Chapter 3

Inlets-Reference

Node Placement Options

Node: Properties

Node ID — GEOPAK will automatically number the nodes based on the order in which the nodes are entered. The nodes can be renumbered later in the design process. This is discussed in the Chapter about Design
Revisions.

Description (optional) — This may be used to better describe the node.

Node Type — This will show the different node types defined in the drainage library.

Profile — The designer needs to specify the profile condition of the particular node to be placed. On Grade or in Sag condition. This affects the input and calculations for spread.

Library Item — Depending of the Node Type selected above, the list box will only show the available nodes that match the type condition.

By Pass to Node — The designer can specify or ID the node that will take the by passed discharge from the active node.

Max By Pass — Defines the maximum allowable by pass flow from the inlet. No specific computations are adjusted by this value; it is used to merely query the system for by pass flows which exceed this value. Used for On Grade Inlets only. This value could be left at zero (default) if no By Pass to Node is specified.

Node Bottom — This allows the user to specify a box size to be used along with the type of inlet and enables GEOPAK to assign an item for quantity calculations.
MoDOT has not use this type of node in the past and currently the system is not yet set up to use the Node Bottom for quantity calculation purposes. The new drainage library contains Node Bottom items that can be used if desired.

Override Library Item — Each node in the drainage library is associated to a pay item or Item ID in the Design and Computation Manager database. This option will override this linkage, allowing the user to select their own Item ID. The Department uses that option to make the placed node an “existing” node for quantity computations.

Node: Location

Chain	A previously defined horizontal alignment stored in the "gpk" file. Activate the toggle to the left of the field and select the chain from the list.
Profile	A previously defined vertical profile stored in the "gpk" file. Activate the toggle to the left of the field and select the desired profile from the list.
Align: At Point	When this option is utilized, the node is placed at the active angle in the MicroStation file at the current or dynamic Node coordinates.
Align: Tangent to Chain	When this option is utilized, the node is dynamically moved along the Chain, and is rotated maintaining tangency to the chain. The designer can enter the station location or place the node dynamically.
Align: Tangent on Element	When this option is utilized, the **ID** button to the right of the option is activated and the designer is prompted to identify and accept a MicroStation element. The Node is placed tangent to and on the identified element projected from the current or dynamic Node coordinates. The designer can enter the station location or place the node dynamically.
Align: Tangent to Element	When this option is utilized, the **ID** button to the right of the option is activated and the designer is prompted to identify and accept a MicroStation element. The Node is placed tangent to the identified element at the current or dynamic Node coordinates.
Angle	An optional angle rotation could be applied to the node. A 180-degree angle is often needed to properly align the throat of curb inlets and is sometimes used in conjunction with the Mirror Node toggle.
Station and Offset	Nodes may be located by entering the station and offset in reference to the selected chain. If "Tangent on Element" is used, the offset is computed.
Mirror Node	When activated, the node cell is mirrored, in order that the same cell can be utilized to accommodate flow coming from either direction.

Offset from Gutter to Inlet

Inlet hydraulic equations assume the Inlet is at the edge of the computed spread (i.e. the Curb). If the Inlet is offset from the Curb, the discharge in the spread section will bypass the Inlet. This value, expressed in terms of feet or meters, is used to compute this bypass and adjust the actual flow to the Inlet. This may be used, for example, when a Grate Inlet is actually set some distance away from the curb of the road.
Therefore any flow calculated in that segment will not be added to the inlet and it will bypass to the next assigned one.

Node: Spread Criteria

User Supplied

The designer will enter the width and slopes across the spread section starting from the Inlet and continuing towards the edge of the section farthest away from the inlet.

Reference TIN

A spread cross section will be extracted at the inlet location from the TIN file defined in the Project Components item under the Drainage Project Preferences. The designer needs to be careful on what DTM is referenced since for most MoDOT projects the only TIN file generated is the existing ground DTM.

Library Item

A spread cross section will be assigned to the inlet using a Spread Section item defined in the Drainage Library. Once a Library Item has been selected, the spread source can be changed to User Supplied and the spread section defined by the Library Item modified to accommodate non-typical situations such as pavement width transitions.

Shape

A spread cross section will be extracted at the inlet location from the Superelevation Shapes dgn file defined in the Project Components item under the Drainage Project Preferences and shown in the Spread Criteria table.
For curb inlets in superelevation or superlevation transition, the designer can use this option or enter the spread source (cross section) as User Supplied.
If the superelevation shapes are not defined to the edge of pavement, the designer can take advantage of the toggle:”Extend Superelevation Shapes to Inlet at Shape Slope”, located in *Drainage > Project > Preferences* under the Inlet Options item. This will extend the last slope of the shape to the node location point defined in the structure.
Therefore, if the shape file is used to define the spread, be aware that the cross section starts at the edge of pavement creating a theoretical section that is shifted from the actual spread section by the width of the gutter. This is acceptable because the calculated spread width is the same regardless of the shift. The gutter depression cannot be modeled with this approach. To account for the gutter depression while using the shape option, the "Shape and Library Item" would need to be used.

Shape and Library Item A spread cross section will be assigned to the inlet combining the section extracted from the Superelevation Shapes dgn file and Library item from the Drainage Library. If the gutter section is made a library item, this option can be used to account for the gutter capacity.
To properly use this option, the superelevation shapes need to be defined to the edge of pavement line, and the ”Extend Superelevation Shapes to Inlet at Shape Slope” toggle must be off.

Maximum Ponded Depth The maximum depth allowed for ponding in the cross section (expressed in terms of feet or meters). This does not affect any computations, but will produce a warning if the computed depth is greater.
For sag inlets, this value is used to compute the capacity of the node.

Maximum Ponded Width The maximum width allowed for ponding in the cross section (expressed in terms of feet or meters). This does not affect any computations, but will produce a warning if the computed depth is greater.

Reference PGL Slope will be extracted from the profile defined in the Location item of the Node dialog box at the inlet location. The slope will update as the .gpk file is updated.

User Supplied Slope will be entered by the designer in percentage format while omitting the % sign.

Shape Slope will be extracted from the superelevation shapes dgn file defined in the Project Components item in the Drainage Project Preferences.
For inlets in superelevation, superelevation transition, or other transitions, the designer can use this option or enter the longitudinal slope as User Supplied.

For an inlet in sag conditions, the approaching longitudinal slopes have no effect on the calculation of the inlet capacity or spread at the inlet. The spread approaching a sag inlet needs to be calculated and the approaching longitudinal slopes affect those calculations. The fields unique to Spread Criteria for Sags relate to the spread along the approaching longitudinal slopes and are discussed below. The designer must specify a value for Maximum Ponded depth for sag inlets. Although this value is not needed to compute spread, it is used by GEOPAK to compute the capacity of sag inlets.

% Slope Left and Right — For defining the longitudinal slope to use in spread (ponded width) computations for the flow approaching from the right and left side of the inlets. The terminology (right and left) is somewhat arbitrary as long as the designer recalls which side is intended as left and right.

% Discharge Left and Right — Defines the percentage of the total discharge to the inlet to allocate to the left and right approach spread computations. The terminology right and left are somewhat arbitrary as long as the designer recalls which side is intended as left and right and is consistent with the definition of % Slope Left and Right.

Node: Elevations

Reference Surface Define the desired TIN File or a Model or Object within the site project specified in the Drainage Preferences – Project Components.

Elevation Source Defines the source of the Node elevation. With the source specified as something other than User Supplied, the Node elevation will
automatically update as the Node is moved. The options are:
Reference Surface: Computes the actual elevation from the X and Y coordinates of the structure from the Location dialog and the Reference TIN File or Site Model. This option may be useful for placing Ditch Bottom Inlets at the existing ground elevation depicted in a TIN file.
Reference PGL: Utilizes the Station from the Location dialog to ascertain the profile elevation on the Reference PGL. Note: This option will report the elevation directly at the station on the PGL.
PGL+Spread Section: Utilizes the PGL and information from the Spread Criteria cross section to compute the elevation. The elevation is ascertained along the PGL at the specified Station and then adjusted along the spread cross section width and slope segments to the end of the cross section. Although it says PGL "plus" spread section, the programs subtracts positive values from the PGL.

Node Elevation Options: The designer may adjust the inlet elevations up or down from the Elevation Source item. These options are:
Same as Source: matches the node elevation with elevation source.
Constant Offset: enables a plus or minus value to the elevation source selected. For example, if the reference profile is PGL+ Spread Section to the flow line of the gutter, a Constant Offset can be specified to have the node elevation be the edge of pavement (EOP) elevation. This is useful because the EOP is used for curb inlet elevations. A plus offset will add to the elevation value.
User Supplied: The user may specify an elevation.
For the outlet node elevation, the elevation is not a physical point on the structure. The elevation should be at least 1 foot above the tailwater to avoid a warning. In general, using the berm or ground elevation that covers the outlet structure is acceptable for the outlet node elevation.

Vertical Alignment Alignment preferences for incoming and outgoing pipes from the Node. As pipes are designed the elevations will be set according to the selected preference.

	Options available are: • Match Soffit: aligns all the pipes in the system by matching the inside top surface of each pipe. (Also referred to as the crown of the pipe) • Match Invert: aligns all the pipes in the systems by matching the bottom inside surface of each pipe. • Match Surface: aligns the pipes following the elevation of the water surface inside the pipes. • Allow Drop Manhole: allows for "drops" inside the node for the pipes arriving or existing the node. Not matching inverts or soffits will be performed. This option allows for greater flexibility. Since the design preference is to minimize excavation, the first pass during the design will align all the pipes at the soffit. As the designer needs to move the inverts of certain pipes due to various factors, e.g. utility conflicts, the change will only affect the selected pipe and others will remain at the previously set elevation. • Min. Fix Drop: sets a minimum drop in elevation between the pipes arriving and exiting the node.
Minimum Depth	Minimum depth expressed in master units (i.e., feet or meters) for the pipe to be buried (minimum cover) measured from the Node Elevation to the soffit (top inside) of the highest pipe. This value is used to establish the minimum cover elevation noted in the Link Configuration Conditions dialog box. For additional information see below.
Maximum Depth	Maximum depth expressed in master units (i.e., feet or meters), for the pipe to be buried measured from the Node Elevation to the invert of the lowest pipe. This value is used to establish the Maximum Depth elevation noted in the Link Configuration Conditions dialog box. For additional information see below.
Add Sump Depth	Extra depth to be allowed in the manhole structure after the maximum depth of the structure has been computed. This has no effect in the hydraulic calculations, but some designers add this extra depth for pollution control measures. MoDOT does not use this option

Minimum and Maximum Depth at Nodes Definition

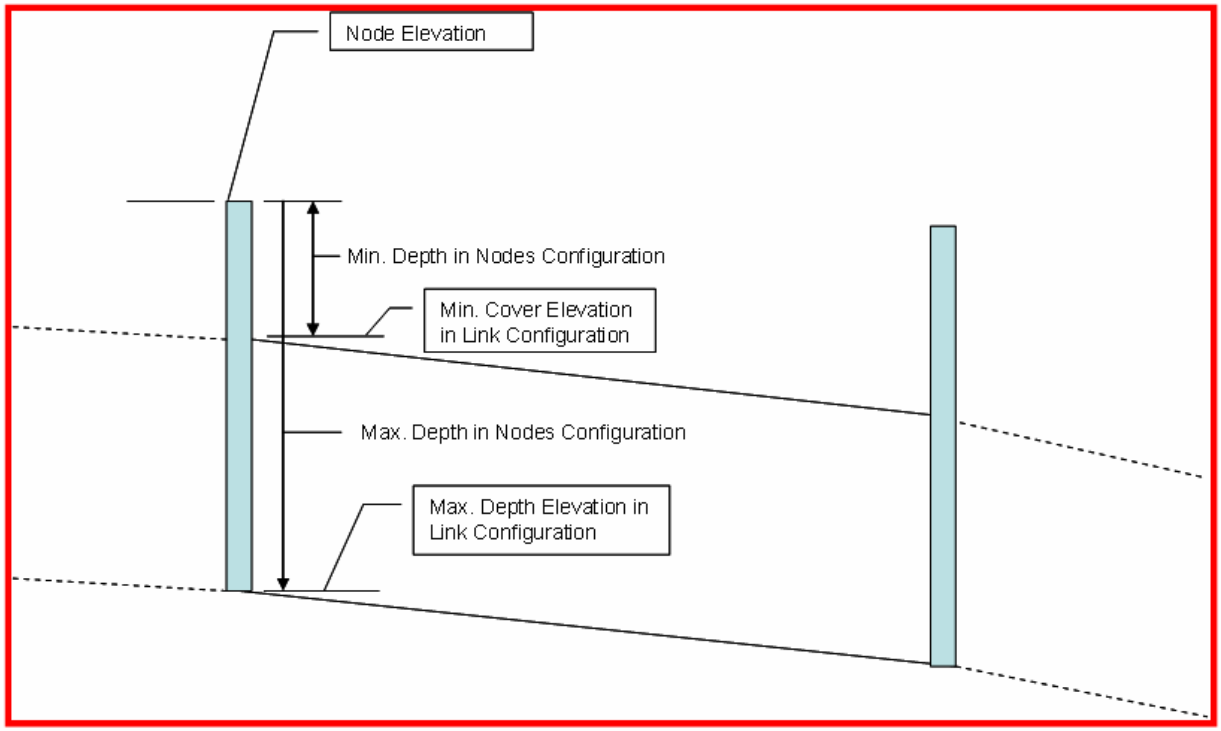
The values entered for Minimum and Maximum Depth define the vertical limits that the program uses to place the pipe. The Minimum Depth establishes the upper limit that pipes are designed in. The Maximum Depth establishes the lower limit.

The minimum depth of a pipe is often established by cover.

.

Consider the following for the Maximum Depth: The approximate elevation of the outlet node should be known while designing the storm drain. The outlet elevation may be controlled by the minimum pipe slope or by the depth of the pond at the outlet. The designer will be able to lock the elevation of the outlet pipe in the Link Configurations-Conditions dialog. Locking the elevation of the outlet will control the total drop through the system. This will limit the allowable pipe envelope that the pipes are designed within. Reasonable results should be obtained by setting the Maximum Depth for all nodes to be deeper than the outlet pipe (maybe use a tentative 20' depth). Again, GEOPAK will not fully use this depth to design the pipes if the outlet elevation is locked.

Regardless of what depths are used, the designer will still need to check for adequate depth, pipe slope, and hydraulic gradient clearance later in the design process.



Nodes: Discharge Options

Use Computed Discharge — Indicates using the computed discharge from a stored Drainage Area as the discharge to the Node.

Supplied Discharge — This option allows for a user supplied discharge, with disregard to any calculated value from a drainage area.

Disable Inlet Calculations Capacity — When toggled on, the designer may provide the desired inlet capacity overriding any GEOPAK Drainage calculated value.

Link Base Flow Area / Link Base Flow Discharge — When toggled on, an additional drainage area may be defined. The area can be identified graphically by clicking **ID** and selecting the MicroStation shape previously defined as a GEOPAK Drainage Area.
For the Link Base Flow Discharge. the designer can also enter a value for the extra discharge in the proper units defined in the Project Preferences (cubic feet per second or cubic meters per second).
This “extra” area or discharge is included in the pipe, but is not included in the inlet spread calculations.