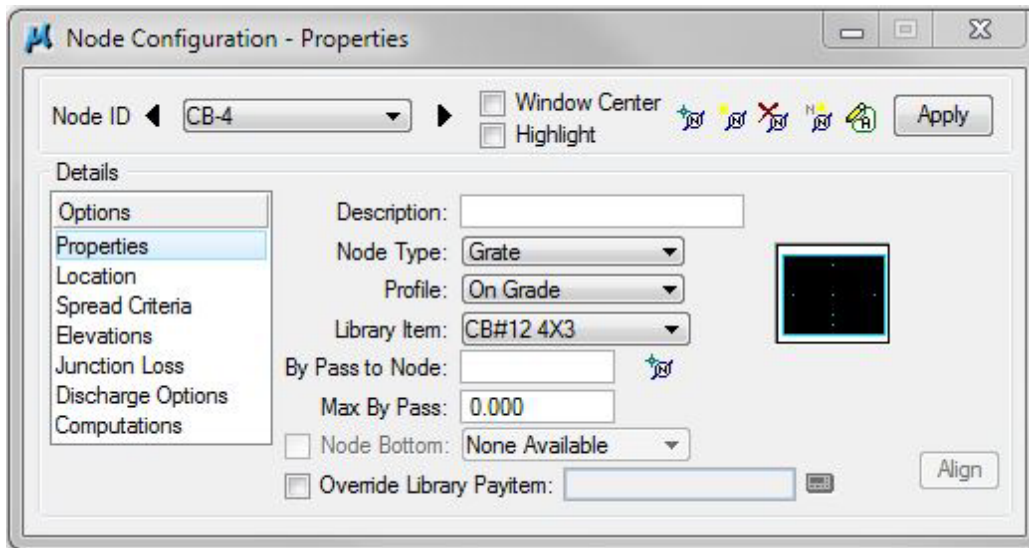
## 5.7 Design Inlet CB – 4

It has been determined that another standard **CB#12 4X3** will be used.

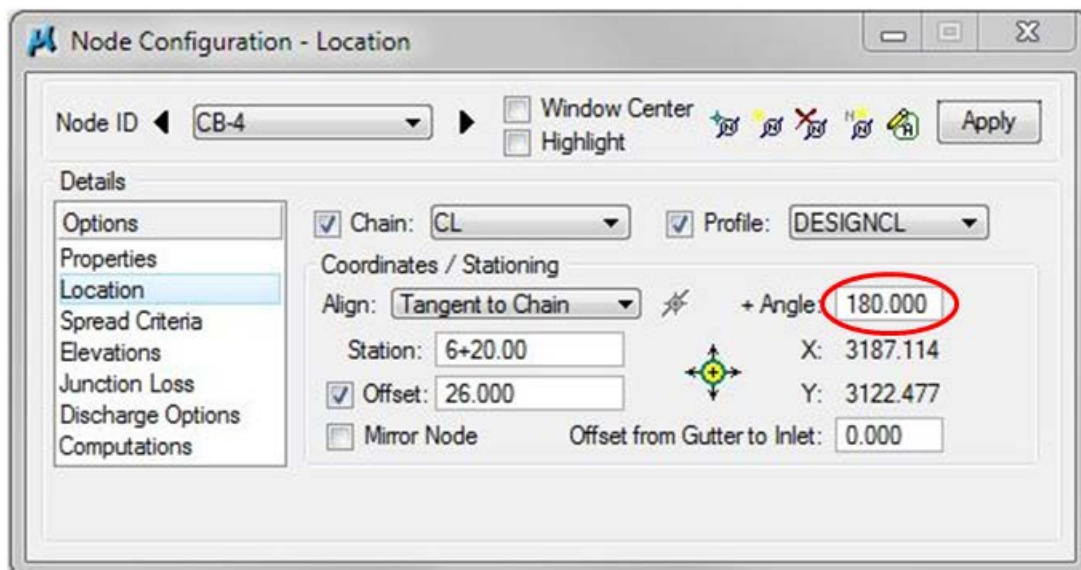
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-4.

**Properties >** Verify the Node Properties are defaulted from the previous Node such that no user-input is required:



- b) **Location >** All Reference information is defaulted from the previous Node (CB-3) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. We will set this catch basin at the same Station as CB-3.:

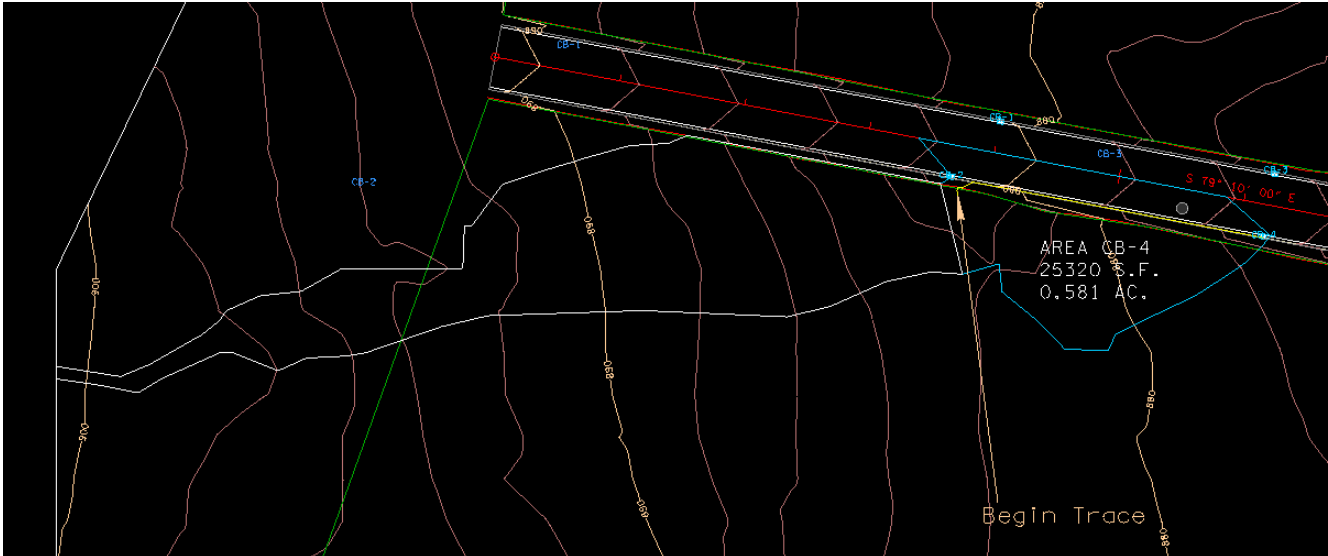


- c) Click the **Apply** button to include this node in the Drainage Project.

## 5.8 Delineate Drainage Area CB – 4

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-4** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 4. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-4 and turn off DA\_CB-3.

Delineate Drainage Area:



**NOTE:** After a first iteration the spread for the entire contributing drainage area was found to exceed the spread limit. After consideration it was determined an area drain could collect the water before it spills over the back of the curb. The white shape shows the drainage area to be captured by that area drain. (See next Exercise 5.9)

- Define Drainage Area:

## Exercise 5

b) Calculate Time of Concentration:

**Time of Concentration**

Drainage Area ID: CB-4

TIN File: final.tin

Define Path: Trace ID - Segments

☒ **Sheet Flow**  
 Method: FHA Length: 10.000  
 n Value: 0.400 Slope: 2.660

☒ **Shallow Flow**  
 Length: 10.000  
 Inter. K: 0.491 Slope: 8.405

☒ **Concentrated Flow**  
 Method: Continuity Length: 232.777  
 Velocity: 5.000

Accum. Distance: 251.638  
 Accum. Avg. Slope: 2.740

**Tc = 3.737** Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
3.52	1.52	1.52	Sheet
1.76	2.73	1.92	Sheet
0.25	2.73	1.96	Sheet
0.01	6.27	1.96	Sheet
0.04	6.27	1.99	Sheet
0.07	6.27	2.04	Sheet
0.00	6.27	2.04	Sheet
0.10	12.92	2.23	Sheet
0.12	5.12	2.28	Sheet
0.09	13.15	2.46	Sheet
0.13	2.71	2.46	Sheet
3.16	0.19	1.69	Sheet
0.19	50.04	2.66	Sheet
0.00	3.21	2.66	Sheet

Distance: 3.520 Slope: 1.520 Adjust Flow

Max Sheet Flow Distance: 10.000  
 Max Shallow Flow Distance: 10.000

Apply

The calculated Time of Concentration is less than the minimum of 5 minutes, therefore 5 must be manually typed in the Drainage Area Definition dialog after hitting apply in the Time of Concentration Window.

The maximum length for sheet flow and shallow flow has changed and will vary depending upon the drainage area. For this area, set Max. Sheet Flow and Max. Shallow Flow to 10.

c) Delineate Subareas utilizing the Land Use DGN:

**Drainage Area Subareas**

Area ID: CB-4

☐ Window Center ☐ Highlight

**Details**

Subarea	C Value	Description
0.1531	0.900	Conc./Asphalt Pvmnt
0.3753	0.300	Forested Areas

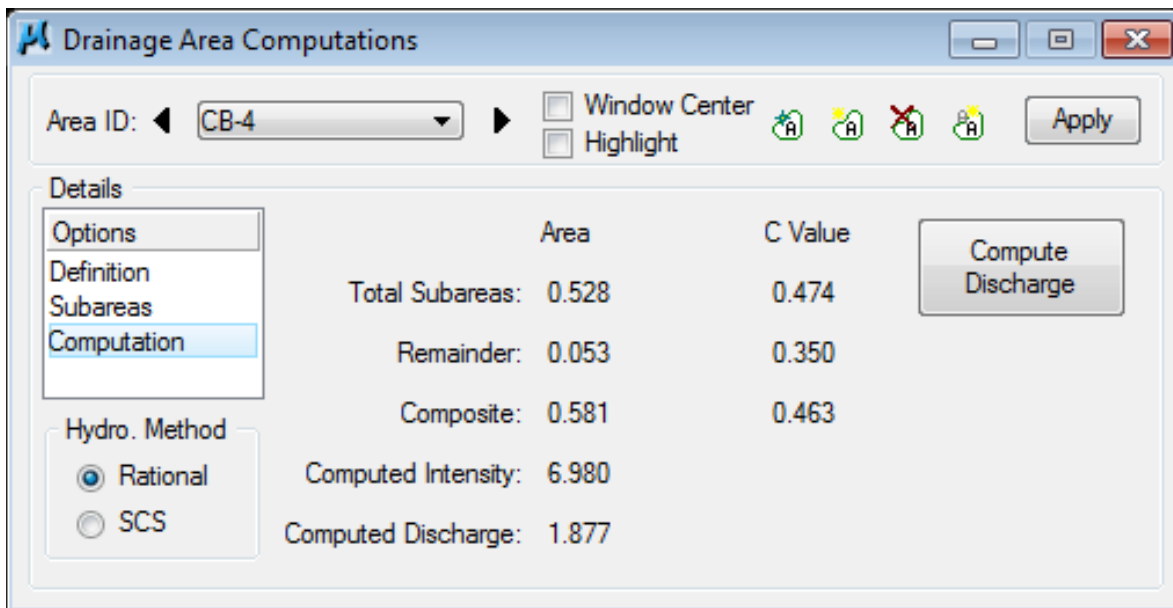
Hydro. Method: ☒ Rational ☐ SCS

0.375 0.300 Forested Areas

Automatic Delineation

☒ Display Only

d) **Compute Discharge and Apply:**

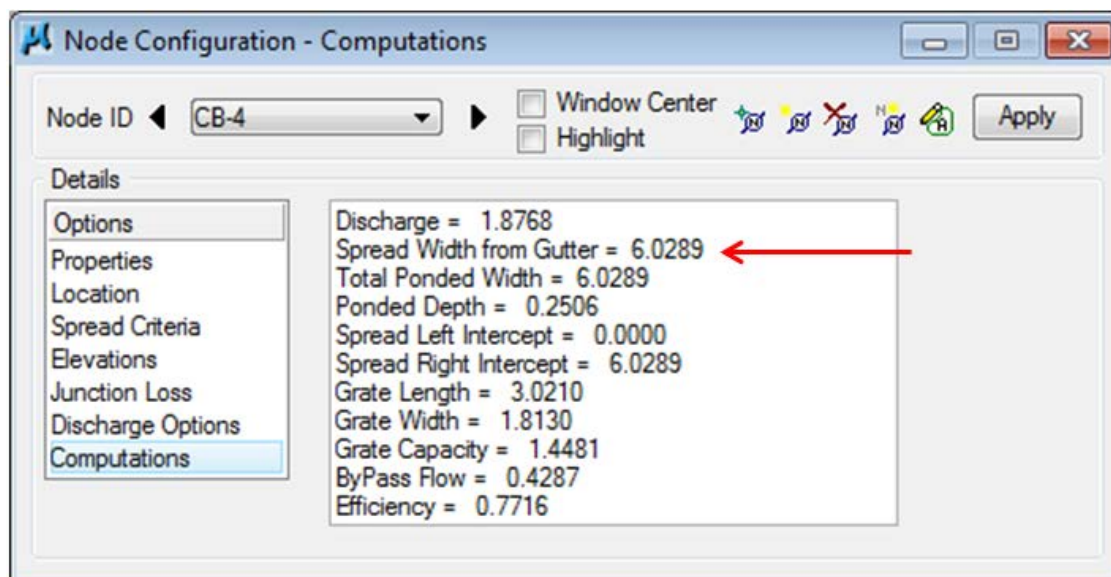


The 'Drainage Area Computations' dialog box shows the 'Area ID' as 'CB-4'. The 'Details' section on the left has 'Computation' selected. The 'Hydro. Method' section has 'Rational' selected. The main area displays the following data:

	Area	C Value
Total Subareas:	0.528	0.474
Remainder:	0.053	0.350
Composite:	0.581	0.463
Computed Intensity:	6.980	
Computed Discharge:	1.877	

Buttons for 'Window Center', 'Highlight', 'Apply', and 'Compute Discharge' are visible.

e) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The 'Node Configuration - Computations' dialog box shows the 'Node ID' as 'CB-4'. The 'Details' section on the left has 'Computations' selected. The main area displays the following data:

Discharge =	1.8768
Spread Width from Gutter =	6.0289
Total Ponded Width =	6.0289
Ponded Depth =	0.2506
Spread Left Intercept =	0.0000
Spread Right Intercept =	6.0289
Grate Length =	3.0210
Grate Width =	1.8130
Grate Capacity =	1.4481
ByPass Flow =	0.4287
Efficiency =	0.7716

A red arrow points to the 'Spread Width from Gutter' value of 6.0289.

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

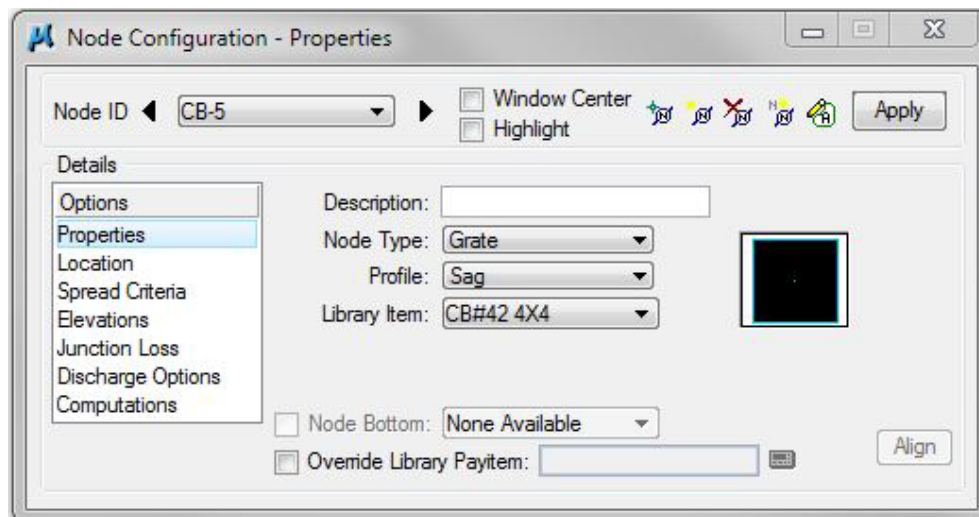
## 5.9 Design Inlet CB – 5

- a) After a first iteration, it has been determined that an area drain needs to be installed behind the curb at **Station 3+70.00, Offset 35.00' RT** in order to catch flow that would otherwise enter the roadway and cause the roadway spread to exceed the allowable limit.

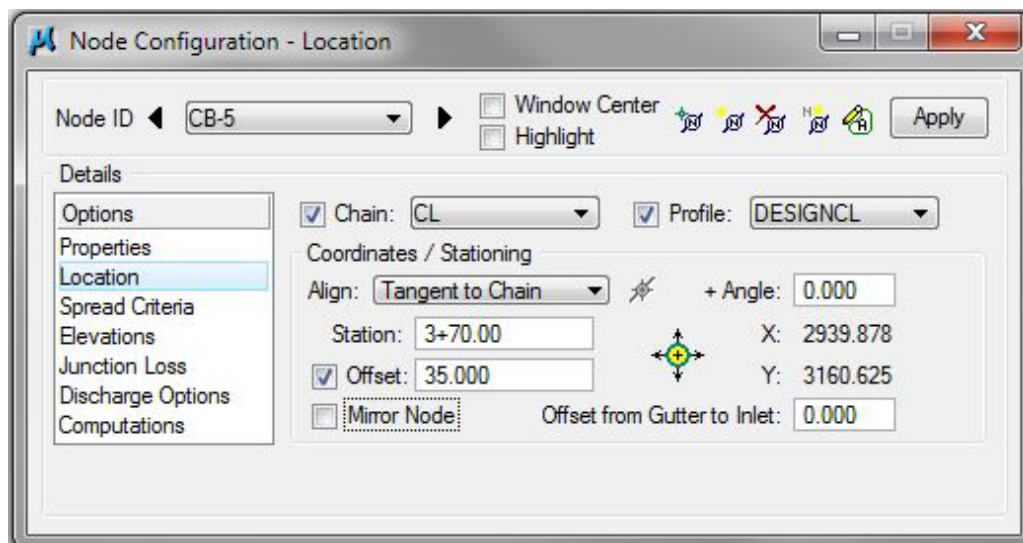
One way to determine the appropriate catch basin to be used is to review [TDOT Drainage Manual Chapter 7](#) Table 7-3 *Standard Inlet Types and Applications*.

It has been determined that a **CB#42 4X4** will be used. See Standard Drawing D-CB-42SB for details.

- b) **Properties >** Change **Profile** to **Sag** and change **Library Item** to **CB#42 4X4**:



- c) **Location >** All Reference information is defaulted from the previous Node such that only the **+Angle**, **Station** and the **Offset** needs to be changed:



**NOTE:** Since CB-5 is an area drain, it does not matter if the angle is 0 or 180, even though it is on the right side of the roadway.



d) **Spread Criteria** > For an inlet in a sag, we must specify certain spread criteria for each side of an inlet.

**% Slope Left:** 1.00 % (From DTM Tools>Analysis>Height/Slope)

**% Slope Right:** 1.00 % (From DTM Tools>Analysis>Height/Slope)

**% Discharge Left:** 98.00% (Estimated based on placement within drainage area)

**% Discharge Right:** 2.00% (Leftover area)

**NOTE:** Left and Right should be defined based on an inlet at angle = 0.

In other words:

Left of inlet is Viewed Left for all inlets at angles <90 and >270.

Right of inlet is Viewed Right for all inlets at angles <90 and >270.

Left of inlet is Viewed Right for all inlets at angles >90 and <270.

Right of inlet is Viewed Left for all inlets at angles >90 and <270.

Node Configuration - Optional Spread Criteria for Sags

Node ID: CB-5

☐ Window Center  
☐ Highlight

Apply

Details

Options  
Properties  
Location  
Spread Criteria  
Elevations  
Junction Loss  
Discharge Options  
Computations

% Slope Left: 1.000 Right: 1.000  
% Discharge Left: 98.000 Right: 2.000

Spread Cross Section:

Spread Source: Reference Surface

Width	% Slope	Roughness
2.287	-1.580	0.016
0.063	-6.265	0.016
0.005	-6.265	0.016

Maximum  
Pond Depth: 0.500  
Pond Width: 8.000



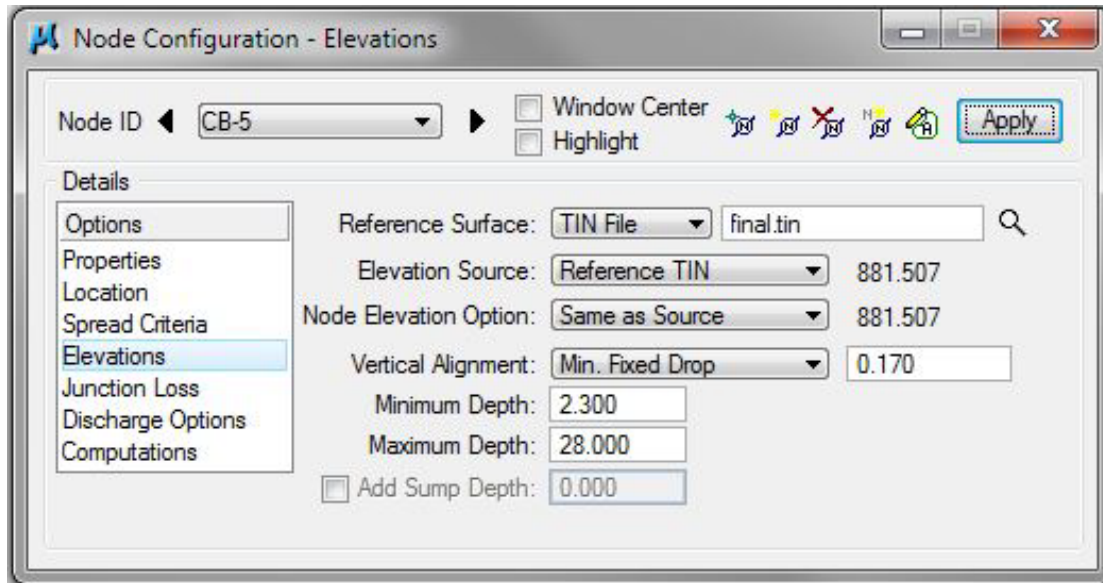
## Exercise 5

- e) **Elevations** > Elevation Data must be changed to match a CB#42. From the TDOT GEOPAK Drainage Nodes Document set the following:

**Vertical Alignment:** Min. Fixed Drop, 0.17

**Minimum Depth:** 2.30 feet (See note at top of page 5-7)

**Maximum Depth:** 28.00 feet



- f) Click the **Apply** button to include this node in the Drainage Project.

### Catch Basins – Outlet Only:

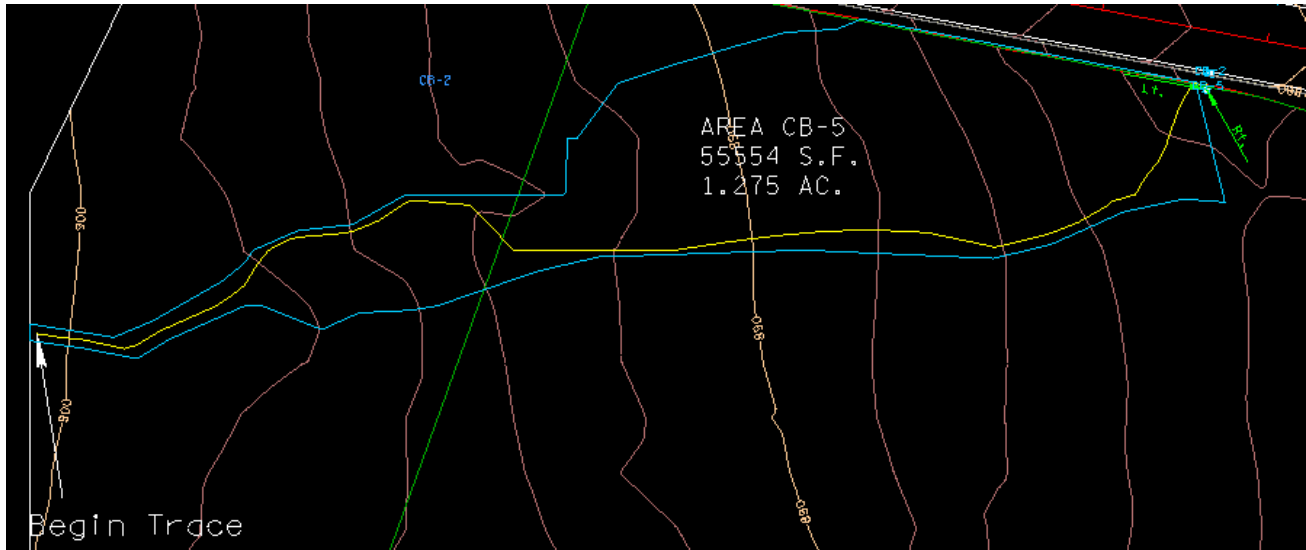
Drop Across Bottom of Structure + Min. Depth of Cover = Minimum Depth

$$\text{CB\#42 4x4: } 0.17' + 2.13' = 2.30'$$

## 5.10 Delineate Drainage Area CB – 5

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-5** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 5. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-5 and turn off DA\_CB-4.

Delineate Drainage Area:



- Define Drainage Area:

Drainage Area Definition

Area ID: ◀ CB-5 ▶ ☐ Window Center ☐ Highlight

Details

Options  
Definition  
Subareas  
Computation

Description: To Node ID: CB-5

Drainage Area: 1.275  
Base C Value: 0.350  
Time of Conc.: 5.000

Hydro. Method  
☒ Rational  
☐ SCS

Area Selection / Creation

## Exercise 5

d) Calculate Time of Concentration:

Time of Concentration

Drainage Area ID: CB-5

TIN File: final.tin

Define Path: Trace, ID - Segments

☒ **Sheet Flow**  
 Method: FHA Length: 300.000  
 n Value: 0.400 Slope: 2.247

☒ **Shallow Flow**  
 Length: 100.000  
 Inter. K: 0.491 Slope: 2.205

☒ **Concentrated Flow**  
 Method: Continuity Length: 387.326  
 Velocity: 5.000

Accum. Distance: 787.326  
 Accum. Avg. Slope: 2.431

**Tc= 34.154** Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
14.05	2.84	2.84	Sheet
14.02	2.96	2.90	Sheet
25.20	1.49	2.23	Sheet
7.76	2.69	2.29	Sheet
16.60	1.50	2.12	Sheet
36.26	0.98	1.76	Sheet
12.23	1.09	1.69	Sheet
8.66	2.04	1.72	Sheet
14.92	1.51	1.70	Sheet
10.36	3.16	1.79	Sheet
13.31	2.25	1.83	Sheet
6.21	1.29	1.81	Sheet
22.86	4.13	2.07	Sheet
9.38	4.49	2.18	Sheet

Distance: 14.050 Slope: 2.840 Adjust Flow

Max Sheet Flow Distance: 300.000  
 Max Shallow Flow Distance: 100.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

The maximum length for sheet flow and shallow flow has changed and will vary depending upon the drainage area. For this area, set Max. Sheet Flow to 300 and Max. Shallow Flow to 100.

e) Delineate Subareas utilizing the Land Use DGN:

Drainage Area Subareas

Area ID: CB-5

☐ Window Center ☐ Highlight

**Details**

Options: Definition, Subareas, Computation

Hydro. Method: ☒ Rational ☐ SCS

To Node ID: CB-5

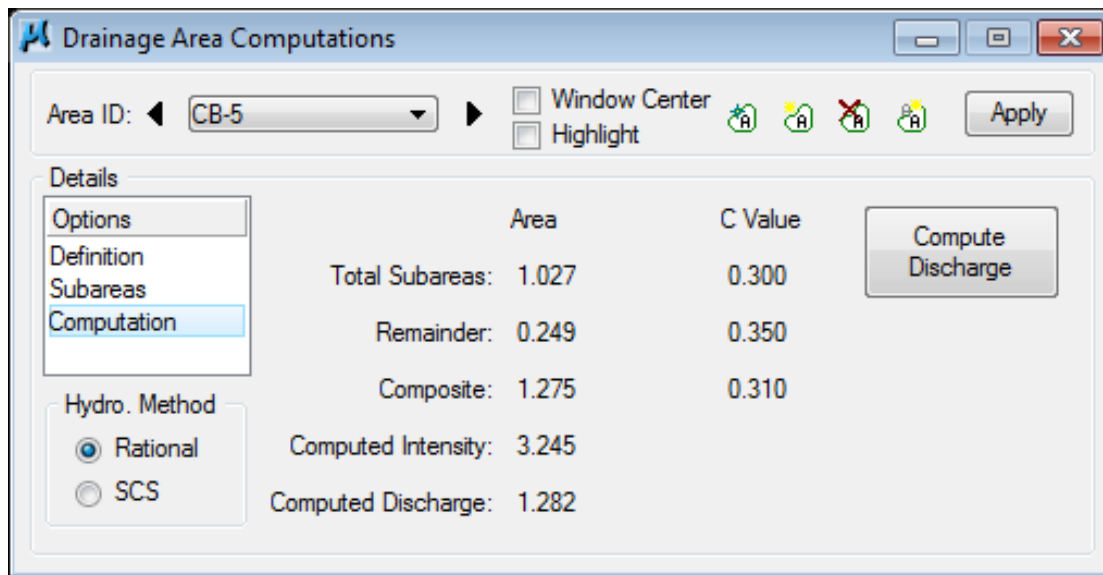
Subarea	C Value	Description
1.0267	0.300	Forested Areas

Automatic Delineation

☒ Display Only

1.027 0.300 Forested Areas

f) **Compute Discharge and Apply:**

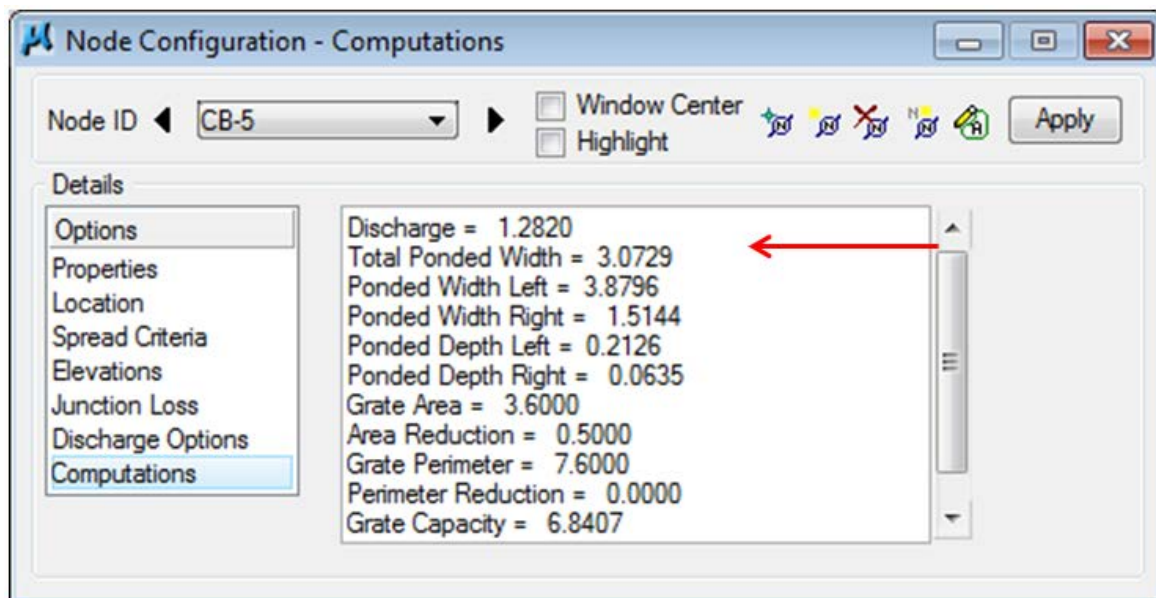


The 'Drainage Area Computations' dialog box shows the 'Area ID' as 'CB-5'. It has checkboxes for 'Window Center' and 'Highlight'. A 'Details' sidebar on the left lists 'Options', 'Definition', 'Subareas', 'Computation' (selected), and 'Hydro. Method'. The 'Hydro. Method' section has 'Rational' selected and 'SCS' unselected. The main area displays a table of computations:

	Area	C Value
Total Subareas:	1.027	0.300
Remainder:	0.249	0.350
Composite:	1.275	0.310
Computed Intensity:	3.245	
Computed Discharge:	1.282	

Buttons for 'Compute Discharge' and 'Apply' are present.

g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The 'Node Configuration - Computations' dialog box shows the 'Node ID' as 'CB-5'. It has checkboxes for 'Window Center' and 'Highlight'. A 'Details' sidebar on the left lists 'Options', 'Properties', 'Location', 'Spread Criteria', 'Elevations', 'Junction Loss', 'Discharge Options', and 'Computations' (selected). The main area displays a list of computed values:

- Discharge = 1.2820
- Total Ponded Width = 3.0729
- Ponded Width Left = 3.8796
- Ponded Width Right = 1.5144
- Ponded Depth Left = 0.2126
- Ponded Depth Right = 0.0635
- Grate Area = 3.6000
- Area Reduction = 0.5000
- Grate Perimeter = 7.6000
- Perimeter Reduction = 0.0000
- Grate Capacity = 6.8407

A red arrow points to the 'Discharge' value.

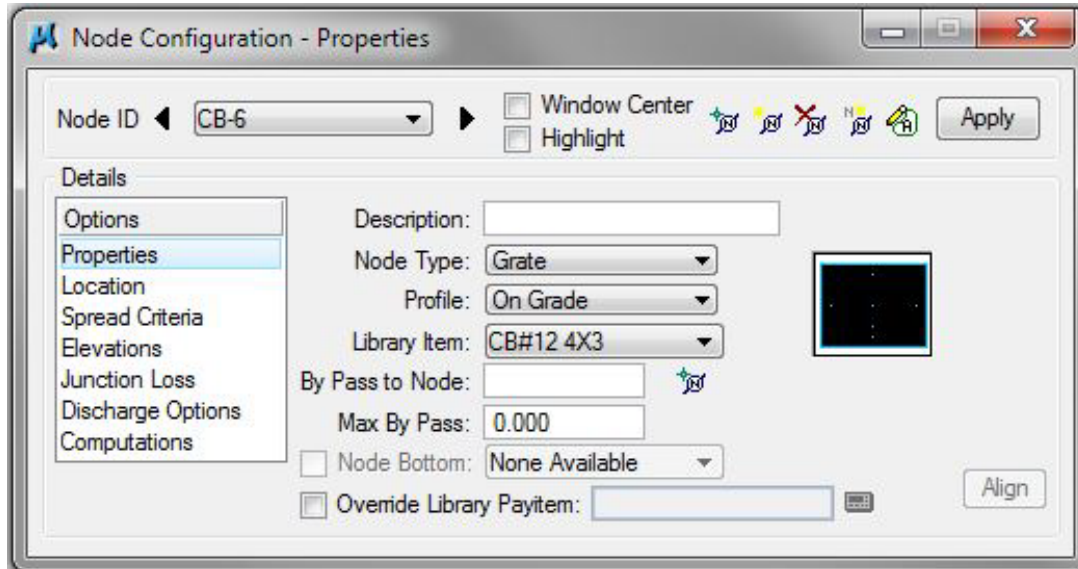
Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

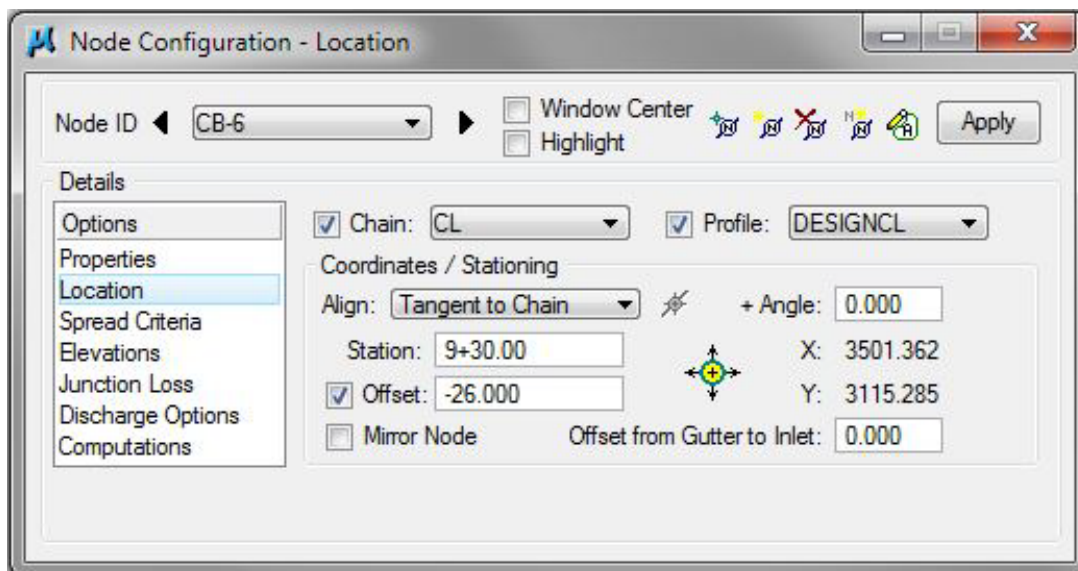
## 5.11 Design Inlet CB – 6

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-6

**Properties >** Change the Node **Properties** back to **On Grade** and to a **CB#12 4X3**:



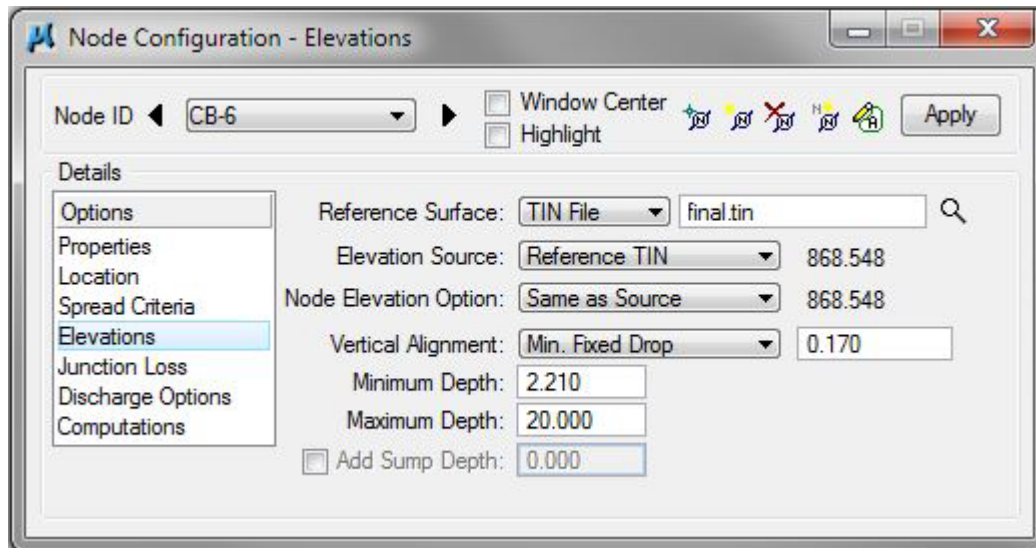
- b) **Location >** All Reference information is defaulted from the previous Node (CB-5) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. Discussion for the reason this station was chosen is presented in Step 2 of 5.11.:



**NOTE:** The **Spread Criteria** defaults back automatically when the node is changed back to **ON GRADE**, therefore no changes are necessary.



- c) **Elevations** > Be sure to change the elevation data back to that which is required for a Type 12 catch basin.



- d) Click the **Apply** button to include this node in the Drainage Project.

### **Catch Basins – Inlet and Outlet:**

Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

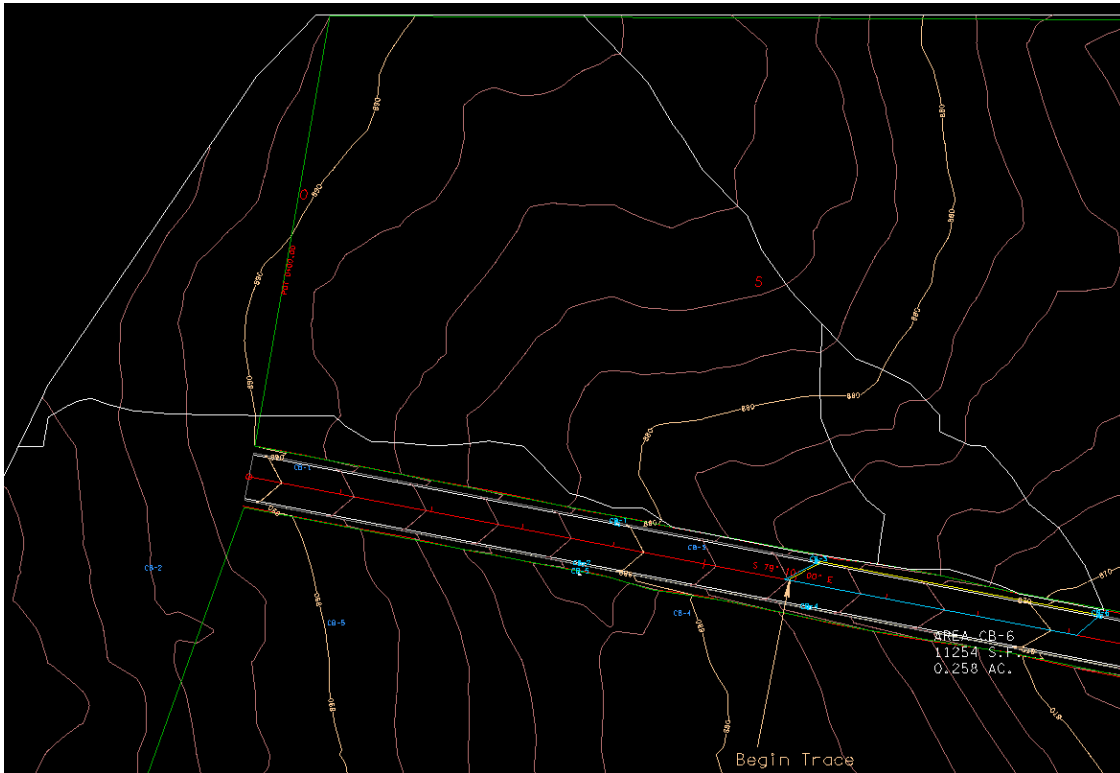
$$\text{CB\#12 4x3: } 3.88' - 18''/12 - .17' = 2.21'$$



## 5.12 Delineate Drainage Area CB – 6

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-6** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 6. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-6 and turn off DA\_CB-5.

Delineate Drainage Area:



**NOTE:** Upon inspection of the entire drainage area, it has been determined that area drains need to be installed to collect runoff before it enters the roadway. The white area shapes show the area to be collected by these drains which will be input in subsequent exercises.

- Define Drainage Area:

d) Calculate Time of Concentration:

Time of Concentration

Drainage Area ID: CB-6

TIN File: final.tin

Define Path

Trace ID - Segments

☒ Sheet Flow

Method: FHA Length: 20.000

n Value: 0.012 Slope: 3.213

☐ Shallow Flow

Length: 0.000

Inter. K: 0.491 Slope: 0.000

☒ Concentrated Flow

Method: Continuity Length: 325.164

Velocity: 5.000

Accum. Distance: 345.164

Accum. Avg. Slope: 2.147

Tc= 1.595

Compute Apply

Details

Distance	Slope	Avg. Slope	Flow
1.15	3.21	3.21	Sheet
3.81	3.21	3.21	Sheet
2.58	3.21	3.21	Sheet
2.22	3.21	3.21	Sheet
4.17	3.21	3.21	Sheet
0.63	3.21	3.21	Sheet
1.91	3.21	3.21	Sheet
2.89	3.21	3.21	Sheet
0.96	3.21	3.21	Conc
1.91	3.21	3.21	Conc
4.48	3.21	3.21	Conc
2.25	3.21	3.21	Conc
4.14	3.21	3.21	Conc
0.66	3.21	3.21	Conc

Distance: 1.150 Slope: 3.210 Adjust Flow

Max Sheet Flow Distance: 20.000

Max Shallow Flow Distance: 0.000

Apply

The calculated Time of Concentration is less than the minimum of 5 minutes, therefore **5 must be manually typed** in the Drainage Area Definition dialog after hitting apply in the Time of Concentration Window.

Since the flow appears to go directly from sheet to concentrated flow we unchecked shallow flow. For this area, set Max Sheet Flow to 20. Also note that the n Value changes to 0.012 (Asphalt).

e) Delineate Subareas utilizing the Land Use DGN:

Drainage Area Subareas

Area ID: CB-6

Window Center Highlight

Apply

Details

Options Definition Subareas Computation

To Node ID: CB-6

Subarea	C Value	Description
0.1877	0.900	Conc/Asphalt Pvmnt
0.0136	0.300	Forested Areas

Automatic Delineation

Display Only

Hydro. Method

☒ Rational

☐ SCS

0.014 0.300 Forested Areas

## f) Compute Discharge and Apply:

Drainage Area Computations

Area ID: ◀ CB-6 ▶

☐ Window Center  
☐ Highlight

Apply

Details

Options	Area	C Value
Definition	Total Subareas: 0.201	0.859
Subareas	Remainder: 0.056	0.350
Computation	Composite: 0.257	0.749

Hydro. Method

☒ Rational  
☐ SCS

Computed Intensity: 6.980  
Computed Discharge: 1.343

Compute Discharge

## g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.

Node Configuration - Computations

Node ID: ◀ CB-6 ▶

☐ Window Center  
☐ Highlight

Apply

Details

Options
Properties
Location
Spread Criteria
Elevations
Junction Loss
Discharge Options
Computations

Discharge = 1.3432  
Spread Width from Gutter = 5.5181  
Total Ponded Width = 5.5181  
Ponded Depth = 0.2404  
Spread Left Intercept = 0.0000  
Spread Right Intercept = 5.5181  
Grate Length = 3.0210  
Grate Width = 1.8130  
Grate Capacity = 1.1155  
ByPass Flow = 0.2277  
Efficiency = 0.8305

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

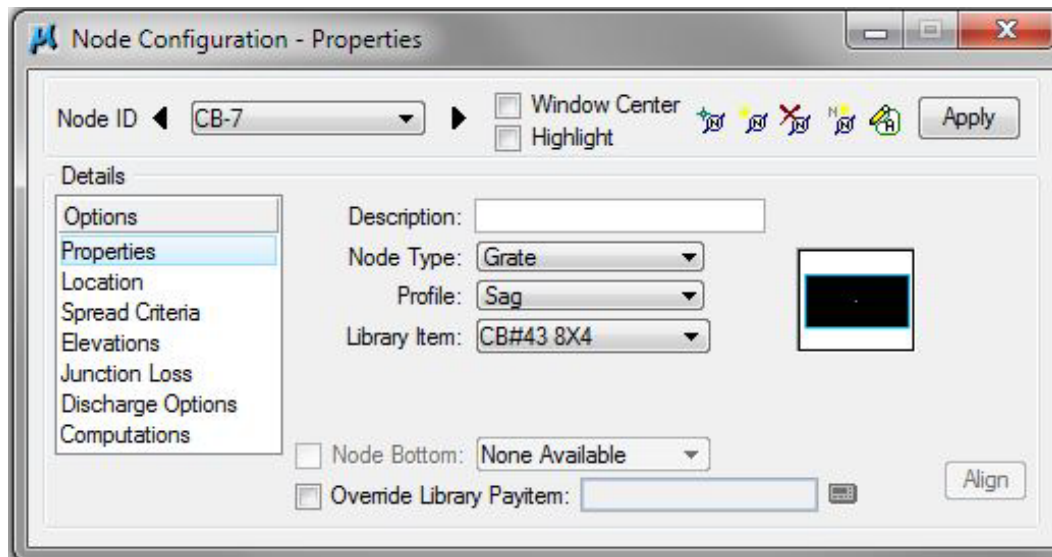
## 5.13 Design Inlet CB – 7

It has been determined that a **CB#43 8X4** will be used.

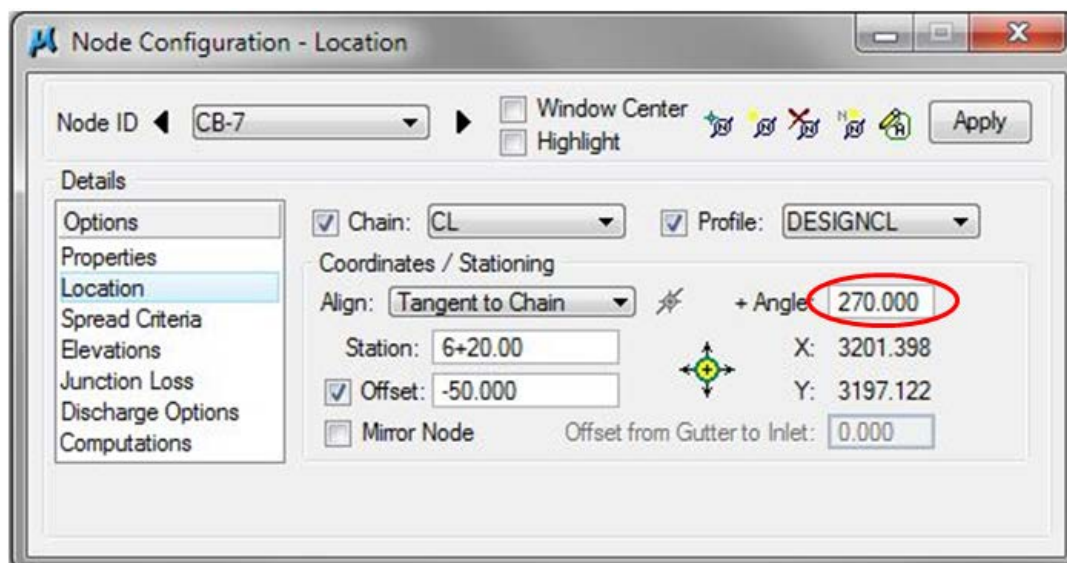
See Standard Drawing D-CB-43SB for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-7

**Properties >** Change the Node **Properties** to **Sag** and to a **CB#43 8X4** (a type #43 catch basin was chosen due to the fact that this will collect a significant amount of water not on the roadway):



- b) **Location >** All Reference information is defaulted from the previous Node (CB-6) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. Pay special attention to the placement and rotation of this catch basin. It has been rotated to intercept as much runoff as possible:





## Exercise 5

**NOTE:** The following image shows why this location was chosen for CB-7. Upon inspection of the TIN File, utilizing the DTM Drainage Tools discussed in Chapter 3, a ponded area was discovered at this location. CB-7 was set at the low point of the ponded area. To simplify the design and minimize land disturbance, CB-3 and CB-4 were set at the same station. **The iterative steps required for this determination were not shown in this manual, but would be required in an actual design project.**



c) **Spread Criteria** > Enter the Spread Criteria as shown below.

**% Slope Left:** 5.00 % (From DTM Tools>Analysis>Height/Slope)

**% Slope Right:** 3.50 % (From DTM Tools>Analysis>Height/Slope)

**% Discharge Left:** 10.00% (Estimated based on placement within drainage area)

**% Discharge Right:** 90.00% (Leftover area)

**NOTE:** Left and Right are defined by a node at angle 0. To gain your bearing, remember this node has been rotated 270 degrees or 90 degrees clockwise.

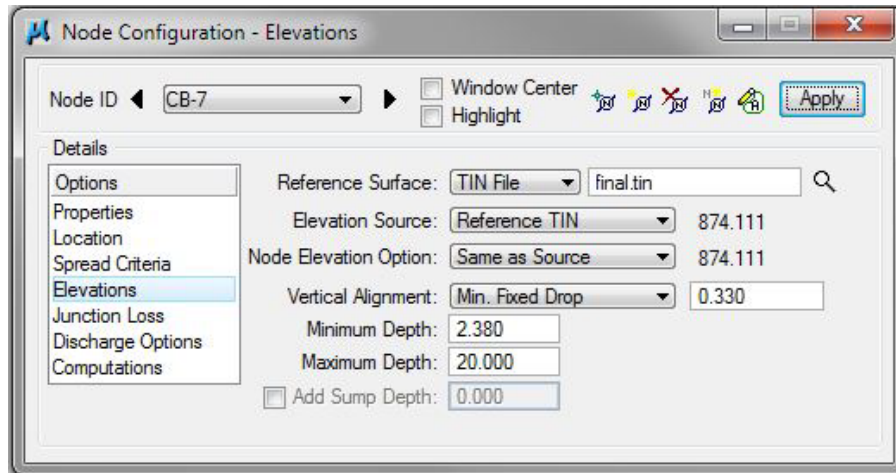
Width	% Slope	Roughness
0.088	2.685	0.016
0.181	4.897	0.016
0.103	4.897	0.016

- d) **Elevations** > Elevation Data must be changed to match a CB#43 8x4. From the [TDOT GEOPAK Drainage Nodes](#) Document set the following:

**Vertical Alignment:** Min. Fixed Drop, 0.33

**Minimum Depth:** 2.38 feet (See note at top of page 5-7)

**Maximum Depth:** 20.00 feet



- e) Click the **Apply** button to include this node in the Drainage Project.

#### **Catch Basins – Outlet Only:**

Drop Across Bottom of Structure + Min. Depth of Cover = Minimum Depth

$$\text{CB\#43 8x4: } .33' + 2.05' = 2.38'$$

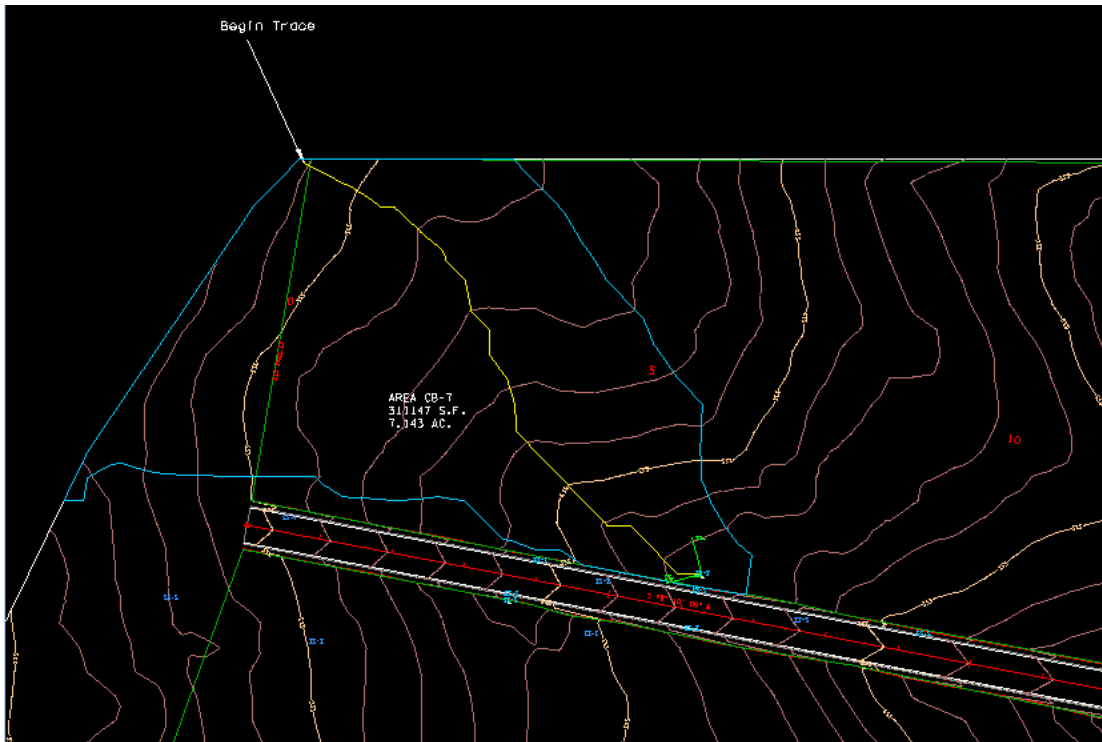
**NOTE:** See Appendix A, pg. A-4



## 5.14 Delineate Drainage Area CB – 7

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-7** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 7. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-7 and turn off DA\_CB-6.

Delineate Drainage Area:



**NOTE:** As discussed in Exercise 5.12 *Delineate Drainage Area CB-6* this area will catch a large amount of runoff prior to it entering the roadway.

- Define Drainage Area:

d) Calculate Time of Concentration:

Drainage Area ID: CB-7  
TIN File: final.tin

Define Path  
Trace ID - Segments

☒ **Sheet Flow**  
Method: FHA Length: 300.000  
n Value: 0.400 Slope: 1.959

☒ **Shallow Flow**  
Length: 100.000  
Inter. K: 0.491 Slope: 1.537

☒ **Concentrated Flow**  
Method: Continuity Length: 437.279  
Velocity: 5.000

Accum. Distance: 837.279  
Accum. Avg. Slope: 2.162

Tc= 36.141 Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
0.67	2.81	2.81	Sheet
28.87	2.86	2.86	Sheet
28.43	2.67	2.77	Sheet
7.77	2.53	2.74	Sheet
5.13	2.57	2.73	Sheet
32.34	2.42	2.63	Sheet
17.99	2.12	2.56	Sheet
17.83	1.68	2.44	Sheet
0.25	2.53	2.44	Sheet
43.26	1.78	2.29	Sheet
4.76	1.58	2.27	Sheet
37.65	1.33	2.11	Sheet
10.29	0.95	2.06	Sheet
6.50	1.91	2.06	Sheet

Distance: 0.670 Slope: 2.810 Adjust Flow

Max Sheet Flow Distance: 300.000  
Max Shallow Flow Distance: 100.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

**NOTE:** The maximum length for sheet flow has changed and will vary depending upon the drainage area. For this area, the Max Sheet Flow changes to 300 and the Max Shallow Flow changes to 100. The n Value for Sheet Flow changes back to 0.400

e) Delineate Subareas utilizing the Land Use DGN:

Area ID: CB-7 Window Center Highlight Apply

**Details**

Options Definition Subareas Computation

Hydro. Method  
Rational SCS

To Node ID: CB-7

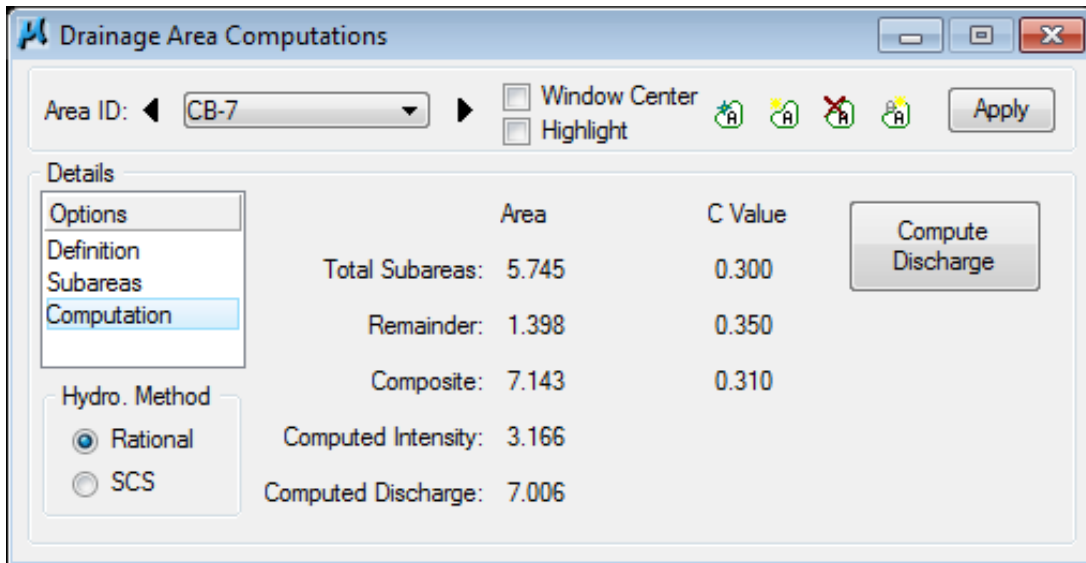
Subarea	C Value	Description
5.7452	0.300	Forested Areas

Automatic Delineation  
Display Only

5.745 0.300 Forested Areas

## Exercise 5

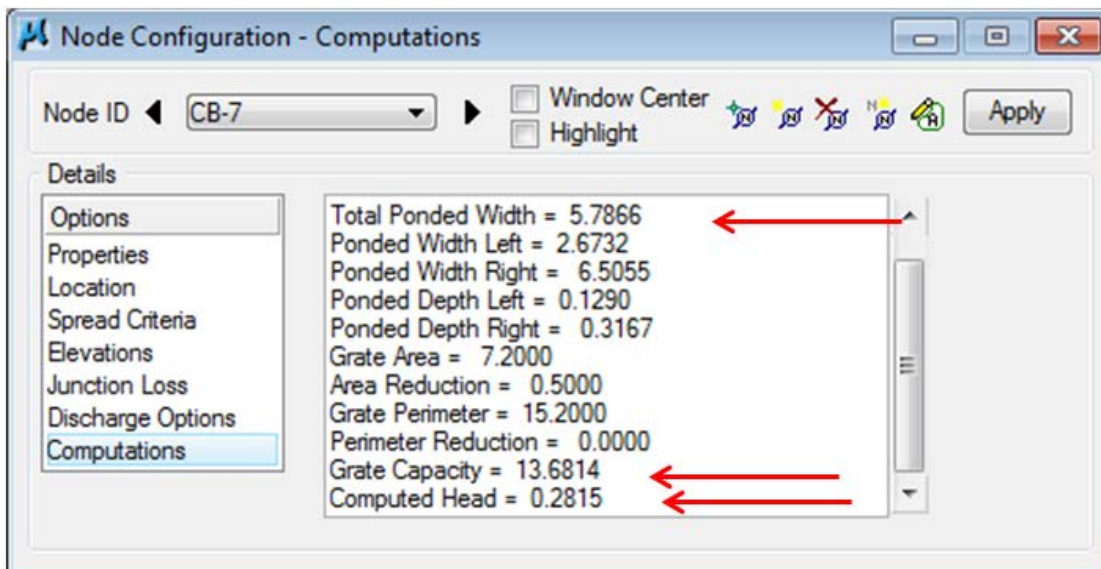
### f) Compute Discharge and Apply:



The **Drainage Area Computations** dialog box shows the following details:

- Area ID: CB-7
- Window Center: ☐
- Highlight: ☐
- Details:
  - Options: Options, Definition, Subareas, **Computation**
  - Hydro. Method: ☒ Rational, ☐ SCS
- Area:
  - Total Subareas: 5.745
  - Remainder: 1.398
  - Composite: 7.143
- C Value:
  - 0.300
  - 0.350
  - 0.310
- Computed Intensity: 3.166
- Computed Discharge: 7.006
- Buttons: Compute Discharge, Apply

### g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

- Node ID: CB-7
- Window Center: ☐
- Highlight: ☐
- Details:
  - Options: Options, **Properties**, Location, Spread Criteria, Elevations, Junction Loss, Discharge Options, **Computations**
- Computed Data:
  - Total Pounded Width = 5.7866
  - Pounded Width Left = 2.6732
  - Pounded Width Right = 6.5055
  - Pounded Depth Left = 0.1290
  - Pounded Depth Right = 0.3167
  - Grate Area = 7.2000
  - Area Reduction = 0.5000
  - Grate Perimeter = 15.2000
  - Perimeter Reduction = 0.0000
  - Grate Capacity = 13.6814
  - Computed Head = 0.2815
- Buttons: Apply

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Review the Computed Data. Items to review specifically are:

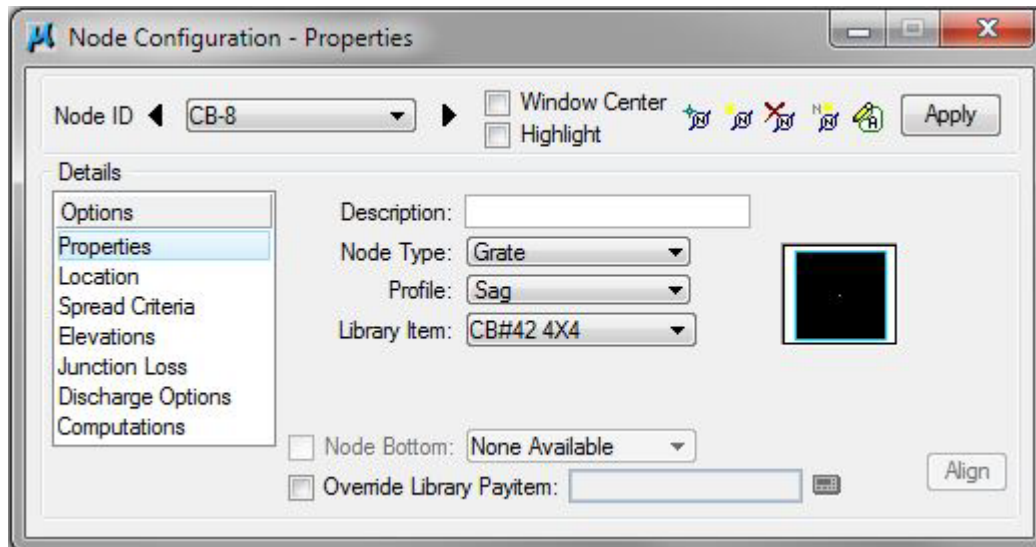
**Total Pounded Width, Grate Capacity** compared with **Computed Discharge** and **Computed Head**

## 5.15 Design Inlet CB – 8

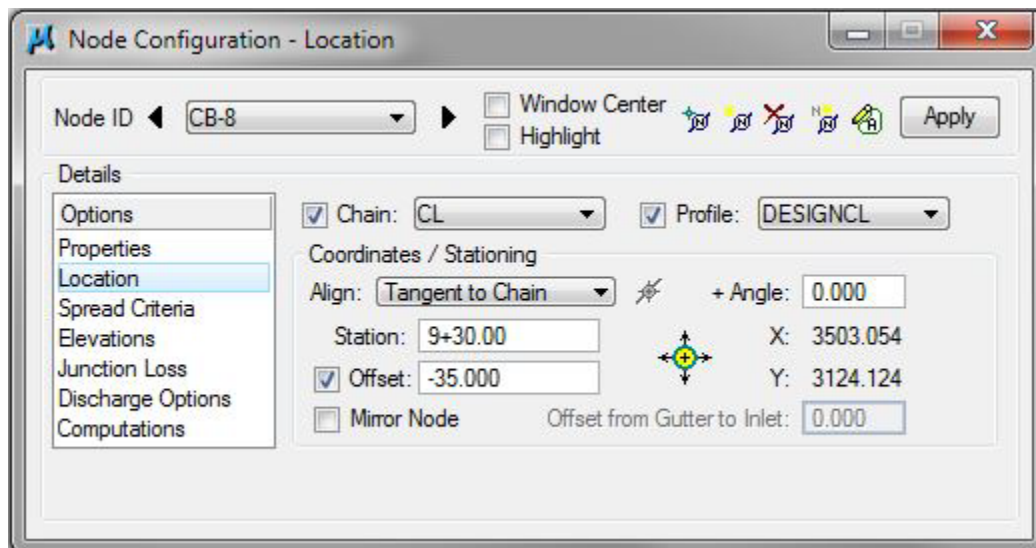
It has been determined that a **CB#42 4X4** will be used. See Standard Drawing D-CB-42SB for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-8

**Properties >** Change the Node **Properties** to **Sag** and to a **CB#42 4X4**:



- b) **Location >** All Reference information is defaulted from the previous Node (CB-7) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed:



## Exercise 5

c) **Spread Criteria** > Enter the Spread Criteria as shown below.

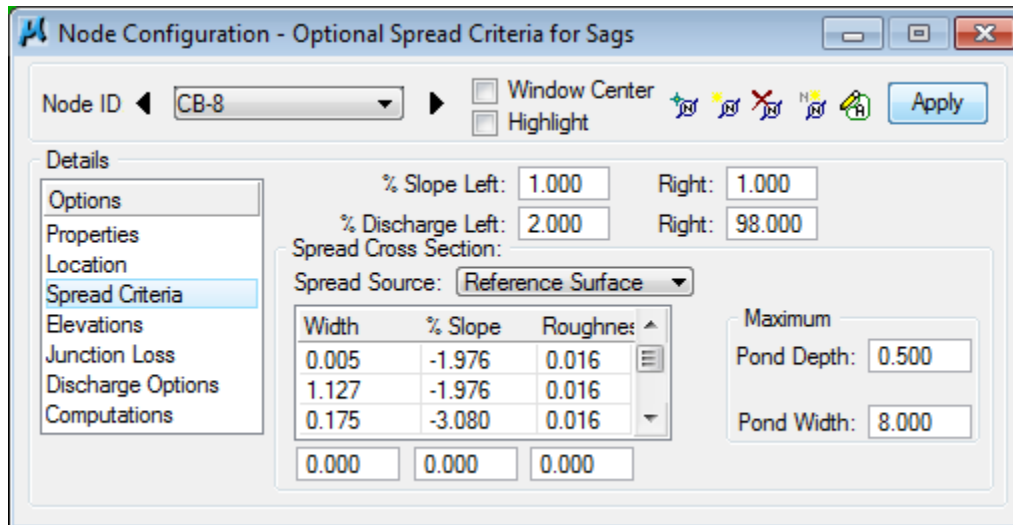
% Slope Left: 1.00 % (From DTM Tools>Analysis>Height/Slope)

% Slope Right: 1.00 % (From DTM Tools>Analysis>Height/Slope)

% Discharge Left: 2.00% (Estimated based on placement within drainage area)

% Discharge Right: 98.00% (Leftover area)

**NOTE:** Left and Right are defined by a node at angle 0.



Node Configuration - Optional Spread Criteria for Sags

Node ID: CB-8

☐ Window Center ☐ Highlight

Details

- Options
- Properties
- Location
- Spread Criteria
- Elevations
- Junction Loss
- Discharge Options
- Computations

% Slope Left: 1.000 Right: 1.000

% Discharge Left: 2.000 Right: 98.000

Spread Cross Section:

Spread Source: Reference Surface

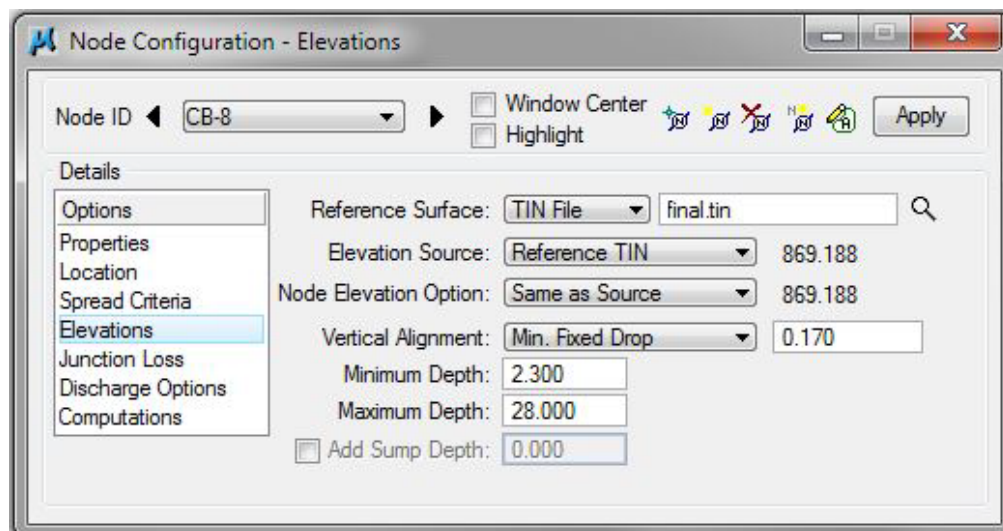
Width	% Slope	Roughness
0.005	-1.976	0.016
1.127	-1.976	0.016
0.175	-3.080	0.016
0.000	0.000	0.000

Maximum Pond Depth: 0.500

Pond Width: 8.000

Apply

d) **Elevations** > Elevation Data must be changed to match a CB#42 4X4. From the [TDOT GEOPAK Drainage Nodes](#) Document set the following:



Node Configuration - Elevations

Node ID: CB-8

☐ Window Center ☐ Highlight

Details

- Options
- Properties
- Location
- Spread Criteria
- Elevations
- Junction Loss
- Discharge Options
- Computations

Reference Surface: TIN File final.tin

Elevation Source: Reference TIN 869.188

Node Elevation Option: Same as Source 869.188

Vertical Alignment: Min. Fixed Drop 0.170

Minimum Depth: 2.300

Maximum Depth: 28.000

☐ Add Sump Depth: 0.000

Apply

e) Click the **Apply** button to include this node in the Drainage Project.

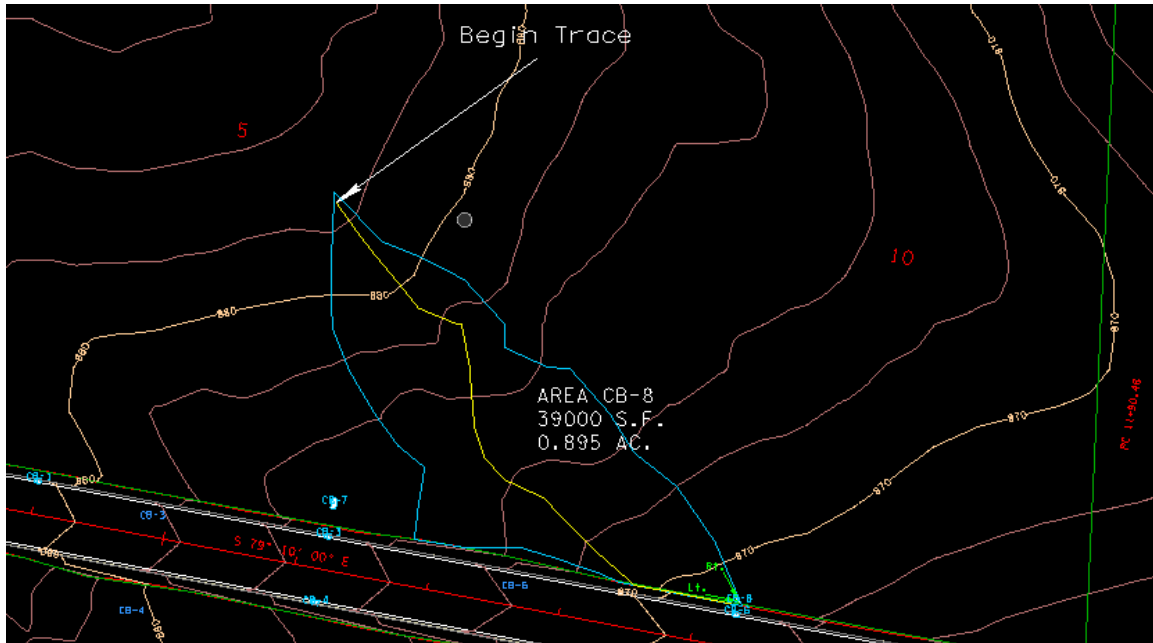
$$\text{CB\#42 4x4: } 0.17' + 2.13' = 2.30'$$



## 5.16 Delineate Drainage Area CB – 8

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-8** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 8. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-8 and turn off DA\_CB-7.

Delineate Drainage Area:



**NOTE:** As discussed in Exercise 5.11 *Create Drainage Area CB-6* this area will catch runoff prior to it entering the roadway.

- Define Drainage Area:

## Exercise 5

d) Calculate Time of Concentration:

Time of Concentration

Drainage Area ID: CB-8

TIN File: final.tin

Define Path: Trace, ID - Segments

☒ Sheet Flow

Method: FHA Length: 300.000 n Value: 0.400 Slope: 3.167

☒ Shallow Flow

Length: 100.000 Inter. K: 0.491 Slope: 3.016

☒ Concentrated Flow

Method: Continuity Length: 62.295 Velocity: 5.000

Accum. Distance: 462.295 Accum. Avg. Slope: 2.907

Tc= 28.956 Compute Apply

Details

Distance	Slope	Avg. Slope	Flow
29.62	3.31	3.31	Sheet
19.65	3.14	3.24	Sheet
23.08	3.23	3.24	Sheet
27.49	3.30	3.25	Sheet
30.96	6.73	4.08	Sheet
3.47	6.27	4.13	Sheet
33.32	0.81	3.47	Sheet
6.67	3.52	3.47	Sheet
26.61	3.40	3.46	Sheet
9.73	3.70	3.47	Sheet
24.67	3.17	3.44	Sheet
22.27	1.43	3.27	Sheet
31.67	2.49	3.18	Sheet
4.83	2.33	3.17	Sheet

Distance: 29.620 Slope: 3.310 Adjust Flow

Max Sheet Flow Distance: 300.000 Max Shallow Flow Distance: 100.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

The maximum length for sheet flow has changed and will vary depending upon the drainage area. Keep Max Sheet Flow at 300 and Max Shallow Flow at 100.

e) Delineate Subareas utilizing the Land Use DGN:

Drainage Area Subareas

Area ID: CB-8

Window Center Highlight

Details

Options Definition Subareas Computation

Subarea C Value Description

0.8928	0.300	Forested Areas
--------	-------	----------------

To Node ID: CB-8

Automatic Delineation

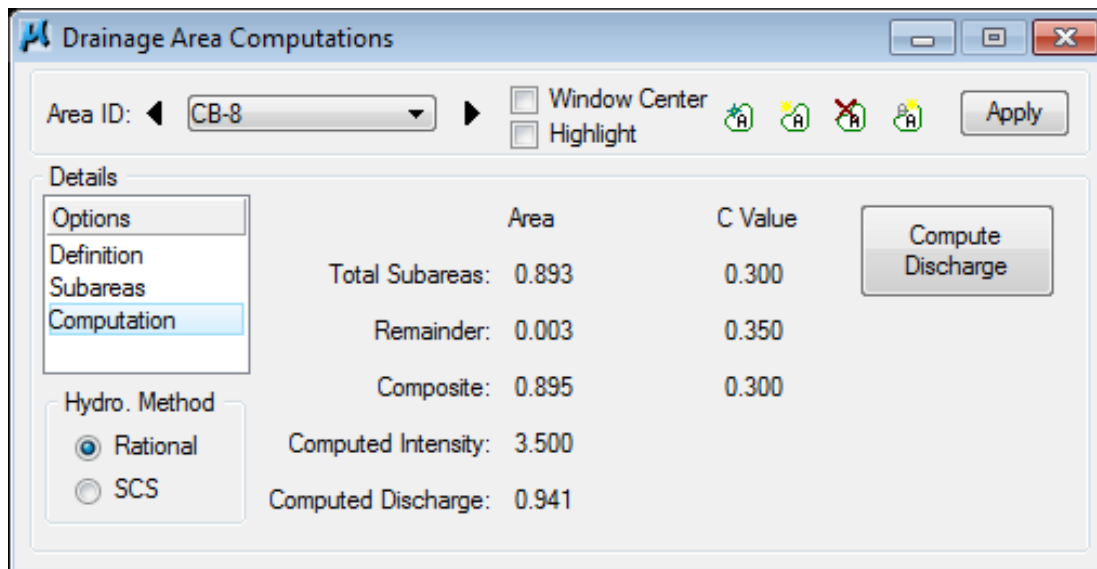
Display Only

Hydro. Method

☒ Rational ☐ SCS

0.893 0.300 Forested Areas

f) **Compute Discharge and Apply:**

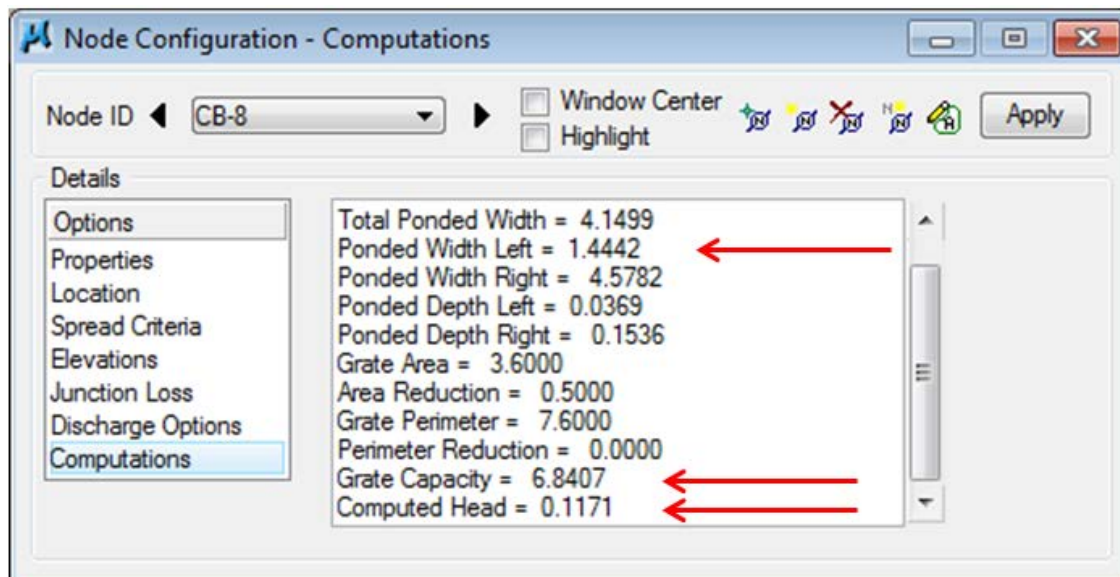


The **Drainage Area Computations** dialog box shows the following details:

- Area ID:** CB-8
- Options:**
  - ☐ Window Center
  - ☐ Highlight
- Details:**
  - Options:**
    - Definition
    - Subareas
    - Computation**
  - Hydro. Method:**
    - ☒ Rational
    - ☐ SCS
- Area and C Value:**

	Area	C Value
Total Subareas:	0.893	0.300
Remainder:	0.003	0.350
Composite:	0.895	0.300
- Computed Intensity:** 3.500
- Computed Discharge:** 0.941
- Buttons:** Compute Discharge, Apply

g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

- Node ID:** CB-8
- Options:**
  - ☐ Window Center
  - ☐ Highlight
- Details:**
  - Options:**
    - Options
    - Properties**
    - Location
    - Spread Criteria
    - Elevations
    - Junction Loss
    - Discharge Options
    - Computations**
- Computed Data:**
  - Total Poned Width = 4.1499
  - Poned Width Left = 1.4442
  - Poned Width Right = 4.5782
  - Poned Depth Left = 0.0369
  - Poned Depth Right = 0.1536
  - Grate Area = 3.6000
  - Area Reduction = 0.5000
  - Grate Perimeter = 7.6000
  - Perimeter Reduction = 0.0000
  - Grate Capacity = 6.8407
  - Computed Head = 0.1171
- Buttons:** Apply

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Review the Computed Data. Items to review specifically are:

**Total Poned Width, Grate Capacity** compared with **Computed Discharge** and **Computed Head**

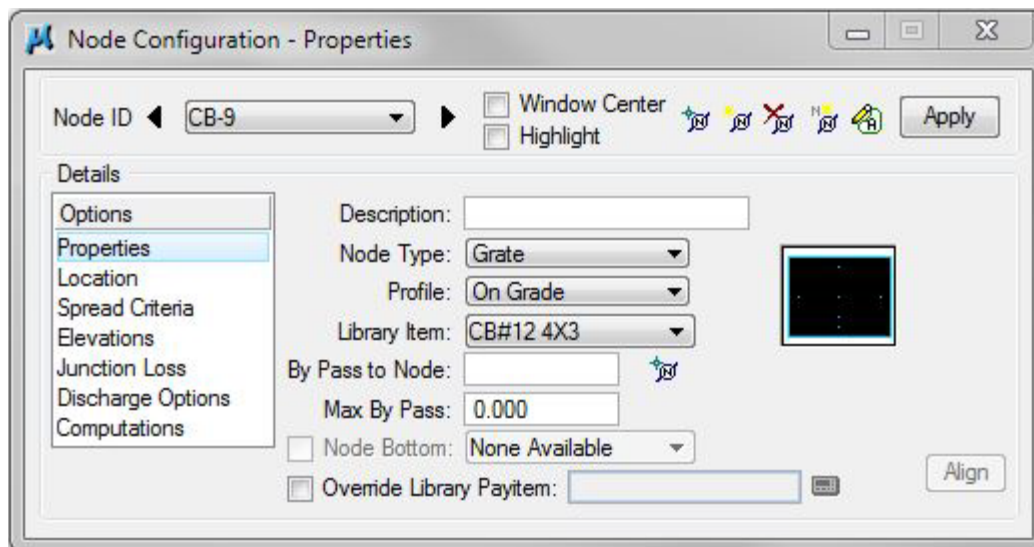
## 5.17 Design Inlet CB – 9

It has been determined that another standard **CB#12 4X3** will be used.

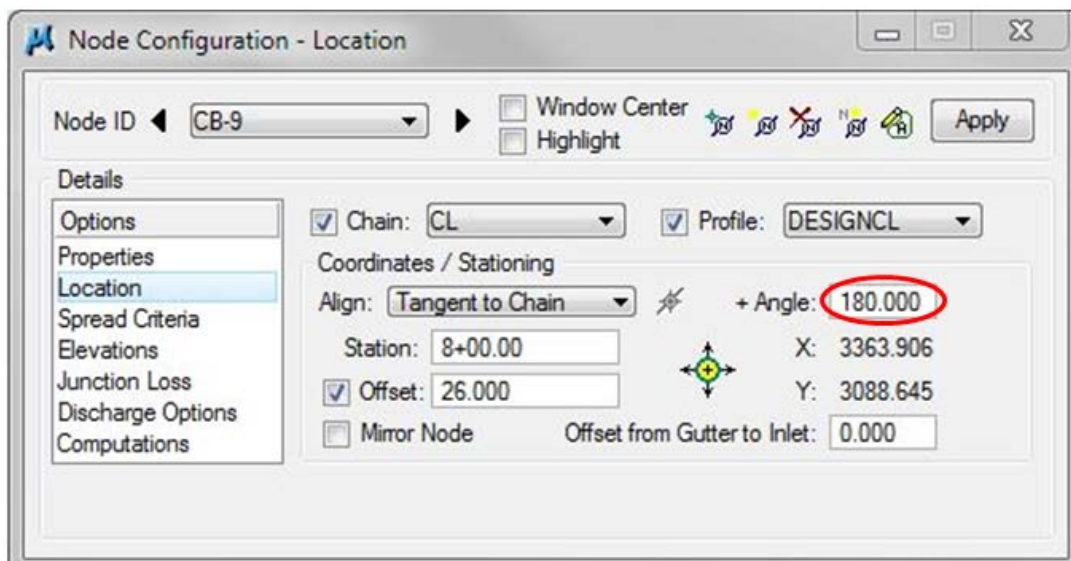
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-9

**Properties >** Change the Node **Properties** to **On Grade** and to a **CB#12 4X3**:

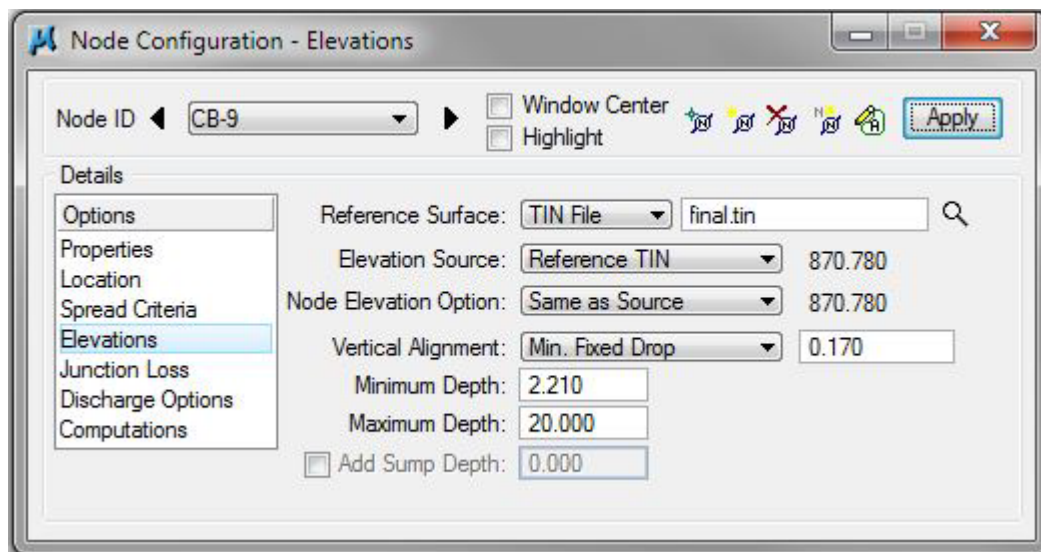


- b) **Location >** All Reference information is defaulted from the previous Node (CB-8) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. The reasoning for the location of CB-9 will be given in the drainage area discussion:



**NOTE:** The **Spread Criteria** defaults back automatically when the node is changed back to **ON GRADE**, therefore no changes are necessary.

- c) **Elevations** > Elevation Data must be changed to match a CB#12 4X3. From the [IDOT GEOPAK Drainage Nodes](#) Document set the following:



- d) Click the **Apply** button to include this node in the Drainage Project.

### **Catch Basins – Inlet and Outlet:**

Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

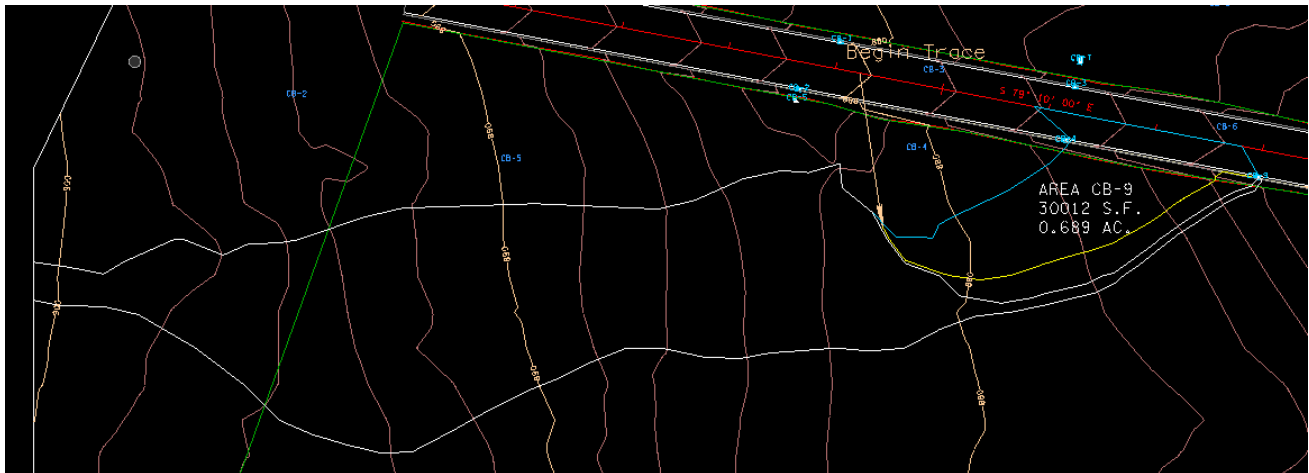
$$\text{CB\#12 4x3: } 3.88' - 18''/12 - 0.17' = 2.21'$$



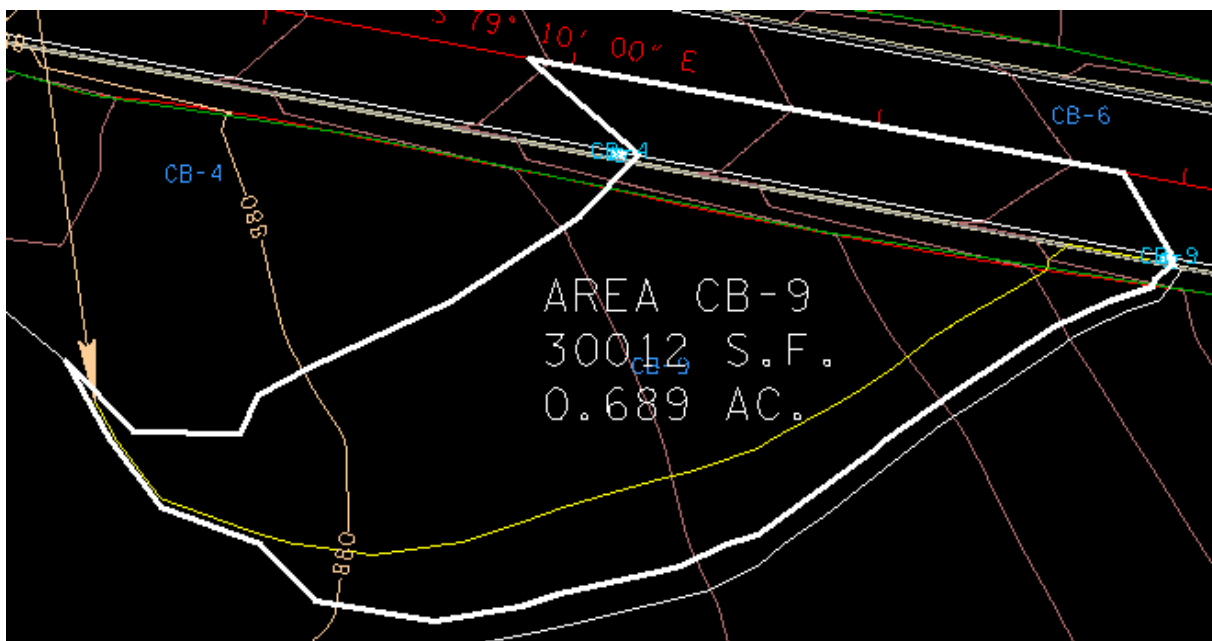
## 5.18 Delineate Drainage Area CB – 9

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-9** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 9. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-9 and turn off DA\_CB-8.

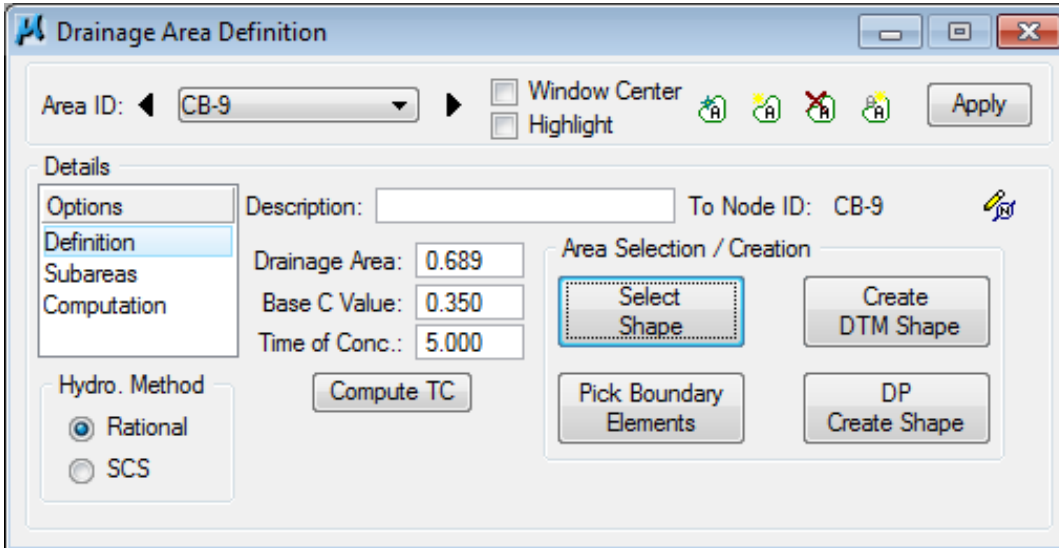
Delineate Drainage Area:



**NOTE:** Many iterations and much investigation went into developing the placement of the next few catch basins. The whole of the drainage area if one were to set CB-9 at the same station as CB-6 & CB-8 is delineated by CB-9 Area and the white drainage area. These were divided to keep the roadway spread within the required limits. The large portion of the drainage area and the odd shape will be discussed in Exercise 5.19.

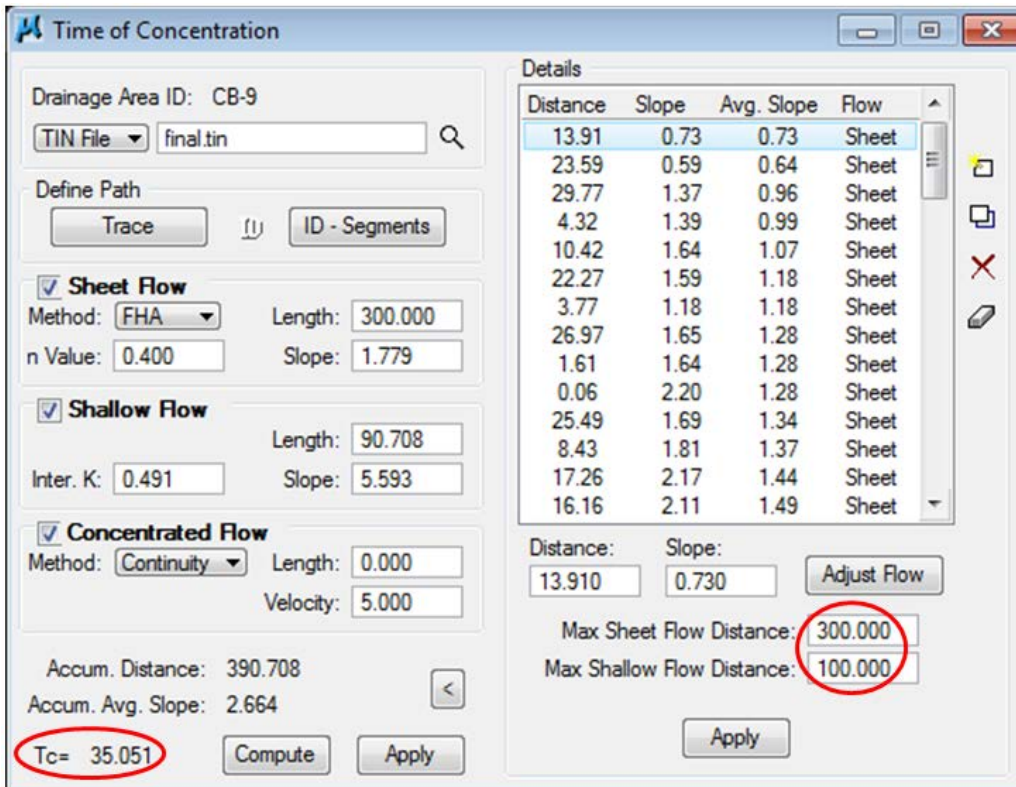


c) Define Drainage Area:



The **Drainage Area Definition** dialog box is shown. The **Area ID** is set to **CB-9**. The **Details** tab is selected, showing the **Description** field, **To Node ID** (CB-9), **Drainage Area** (0.689), **Base C Value** (0.350), and **Time of Conc.** (5.000). The **Hydro. Method** is set to **Rational**. The **Area Selection / Creation** section includes buttons for **Select Shape**, **Create DTM Shape**, **Pick Boundary Elements**, and **DP Create Shape**. The **Compute TC** button is also visible.

d) Calculate Time of Concentration:



The **Time of Concentration** dialog box is shown. The **Drainage Area ID** is **CB-9**. The **TIN File** is **final.tin**. The **Define Path** section has **Trace** and **ID - Segments** buttons. The **Sheet Flow** method is selected with **Method** **FHA**, **Length** **300.000**, and **n Value** **0.400**. The **Shallow Flow** method is also selected with **Length** **90.708** and **Inter. K** **0.491**. The **Concentrated Flow** method is selected with **Method** **Continuity**, **Length** **0.000**, and **Velocity** **5.000**. The **Details** table shows the following data:

Distance	Slope	Avg. Slope	Flow
13.91	0.73	0.73	Sheet
23.59	0.59	0.64	Sheet
29.77	1.37	0.96	Sheet
4.32	1.39	0.99	Sheet
10.42	1.64	1.07	Sheet
22.27	1.59	1.18	Sheet
3.77	1.18	1.18	Sheet
26.97	1.65	1.28	Sheet
1.61	1.64	1.28	Sheet
0.06	2.20	1.28	Sheet
25.49	1.69	1.34	Sheet
8.43	1.81	1.37	Sheet
17.26	2.17	1.44	Sheet
16.16	2.11	1.49	Sheet

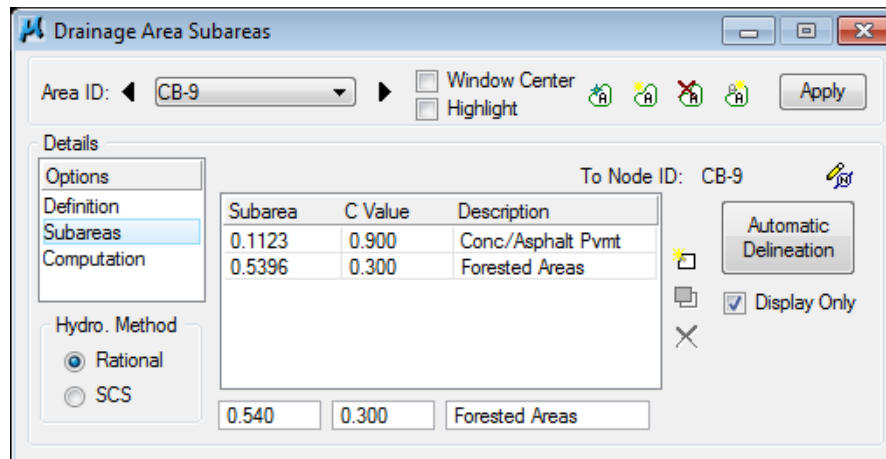
The **Distance** and **Slope** fields are set to **13.910** and **0.730** respectively. The **Adjust Flow** button is visible. The **Max Sheet Flow Distance** is **300.000** and the **Max Shallow Flow Distance** is **100.000**. The **Accum. Distance** is **390.708** and the **Accum. Avg. Slope** is **2.664**. The **Tc** is **35.051**. The **Compute** and **Apply** buttons are visible.

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

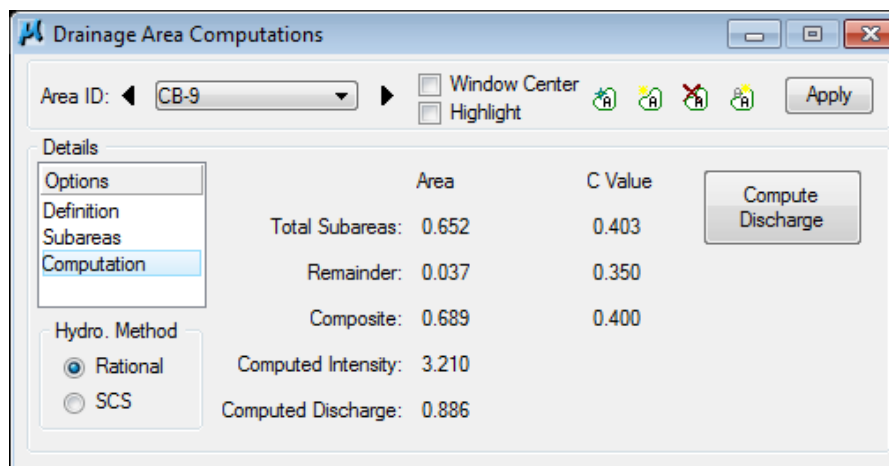
**NOTE:** The maximum length for sheet flow has changed and will vary depending upon the drainage area. Keep Max Sheet Flow at 300 and Max Shallow Flow at 100.

## Exercise 5

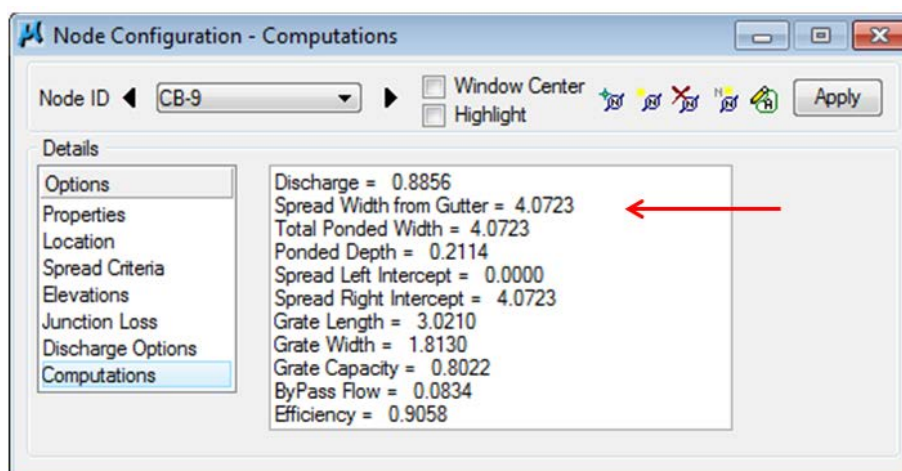
e) Delineate Subareas utilizing the Land Use DGN:



f) Compute Discharge and Apply:



g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

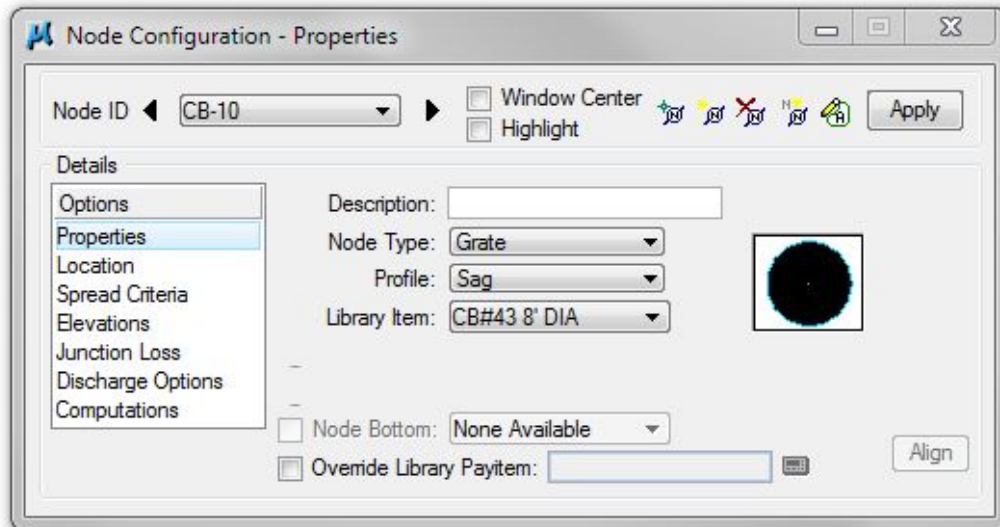
## 5.19 Design Inlet CB – 10

It has been determined that a **CB#43 8' DIA.** will be used.

See Standard Drawing D-CB-43R for details.

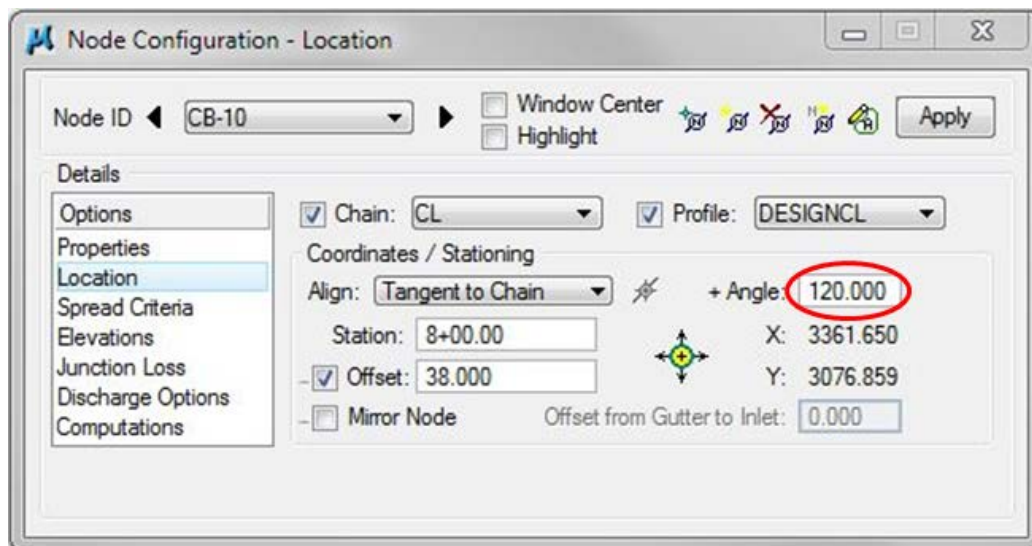
- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-10

**Properties >** Change the Node **Properties** to **Sag** and to a **CB#43 8' DIA**:



**NOTE:** 8' Diameter is a round catch basin. The reasoning behind this selection is the need for the grates to be at such an angle that a pipe cannot be attached at a skew within the required limits. See TDOT Drainage Manual Chapter 7 Section 7.03.5.5 Pipe Connections to Structures.

- b) **Location >** All Reference information is defaulted from the previous Node (CB-9) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. The reasoning for the location of CB-10 will be given in the drainage area discussion. Especially note the Angle and Offset:



## Exercise 5

c) **Spread Criteria** > Enter the Spread Criteria as shown below.

**% Slope Left:** 5.00 % (From DTM Tools>Analysis>Height/Slope)

**% Slope Right:** 5.00 % (From DTM Tools>Analysis>Height/Slope)

**% Discharge Left:** 50.00% (Estimated based on placement within drainage area)

**% Discharge Right:** 50.00% (Leftover area)

**NOTE:** Left and Right are set equal since the flow will come to each equally.

Node ID: CB-10

Window Center ☐ Highlight ☐

Apply

Details

Options  
Properties  
Location  
Spread Criteria  
Elevations  
Junction Loss  
Discharge Options  
Computations

% Slope Left: 5.000 Right: 5.000

% Discharge Left: 50.000 Right: 50.000

Spread Cross Section: Reference Surface

Spread Source: Reference Surface

Width	% Slope	Roughness
4.095	-1.925	0.016
1.906	-50.003	0.016
1.000	-2.000	0.016

Maximum Pond Depth: 0.500

Pond Width: 8.000

d) **Elevations** > Elevation Data must be changed to match a CB#43 8' DIA. From the [TDOT GEOPAK Drainage Nodes](#) Document set the following:

Node ID: CB-10

Window Center ☐ Highlight ☐

Apply

Details

Options  
Properties  
Location  
Spread Criteria  
Elevations  
Junction Loss  
Discharge Options  
Computations

Reference Surface: TIN File final.tin

Elevation Source: Reference TIN 872.383

Node Elevation Option: Same as Source 872.383

Vertical Alignment: Min. Fixed Drop 0.330

Minimum Depth: 2.790

Maximum Depth: 40.000

Add Sump Depth: ☐ 0.000

e) Click the **Apply** button to include this node in the Drainage Project.

### Catch Basins – Outlet Only:

Drop Across Bottom of Structure + Min. Depth of Cover = Minimum Depth

$$\text{CB\#43 8'DIA: } 0.33' + 2.46' = 2.79$$

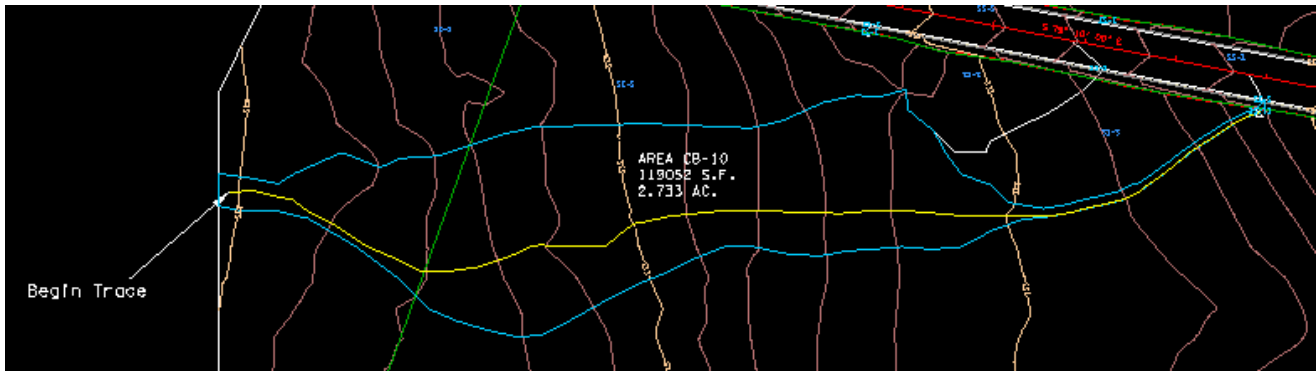
**NOTE:** See Appendix A, pg. A-4



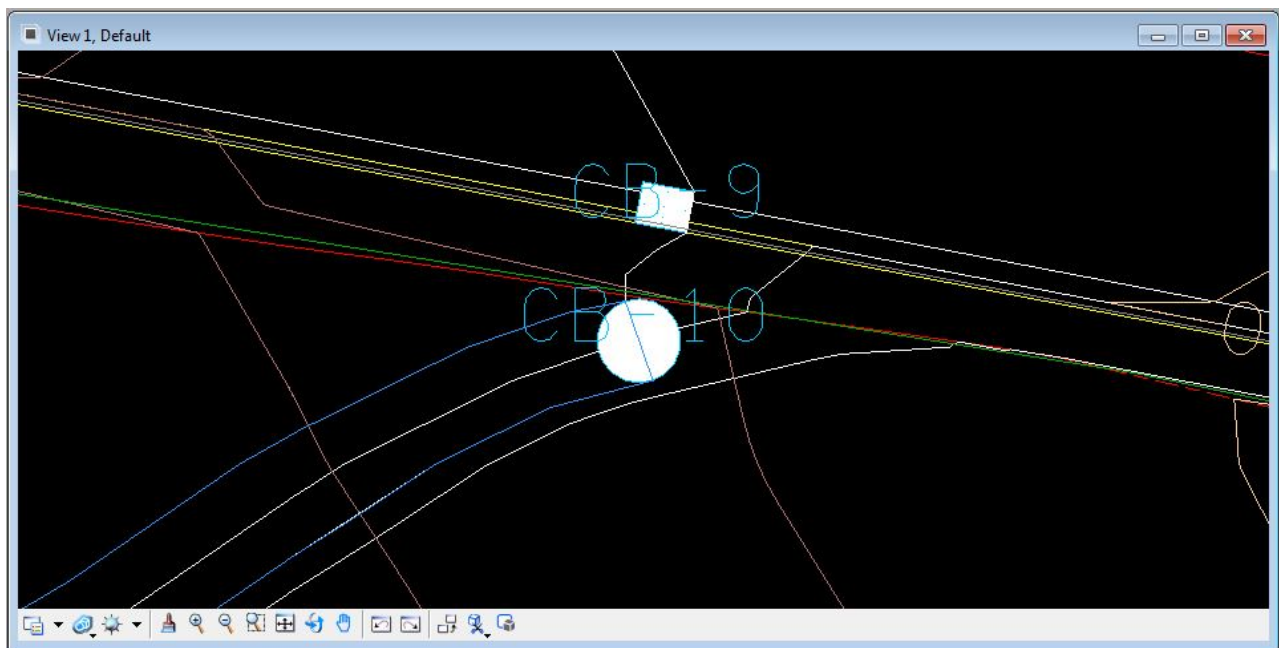
## 5.20 Delineate Drainage Area CB – 10

- a) From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-10** should automatically appear, click **OK**.
- b) Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 10. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-10 and turn off DA\_CB-9.

Delineate Drainage Area:

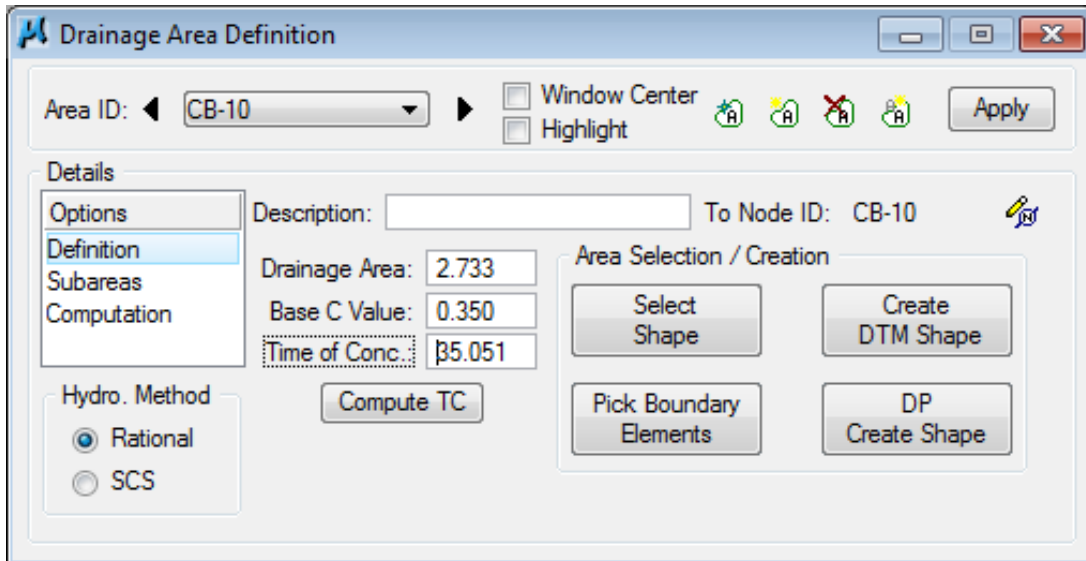


**NOTE:** Drainage area CB-10 was created by first using downstream trace and discovering that it converges into a relatively small area. Therefore when CB-10 was placed, upstream trace was used from either side of the catch basin to determine the drainage area. CB-10 was rotated to match the contours in order to catch as much flow as possible.



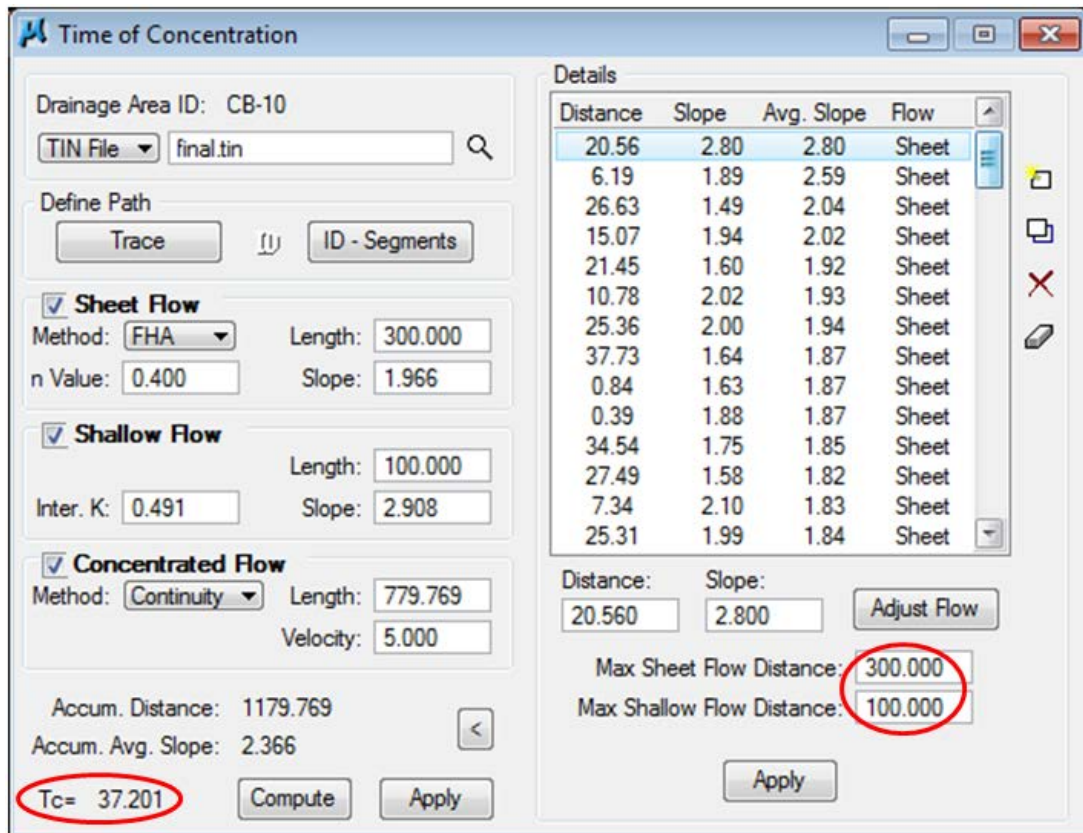
## Exercise 5

c) Define Drainage Area:



The **Drainage Area Definition** dialog box is shown. The **Area ID** is set to **CB-10**. The **Details** tab is selected, showing the **Description** field, **To Node ID** (CB-10), **Drainage Area** (2.733), **Base C Value** (0.350), and **Time of Conc.** (35.051). The **Hydro. Method** is set to **Rational**. The **Area Selection / Creation** section includes buttons for **Select Shape**, **Create DTM Shape**, **Pick Boundary Elements**, and **DP Create Shape**. The **Compute TC** button is also visible.

d) Calculate Time of Concentration:



The **Time of Concentration** dialog box is shown. The **Drainage Area ID** is **CB-10**. The **TIN File** is **final.tin**. The **Define Path** section includes **Trace** and **ID - Segments** buttons. The **Sheet Flow** section is checked, with **Method** set to **FHA**, **Length** (300.000), and **n Value** (0.400). The **Shallow Flow** section is checked, with **Length** (100.000) and **Inter. K** (0.491). The **Concentrated Flow** section is checked, with **Method** set to **Continuity**, **Length** (779.769), and **Velocity** (5.000). The **Accum. Distance** is 1179.769 and the **Accum. Avg. Slope** is 2.366. The **Tc** is 37.201. The **Details** table shows the following data:

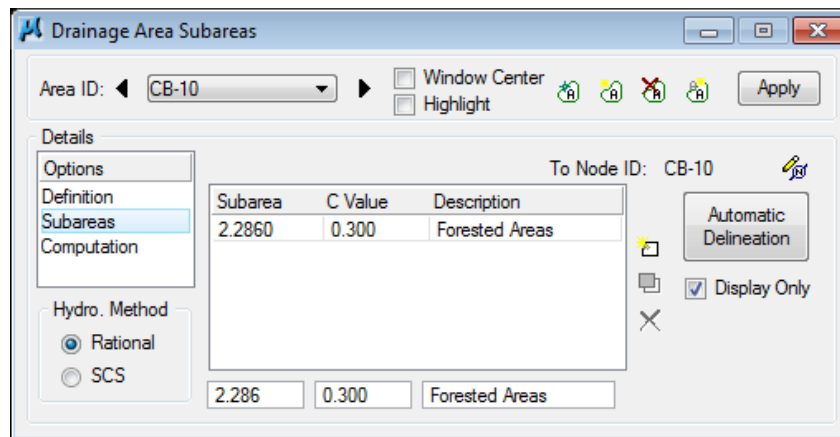
Distance	Slope	Avg. Slope	Flow
20.56	2.80	2.80	Sheet
6.19	1.89	2.59	Sheet
26.63	1.49	2.04	Sheet
15.07	1.94	2.02	Sheet
21.45	1.60	1.92	Sheet
10.78	2.02	1.93	Sheet
25.36	2.00	1.94	Sheet
37.73	1.64	1.87	Sheet
0.84	1.63	1.87	Sheet
0.39	1.88	1.87	Sheet
34.54	1.75	1.85	Sheet
27.49	1.58	1.82	Sheet
7.34	2.10	1.83	Sheet
25.31	1.99	1.84	Sheet

The **Distance** and **Slope** fields are set to 20.560 and 2.800 respectively. The **Adjust Flow** button is visible. The **Max Sheet Flow Distance** is 300.000 and the **Max Shallow Flow Distance** is 100.000. The **Apply** button is at the bottom right.

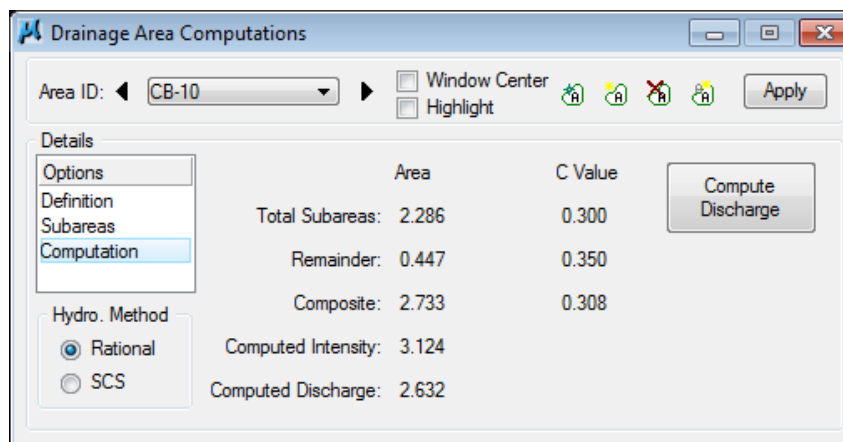
The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required.

**NOTE:** The maximum length for sheet flow has changed and will vary depending upon the drainage area. Keep Max Sheet Flow at 300 and Max Shallow Flow at 100.

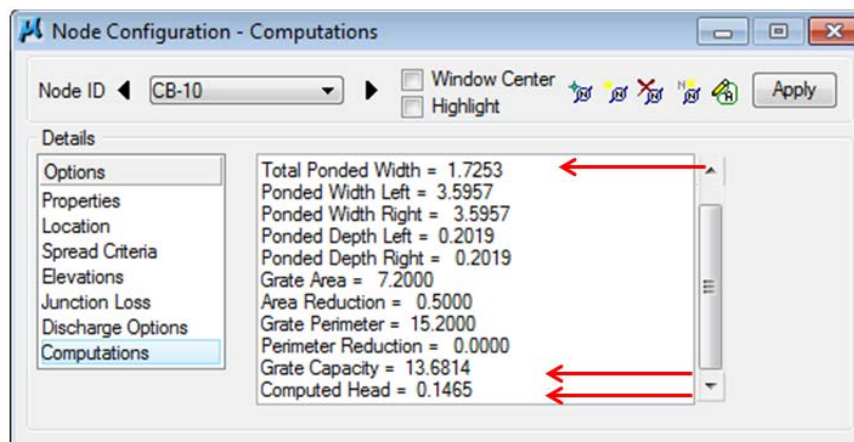
e) Delineate Subareas utilizing the Land Use DGN:



f) Compute Discharge and Apply:



g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Review the Computed Data. Items to review specifically are:

**Total Pondered Width, Grate Capacity** compared with **Computed Discharge** and **Computed Head**

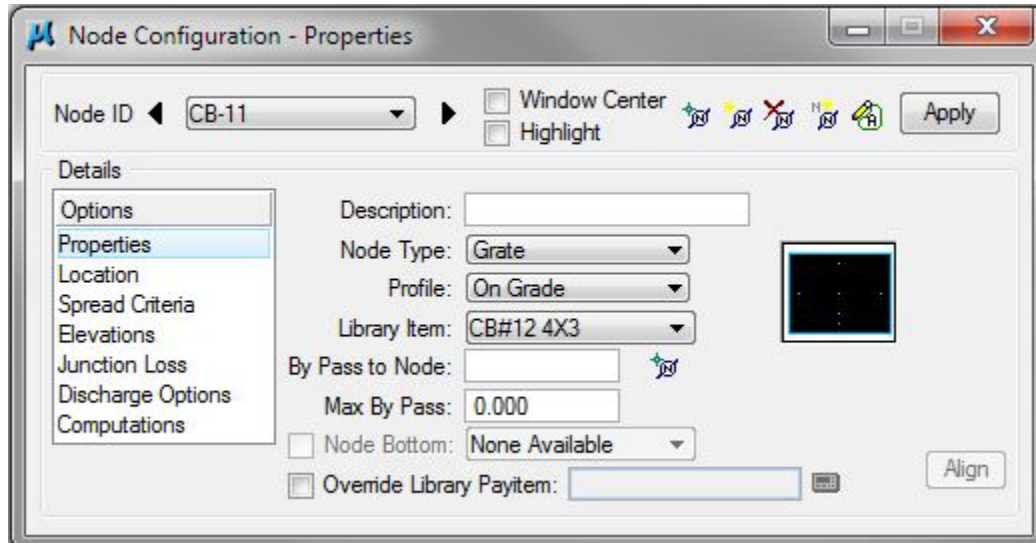
## 5.21 Design Inlet CB – 11

It has been determined that another standard **CB#12 4X3** will be used.

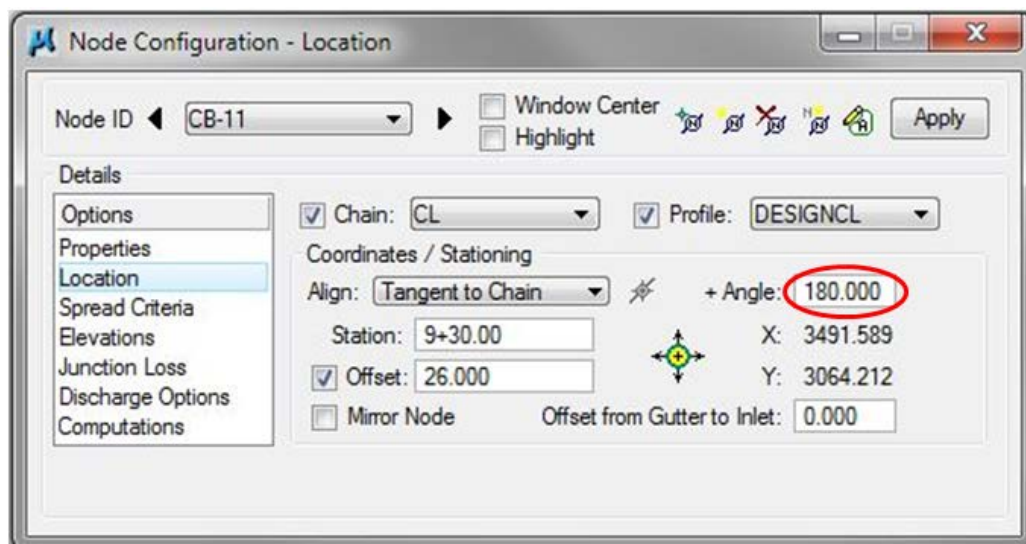
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-11

**Properties >** Change the Node **Properties** to **On Grade** and to a **CB#12 4x3**:



- b) **Location >** All Reference information is defaulted from the previous Node (CB-10) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed:



**NOTE:** The **Spread Criteria** defaults back automatically when the node is changed back to **ON GRADE**, therefore no changes are necessary.

- c) **Elevations** > Elevation Data must be changed to match a CB#12 4X3. From the [IDOT GEOPAK Drainage Nodes](#) Document set the following:

Node Configuration - Elevations

Node ID: CB-11

Window Center ☐ Highlight ☐

Apply

Details

Options  
Properties  
Location  
Spread Criteria  
**Elevations**  
Junction Loss  
Discharge Options  
Computations

Reference Surface: TIN File final.tin

Elevation Source: Reference TIN 868.518

Node Elevation Option: Same as Source 868.518

Vertical Alignment: Min. Fixed Drop 0.170

Minimum Depth: 2.210

Maximum Depth: 20.000

☐ Add Sump Depth: 0.000

- d) Click the **Apply** button to include this node in the Drainage Project.

### **Catch Basins – Inlet and Outlet:**

Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

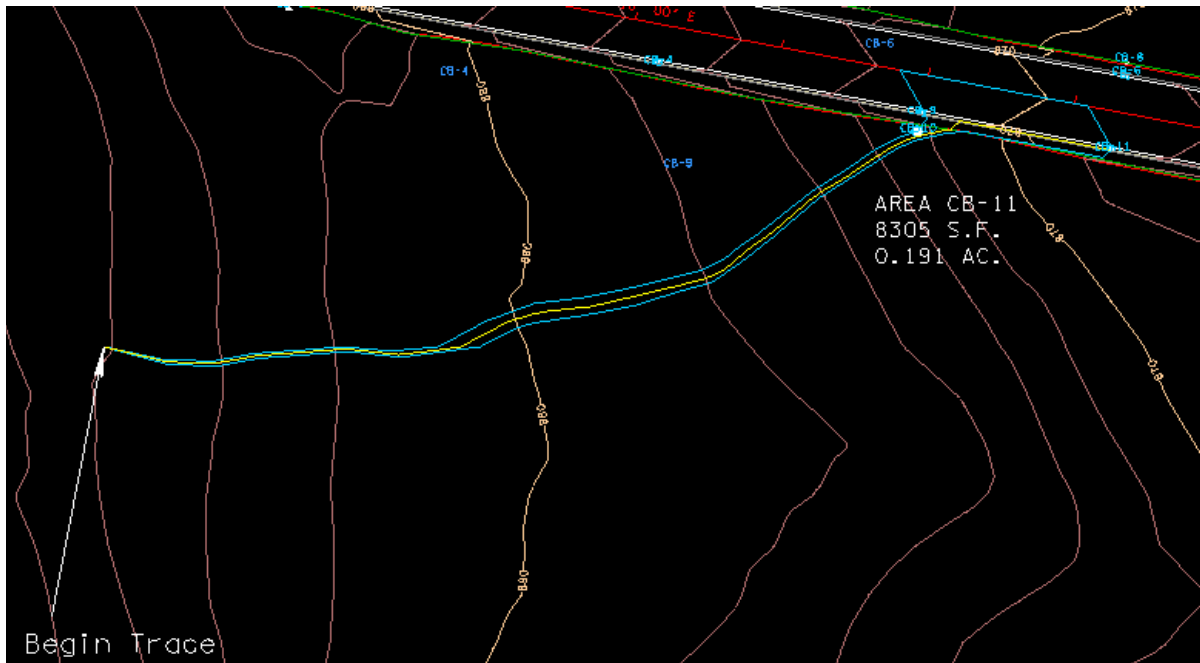
$$\text{CB\#12 4x3: } 3.88' - 18''/12 - 0.17' = 2.21'$$



## 5.22 Delineate Drainage Area CB – 11

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-11** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 11. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-11 and turn off DA\_CB-10.

Delineate Drainage Area:



**NOTE:** There is a small sliver of CB-11 Drainage Area that lies alongside CB-10. This is included to make sure all drainage area is captured. In reality, this sliver would likely be captured by CB-10

- Define Drainage Area:

Drainage Area Definition

Area ID: CB-11

Window Center ☐ Highlight ☐

Apply

Details

Options Definition Subareas Computation

Description: To Node ID: CB-11

Drainage Area: 0.191

Base C Value: 0.350

Time of Conc.: 37.201

Compute TC

Area Selection / Creation

Select Shape

Create DTM Shape

Pick Boundary Elements

DP Create Shape

Hydro. Method

☒ Rational

☐ SCS

d) Calculate Time of Concentration:

Drainage Area ID: CB-11

TIN File: final.tin

Define Path: Trace ID - Segments

☒ **Sheet Flow**  
 Method: FHA Length: 300.000  
 n Value: 0.400 Slope: 2.104

☒ **Shallow Flow**  
 Length: 100.000  
 Inter. K: 0.491 Slope: 1.593

☒ **Concentrated Flow**  
 Method: Continuity Length: 320.915  
 Velocity: 5.000

Accum. Distance: 720.915  
 Accum. Avg. Slope: 2.444

**Tc= 34.801** Compute Apply

**Details**

Distance	Slope	Avg. Slope	Flow
32.96	2.54	2.54	Sheet
10.08	2.34	2.50	Sheet
22.33	2.79	2.60	Sheet
10.63	2.71	2.61	Sheet
21.79	3.47	2.80	Sheet
5.83	2.82	2.81	Sheet
26.45	2.29	2.70	Sheet
3.64	2.32	2.69	Sheet
28.53	2.35	2.63	Sheet
1.33	2.03	2.63	Sheet
30.93	1.66	2.47	Sheet
5.05	1.57	2.45	Sheet
27.22	1.98	2.39	Sheet
1.85	1.19	2.38	Sheet

Distance: 32.960 Slope: 2.540 Adjust Flow

Max Sheet Flow Distance: 300.000  
 Max Shallow Flow Distance: 100.000

Apply

The calculated Time of Concentration is **GREATER** than the minimum of 5 minutes; therefore the Time of Concentration will automatically be filled in after hitting Apply with NO further steps required. Keep Max Sheet Flow at 300 and Max Shallow Flow at 100.

e) Delineate Subareas utilizing the Land Use DGN:

Area ID: CB-11

☐ Window Center  
☐ Highlight

**Details**

Options  
 Definition  
 Subareas  
 Computation

Hydro. Method  
☒ Rational  
☐ SCS

To Node ID: CB-11

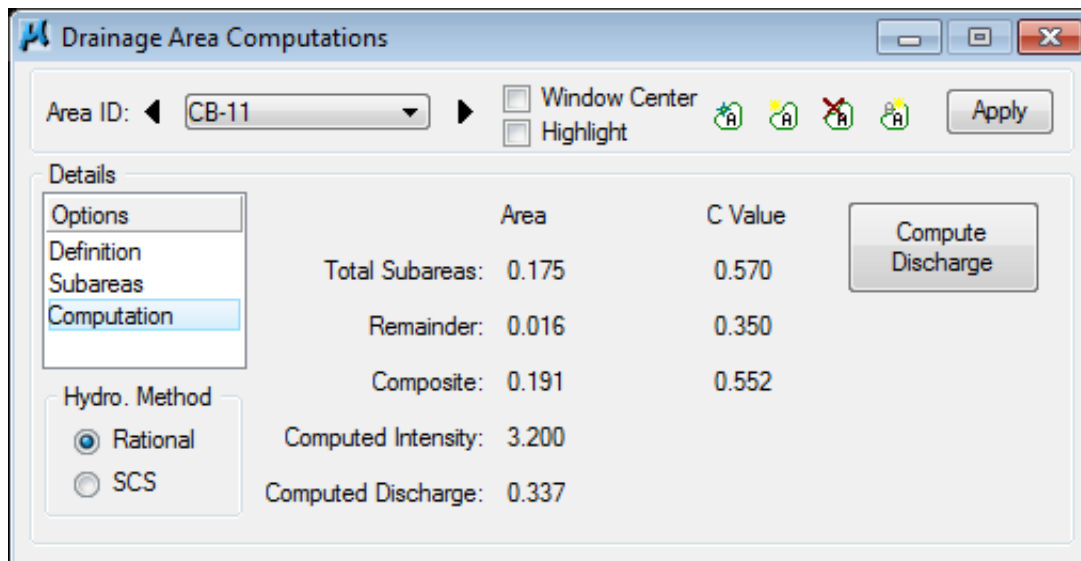
Subarea	C Value	Description
0.0788	0.900	Conc./Asphalt Pvmnt
0.0961	0.300	Forested Areas

Automatic Delineation  
☒ Display Only

0.096 0.300 Forested Areas

## Exercise 5

### f) Compute Discharge and Apply:



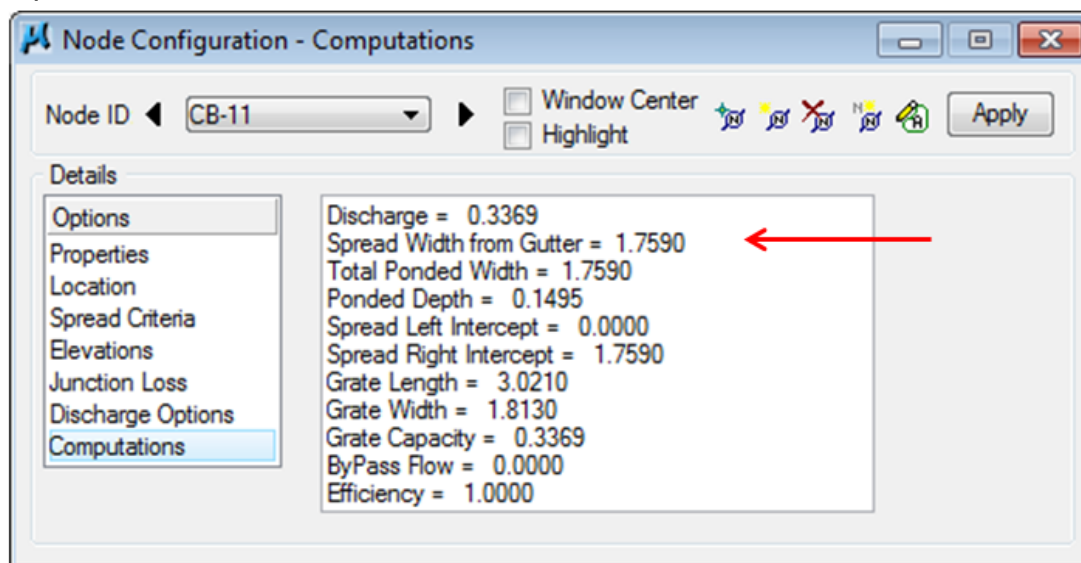
The **Drainage Area Computations** dialog box shows the following details:

Area	C Value
Total Subareas: 0.175	0.570
Remainder: 0.016	0.350
Composite: 0.191	0.552

Hydro. Method: ☒ Rational, ☐ SCS  
Computed Intensity: 3.200  
Computed Discharge: 0.337

Buttons: **Compute Discharge**, **Apply**

### g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

Discharge = 0.3369
Spread Width from Gutter = 1.7590
Total Ponded Width = 1.7590
Ponded Depth = 0.1495
Spread Left Intercept = 0.0000
Spread Right Intercept = 1.7590
Grate Length = 3.0210
Grate Width = 1.8130
Grate Capacity = 0.3369
ByPass Flow = 0.0000
Efficiency = 1.0000

A red arrow points to the **Spread Width from Gutter = 1.7590** value.

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

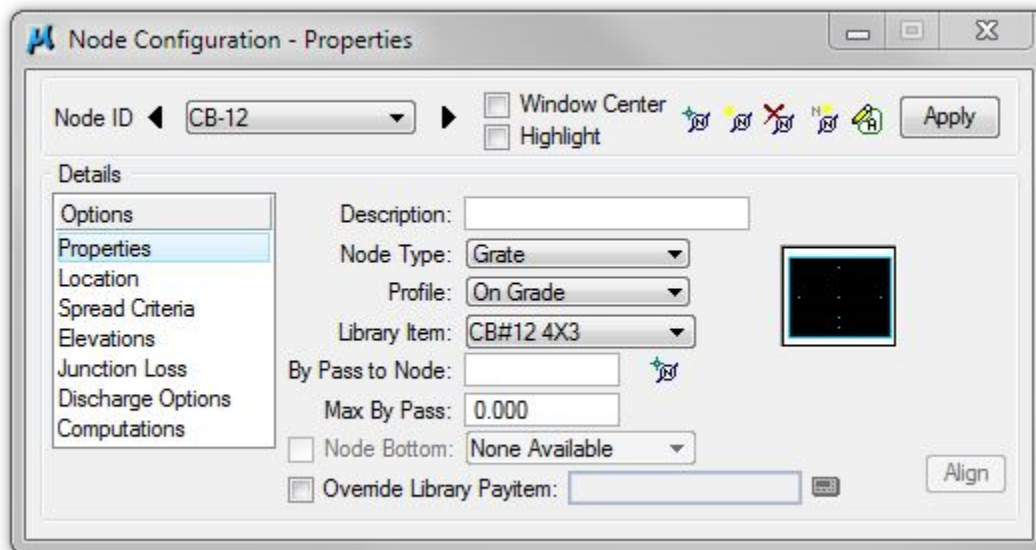
## 5.23 Design Inlet CB – 12

It has been determined that another standard **CB#12 4X3** will be used.

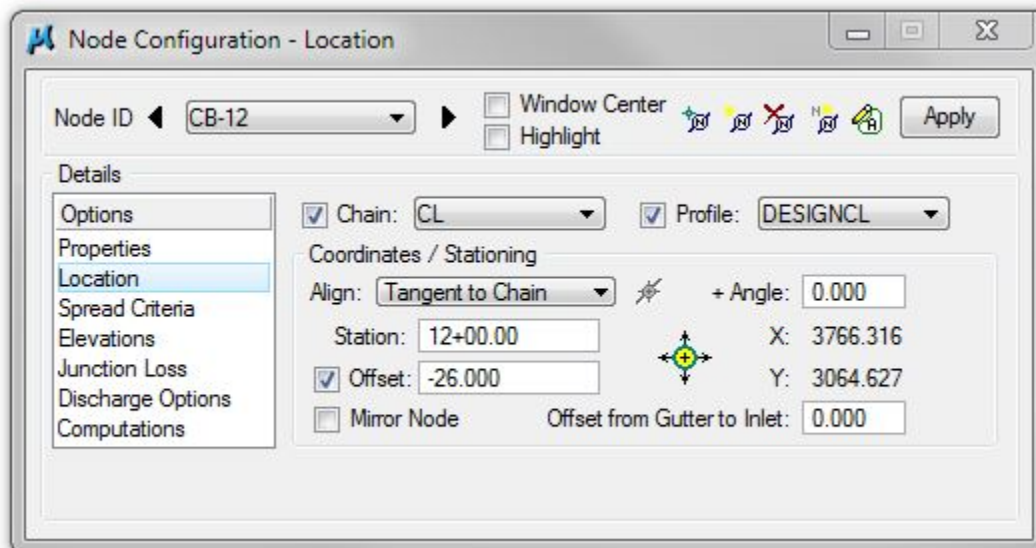
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-12

**Properties >** Verify the Node Properties are defaulted from the previous Node (CB-11) such that no user-input is required for this similar curb inlet.



- b) **Location >** All Reference information is defaulted from the previous Node (CB-11) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed:

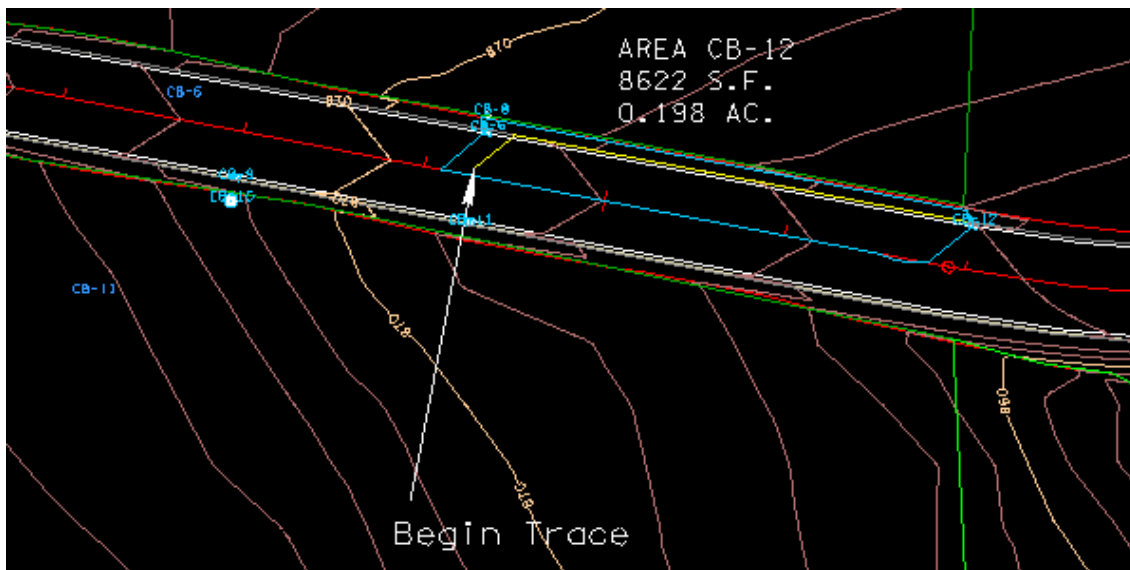


- c) Click the **Apply** button to include this node in the Drainage Project.

## 5.24 Delineate Drainage Area CB – 12

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-12** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 12. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-12 and turn off DA\_CB-11.

Delineate Drainage Area:



- Define Drainage Area:

Drainage Area Definition

Area ID: ◀ CB-12 ▶ ☐ Window Center ☐ Highlight Apply

Details

Options  
Definition  
Subareas  
Computation

Description:  To Node ID: CB-12

Drainage Area: 0.199  
Base C Value: 0.350  
Time of Conc.: 5.000

Hydro. Method  
☒ Rational  
☐ SCS

Area Selection / Creation

Compute TC

Select Shape  
Pick Boundary Elements

Create DTM Shape  
DP Create Shape



d) Calculate Time of Concentration:

Drainage Area ID: CB-12

TIN File: final.tin

Define Path: Trace (selected), ID - Segments

☒ Sheet Flow  
 Method: FHA Length: 31.000  
 n Value: 0.012 Slope: 2.940

☐ Shallow Flow  
 Length: 0.000  
 Inter. K: 0.491 Slope: 0.000

☒ Concentrated Flow  
 Method: Continuity Length: 252.483  
 Velocity: 5.000

Accum. Distance: 283.483  
 Accum. Avg. Slope: 1.846

Tc = 1.524

Details Table:

Distance	Slope	Avg. Slope	Flow
4.62	2.63	2.63	Sheet
1.82	2.63	2.63	Sheet
3.74	2.63	2.63	Sheet
1.43	2.63	2.63	Sheet
0.70	2.63	2.63	Sheet
4.48	2.63	2.63	Sheet
3.22	2.63	2.63	Sheet
1.95	2.63	2.63	Sheet
4.01	2.63	2.63	Sheet
0.42	8.67	2.73	Sheet
1.62	8.67	3.07	Sheet
0.72	1.71	3.04	Sheet
2.27	1.71	2.94	Sheet
2.73	1.71	2.84	Conc

Distance: 4.620 Slope: 2.630 Adjust Flow

Max Sheet Flow Distance: 31.000  
 Max Shallow Flow Distance: 0.000

Apply

The calculated Time of Concentration is less than the minimum of 5 minutes, therefore **5 must be manually typed** in the Drainage Area Definition dialog after hitting apply in the Time of Concentration Window.

The maximum length for sheet flow has changed and will vary depending upon the drainage area. Max. Sheet Flow is 31 and Shallow Flow should be toggled off. The n value should be set to .012.

e) Delineate Subareas utilizing the Land Use DGN:

Area ID: CB-12

Window Center (unchecked)  
 Highlight (unchecked)

Details

Options  
 Definition  
 Subareas (selected)  
 Computation

To Node ID: CB-12

Subarea	C Value	Description
0.1617	0.900	Conc/Asphalt Pvm

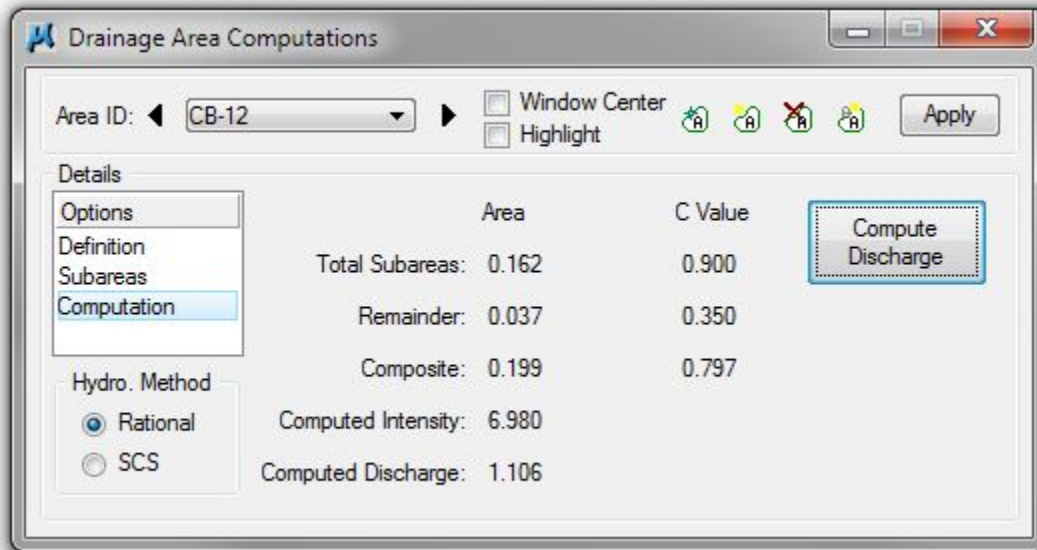
Hydro. Method: Rational (selected), SCS

Automatic Delineation

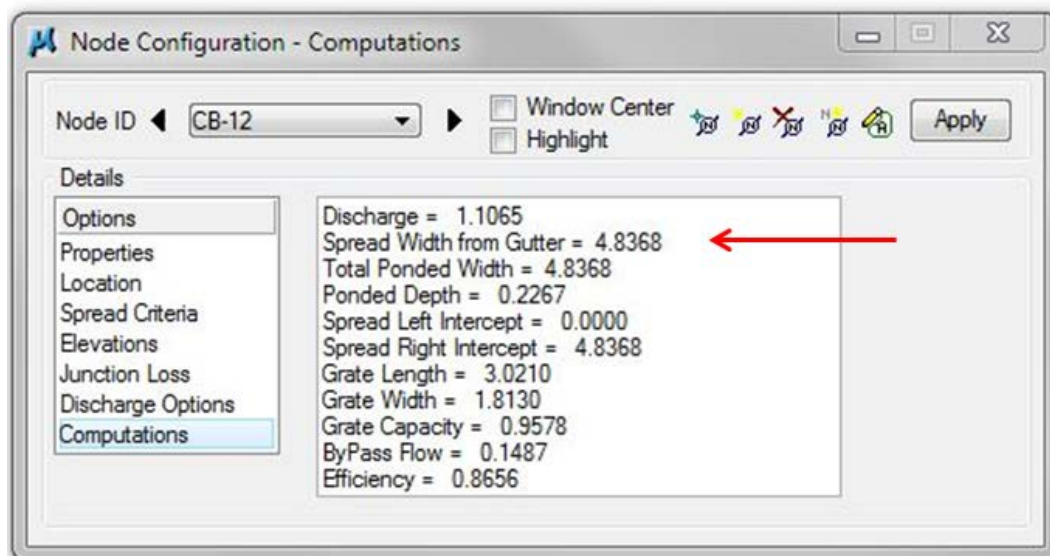
Display Only (checked)

0.162 0.900 Conc/Asphalt Pvm

## f) Compute Discharge and Apply:



## g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

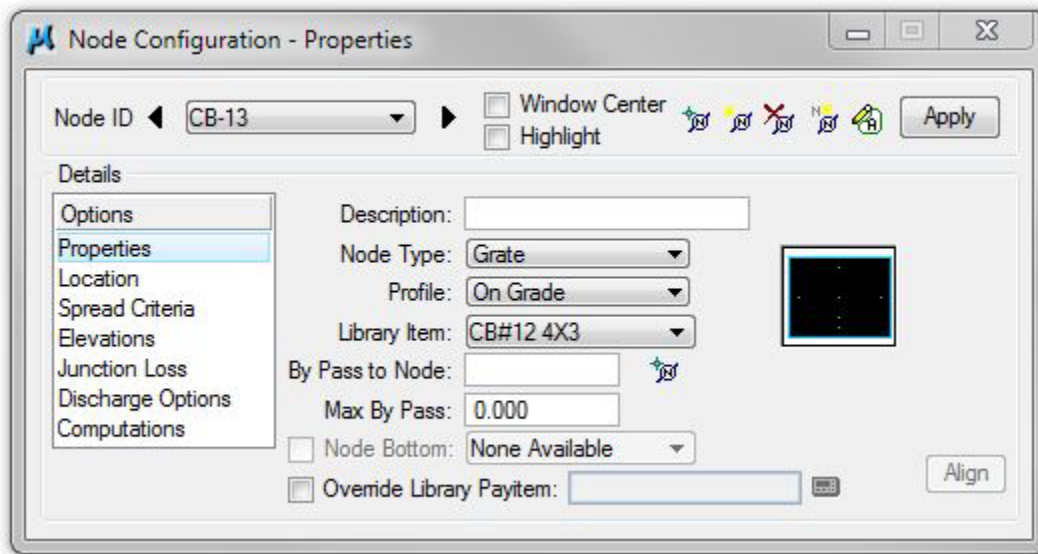
## 5.25 Design Inlet CB – 13

It has been determined that another standard **CB#12 4X3** will be used.

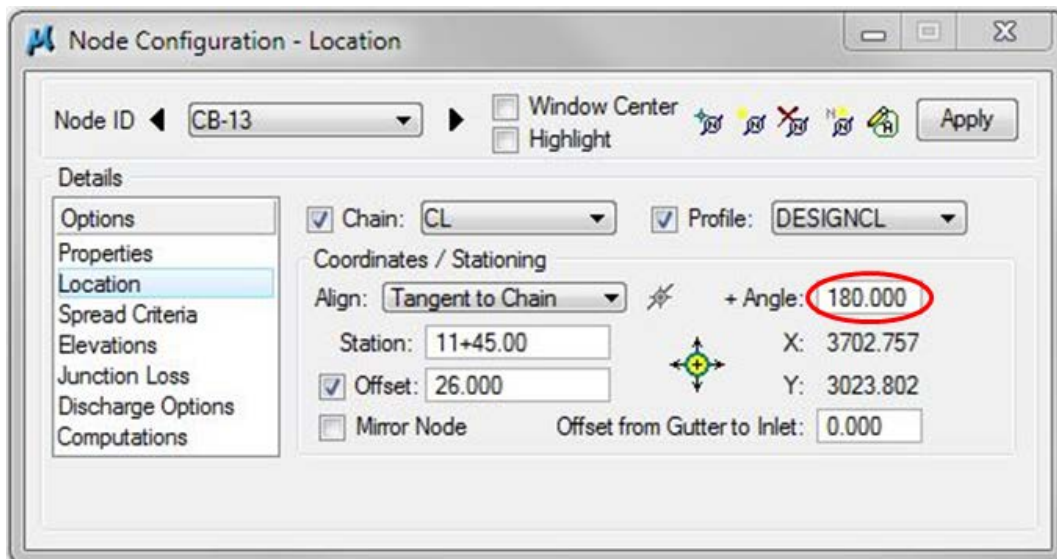
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-13

**Properties >** Verify the Node Properties are defaulted from the previous Node (CB-12) such that no user-input is required for this similar curb inlet.



- b) **Location >** All Reference information is defaulted from the previous Node (CB-12) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. This station is not set equal to CB-12 due to changing super elevation shapes. After a few iterations this station was chosen in order to keep the spread within the limits. :

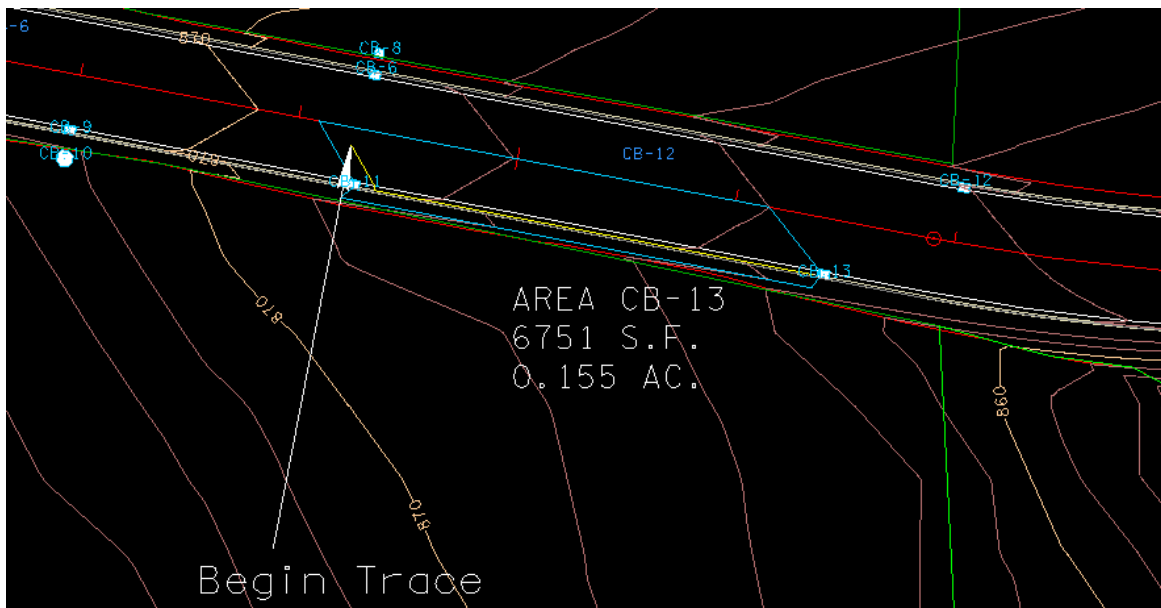


- c) Click the **Apply** button to include this node in the Drainage Project.

## 5.26 Delineate Drainage Area CB – 13

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-13** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 13. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-13 and turn off DA\_CB-12.

Delineate Drainage Area:



- Define Drainage Area:



d) Calculate Time of Concentration:

Time of Concentration

Drainage Area ID: CB-13

TIN File: final.tin

Define Path: Trace, ID - Segments

☒ Sheet Flow

Method: FHA Length: 20.000

n Value: 0.012 Slope: 2.631

☐ Shallow Flow

Length: 0.000

Inter. K: 0.491 Slope: 0.000

☒ Concentrated Flow

Method: Continuity Length: 208.668

Velocity: 5.000

Accum. Distance: 228.668

Accum. Avg. Slope: 1.719

Tc= 1.238

Compute Apply

Details

Distance	Slope	Avg. Slope	Flow
1.37	2.63	2.63	Sheet
4.03	2.63	2.63	Sheet
1.15	2.63	2.63	Sheet
0.56	2.63	2.63	Sheet
1.62	2.63	2.63	Sheet
6.07	2.63	2.63	Sheet
5.21	2.63	2.63	Sheet
1.18	2.63	2.63	Conc
1.84	8.67	3.11	Conc
0.20	8.67	3.16	Conc
0.45	1.71	3.13	Conc
5.00	1.71	2.89	Conc
5.00	1.71	2.71	Conc
5.00	1.71	2.58	Conc

Distance: 1.370 Slope: 2.630 Adjust Flow

Max Sheet Flow Distance: 20.000

Max Shallow Flow Distance: 0.000

Apply

The calculated Time of Concentration is less than the minimum of 5 minutes, therefore **5 must be manually typed** in the Drainage Area Definition dialog after hitting apply in the Time of Concentration Window.

**NOTE:** Since the majority of flow is in the gutter (Concentrated Flow), we toggle off Shallow Flow and change Max Sheet Flow to 20. The n Value for Sheet flow changes to 0.012.

e) Delineate Subareas utilizing the Land Use DGN:

Drainage Area Subareas

Area ID: CB-13

Window Center Highlight

Apply

Details

Options

Definition

Subareas

Computation

Hydro. Method

☒ Rational

☐ SCS

To Node ID: CB-13

Subarea	C Value	Description
0.1306	0.900	Conc/Asphalt Pvmnt

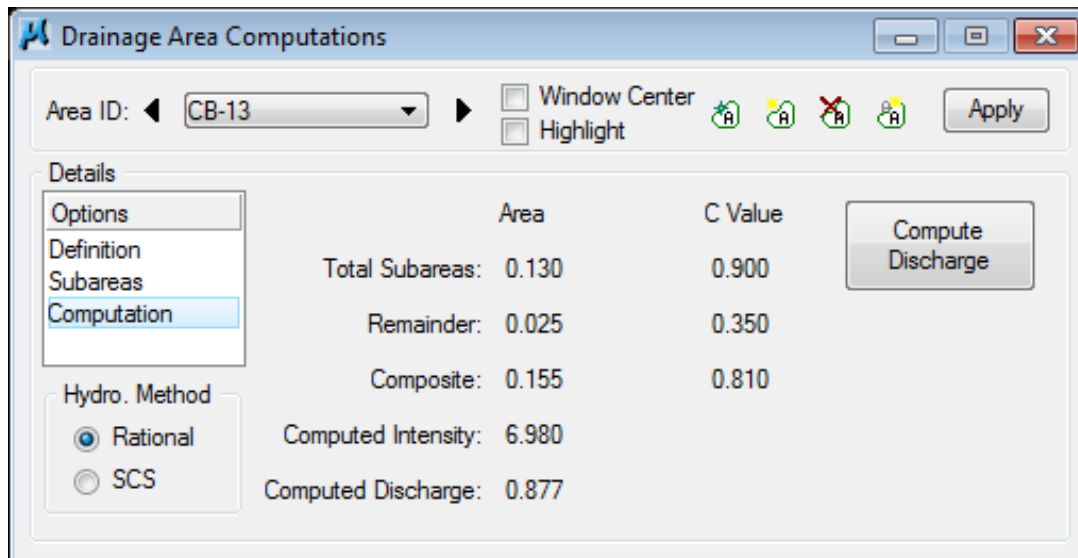
Automatic Delineation

☒ Display Only

0.131 0.900 Conc/Asphalt Pvmnt



## f) Compute Discharge and Apply:



Drainage Area Computations

Area ID: CB-13

☐ Window Center  
☐ Highlight

Apply

Details

Options

Definition

Subareas

Computation

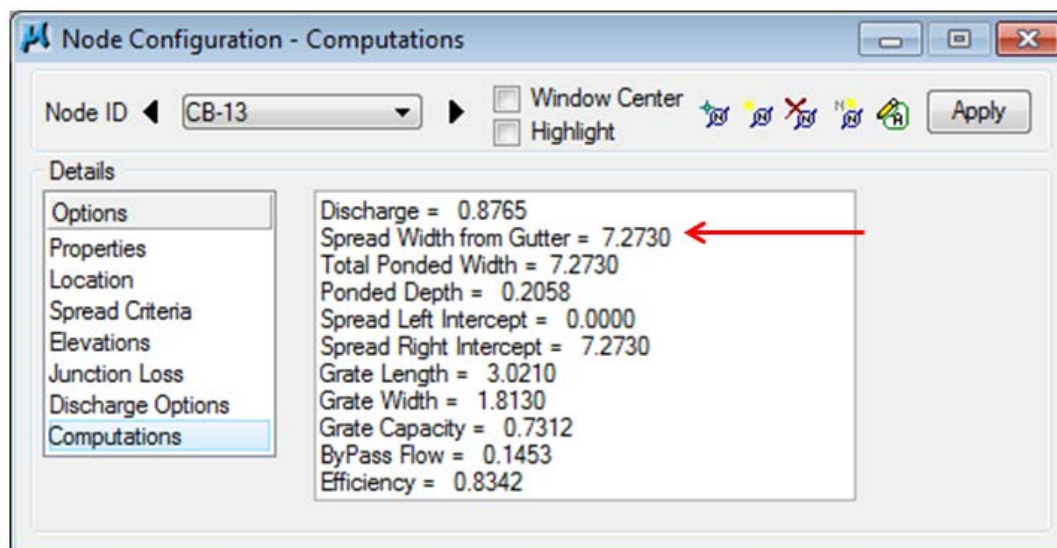
Hydro. Method

☒ Rational  
☐ SCS

	Area	C Value
Total Subareas:	0.130	0.900
Remainder:	0.025	0.350
Composite:	0.155	0.810
Computed Intensity:	6.980	
Computed Discharge:	0.877	

Compute Discharge

## g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



Node Configuration - Computations

Node ID: CB-13

☐ Window Center  
☐ Highlight

Apply

Details

Options

Properties

Location

Spread Criteria

Elevations

Junction Loss

Discharge Options

Computations

Discharge = 0.8765  
Spread Width from Gutter = 7.2730  
Total Ponded Width = 7.2730  
Ponded Depth = 0.2058  
Spread Left Intercept = 0.0000  
Spread Right Intercept = 7.2730  
Grate Length = 3.0210  
Grate Width = 1.8130  
Grate Capacity = 0.7312  
ByPass Flow = 0.1453  
Efficiency = 0.8342

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

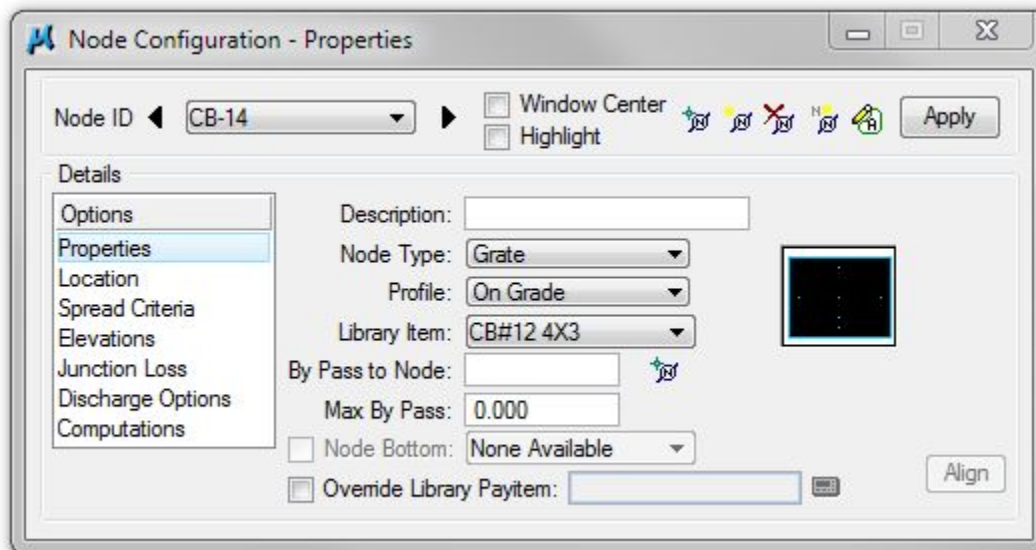
## 5.27 Design Inlet CB – 14

It has been determined that another standard **CB#12 4X3** will be used.

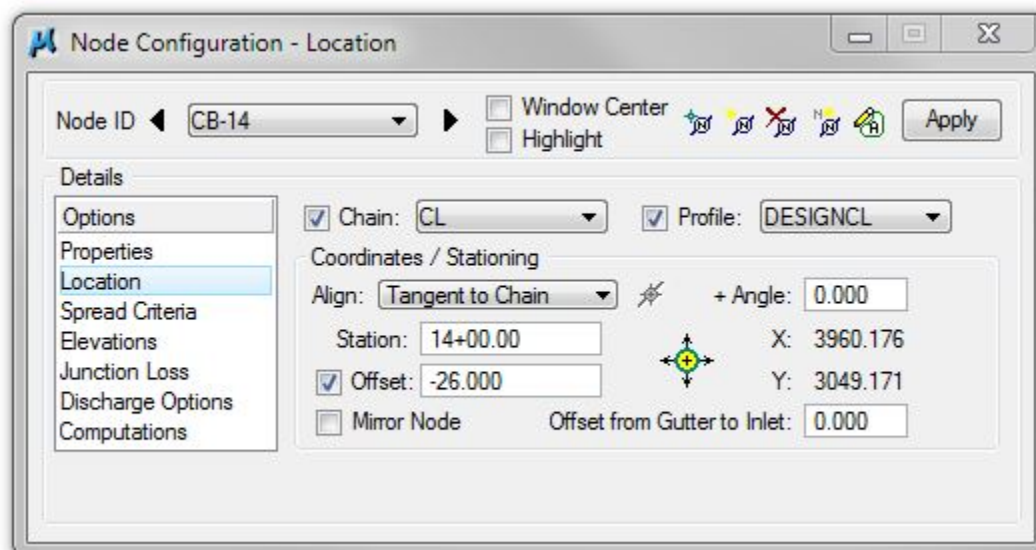
See Standard Drawing D-CB-12S for details.

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name CB-14

**Properties >** Verify the Node Properties are defaulted from the previous Node (CB-13) such that no user-input is required for this similar curb inlet.



- b) **Location >** All Reference information is defaulted from the previous Node (CB-13) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. This station is chosen since it is on an even station and near where we want our outlet:

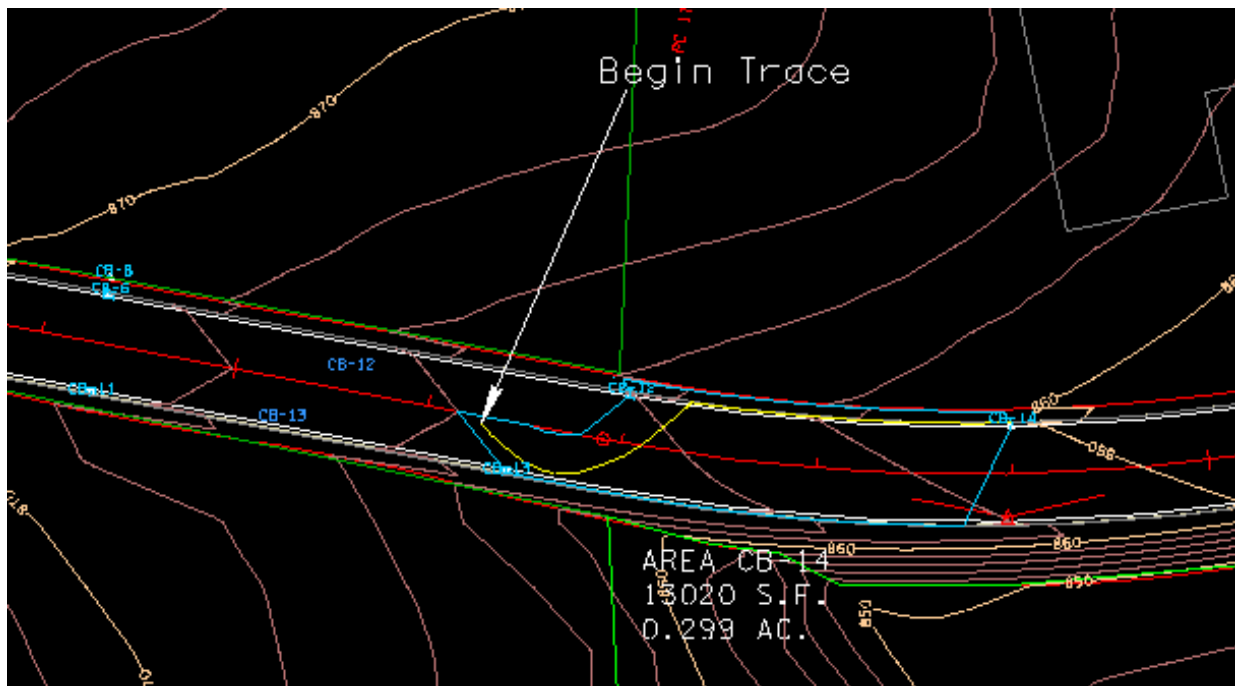


- c) Click the **Apply** button to include this node in the Drainage Project.

## 5.28 Delineate Drainage Area CB – 14

- From the Node Configuration dialog select **Edit Area**. When asked if you want to create a new drainage area click **Yes**. The name **CB-14** should automatically appear, click **OK**.
- Follow the steps in Exercise 3.2 to delineate and define the drainage area for Catch Basin 14. (You may use the following images as reference points. It is ok if your numbers do not match exactly.) Attach reference file DA\_CB-14 and turn off DA\_CB-13.

Delineate Drainage Area:



- Define Drainage Area:

d) Calculate Time of Concentration:

Time of Concentration

Drainage Area ID: CB-14

TIN File: final.tin

Define Path

Trace ID - Segments

☒ Sheet Flow

Method: FHA Length: 120.000

n Value: 0.012 Slope: 1.730

☐ Shallow Flow

Length: 0.000

Inter. K: 0.491 Slope: 0.000

☒ Concentrated Flow

Method: Continuity Length: 170.667

Velocity: 5.000

Accum. Distance: 290.667

Accum. Avg. Slope: 1.933

Tc= 2.372

Compute Apply

Details

Distance	Slope	Avg. Slope	Flow
2.42	2.06	2.06	Sheet
4.43	1.76	1.87	Sheet
1.91	1.98	1.89	Sheet
1.17	1.98	1.90	Sheet
4.55	1.57	1.80	Sheet
0.13	1.66	1.80	Sheet
0.04	1.27	1.80	Sheet
0.09	1.27	1.79	Sheet
5.54	1.50	1.71	Sheet
1.95	1.17	1.66	Sheet
3.66	1.43	1.63	Sheet
3.16	1.09	1.57	Sheet
2.30	1.38	1.56	Sheet
1.83	1.38	1.55	Sheet

Distance: 2.420 Slope: 2.060 Adjust Flow

Max Sheet Flow Distance: 120.000

Max Shallow Flow Distance: 0.000

Apply

The calculated Time of Concentration is less than the minimum of 5 minutes, therefore **5 must be manually typed** in the Drainage Area Definition dialog after hitting apply in the Time of Concentration Window

**NOTE:** The maximum length for sheet flow has changed and will vary depending upon the drainage area. Change Max. Sheet Flow to 120 and leave Shallow Flow toggled off.

e) Delineate Subareas utilizing the Land Use DGN:

Drainage Area Subareas

Area ID: CB-14

Window Center Highlight

Apply

Details

Options

Definition

Subareas

Computation

Hydro. Method

☒ Rational

☐ SCS

To Node ID: CB-14

Subarea	C Value	Description
0.2709	0.900	Conc/Asphalt Pvmnt

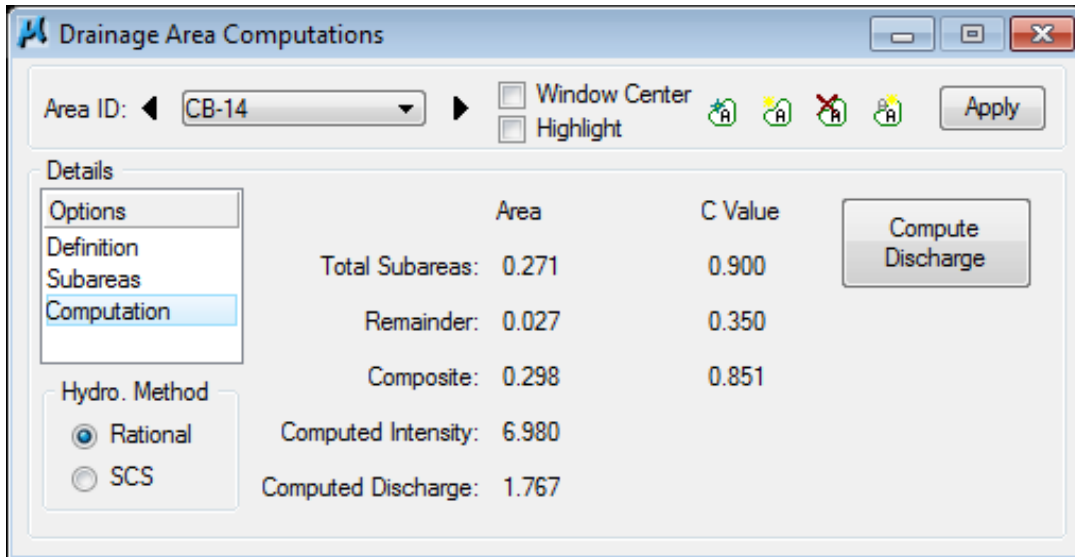
Automatic Delineation

☒ Display Only

0.271 0.900 Conc/Asphalt Pvmnt

## Exercise 5

### f) Compute Discharge and Apply:



The **Drainage Area Computations** dialog box shows the following details:

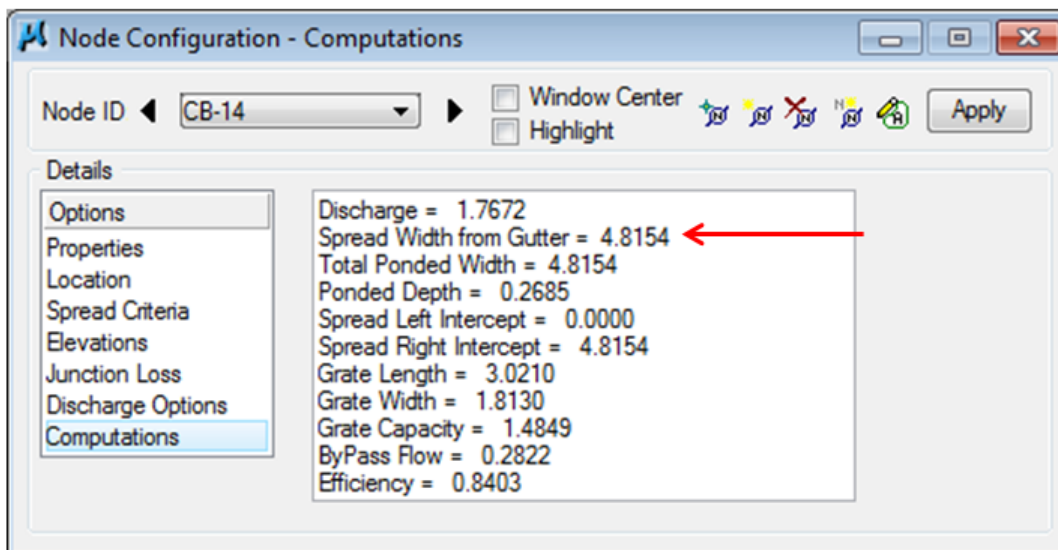
Options	Area	C Value
Total Subareas:	0.271	0.900
Remainder:	0.027	0.350
Composite:	0.298	0.851

Hydro. Method: ☒ Rational, ☐ SCS

Computed Intensity: 6.980  
Computed Discharge: 1.767

Buttons: ☐ Window Center, ☐ Highlight,  (disabled),

### g) Back in the **Node Configuration** dialog box click on **Properties**, then click again on **Computations**. This allows the program to update and run calculations. Review the Computations.



The **Node Configuration - Computations** dialog box shows the following details:

Discharge =	1.7672
Spread Width from Gutter =	4.8154
Total Ponded Width =	4.8154
Ponded Depth =	0.2685
Spread Left Intercept =	0.0000
Spread Right Intercept =	4.8154
Grate Length =	3.0210
Grate Width =	1.8130
Grate Capacity =	1.4849
ByPass Flow =	0.2822
Efficiency =	0.8403

A red arrow points to the **Spread Width from Gutter = 4.8154** value.

Don't be alarmed if your results are off by a few 100<sup>th</sup>s. It could just be a tolerance issue.

**NOTE:** Upon review of the computations the **Spread Width from Gutter** is within our limit of 8.0 feet, therefore the inlet is in good position.

This is the last catch basin in this network. The curb and gutter section continues and any ByPass will be caught by the next network. If this were not the case, we would need to take steps to capture or mitigate the ByPass Flow.



## 5.29 Design Junction MH-1

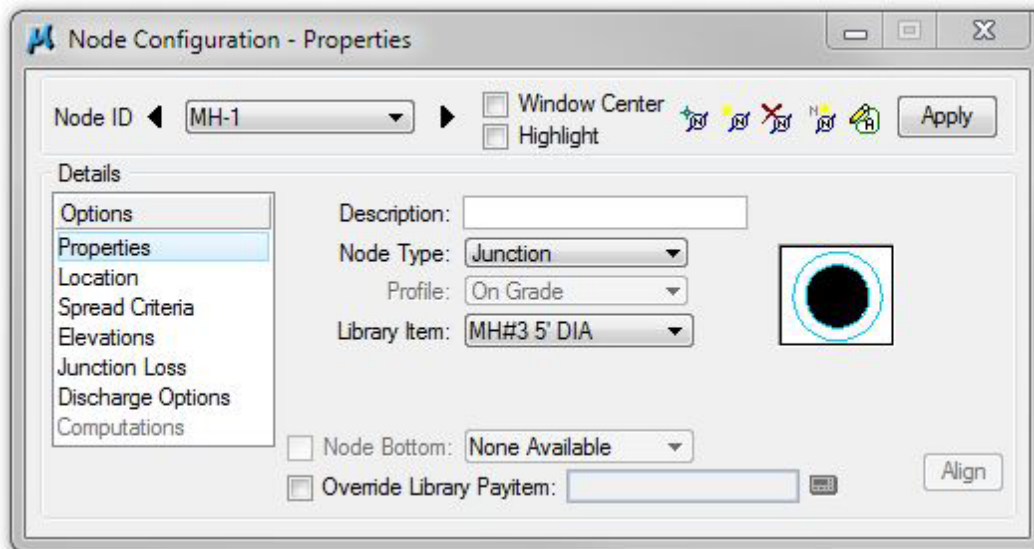
- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name MH-1

**Properties >** Make the following changes:

**Node Type:** Junction

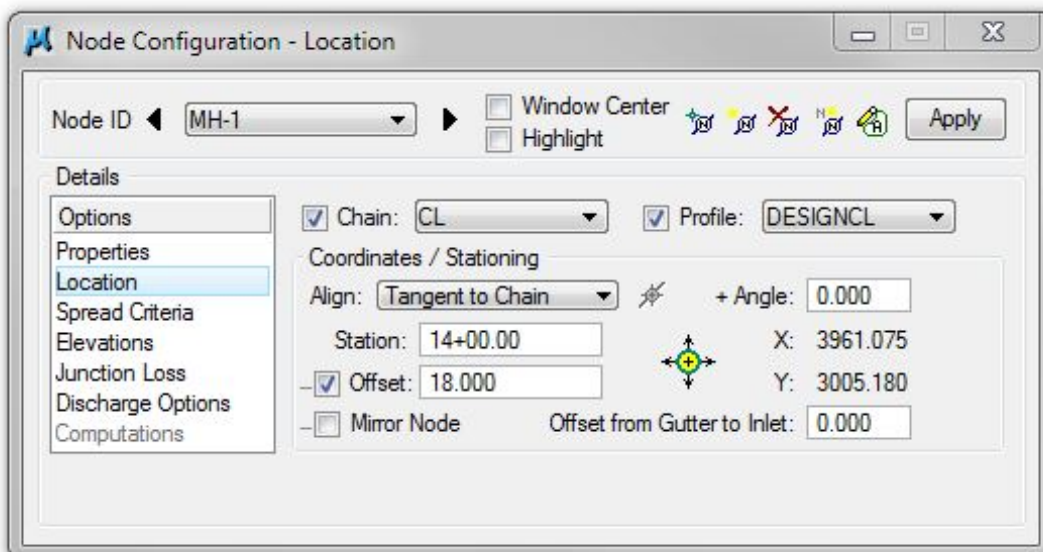
**Library Item:** **MH#3 5' DIA**

(See Standard Drawing D-MH-3 for details.)



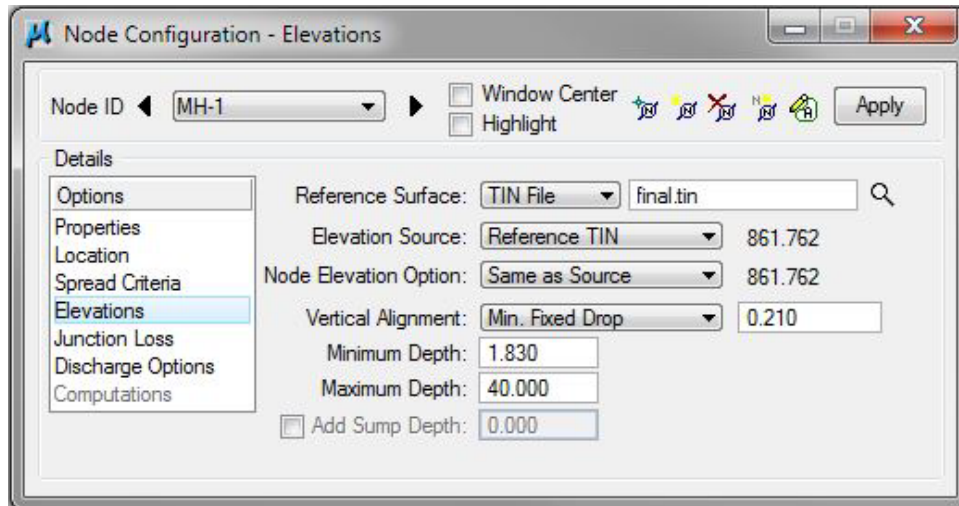
**NOTE:** A manhole is used at this location since; a junction is required, the superelevation of the roadway is such that there is little to no flow, and Junction Boxes are not allowed to be used under roadways.

- b) **Location >** All Reference information is defaulted from the previous Node (CB-14) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. Be sure manholes are located out of wheel paths:



## Exercise 5

- c) **Elevations** > Elevation Data must be changed to match a **MH#3 5' DIA.** From the [TDOT GEOPAK Drainage Nodes](#) Document set the following:



- d) Click the **Apply** button to include this node in the Drainage Project.

### Manhole:

Min. Depth of Basin – Pipe Size – Drop Across Bottom of Structure = Minimum Depth

$$\text{MH\#3 5'DIA: } 3.54' - 18''/12 - 0.21' = 1.83'$$

**NOTE:** See Appendix A, pg. A-5

## 5.30 Design Outlet EW-1

- a) Select from the Main Menu Bar: **Component > Node > Add**; or from the Main Toolbar: **Add Drainage Node**; or click the **Add Node** button within the Node Configuration Dialog. Click **OK** to set the name EW-1

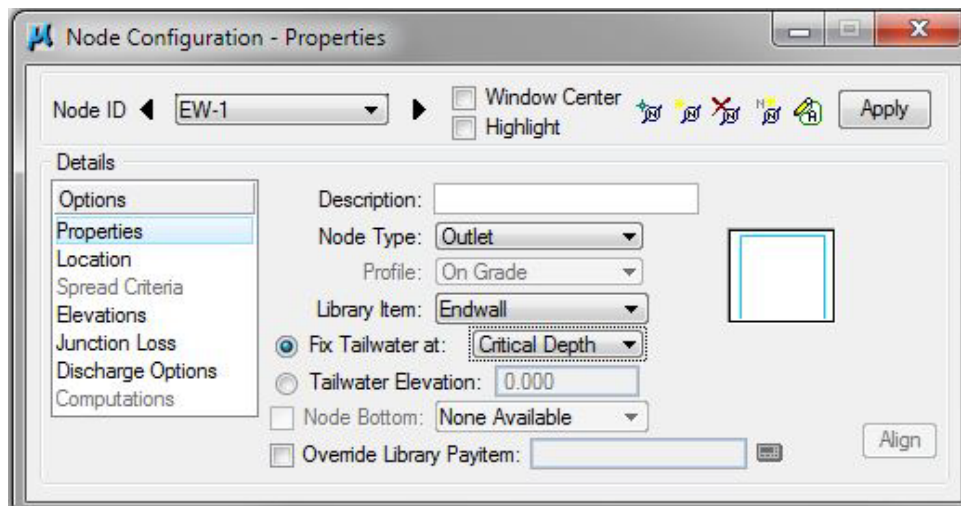
**Properties** > Make the following changes:

**Node Type:** Outlet

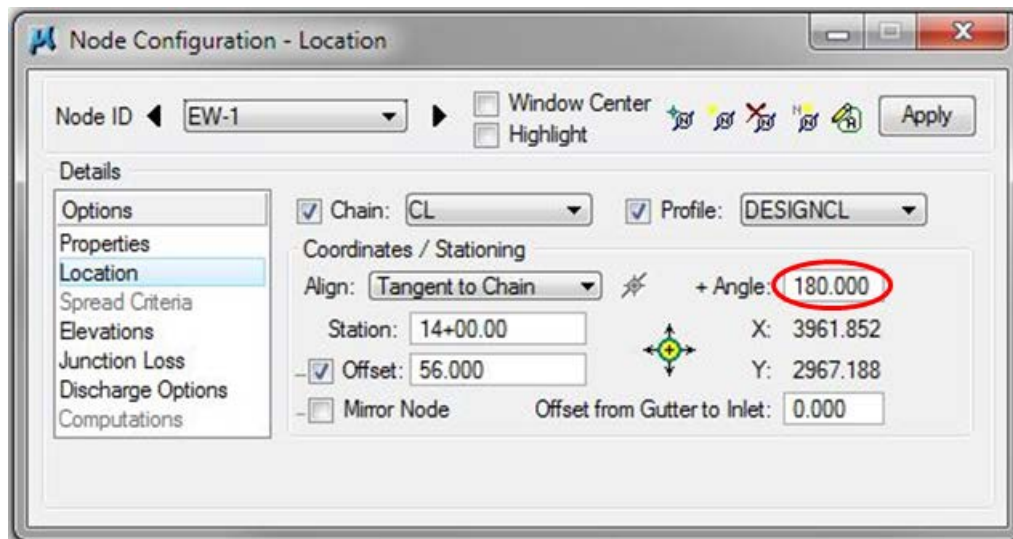
**Library Item:** Endwall

**Fix Tailwater at:** Critical Depth

Other Tailwater options are: Uniform Depth, Soffit (Top of pipe), or Elevation: User input (known elevation)



- b) **Location** > All Reference information is defaulted from the previous Node (CB-14) such that only the **+ Angle**, **Station** and the **Offset** needs to be changed. Angle is critical as to direction node will be displayed.



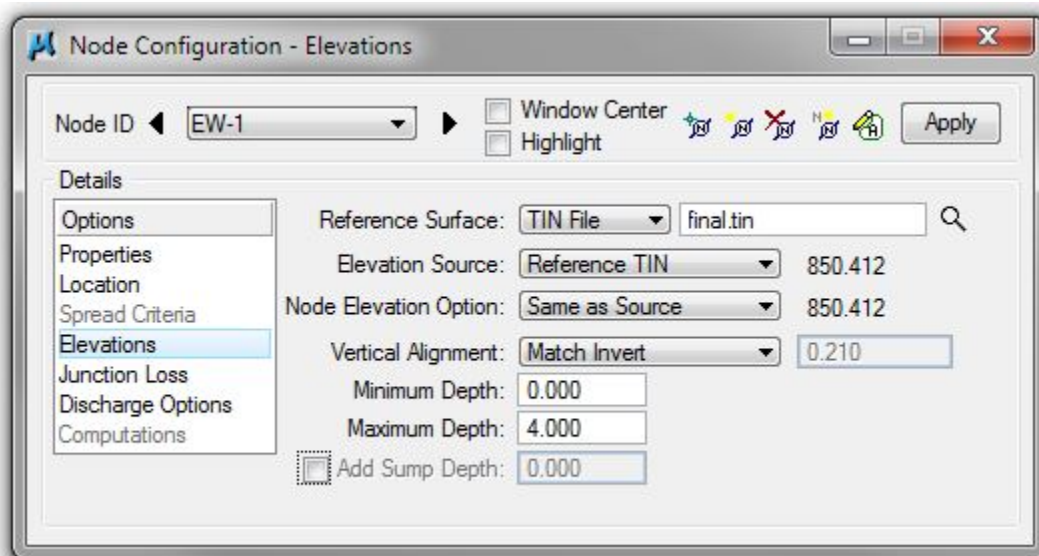
The image shows the 'Node Configuration - Location' dialog box. The 'Node ID' is 'EW-1'. The 'Chain' is 'CL' and the 'Profile' is 'DESIGNCL'. The 'Align' is 'Tangent to Chain' and the '+ Angle' is '180.000' (circled in red). The 'Station' is '14+00.00'. The 'Offset' is '56.000'. The 'Mirror Node' checkbox is unchecked. The 'Offset from Gutter to Inlet' is '0.000'. The 'Coordinates / Stationing' section shows 'X: 3961.852' and 'Y: 2967.188'. The 'Details' pane on the left has 'Location' selected.

- c) **Elevations** > Change the Elevation data to the following:

**Vertical Alignment:** Match Invert

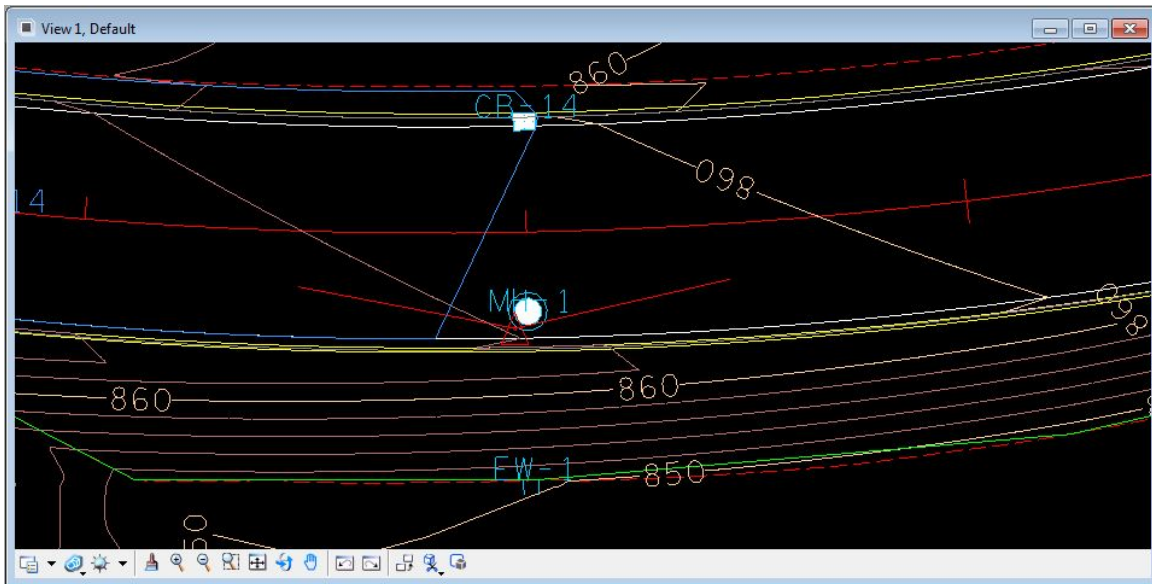
**Minimum Depth:** 0.000

**Maximum Depth:** 4.000



The image shows the 'Node Configuration - Elevations' dialog box. The 'Node ID' is 'EW-1'. The 'Reference Surface' is 'TIN File' and the file name is 'final.tin'. The 'Elevation Source' is 'Reference TIN' with a value of '850.412'. The 'Node Elevation Option' is 'Same as Source' with a value of '850.412'. The 'Vertical Alignment' is 'Match Invert' with a value of '0.210'. The 'Minimum Depth' is '0.000'. The 'Maximum Depth' is '4.000'. The 'Add Sump Depth' checkbox is unchecked and the value is '0.000'. The 'Details' pane on the left has 'Elevations' selected.

**NOTE:** This is a preliminary location used to determine outlet elevation, etc. This node will need to be adjusted to account for the side slope, endwall, velocity, and the final pipe size which is designed.

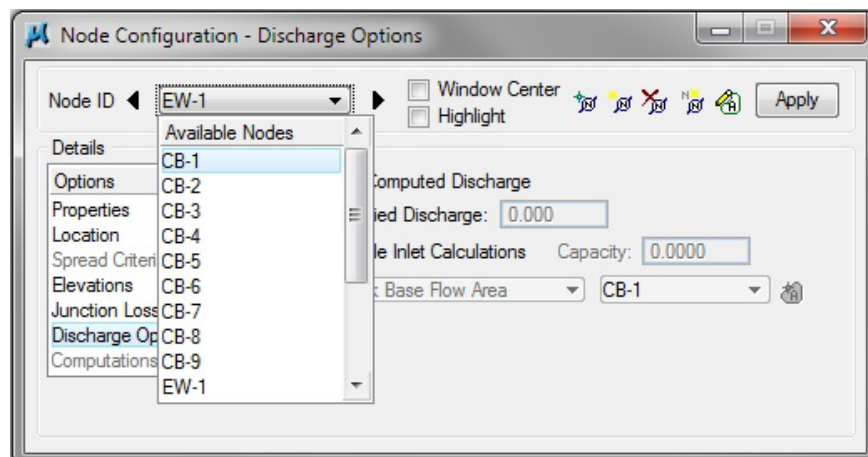
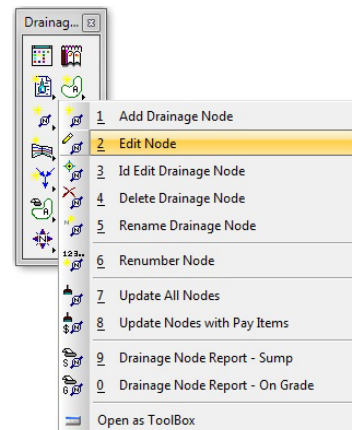
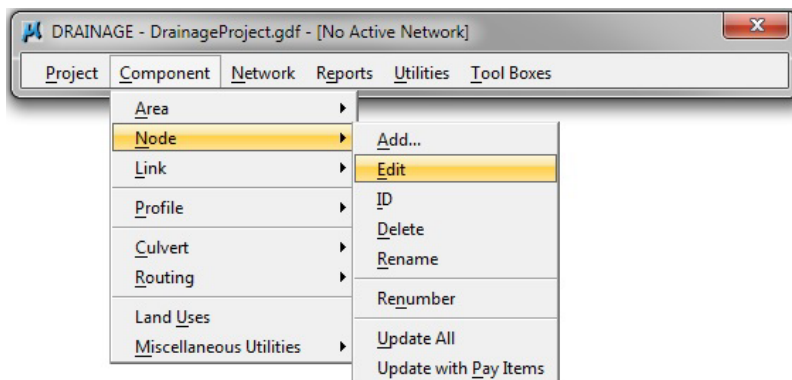


- d) Click the **Apply** button to include this node in the Drainage Project.

## 5.31 Inlet Bypass

Set the Inlet bypass as required to bypass flow to the downstream inlets.

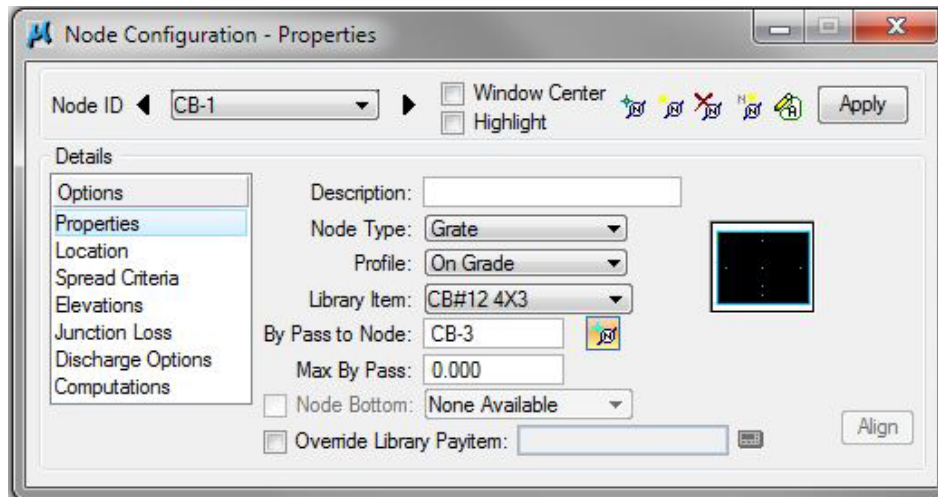
- a) Select **Component > Node > Edit** or choose from the Tool Box and use the drop-down menu to select CB-1.



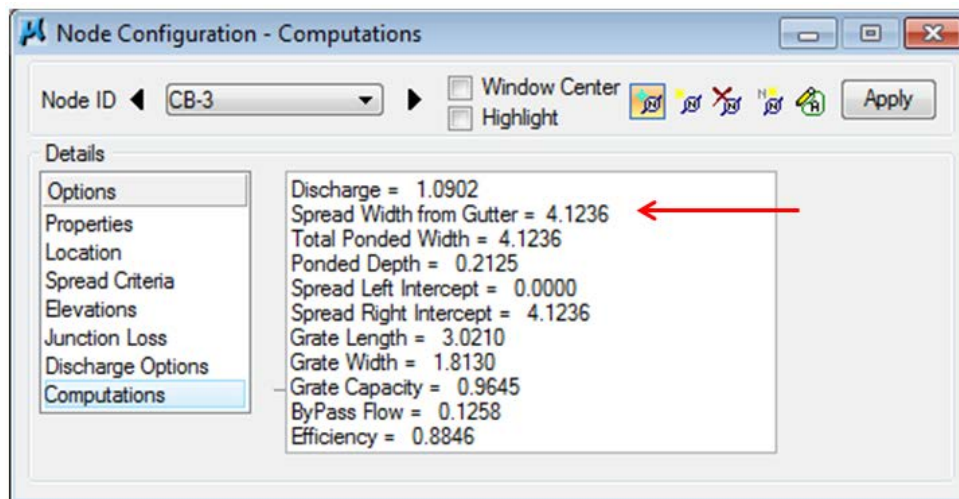


- b) **Properties** > Keyin the **By Pass to Node** as CB-3 or click the **ID** button and data point on the node in the plan view.

The Bypass flow from this inlet will then contribute its resulting bypass flow to CB-3.  
Click the **Apply** button to accept the changes.



- c) Select **CB-3, Computations** > Review the computations to make sure the spread is still within the design limits.



- d) Follow the same procedures to bypass the remaining flow to the inlets as described in the table below:

Node ID	By Pass to Node	Spread Width	
		Before Bypass	After Bypass
CB-2	CB-4	6.0289	7.1331
CB-3	CB-6	5.5181	5.8409
CB-4	CB-9	4.0723	6.1784
CB-6	CB-12	4.8368	5.6188
CB-9	CB-11	1.7590	3.1144
CB-11	CB-13	7.2730	7.5241
CB-12	CB-14	4.8154	5.1393
CB-13	CB-14	5.1393	5.3333