Example Network

In pavement drainage, artificial ridges and peaks are formed by cross slopes and vertical curves. In Figures 4-2 and 4-3 below, each drainage basin is delineated by the crown of the roadway to the top of ditch backslope and between each vertical curve crest. If the discharges from both culverts join within a quarter mile, all four drainage basins would combine to make one TDA, as indicated in Figure 4-2. If discharges remain separate for at least a quarter mile downstream of the project site, drainage basins A1 and A2 combine to make one TDA and drainage basins A3 and A4 combine to make a second TDA (See Figure 4-2). The new, replaced, and existing impervious areas must be estimated for each TDA. Minimum requirement thresholds for western Washington are applied to each TDA. See Chapter 2 for Minimum Requirement applicability.

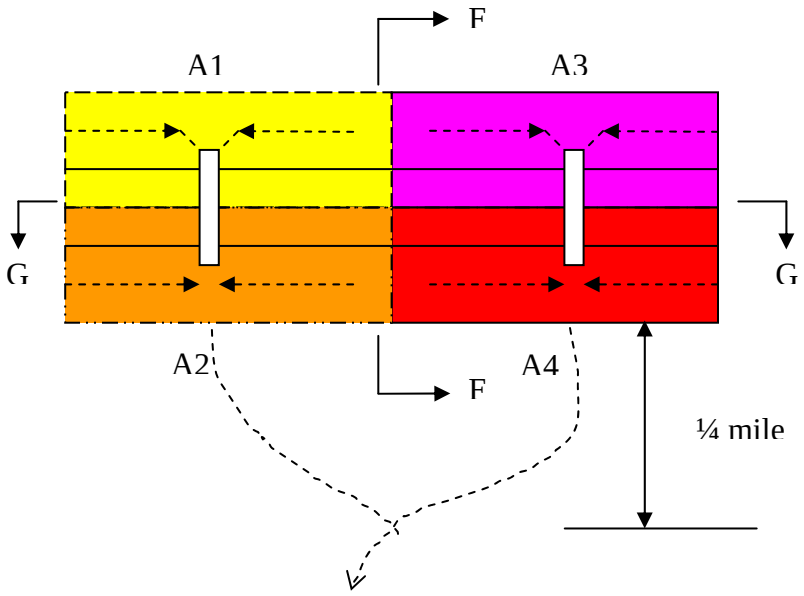


Figure 4-2. Drainage Basin Areas / Threshold Discharge Areas (Plan)

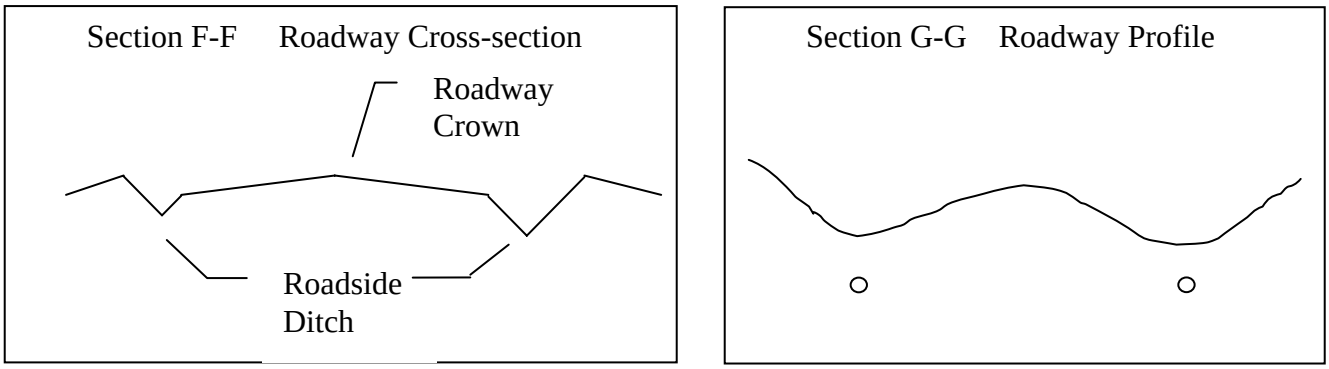


Figure 4-3. Drainage Basin Areas / Threshold Discharge Areas (Section and Profile)

Example Network

Create a storm drain network and route flow through the network using the 25-year storm to design the pipes. Do not change the pipe inverts and make sure the flow is not creating a full flow conditions.

The section of roadway of concern is in a sag, see Figure 3. CB2 and CB6 are both 300 feet from the low point on the curve. The curve crest is 600 feet north of CB2 and the 600 feet south of CB6. See Figure 1 for the plan view layout. Assume the catch basins are perfectly efficient in other words; all upstream gutter flow is intercepted. Assume that all Schedule A pipe material may be used throughout the project with a Manning's "n" of 0.013. Use an entrance loss coefficient for Headwall of 0.5 for catch basins. Use a Type-1 Catch Basin for all structures.

For the catch basin and pipe design use the following tables:

Catch Basin	Outlet Inv El.	Rim El.
CB1	332.5	337.0
CB2	332.0	337.0
CB3	330.0	336.0
CB4	330.5	336.0
CB5	334.8	338.5
CB6	334.5	338.5
dummy	325.0	330.0

Pipe	Length	Upstream Inv.	Slope
P-001	36	332.5	1.39%
P-002	298	332.0	0.67%
P-003	36	330.5	1.39%
P-004	298	334.5	1.51%
P-005	36	334.8	0.83
P-006	15	330.0	33.33%

Figure 1 – PLAN VIEW

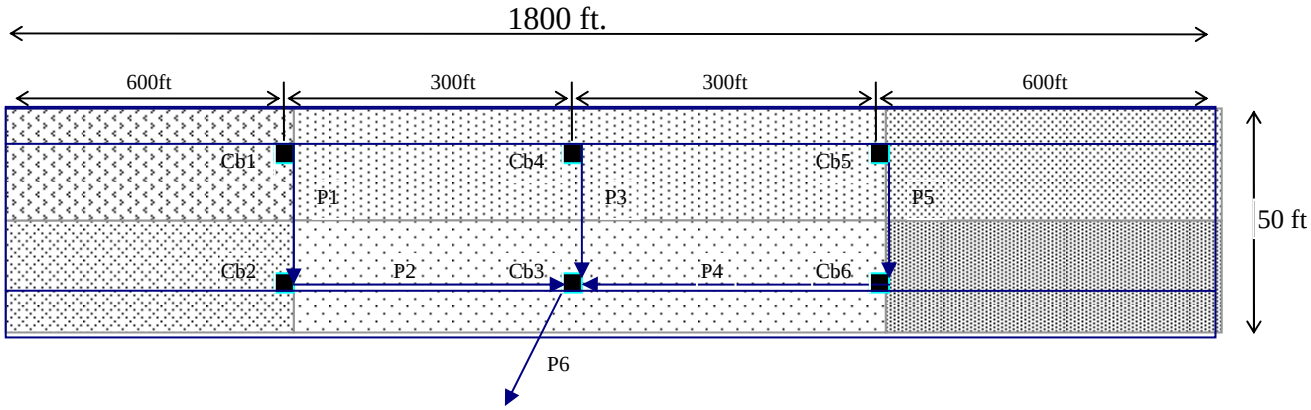
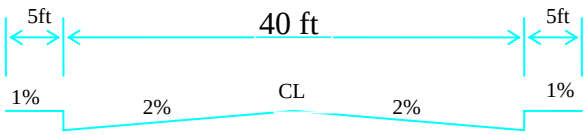
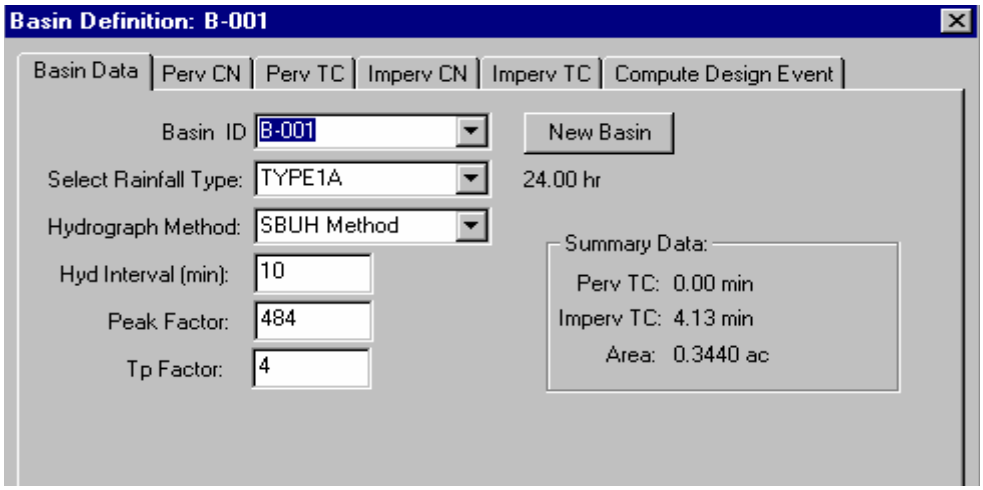


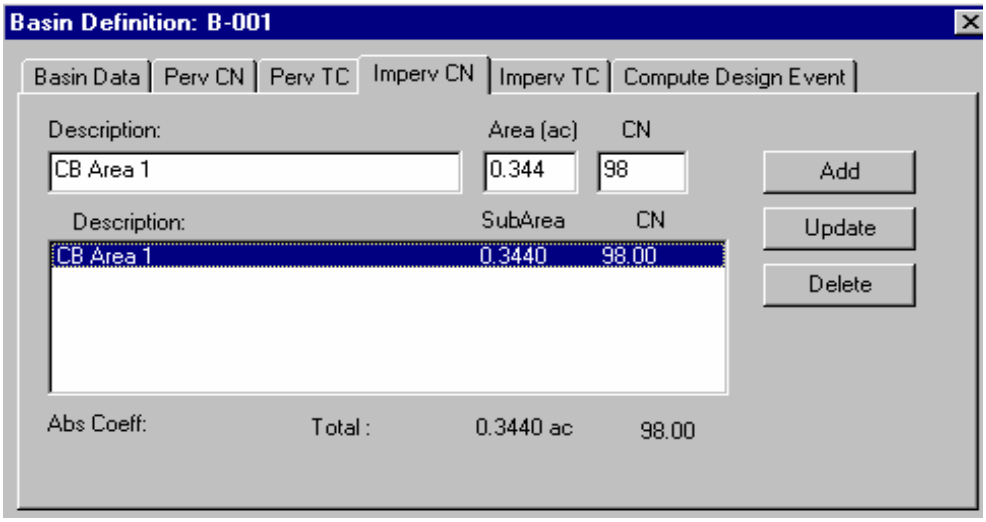
Figure 2 - CROSS SECTION

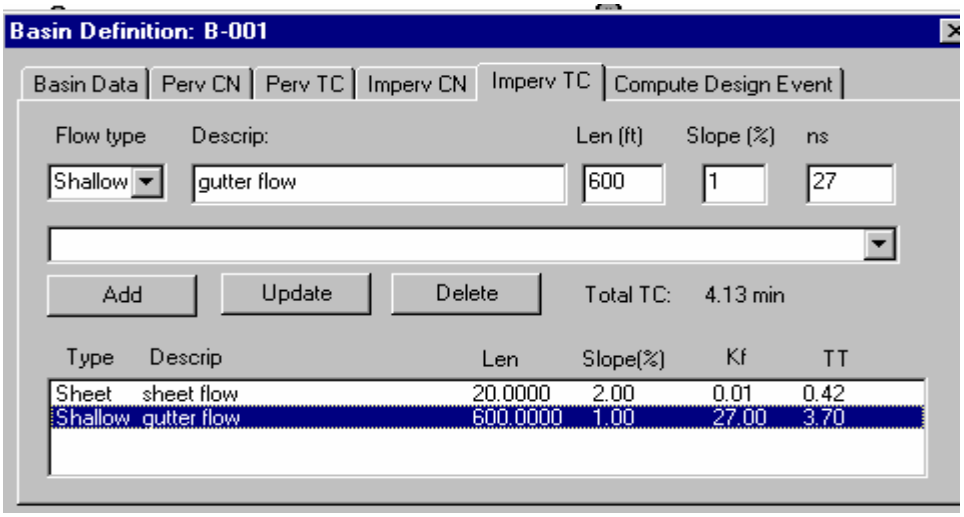


Example Network

Define the drainage basins for each area contributing to one of the catch basins. Below is the drainage basin contributing to catch basin 1 (CB1).



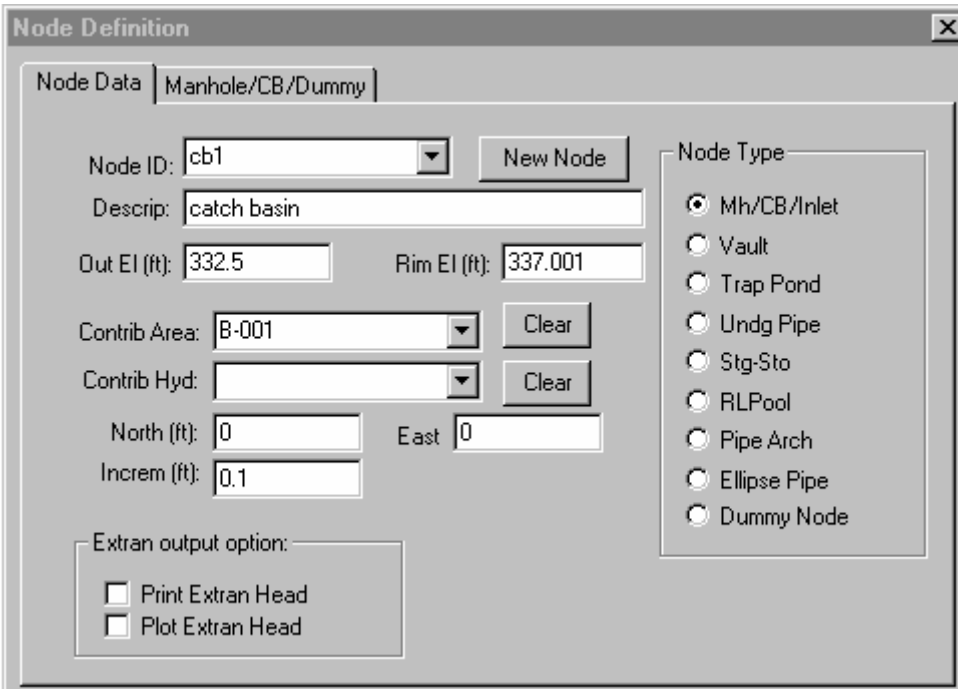


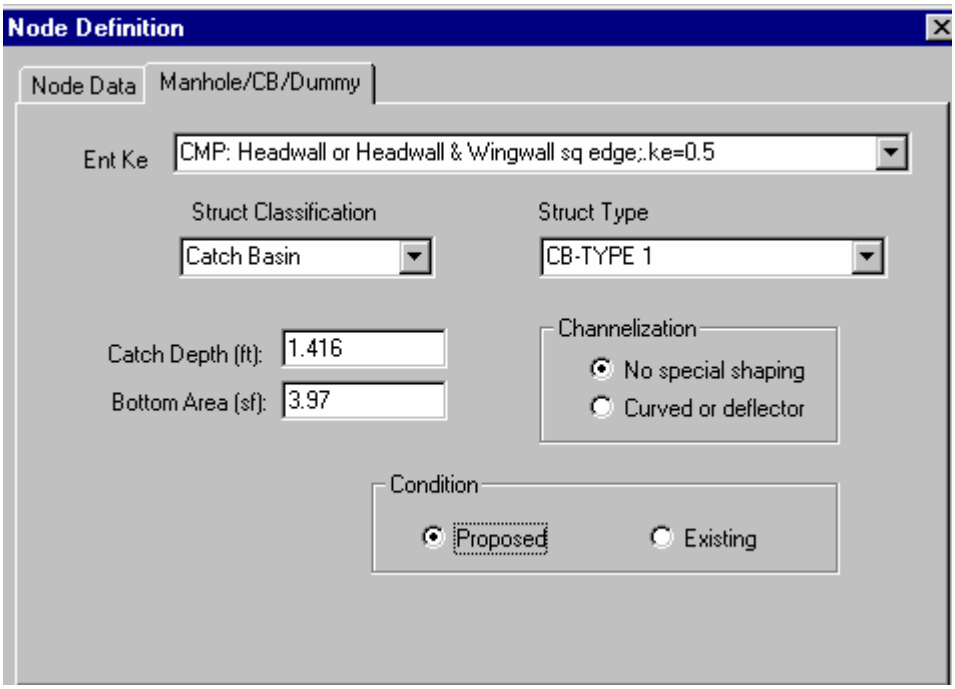


Repeat this for the other 5 Drainage basins, use this basin to create the new ones.

Example Network

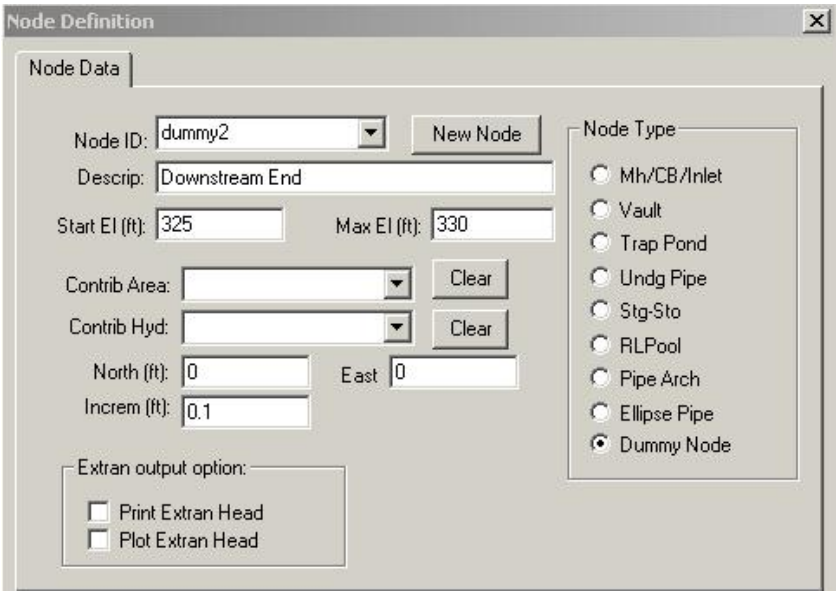
Define a Node for each of the catch basins. The contributing area should be the associated drainage basin that was just defined in the last step. The Northing and Easting is optional and not necessary for this example since we will be defining the location using the Layout View.



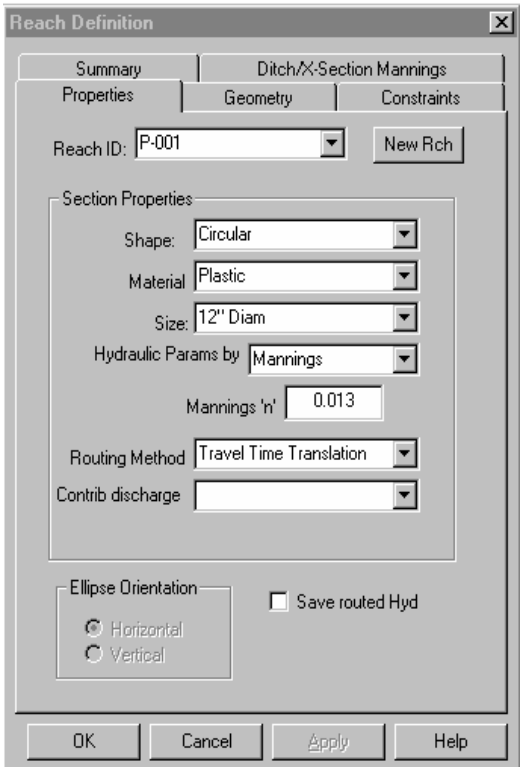


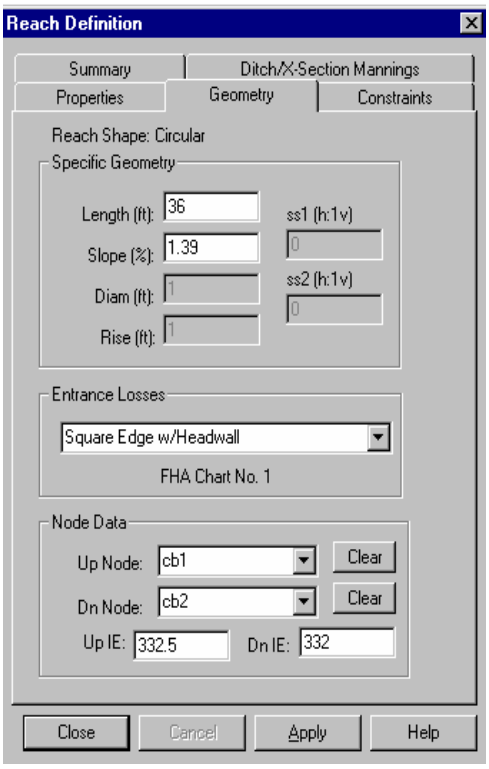
Example Network

A Dummy Node must be defined to represent the downstream end of the storm drain. There is no actual node at the end of the outfall pipe, but StormSHED needs a node to perform the calculations.



Define the pipes using the Reach Definition; begin with the minimum allowed pipe diameter (12”). When StromSHED routes flow through the pipe it will determine if a larger pipe is necessary. Below is the pipe connecting CB1 to CB2.

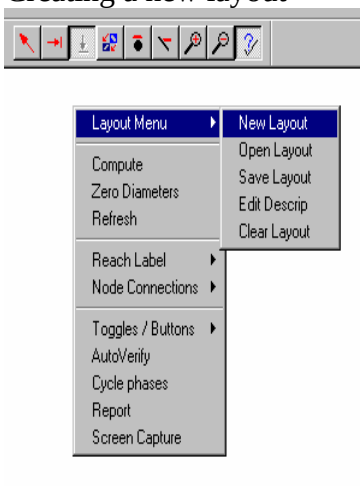


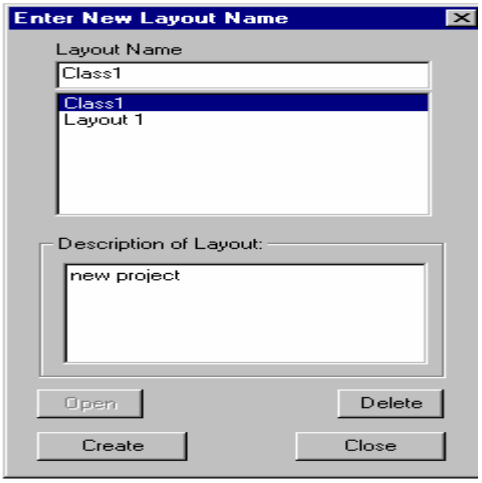


Example Network

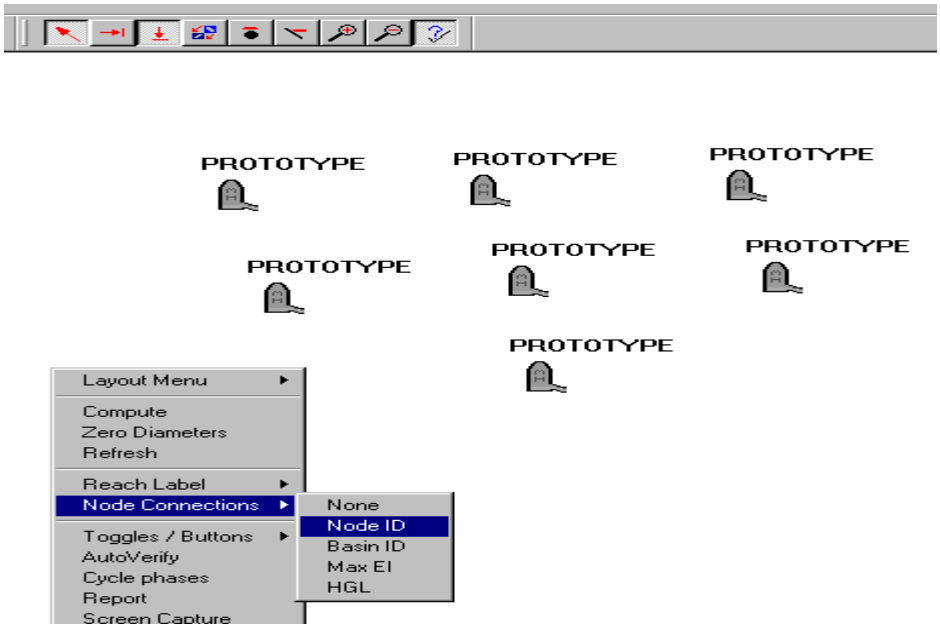
Now that the pipe and catch basin data has been entered, the storm drain layout can be created. Click anywhere in the Layout View area with the right mouse button. From the menu that appears, select Layout and then New Layout. Give the layout a name that makes sense to you for the project. Then enter the 7 structures for this example (6 catch basins and a dummy node) by clicking "Insert a Node" radio button on the tool bar and then clicking anywhere in the Layout View area with the left mouse button to place the structure. The structures do not have to be in their exact location , they can be moved later. Every structure entered this way will be assigned "Prototype" which will be changed.

Creating a new layout



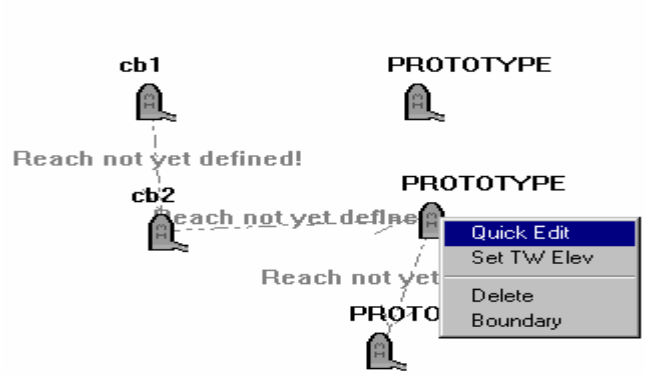


Insert a Node



Example Network

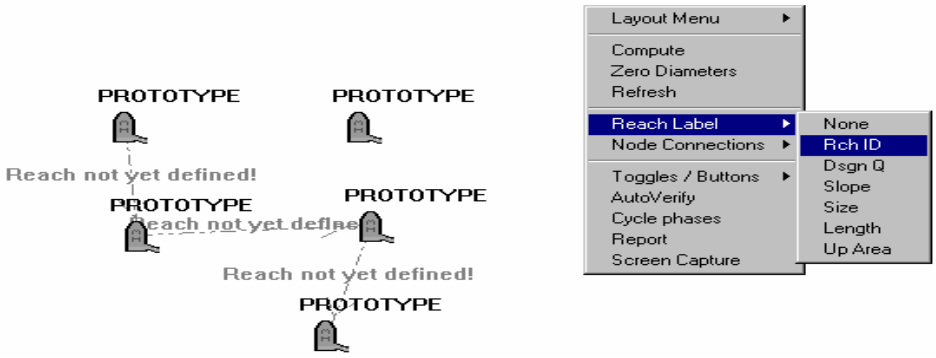
After all 7 structures are entered, toggle off the “Insert a Node” radio button. It is now time to assign names to each of the catch basins. Using the right mouse button, click on a node. The select Quick Edit. The node will default to Prototype, change this to the appropriate catch basin name.



Do this for all of the nodes, including the Dummy Node at the outlet of the storm drain system.

Then toggle on the “Insert a Reach” radio button. The pipes must be entered from the upstream node to the downstream node. Click at the most upstream node and click on the next downstream node, following the flow path.

Insert a Reach

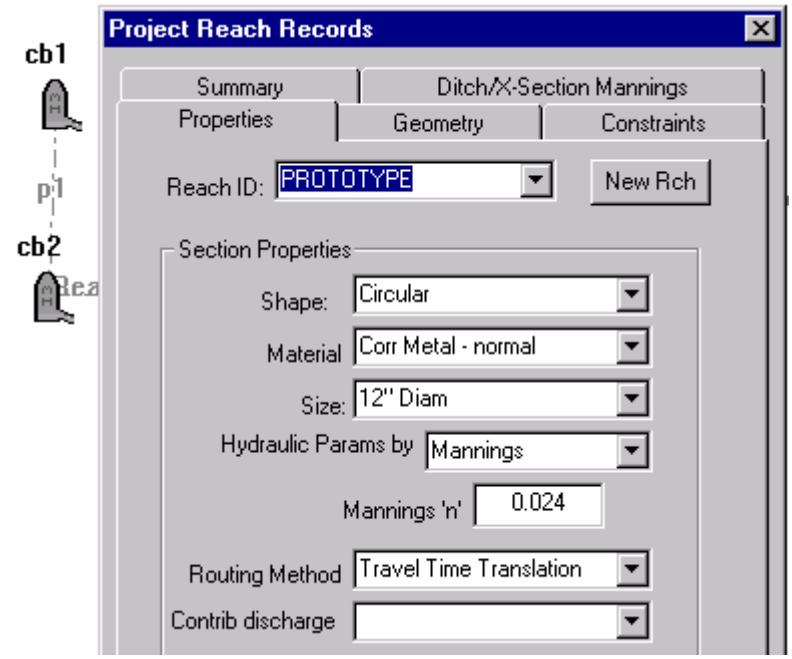


To end the pipe run, toggle off “Insert a Reach” and then toggle it back to start the new flow path. This will start a new pipe run, so once again, click on the most upstream node that does not have a pipe and move downstream until you reach the most downstream node.

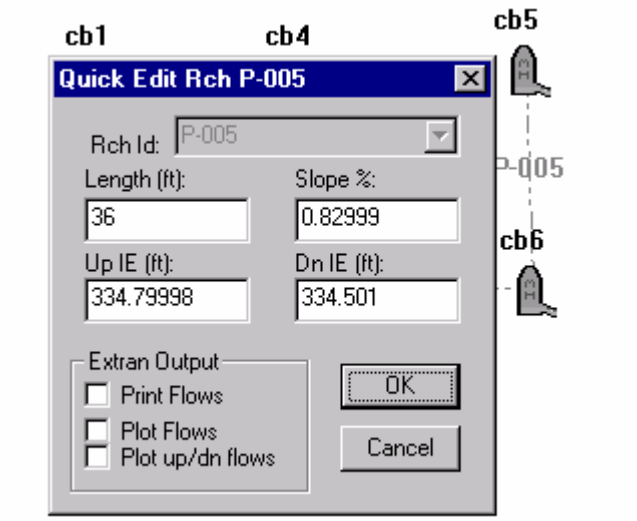
After all the pipes have been created, turn off the create pipe button on the tool bar. Then using the left mouse button, click and hold to drag the nodes to where they should be. This is a schematic view and not to scale; however, it is important that the angles between the pipes is accurately represented since StormSHED will use these angles to calculate headloss of flow through the system.

Example Network

Once the pipes have been drawn, they now have to be defined. Using the ***Left mouse button***, double click on a pipe and select the appropriate pipe and hit Apply. This changes the name from "Reach not yet defined" to the appropriate pipe name.

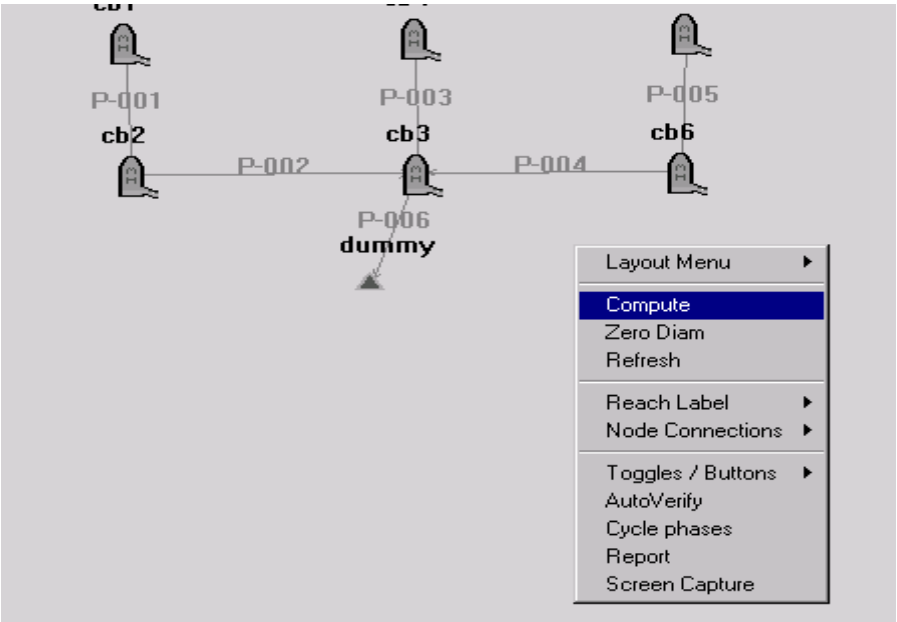


Using the right mouse button, you get the following menu. It identifies the pipe, but it won't let you choose the reach id. This is an information only command.

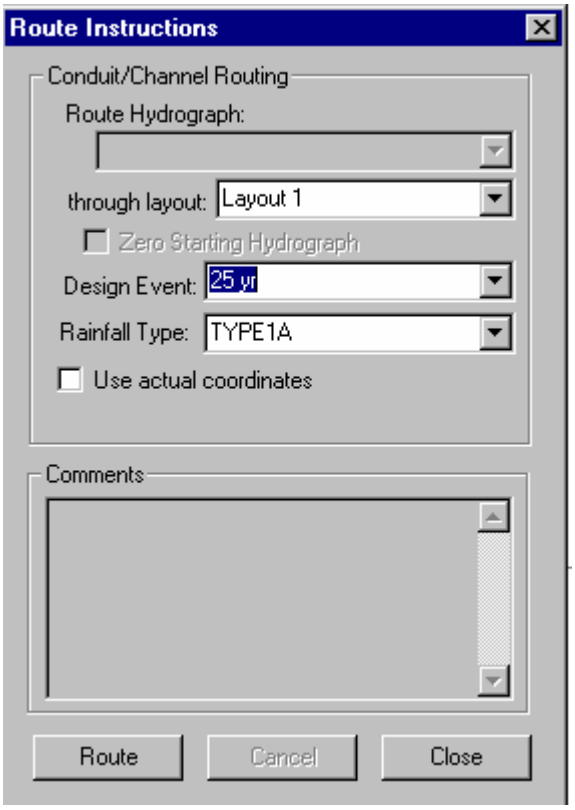


Example Network

Now the network is completely entered and ready for analysis. Using the right mouse button, click anywhere in the Layout View area that is blank. From the pop-up menu select the Compute option.



Enter the design storm you want to compute and route the storm through the system.



Example Network

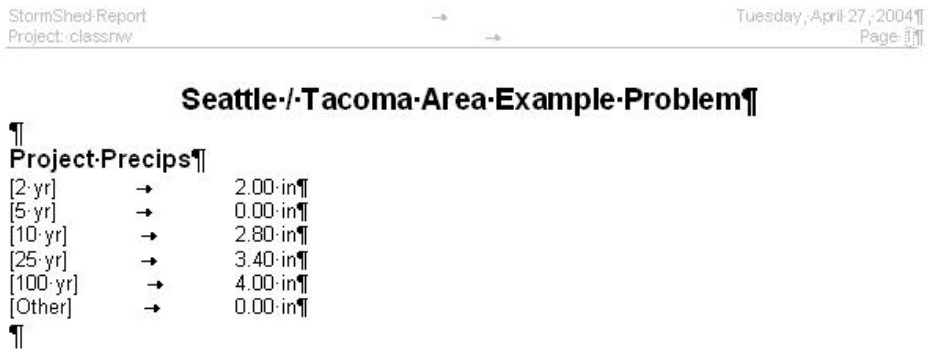
The results of the analysis will be written to the History View area. The results of any specific pipe can also be viewed by double clicking on the pipe and going to the Summary tab.

The History Summary for the 25 year event is what is seen below. Two things to look at when reviewing the results, first you want to make sure your pipes are not flowing full and second the velocity must be above 3fps for full flow to avoid siltation. Additionally , if a Hydraulic Grade Line is required due to high velocities (>6ft/s) or shallow cover, the designer should verify that the HW Elevation is less than Rim Elevation.

History Summary 25yr event

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
P-001	0.3440	0.2723	4.2118	0.06	0.1723	12" Diam	3.0166	5.3626	B-001
P-002	0.6880	0.5571	2.9241	0.19	0.2958	12" Diam	2.8672	3.7231	B-003
P-005	0.3440	0.2723	3.2546	0.08	0.1956	12" Diam	2.5147	4.1439	B-005
P-004	0.6880	0.5446	4.3753	0.12	0.2382	12" Diam	3.7971	5.5708	B-006
P-003	0.3440	0.2848	4.2118	0.07	0.1761	12" Diam	3.0562	5.3626	B-004
P-006	2.0640	1.6713	20.6242	0.08	0.1925	12" Diam	15.7864	26.2595	B-003

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	dummy					325.5493	
cb3	dummy	330.6491	0.2239	0.0665	0.1574	330.6491	336.0000
cb2	cb3	332.4236	0.1413	0.1881	------	332.4704	337.0000
cb1	cb2	332.7841	------	------	------	332.7841	337.0010
cb6	cb3	334.9142	0.0982	0.1303	------	334.9463	338.5000
cb5	cb6	335.0869	------	------	------	335.0869	338.5000
cb4	cb3	330.7911	------	------	------	330.7911	336.0000

To make your hydraulic report complete, you will also need to provide the basin, reach and node information. To record this information to the History View, you must first verify RTF editor of your computer is set to the correct path.

- Click on the RMB in the white space of the Tree View.
- Click on Options, Program Configuration Tab.
- The RTF wordprocessor should be set to **c:\program files\Microsoft office\office\winword.exe.**
- Once this is set, click on the RMB in the Layout View.
- Click on Report Tab. A **temp.rtf** word document will appear on the Active Window Bar at the bottom of the screen.