Volume

2

ENGENIOUS SYSTEMS, INC.

StormShed 2nd Generation

Program Description

STORMSHED 2ND GENERATION

Program Description

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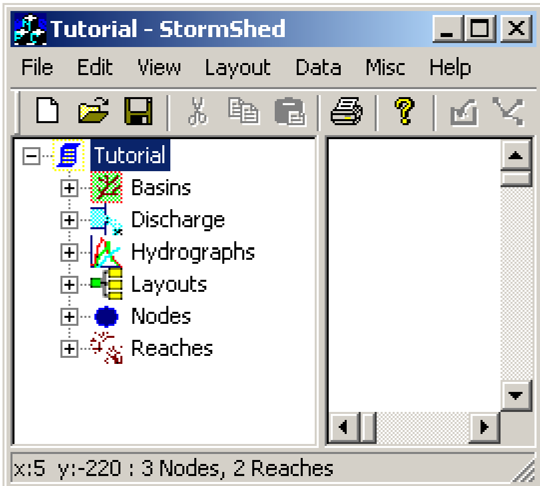
Program Overview/Organization



StormShed2G is organized into two (2) views, the view on the left is known as the tree view while the view on the right is commonly referred to the main view. The tree view shows the categories of data that StormShed2G maintains for each project. The main view can display several types of data, depending on what the program is asked to do. The options are a schematic layout of a conveyance system, a detention pond analysis form, or report of the most recent computation.

In addition to the two views, the program will present numerous dialogs that are used to either gather information about a storm drainage related object, or obtain computational instructions.

StormShed2G does not send anything to the printer. Instead, the program is designed to make all information available to your word processing program. In preparation for future versions of the program, this current release creates all output in standard HTML format. This allows all reports to be viewable via any standard browser. In fact, the report view is an HTML compliant browser.

Chapter 1

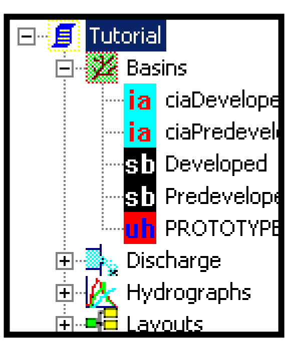
Tree View

The tree view is always present and will display the same categories for each project. However, after that, the data displayed in each category can differ and is unique to each project. The categories are Basins, Discharge, Hydrographs, Layouts, Nodes, and Reaches. They represent the types of data the program manages for each project.

Within each of the data categories is a list of data records for that category. The program is designed to provide basic functionality at this level. By right mouse clicking on any record, a popup menu will appear allowing selection of basic tasks that is appropriate for the data record selected. Most record id's have a 30 character limit. Generally, the tasks are:

- Open the record that is selected.
- Create a New record using the selected record as a template.
- Rename the selected record.
- Send a report to the History View summarizing the record (discussed in a later section).
- Delete the selected record.

The Hydrographs category will have fewer right click popup options, while the Layouts category will have more.

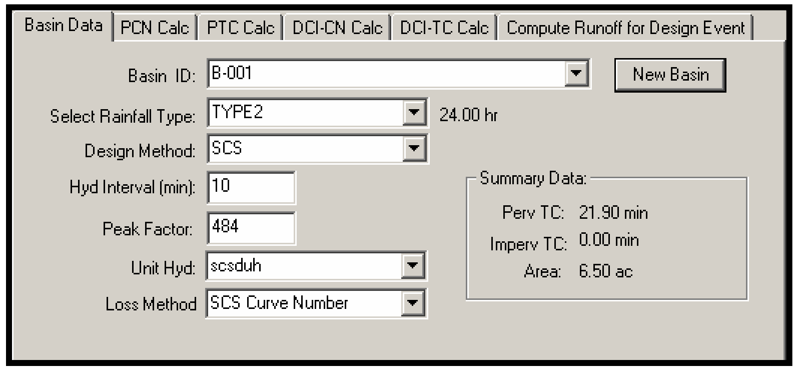


To assist in identifying the types of records shown by the Tree View, StormShed2G includes a small graphic with a letter next to each record. The graphic is meant to help users identify the type of record that is displayed. For example, the graphic elements next to the Basins records in the adjacent chart identifies CIA type records (ia), Santa Barbara Unit Hydrograph type records (sb) and SCS Unit Hydrograph type records (uh).

The program attempts to use a combination of letters and color to distinguish different record types.

Basins Category

Basins are drainage areas. A drainage area describes how runoff is generated. Basins can be very large, 100 acres, or rather small, half an acre. StormShed2G offers the Soils Conversation Service (SCS) TR-20 methodology or the SBUH (Santa Barbara Unit Hydrograph) method to generate runoff.



The Basin Data tab, which is the main tab allows users to specify the Design Method and Rainfall Type.

There are several options associated with each of these. The remaining tabs will change depending on the selection. The primary selection is the Design Method. 2G offers a choice between SCS, SBUH and Rational methods. With the SCS and SBUH methods, the choices are the same for the Rainfall Type. If the Rational Method Design method is chosen, then the Rainfall type becomes an IDF selector. Note that since 2G ships with lots of different rainfall distributions, there is a utility in the Data/Confg dialog that will allow you to move the RAC files that aren't used in your area to a different location so the choices in the drop down become manageable. If the rainfall type is of the IDF variety, there is also a customization feature in the Data/Config dialog that will allow you to specify the type of IDF curves to include in the drop down selection.

The Hyd Interval is a legitimate choice for the SCS and SBUH methods, but becomes inactive for the Rational Method. For the SBUH method, a 10 minute interval is generally acceptable. For the SCS method, it could be smaller. The interval should be at least the hydrograph duration or approx 0.133tc. If the time of concentration is 30 minutes, a 4 minute time step will probably be good enough. If the time of concentration is 6 minutes, we recommend that you set the Hyd Interval to 2 minutes. 2 minutes a good as a bottom limit.

The Peak Factor is only available for the SCS method. It is not appropriate (and available) for the SBUH and the Rational method. Generally, the default is 484. It's range is probably in the range of 200 to 600.

The Unit Hyd field is available for the SCS and SBUH methods, but is unavailable for the IDF method. When the Peak Factor is 484, 2G uses the unit hydrograph table that is used by TR-20. If it varies, the program reverts to an equation to approximate the curve. Volume 1, Methods and Reference talks more about this. The SCS Unit Hydrograph is found in an ASCII file located in the RAC subdirectory with the extension .uh. The file name is SCSDUH.UH. The D stands for dimensionless. Users can define their own .uh files for use by the program.

The Loss Method field is available for the SCS and SBUH methods, but becomes unavailable for the Rational method. Generally, the SCS and SBUH method will use the SCS curve number for losses. 2G also supports the Holtan and Green – Ampt loss methods.

Each ID is unique in a project. New basins are created by selecting the 

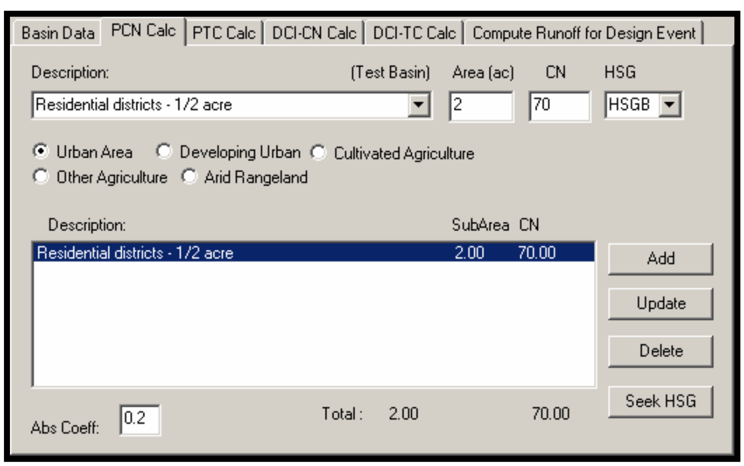
button. To change between previously defined basins, just select the basin ID from the drop down selector.

Composite CNCalculator

There are two CN calculators. One for the pervious land areas and the other for the DCIA (Directly connected impervious areas).

Composite curve numbers, as implemented by the SCS assumes that the land uses are fairly homogeneous. This means that if there are three (2) acres of soils with a curve number (cn) of 70 and eight (2) acres with a curve number of 97, it is not appropriate to combine them for a composite curve number of 83.55. The soils characteristics are apparently not homogeneous. However, this is not to say that the pervious CN calculator cannot have any impervious areas.

In general 2G will assume that any land use areas with a cn of 98 or higher that is included in the PCN calculator is considered unconnected impervious. 2G will first compute a composite CN then again adjust the CN based on the percent imperviousness. If the percent imperviousness is greater than 30%, 2G will make the adjustment differently. See the Methods and Ref volume of the documentation for the different equations.



If there is directly connected land use areas, 2G provides the DCI-CN calculator. The concept is often referred to as Directly Connected Impervious Areas (DCIA). DCIA creates separate hydrographs for pervious and directly connected impervious areas.

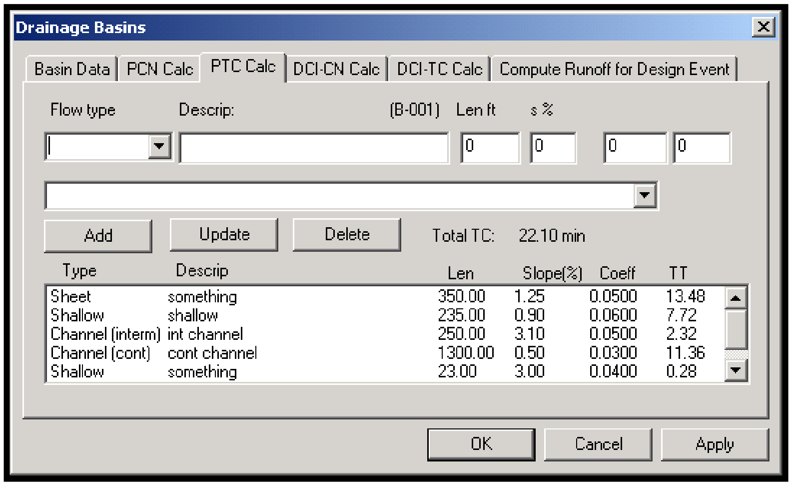
The use of the calculator is pretty straightforward. Select the land use type such as Urban areas or Developing Urban. Once a land use type has been selected, use the drop down description to select the appropriate land use. Enter the area and select the

CN by selecting the HSG. The land uses are all predefined and fully customizable by selecting the **Data\Config\Land Use** menu selection.

Press the 

button to add the land use to the calculator. See the tutorial for a demonstration on entering data.

Time of Concentration Calculator

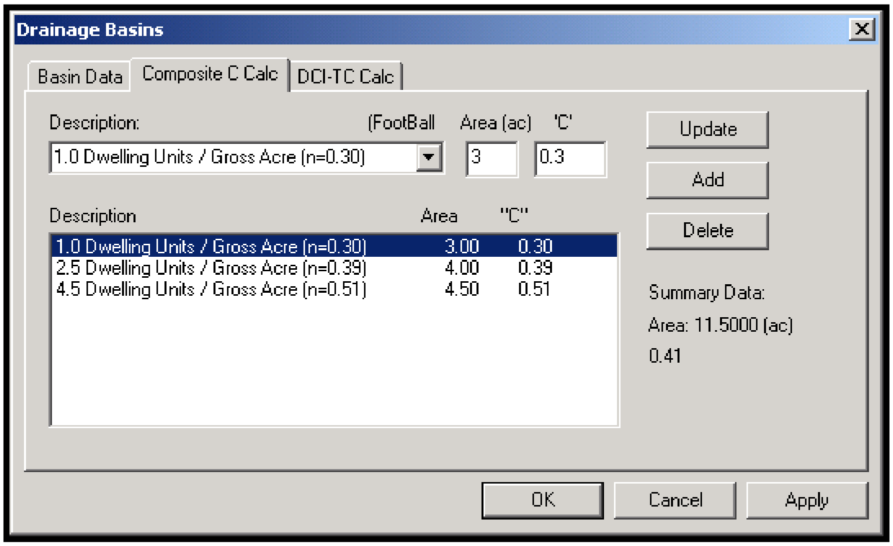


The same input format is used for time of concentration computations for both the SCS/SBUH and Rational design method. Conceptually, the program allows for the creation of numerous travel time reaches that are combined to create a single time of concentration total. StormShed2G permits the following computation methods for each travel time computation.

- Sheet Flow (per TR-55)
- Shallow Flow (per TR-55)
- Channel Flow (per TR-55)
- Federal Aviation Equation
- Izzard equation
- Kerby equation
- Kinematic equation
- Kirpich equation
- Morgali-Lindsay equation
- SCS equation (SCS velocity)
- Fixed rate

Composite 'c' Calculator

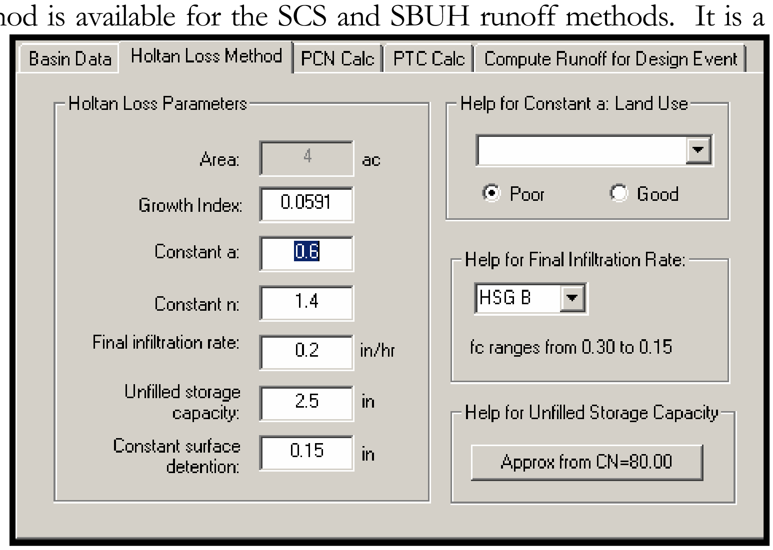
When Rational is selected as the design method, the calculators for the pervious and directly connected impervious curve numbers is replaced with a single composite C calculator.



The Composite C calculator is used compute the average of multiple rational land use types. Again, to assist in the data entry, the program offers a configuration table where predefined land uses can be specified. It is also found in the **Data/Config** menu selection. In this case, it is a land use verses corresponding 'c' value table that the program can use.

Holtan Loss Method

The Holtan loss method is available for the SCS and SBUH runoff methods. It is a replacement for the SCS curve number method, but relies on the SCS curve number to approximate some of the coefficients.



The area input field is inactive and relies on the user to define drainage areas based on the SCS curve number approach. Once the areas have been defined, it is placed in the Area field.

Growth Index is a number from zero to one and represents the relative maturity of the ground cover. It is really more applicable to agricultural areas and used to indicate the development of the root system. In cases where the ground cover is more urban in nature, the Growth Index should be left at 1.0.

Constant “a” is the available storage and is estimated by the land use drop down selector on the right side.

Constant “n” is taken as 1.4.

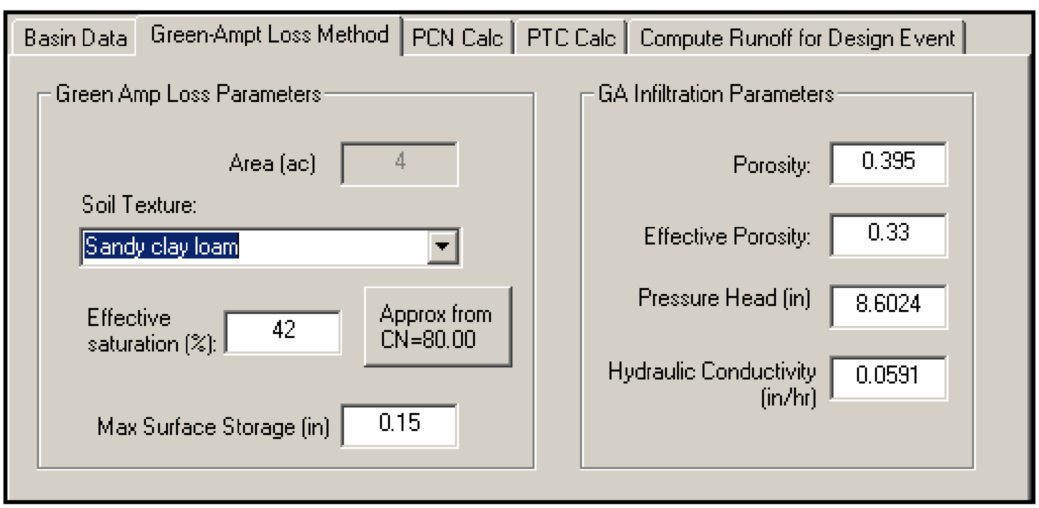
The Final infiltration rate is can be estimated based on the hydrologic soils group.

Unfilled storage capacity is a measure of the available soil storage capacity. This number can also be related to the curve number. It should be noted that engineering judgment would probably be more accurate in estimating the above parameters than strictly using the SCS curve numbers to approximate the values.

The dialog is designed to allow users to obtain approximations based on the SCS methodology, but the override them based on experience.

Green and Ampt Loss Method

Like the Holtan method, the Green – Ampt method is an alternate method for accounting for runoff losses due to infiltration. The GA method is more theoretically based than the Holtan method.



The dialog has fewer input parameters than the Holtan. Like the Holtan method, 2G relies on the Curve Number calculator to obtain the GA area. Unlike Holtan, the link between the SCS Curve number approximation and some of the coefficients are not as obvious.

Soil Texture is a selection that is based on work done elsewhere. It provides a link with the GA infiltration parameters that are commonly used by the program.

The maximum surface storage is similar to the SCS abstraction coefficient an is in the range of 0.15 inches. This is probably a number that agencies will dictate. The most difficult parameter is the effective staturation. Here the CN number can be used to approximate it. Taking the curve number and the ratio between the AMC 1 and AMC2, the effective saturation will be in the neighborhood of 42%.

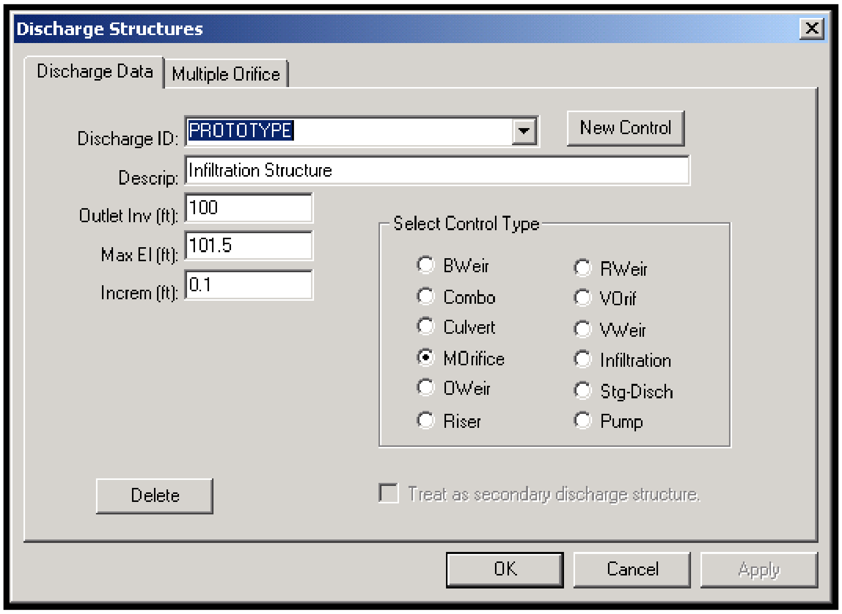
Like the Holtan input dialog, this dialog is designed to present approximations for the various coefficients, then allow the user to modify them as experience dictates.

Discharge Category

StormShed2G has a category of data named Discharge. The purpose is the define discharge control structures for use in detention pond routing. Detention pond routing relies on lookup tables that define the relationship between the storage and a given elevation and the corresponding discharge at the same elevation. This relationship is commonly referred to as a stage-storage and stage-discharge relationship. The Discharge category, defines the control structure that he program will ultimately use to create the stage-discharge relationship.

The discharge structures that can be define within StormShed2G are:

- Broad Crested Weirs.
- Rectangular or Notch Weir.
- Vertical Orifice.
- Vee Weir.
- Culverts (Arch, Elliptical, Box, Circular).
- A special multiple orifice structure.
- Overflow Weir.
- Riser Overflow.
- Three stage pump.
- Infiltration rate (applied to a wetted surface area).
- Stage-Discharge rating curve.
- Combination control (any combination of the above).



The Discharge Structures dialog reacts to the type of control that is selected. When a control is selected from the list of radio buttons on the dialog, the second tab changes to reflect the selection.

It is possible to obtain a plot of the rating curve that is created by a discharge structure. Plots of discharge and storage structures are obtained by selecting the  icon tool bar. The same icon is used to plot hydrographs.

Technical information about the control structures are provided in Volume 1, Methods and References. The Rectangular Weir as implemented by the program offers two alternatives. The first is a constant coefficient and the second is a coefficient that varies based on the head on the weir. When the weir is defined for the purpose of detention design, the variable coefficient is preferable.

The vee weir as implemented by the program permits the definition of weirs with angles less than 20 degrees and greater than 90 degrees. The program will use the same weir equation for all angles. The issue is that the coefficient is computed based on the weir angle at the extremities, or 20 and 90 degrees, the program will default to the coefficients of 2.6 and 2.8. There is no clear indication that the weir equation is valid outside the 20 degree to 90 degree range.

Infiltration as a control structure might be a new concept to some engineers. StormShed2G offers an infiltration control structure. Simply define an infiltration rate in inches/hr (mm/hr) and the program will translate it into a discharge rate from the pond based on the wetted surface area of the pond. A multiplier can also be applied to the infiltration rate to account for the actual wetted area that is to be considered. In the case where the storage element is a perforated pipe, infiltration should not be based on the wetted perimeter of the pipe, but of the gravel backfill surrounding the pipe. The multiplier is actually applied to the wetted surface area to account for the additional area.

StormShed2G also offers a void ratio in vaults. For infiltration galleries where there is a perforated pipe in a rectangular ditch that is filled with gravel, it is probably more accurate to adjust the void ratio in the ditch to account for the perforated pipe.

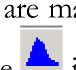
The concept of a program offering various types of discharge structures is not new. StormShed has the Combination control structure that is used to specify multiple controls as a single structure. Generally, when an engineer specifies a control from a detention pond, there is an underlying assumption that the receiving pipe can accommodate the flow. Generally, it is up to the engineer to verify that the assumption was not validated by the computation.

StormShed allows culverts to be specified as "Secondary Structures". When the culvert is included as part of a combination control structure, the program will develop a rating curve that is based on either the conveyance ability of the secondary culvert OR the other discharge structures that are specified. If the combination discharge structure is destined to be a splitter structure, were flows through different controls are routed in different directions, the program will **not** be able to correctly determine which control "feeds" into the secondary culvert. The assumption is that all controls in a combination structure are going to the same receiving pipe. Culverts as secondary structures should not be used with IDPR (Interdependent Detention Pond Routing) analysis either.

Hydrographs

One of the primary functions of StormShed2G is to create hydrographs. The program has no real limit to the number of hydrographs that can be created and stored for a particular project. Each hydrograph can have a 50 character name, including spaces. Each hydrograph can has as many points as need to fully describe its length. Hydrographs are stored as time-flow rate pairs. The default time step when defining drainage areas is 10 minutes, hence a hydrograph created from a Basin based on a 24 hour return period will have approximately 144 data points, each point representing a 10 minute interval.

Right mouse clicking on a specific hydrograph will present a popup menu with only three (3) choices. They are rename the hydrograph, send its data to the History view or delete it.

In actuality, there are many more tasks that can be asked of Hydrographs. They are accessible from the  icon on the program tool bar. Press the  icon on the tool bar to create a plot of the hydrograph. Both these options are discussed in another section.

Layouts

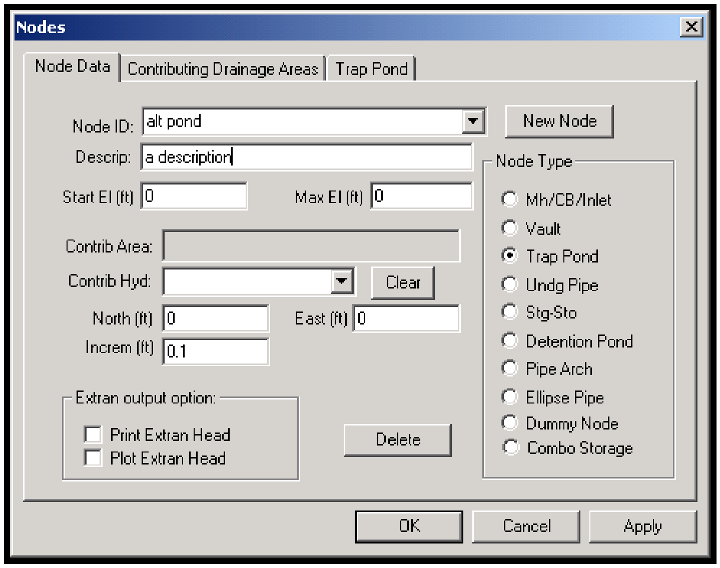
The program can have multiple Layouts. Layouts are schematic in nature, meaning that the was they are placed on the computer screen does not have to correspond to how they are located in the actual design. Although the layouts are schematic, the program does use the relative location of each node to determine an changes in flow direction. The change in direction affects the backwater loss due to change in direction computation.

For the most part, this loss is a small percentage of the velocity head at the node and constitutes a small loss. If exact loss computations are warranted, then there is an option to compute changes in direction based on actual node coordinates. Selecting this option means all actual coordinates for all nodes must be input.

The use of layouts enables the designer to manage the scope of portions of the project computation. The nodes and reaches that constitute a layout are fairly unique. This means that a node appearing in one layout would not realistically appear in another layout. Using nodes in multiple layouts will generally result in program errors.

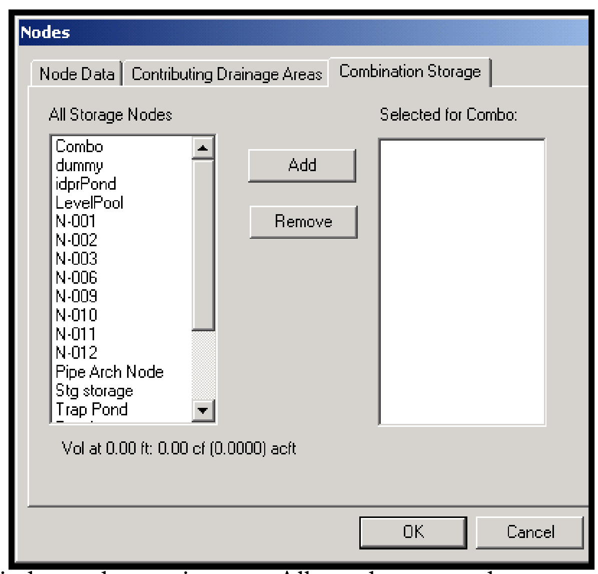
An example of a project with multiple layouts is the City drainage plan. The City conveyance system is generally large, with many standalone type systems that discharge into larger outfalls. There maybe detention facilities at different locations. Layouts enables the designer to effectively place the entire City storm sewer and detention system in a single database, then use different layouts to model smaller pieces of the whole.

Nodes



To StormShed2G, nodes have some notion of volume. Physically, they can be thought of as a point where runoff changes direction. Node types supported by the program are:

- Mh/CB/Inlet type nodes.
- Vaults (Underground).
- Trap Ponds (probably above ground structures).
- Underground Pipes (Arch, Ellipse, Box, and Circular).
- Dummy Nodes
- Combination Storage Structures.
- Detention Ponds
- Stage-Storage Rating Curves.



The most common types of nodes are the Mh/CB/Inlet and Dummy nodes. Dummy nodes represent end point in the system where a pipe or ditch reach terminates. All reaches must have a node at the upper and lower end, hence, for culverts would be terminated with Dummy nodes.

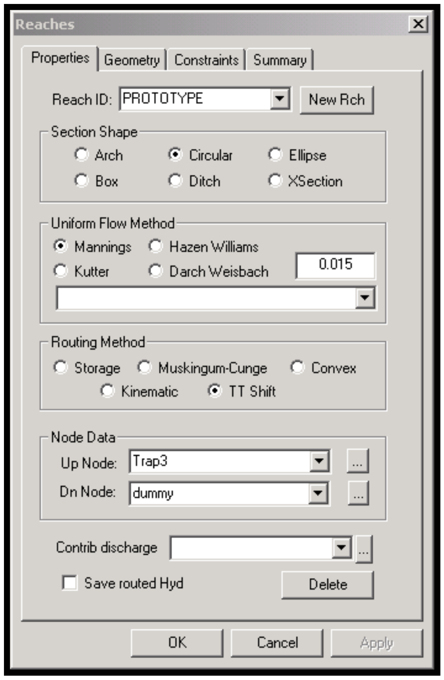
Vaults, Trap Ponds, and Underground Pipes are generally used as storage structures in Detention ponds. The Detention pond node is a special node in that it serves as a pointer to one of the other types of nodes. They are used to let the program know that the computational method to be used when routing through the node is a level pool type computation. (The default computational method when routing through a node is NO computational method.) In addition, the Detention Pond node also tells the program which Discharge structure to use when doing the detention pond computation. Note that even though this paragraph starts by saying that Vaults, Trap Ponds, and Underground Pipes are most commonly used in detention ponds, since all nodes have some notion of volume, the Mh/CB/Inlet and Stage Storage Rating curves could also be used by the Detention Pond node.

The combination structure is an interesting structure. It's intent is not to provide a slick method of creating a rating curve for a whole series of manholes and pipes. It's intent is to combine stage-storage rating curves vertically. That is, specify the volume of a manhole up to a specified elevation, then account for the area available for surface ponding. When the program creates a rating curve from a Combination Storage Structure, the starting and maximum elevation of each of the nodes are respected and a single rating curve is created.

All nodes can also have a Contributing Drainage area associated with it. From the standpoint of an Inlet, it would be the drainage area that was previously defined that enters at the inlet. For a detention pond, the Contributing Drainage area could be the surface area of the pond itself. StormShed2G supports selection of multiple Basins that can contribute to each node.

Reaches

Conceptually, Reaches are anything that conveys runoff. StormShed2G supports multiple reach cross section shapes, using multiple uniform flow method equations and multiple routing methods.



The shapes that are supported include:

- Arch pipe
- Circular pipe
- Elliptical pipe (long axis either horizontal or vertical).
- Box pipe
- Regular prismatic shaped ditches
- Cross-section

When analyzing uniform flow through the reaches, the program can use the following uniform flow equations:

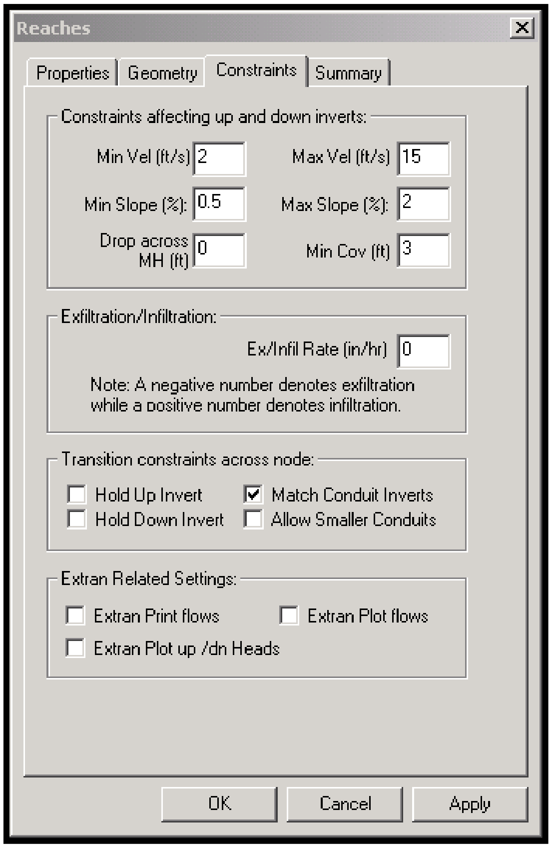
- Manning's Equation.
- Kutter's Formula.
- Hazen-Williams Formula
- Darcy-Weisbach Equation.

Generally, the most common method used is the Manning's equation. However, the most accurate method for modeling uniform flow is Darcy-Weisbach using the Colebrook-White solution

When hydrographs are introduced at the upper end of the reach, the program attempts to route the hydrograph through the reach. The following methods are available:

- Storage Routing
- Muskingum-Cunge
- Convex
- Kinematic
- Travel Time Shift

Generally, the Travel Time shift is the most common method for small conveyance systems. The program will use the uniform flow method that was selected to compute a velocity for the peak hydrograph rate. The velocity is use to compute a travel time to the bottom of the reach and the hydrograph is shifted. StormShed2G does not necessarily shift the hydrograph. It first check to the time interval of the hydrograph (default is 10 minutes) then compares that with the accumulated travel time for the hydrograph. If the accumulated time is greater than or equal to the interval, the hydrograph is shifted the appropriate number of intervals. The remaining travel time is simply accumulated for the next reach.



The reason for this approach is because the hydrograph is stored as a series of discrete time-flow rate points. To shift the hydrograph to an intermediate time step will require interpolating between two points. Given that interpolating always results in a lower flow rate, excessive interpolation will ultimately compromise both the true peak and hydrograph volume. For this reason, StormShed2G only shifts the hydrographs on the hydrograph interval.

The other routing methods do not suffer from the Travel Time Shift method. In fact they are all known as hydrologic routing methods. They will automatically attenuate the hydrograph for each reach. The most stable of the methods that is provided by the program is the Muskingum-Cunge method. For large conveyance systems and flat reaches, the hydrologic methods provide more accurate results.

Associated with each reach is a set of constraints that can be applied to the reach or connecting node. The constraints that affect up and down inverts are only used when the program is asked to size the conduit and set inverts. When the program is asked to just route hydrographs through a conduit the program will ignore the constraints and treat the reach dimensions as "as-built". The constraints affecting up and down inverts only apply to conduit type reaches.

All reaches can have either an exfiltration or infiltration component. StormShed2G treats exfiltration or infiltration as a loss per lineal foot of reach. An Ex/Infil Rate is entered as in/hr (mm/hr) and is converted to a cubic foot per second (cubic meters per second) value based on the length of reach. That value is then removed or added from/to the hydrograph at each hydrograph ordinate.

The "Transition constraints across node" constraints apply to conduits when attempting to set the vertical location entering and exiting the node.

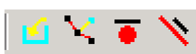
Chapter

2

Main View

The main view can be toggled to display one of three vies of the project data. The views are accessible from the toolbar icons , representing a Layout view, the Current Report view and the Pond Design View. The Layout view is a schematic view of representing a computational sequence. The Current Report view records the computational activity of the program in sequential order. The Pond Design view is a dialog for the design and analysis of detention ponds.

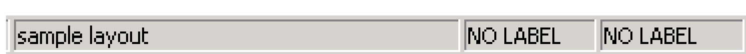
Layout View

As discussed before, the layout view is a schematic view that depicts a computational sequence. A project can have multiple layouts associated with it. Each layout consists of a set of nodes and reaches that are linked together. The tool bar buttons  are used to manage the Layout View. Starting from the left, the buttons are Insert Objects, Start a new sequence, Toggle Node Labels, and Toggle Reach Labels.

Always insert objects from upstream to downstream.

When the Insert Object toolbar button is depressed, left clicking in the Layout View will insert PROTOTPYE Node and Reach objects. They will be linked and will progress in the downstream direction. To start a new sequence (inserting a branch into the main truck of the conveyance system) first depress the Start a New Sequence toolbar button.

Nodes and Reaches can have different labels. The Node Labels are: NO Label, Node ID, Basin ID, Max EL, and HGL. Reaches can be labeled with Reach ID, Design Q, Slope %, Size, Length, UpArea, or NO Label. At any time the current Layout labeling settings are indicated at the lower right of the program window, adjacent to the current layout name.

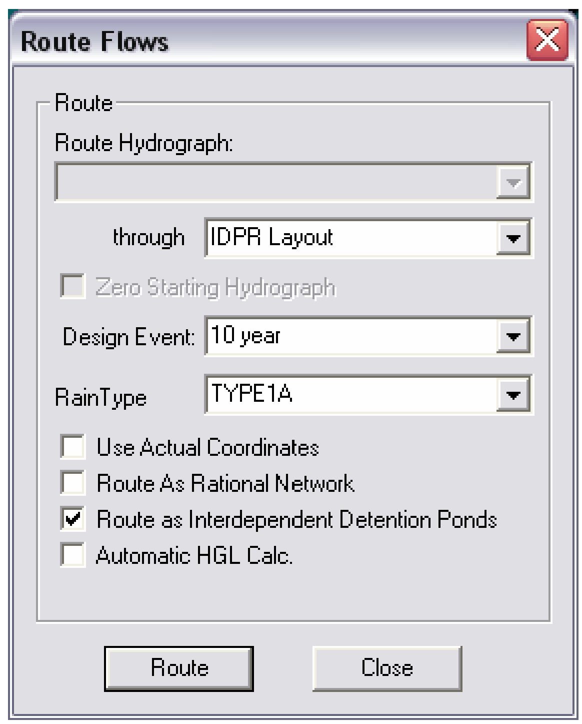


Since there are two views, the Tree View and the Main View, the layout view toolbar buttons are not active if the current focus is in the Tree View. To activate the layout view toolbar buttons, left click in the layout view once. That will transfer focus to the layout view and activate the toolbar buttons.

The Layout View does not support zoom scaling. Instead, it offers a large display area that is accessible by both horizontal and vertical scroll bars along the right and bottom edges of the view. Because of the potentially large size of the layout view, there is no real solution to compressing it to an image that can be fitted on a single page.

Deleting nodes and reaches from the Layout view is very simple, just right mouse click on the node, a pop up menu will appear with Delete as one of the menu choices. Select it. The other menu choice is Set TW. This means set tail water elevation and is only active when right mouse clicking on the last node. The SetTW menu selection does two things, it allows for the definition of a starting tail water elevation for HGL computations. Second, a more subtle feature, it synchronizes the nodes starting elevation with the lowest incoming reach invert.

When the schematic layout is complete, use the toolbar icon  to initiate the computation. StormShed2G will attempt to route all flows through the layout, as it proceeds from the upstream nodes to the downstream nodes. When the icon is selected a dialog will appear to allow the specification of Design Event, and Rain Type. The RainType that is selected at this location will over-ride the selection of the RainType that was selected when the Basins were defined.



There are check boxes to further customize the layout computation. **Use Actual Coordinates** instructs the program to use coordinates that were input into each node to compute losses due to changes of direction (backwater computation only). Normally the program will use the relative coordinates from the schematic to determine the changes in direction.

The **Route As Rational Network** checkbox instructs the program to use the rational method to accumulate peak flow rates instead of accumulating and summing hydrographs. If this option is checked, the program will ignore Basins that are defined as SCS/SBUH drainage areas and only use those that are defined as Rational drainage areas. Also, the program uses the accumulated travel time through the conveyance system as the lookup value for intensity. Be certain that the intensity – duration – frequency tables that were entered the locality are extended far enough!

The "**Route as Interdependent Detention Ponds**" selection is an option designed for cascading ponds. The feature is not intended for analysis of a conveyance system. The scenario envisions multiple ponds that are aligned in series or in parallel, connected by culverts, converging on a single downstream (outlet) pond prior to discharging to a receiving stream. The outlet pond has the governing control structure.

The Automatic HGL Calc determines if HGL computations will be performed with the normal layout routing and with Rational method routing. Generally, you should check this option. The only time when it isn't appropriate is if you have interconnected ponds that are not necessarily interdependent and you want to see the pond surface elevations without the HGL computations on top of it. If this item is checked, the program will compute the peak water surface elevation in each detention pond in the network, then turn around and compute an HGL based on the geometrics of each reach. It then compares the HGL with the ponds peak water surface and reports the higher of the two. Occasionally, you don't want to see that part of the computation.

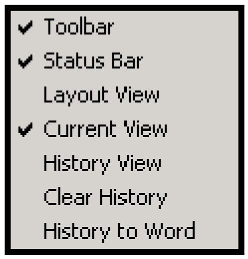
Since StormShed2G classifies a Trap Pond, vault and MH/CB/ Inlet as nodes, a conveyance system entering a detention pond appear the same to the program as a cascading ponds. While the program cannot make the distinction between what is an interdependent pond computation and a series of pipe (with manholes as nodes) entering a detention pond, design engineers should be able to tell the difference. **Conveyance systems should not generally be analyzed as interdependent ponds**.

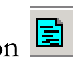
The interdependent pond computation is a step-wise level pool routing analysis where each time step is routed through all the ponds. The distinguishing computation is that the storage characteristics curve for each pond is recomputed at each time step to account for the current water surface of the lower pond.

Interdependent pond routing also accounts for flow reversal between time steps. However, it does not account for the volume of storage that is available in the connecting culvert. Generally, this volume is small and does not have a significant impact on the analysis. This is the primary reason why it is not a good idea to analyze a conveyance system using the interdependent pond analysis procedure. In a conveyance system, the "ponds" are the manholes between reaches. Manhole volumes are very small relative to the amount of volume in the pipes connecting the nodes. Because the program does not account for the volume in the reaches, using the Interdependent pond routing on a conveyance system can introduce a significant computational error by ignoring the volume in the reaches. A possible solution is to attempt to account for the reach volume at each node.

Current Report View

The Current Report View displays the results of the most recent computation or action that would create information that can be used in a report. Right mouse clicking on a data record in the Tree View most often results in a popup menu where one of the choices is To History. The content of the record is sent to the History View, but since it is the most recent activity, it is also sent to the Current Report View for display.



The program actually manages two reports simultaneously. The first is the History Report, which is normally in the background, not readily visible, the second is the Current Report View, which shows the most recent activity. To look at the contents of the History View, first select the Current Report View button  then from the View menu, select History View.

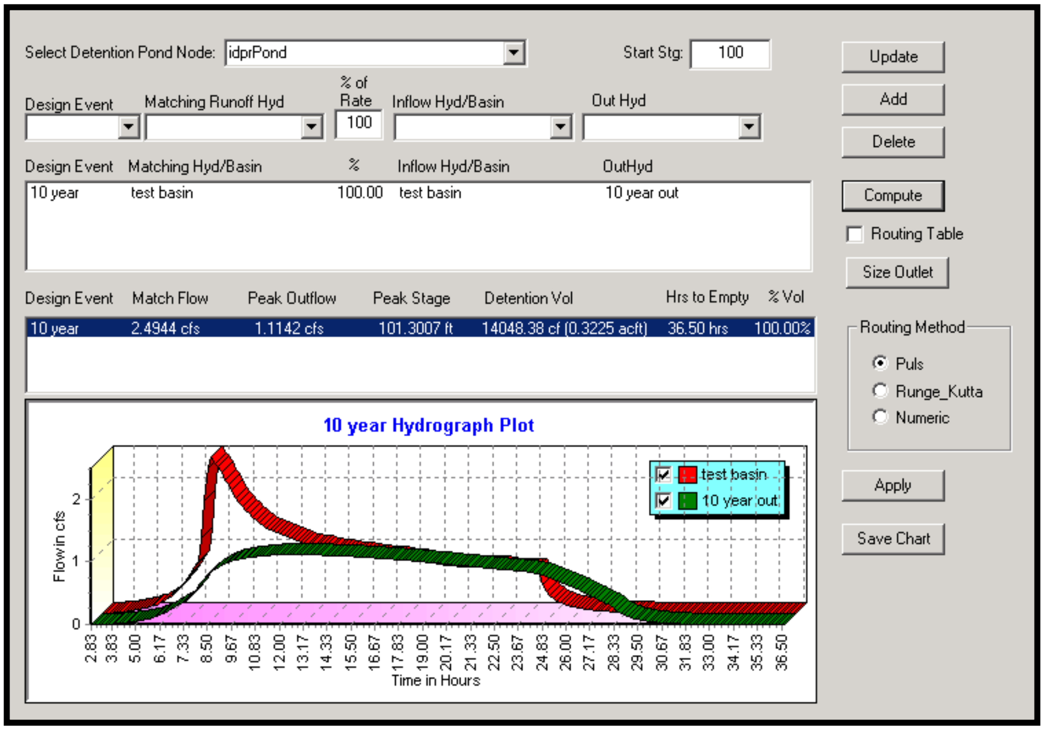
The contents of the Current Report View will be replaced with the History Report. To create a report that is printable Select the History to Word menu selection from the program View menu. The program will start the currently defined word processing program installed on the computer then open the current history report. The History report can be very large!! We recommend that it is cleared prior to executing the computational sequence for the last time. Alternately, select the History to Word menu often and cut and paste into a working report. Then clear the History.

The program creates all reports in standard HTML format. HTML is the format use by the Internet to display text. Because it is universally recognized, it was chosen as the program format. The History to Word menu command just opens the Microsoft Word then opens the HTML file in the project directory named **project**.html

The Report View also supports highlighting, cut and paste using the right mouse button only. That is, use the mouse to highlight a select (Ctrl-a for the entire report), right mouse click in the view and select copy from the popup menu. Move to the word processing program and select paste (Ctrl-v).

Pond Design View

The Pond Design View is used to design or analyze detention ponds. The view remembers the most current Detention Pond Node that was selected. The program will route multiple design events through the Detention Pond Node using one of three (3) detention pond computation methods.



If the Routing Table check box is not selected and the Compute button is pressed, the Current Report View will simply display the results of the computation:

Appended on: 16:01:53 Wednesday, March 27, 2002

LPOOLCOMPUTE [IDPRPOND] SUMMARY USING PULS

Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
10 year	2.4944	1.1142	1.3007	14048.38	0.3225	36.50

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If the Routing Table check box is checked when the Compute button is pressed, the complete routing table is included in the Current Report View:

Appended on: 16:04:11 Wednesday, March 27, 2002

LPOOLCOMPUTE [IDPRPOND] DETAILED USING PULS

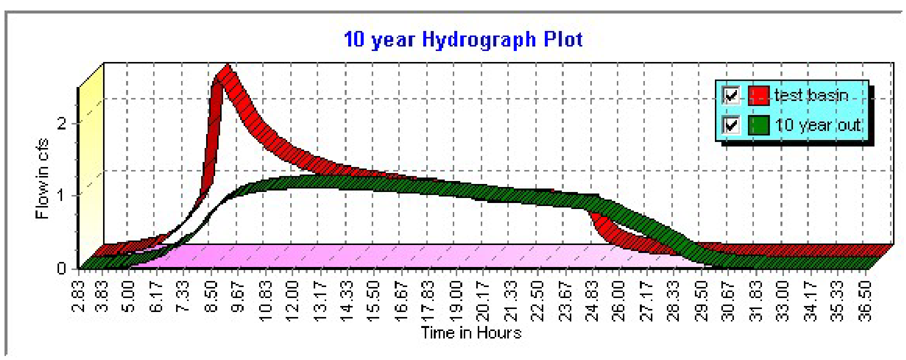
Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
10 year	2.4944	1.1142	1.3007	14048.38	0.3225	36.50

Storage Characteristics Table for 10 year node

Stage (ft)	Increm Vol (acft)	Storage (acft)	Flow(cfs)	Infil (cfs)	S-Odt/2	S+Odt/2
0.0000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000
0.1000	0.0231	0.023095	0.308933	0.000000	0.020967	0.025222
0.2000	0.0465	0.046467	0.436897	0.000000	0.043458	0.049476
0.3000	0.0701	0.070118	0.535088	0.000000	0.066432	0.073803
9.6000	3.7170	3.717007	3.026914	0.000000	3.696161	3.737854
9.7000	3.7742	3.774244	3.042639	0.000000	3.753289	3.795199
9.8000	3.8319	3.831917	3.058282	0.000000	3.810854	3.852980
9.9000	3.8900	3.890027	3.073846	0.000000	3.868858	3.911197
10.0000	3.9486	3.948577	3.089332	0.000000	3.927300	3.969853

Routing Table for 10 year Event

Time (min)	Inflow (cfs)	AvgI (acft)	Stg (ft),	S-0dt/2 (acft)	S+0dt/2 (acft)	Stg (ft)	Outflow (cfs)
0	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.00	0.0000	0.0000	0.0000	0.0000	0.0001	0.0003
20	0.01	0.0001	0.0001	0.0000	0.0001	0.0003	0.0009
30	0.01	0.0001	0.0003	0.0001	0.0002	0.0006	0.0020
40	0.01	0.0002	0.0006	0.0001	0.0003	0.0012	0.0036
50	0.02	0.0002	0.0012	0.0002	0.0005	0.0019	0.0058
2000	0.00	0.0000	0.0001	0.0000	0.0000	0.0001	0.0004
2010	0.00	0.0000	0.0001	0.0000	0.0000	0.0001	0.0003
2020	0.00	0.0000	0.0001	0.0000	0.0000	0.0001	0.0003



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Note that the example print out has rows extracted from the middle of the tables to save space. Also, the method used to insert the information into this manual was to select the tables in the Current Report View (using the mouse, or Ctrl-a) then copying the selection to the computer buffer (Ctrl-c), then pasting into this manual (Ctrl-v). The tabular information was easily 20 pages had the middle of the table not been omitted!

When the Pond Design View has routed the design events through the pond, a plot of the inflow and outflow hydrographs is displayed by left mouse clicking on the design event. The chart can also be sent to the Current Report View by selecting the Save Chart Button.

The Pond Design view supports several computational conditions. The conditions relate to the physical positioning of the control structure. Generally, in a design or analysis computational situation, one finds the following layouts:

- Both the bottom of the pond and the elevation of the control structure are the same. This is the most common condition. Everything is considered live storage.

- The elevation of the control structure is above the pond bottom. This is the case where there is dead storage. If the dead storage is really "dead", change the ponds bottom elevation to match the control structures elevation. An alternative is to use the "Start Stg" input field to specify the starting water surface elevation. If it is zero (0) or equal to the pond bottom elevation, the program will assume that the "dead storage" volume must be filled before any of the runoff hydrograph volume is released from the pond. If the field is set to the control elevation, the program will immediately allow runoff from the inflow hydrograph to leave the pond. There are of course, variations in between. The Start Stg field simply tells the program the starting water surface for the computation.

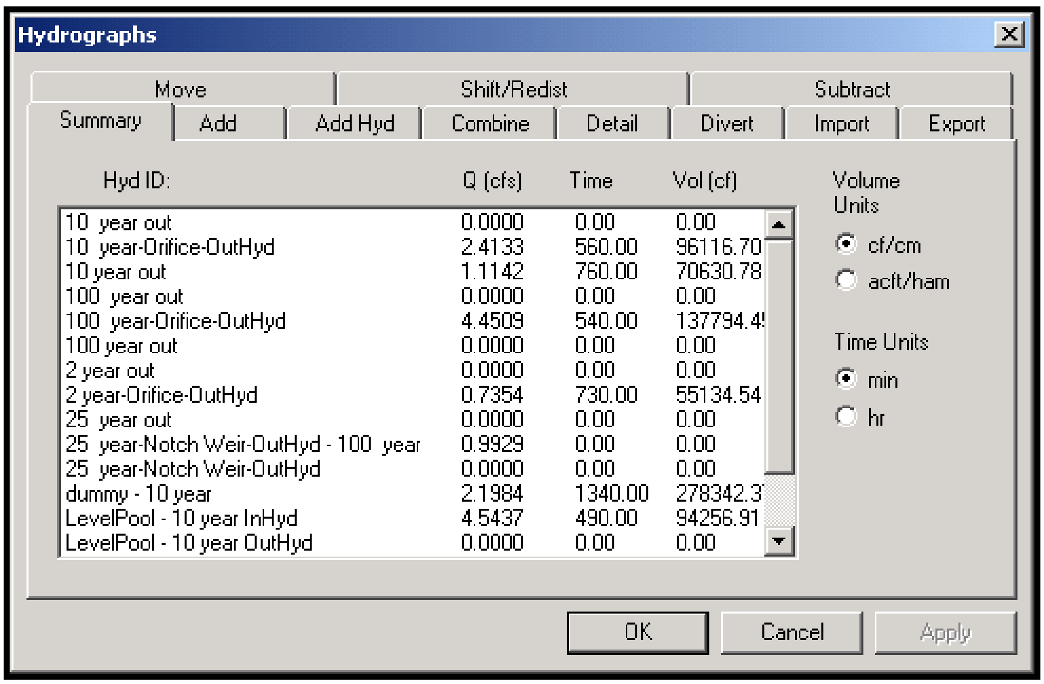
- The computation will not proceed in the case where the control elevation is lower than the pond bottom. The program simply has no way of matching the rating curves.

- The condition where the pond bottom and control elevation coincide and a higher starting stage is specified is acceptable, however, it should only be used with the Compute button. If it is used with the Size Outlet button, the answer will be correct, but not make much sense unless there is some reason why the pond water surface is always at that elevation at the beginning of a design storm.

Chapter 3

Hydrograph Manipulation Dialog

Aside from creating drainage basins and generating runoff hydrographs, this program offers a complete set of tools to manipulate the hydrographs. This feature is accessed from the toolbar icon .



When the dialog opens, it provides a summary of all currently defined hydrographs. It can be used to quickly review the peak flow and volume for each hydrographs. The remaining tabs enable the manipulation of the hydrographs.

Add

This function adds a flow rate to a hydrograph. The flow rate can be added to the entire hydrograph range or just to the hydrograph. There is a difference. Assume we are adding 2 cfs and the **Hydrograph only** radio button is selected. Assume the hydrograph starts at time 40 minutes and returns to zero flow at time step 1440 minutes, the flows will just be added to those time steps. When the hydrograph is then added to another hydrograph that started at time step 20 minutes, the two cfs is not included in the summation until time step 40 minutes.

On the other hand, if the Entire Range option was selected, then when the second hydrograph is added to the first, the 2 cfs would be included at the 20 minute time step.

Add Hyd

This feature combines two hydrograph to a third hydrograph. The only limitation is that the hydrographs must have the same step interval. This is a fairly robust feature in that hydrograph aren't really necessary for the addition. In fact, two Basins could be added together. This is possible because a design event is required as part of the input for each hydrograph.

If two hydrograph are being added, the input form still requires that design events are specified. Anything will be sufficient because hydrographs are not affected by the design event (after all, they are already created!)

It is possible to add to basins with different design events, or even the same basin with different design events. There are many obvious reasons and situations where adding hydrographs are important. There is one that is not so obvious, and the primary reason why this program includes this feature (after all, the program combines the hydrographs automatically, when it needs to). In the case where it is desired to model back to back storms, like a 5 year event followed by a 10 year event.

To do something like that, it is necessary to create the storms. Using this feature, the process would be to create a 10 year runoff hydrograph, shift it 24 hours then add it to the 2 year hydrograph! This gives a single hydrograph with back-to-back storms that can then be routed through a detention pond!

Combine

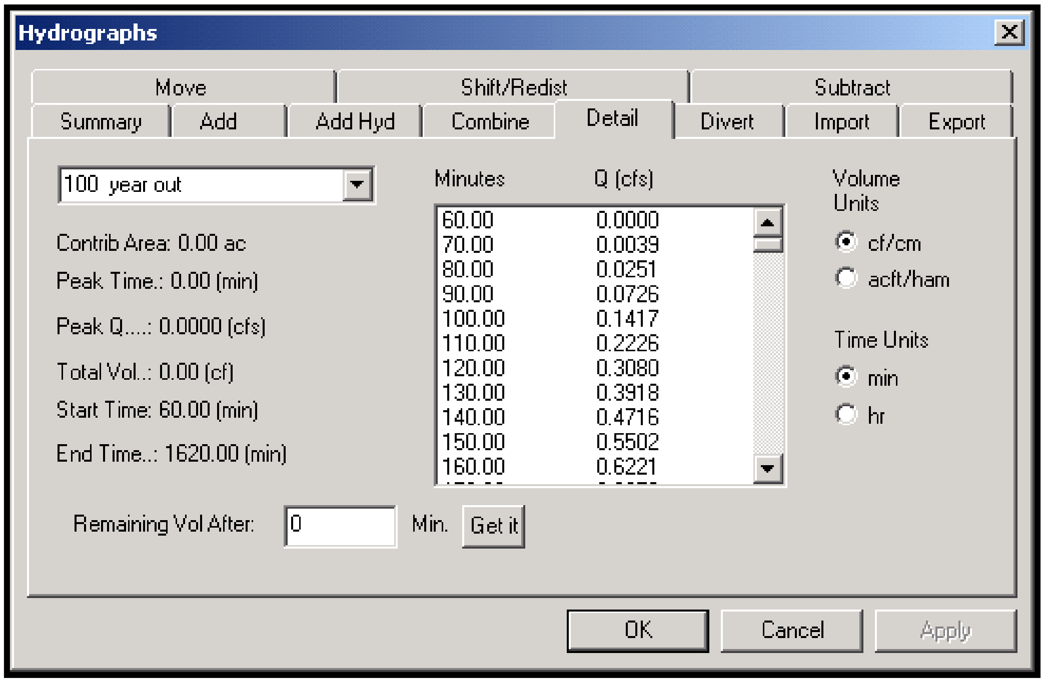
The Combine feature is a super ADD Hydrograph feature. It really shines when the intent is to combine the hydrographs from multiple Basins for a single design event. The program allows the selection or both Basins and hydrographs that were previously created. Since the input form requires a design event, if only hydrographs are selected, then the design event doesn't matter.

If the selection set includes Basins, then the design event does matter because the program has to know what design event to create for the selected drainage areas. Note that it is possible to combine a Basin with a design event of 10 years and a hydrograph that was created based on a different design event. The program isn't very intelligent in that regard. Hopefully the engineer is.

Detail

This tab in the Hydrographs Dialog is used to provide a detailed look at the selected hydrograph. When a hydrograph is selected, the total contributing area , time of peak, peak flow rate, volume, and starting and ending time step is listed.

Note that the total contributing area included areas of all other hydrograph that may have been added to this one. The list box enables a close view of the flow rate at each time step.



Also of interest is the little edit box at the bottom of the dialog. The feature is designed to return the volume remaining in the detention pond after a specified time interval. There is a trick to getting the answer. Use the mouse to click on the field, enter the time step, then either PRESS THE TAB button or use the mouse to click out of the field! When the field looses focus, the answer will appear!

The number indicates the volume that remains in the hydrograph after time step 1400. If the hydrograph is the outflow hydrograph from a detention pond, it is the volume remaining in the pond after that time step.

Divert

Some may wonder why a program such as StormShed2G would even offer a hydrograph divert feature. The Divert feature is mainly a planning level tool. When doing master plans where the is very little detail that is available, one needs to be able to route a hydrograph to a certain point in the watershed, then state a planning level goal of splitting the runoff in multiple directions.

With little detail available in the planning stage, the appropriate method is use the Divert feature to “rough out” the volumes in multiple directions, leaving the detail design of the control structure for when the detail design criteria is available.

There are two flavors of the Divert feature. The divert by percent of hydrograph takes each time step and applies a percentage to the flow. This results in a “shrunk down” version of the original hydrograph.

The second method is to chop off the bottom “x” cfs from the hydrograph. This method leaves one hydrograph that is the base of the original with a “plateau” at the specified rate. The second hydrograph is the peak of the original hydrograph with the bottom cut out of it.

Of the two flavors of Divert, the divert by percent is by far the most interesting. The initial reaction to many is that there is really no practical application for this feature. Consider the case where runoff is developed for a soil type with a CN number in the 60’s. This type of soil has a high permeability. When utilizing the SCS loss method under this condition, it can be a stretch to argue that loss only occurs at the beginning to runoff and that after the abstraction criteria is met no more runoff is loss.

Suppose one determines that the soil can sustain a steady surface loss rate of 0.2 inches in 24 hours. Assuming a one acre parcel and a 24 hour design storm, that amounts to 726 cf of runoff. If SCS hydrograph runoff for the hydrograph yields a runoff volume of 1 ac-ft, you would feel that it is 726 cf too conservative. Using the divert feature one could divert 726/43560 – 0.0167 or 1.67 percent from the hydrograph to obtain a more realistic runoff rate due to the abstraction “adjustment”.

Import

Although we don’t understand why anyone would want to import a hydrograph into the program to take advantage of the program features, the Import command does allow hydrographs to be imported into the program. The Hydrograph can be Tab, Space, or Comma delimited. We don’t recommend Space delimited because information in the first two lines of the file could be lost.

The intent was to provide a format that could be easily created in a spreadsheet program. The format is as follows.

- It needs to be an ascii file.
- The first line must be some type of description line.

- The second line must contain three (3) fields (separated by the delimiter), the first is XY, the second is MIN or HR, and the third is US or SI

- The third line contains a variable number of fields (separated by the delimiter), the first field is the time step in the time units that was specified in the second line. The remaining fields are the names of the hydrographs that are to be imported. There cannot be any spaces in the names, if the re are, place a "_" character in place of the space!

- There can be as many time steps as necessary, one additional line per time step.

The format was designed to accommodate the export feature of most spreadsheets. If the file appears in the Select list box, simply select it and press the import button. If the file is not in the Select list box, then use the [Find .hyc/.dat] button, navigate to the file and select it. **The program will automatically import the selected file**!

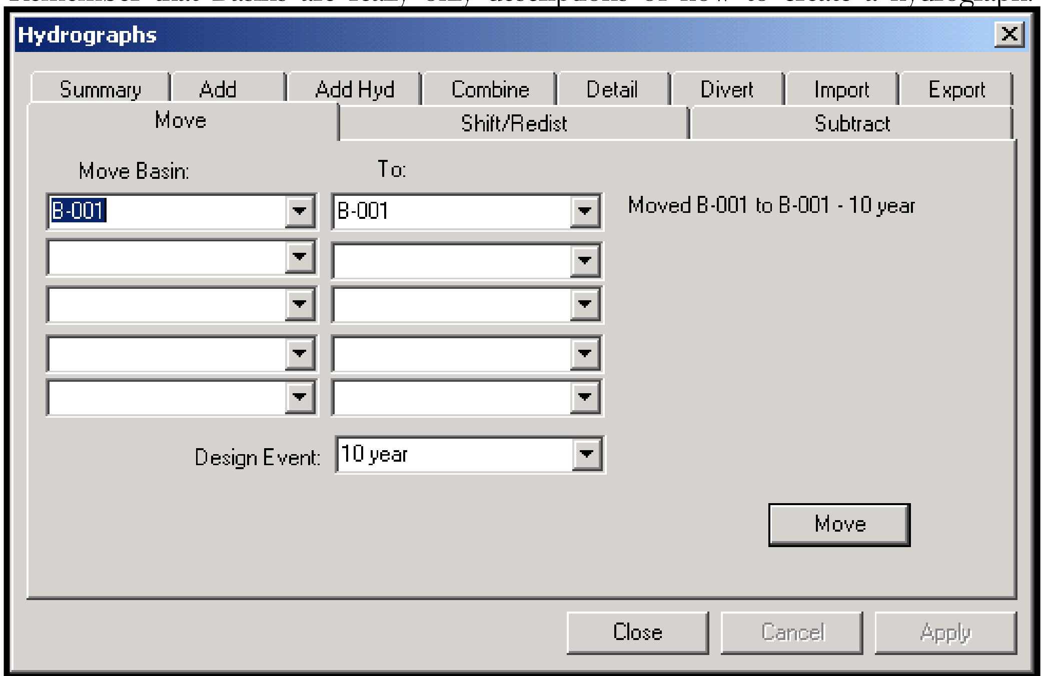
Export

Export is the opposite of Import. Use it to make a hydrograph accessible in a spreadsheet for customized manipulation. We recommend using either the Tab or the Comma delimiter and not the Space. The XY format has been described in the previous section. The Extran format is a format specific to Extran. Specifically, the format is the Extran K1, K2 and K3 cards.

Move

Move is NOT Shifting a hydrograph in time! It is to create hydrographs from Basins.

Remember that Basins are really only descriptions of how to create a hydrograph.

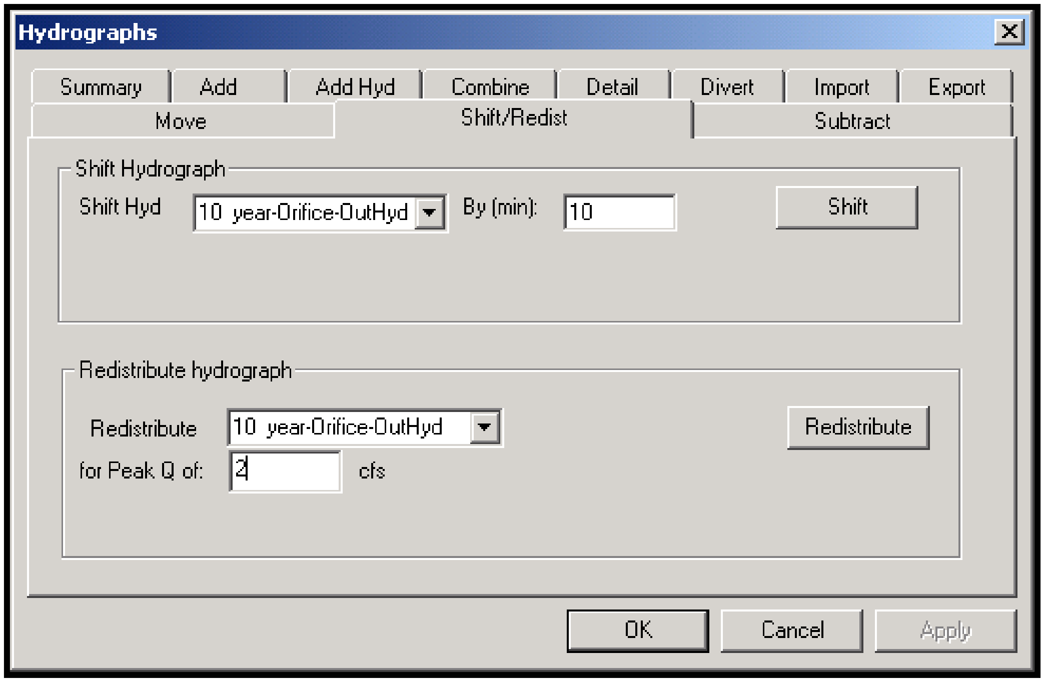


Hydrographs are created based on specific design events. The Move command takes a Basin and creates a hydrograph for it based on the specified design event. In the above dialog, Basin B-001 is moved to the default ID of B-001 based on the 10 year design event.

The result of the command is a new hydrograph named “B-001 – 10 year”. The program automatically appends the design event to the Basin ID so that each hydrograph for a different design event is unique.

Shift/Redist

The Shift feature is functional, but uninteresting. The Redist feature is awesome.



Shift just moves the hydrograph forward in time by the specified number of minutes. No, the program does not allow moving hydrographs back in time. Mathematically, the program would have no difficulty doing it, but there just isn't any reason why one would legitimately want to do that. The hydrograph that is selected is altered by the command.

The Redistribute feature is an awesome feature in that it is available solely for the engineer to exercise engineering judgement. Basically, the two most important characteristics of hydrographs are the peak flow rate and the volume. Of the two, the more important is the volume. That's not to say that the peak rate isn't important, it is because design criteria are often based on the peak rate. Peak rates are just not absolute. Volume, on the other hand, is much more quantitative. Five inches of rain falling on one (1) acre will theoretically result in "X" acre-feet of runoff after subtracting the appropriate losses.

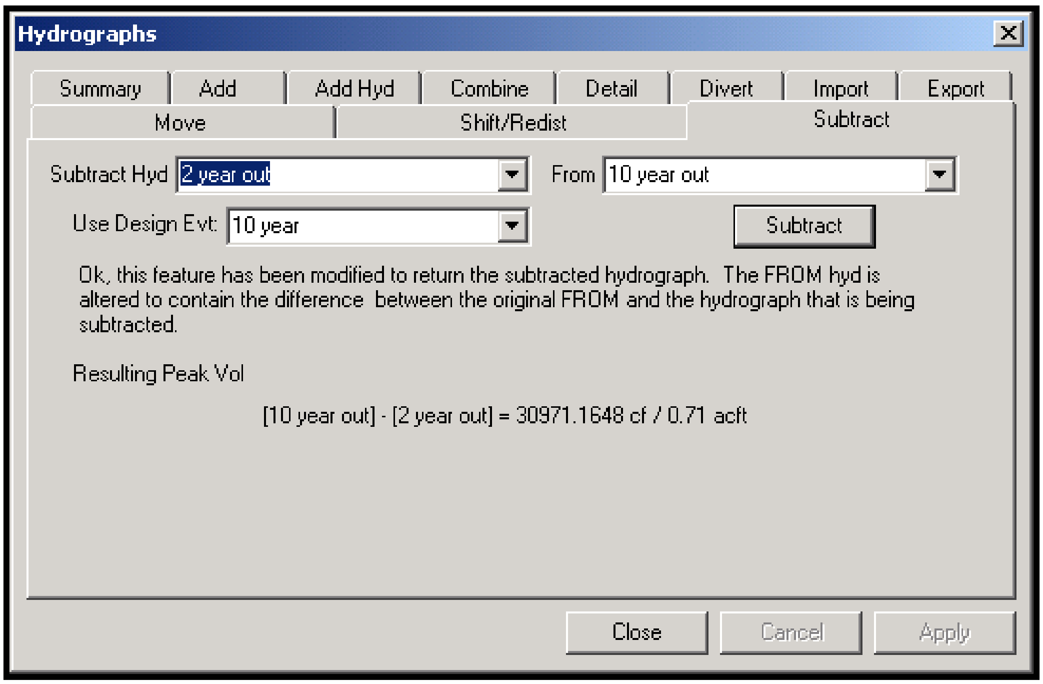
The peak rate is just an approximation at the specified hydrograph time interval. The theoretical peak rate could have occurred at an intermediate time either before or after the rate reported by the program.

In any case, the intent of the Redist feature is to allow the user to look at a hydrograph, and disagree with the peak rate for whatever reason, hopefully good engineering judgment. The program then allows the engineer to specify a "better" peak rate for the hydrograph. The program then redistributes the volume to maintain the hydrographs integrity.

Like we initially said, this is a awesome feature. It allows the engineer to exercise engineering judgment in an age when computer programs often don't allow for disagreement.

Subtract

The most common use of the Subtract command is to subtract two (2) hydrographs in order to estimate the detention volume. In the past, the program only returned the difference in volume. The current version will alter the FROM Hydrograph. That is, the FROM Hydrograph really has the other hydrograph removed from it.



We still really don't know whether we like that or not, but have received so many request that it is available. Our problem with actually subtracting one hydrograph from another is that the resultant hydrograph is not possible other than numerically.

Assume that an engineer uses the subtract feature as part of a drainage design. While the program can perform the math, how is that going to be achieved physically? What does the control structure look like that will come anywhere near the subtraction?

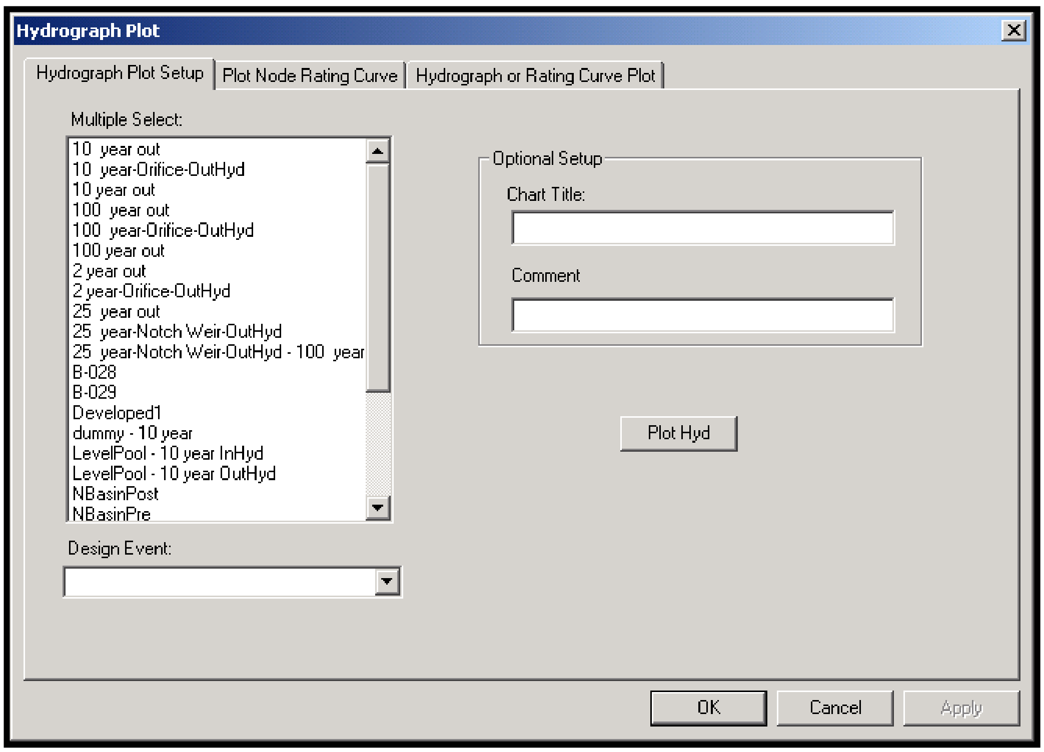
The program provides a very robust method of routing hydrographs through ponds, then allowing flows to be separated based on defined control structures. We would prefer engineers do their subtracting based on something that is physically constructible.

Chapter

4

Hydrograph Plot

The Hydrograph Plot dialog isn't limited to hydrographs. Rating curves for storage and discharge structures are also available from the dialog. This dialog only does plots, if tabular results are desired, use the To History menu selection by right mouse clicking on the data record in the Tree View and selection the To History menu selection from the popup menu.

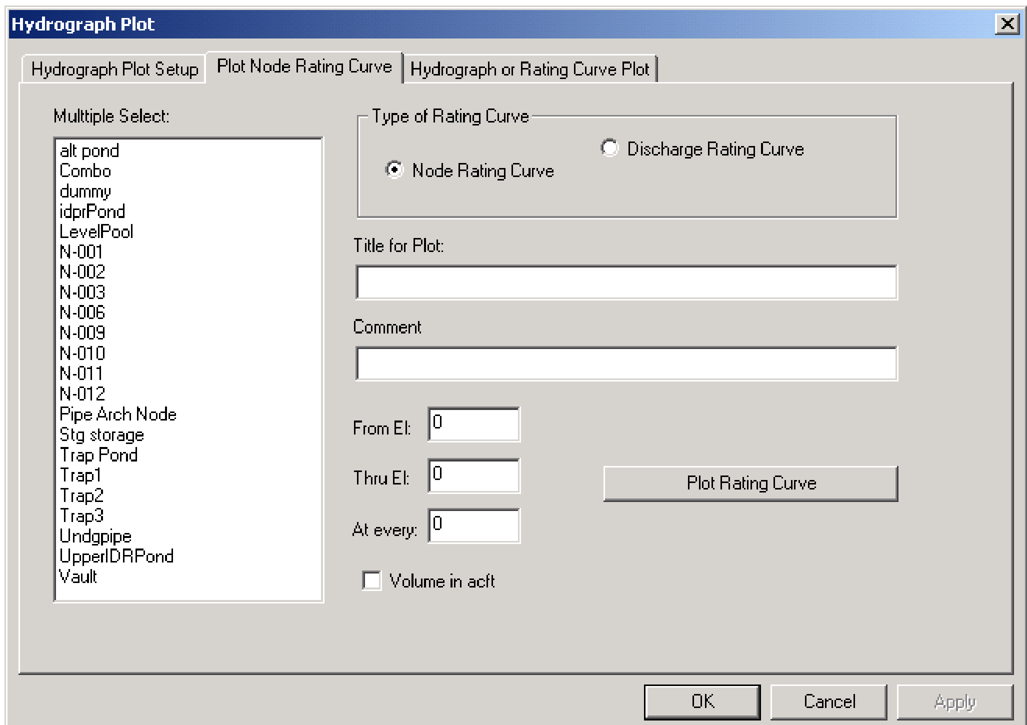


The default plot is the Hydrograph Plot Setup tab. The selection includes both hydrographs and also Basins. Because Basins are include in the selection set, a Design Event is required so that the program will know what design event from the Basin to plot. If only Hydrographs are selected, a Design Event must still be selected even though it has no effect on the hydrograph.

Once the Hydrographs or Basins have been selected, to create the plot, press the Plot Hyd button.

The Hydrograph or Rating Curve Plot tab will automatically be selected and the desired plot will appear. The plot will automatically be written to the Current Report View AND also permanently recorded in the History View.

To plot a rating curve, select the second tab in the dialog.



This dialog allows for the selection of either a Node Rating Curve or a Discharge Rating Curve. If a Discharge Rating Curve is selected, the program wants to know what node will most likely be used with the discharge structure. In most cases the node is for information only, however for control structures like infiltration, it is necessary to know the associated node because infiltration is based on wetted perimeter. Without identifying the node, it is not possible to present a rating curve.

When the data has been entered, press the Plot Rating Curve button. Again the program will switch to the last tab and display the plot. The plot will automatically be included in the Current Report View.

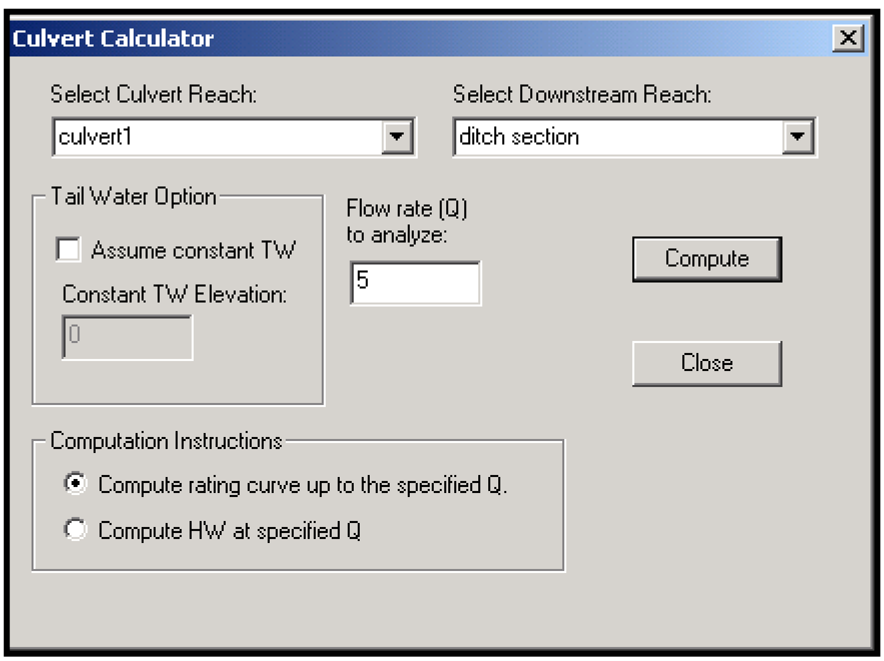
Chapter 5

Misc Calculators

StormShed2G currently provided three (3) calculators. The calculators were originally developed for in-house use. The first is a Culvert Calculator. The second is a flow profile calculator (backwater curve), and the last is one for reverse flow.

Culvert Calculator

While there are plenty of culvert calculators available, there just wasn't one that answered the question that way I normally as it. Besides, if would be nice if the calculator didn't require that all information be continually re-entered for each computation.



The calculator works a number of different ways. First it remembers between uses the last culvert and downstream reach that was selected. The culvert and reaches that the calculator remembers are Discharge Structures and Reaches that are defined in the program. Presumably, these are the very same structures that are contemplated for some part of the project. The downstream reach is necessary in order for the program to computes a tail water elevation based on the capabilities of the reach to convey the flow. The tail water elevation is computed as the normal flow depth of the downstream reach.

There are basically two levels of instructions. The first is to compute a rating curve up to a specified flow rate.

Appended on: 20:18:52 Saturday, March 30, 2002

Culvert Quick Calculator				
Type:	Circular CMP	**FHA Chart:**	2	
Ent Desc:	Projecting	**Ke:**	0.90	
Culv diam:	4.0000 ft			
Length	**Slope**	**Mannings n**	**TW Elev**	**Num**
125.0000 ft	1.10 %	0.0240	100.0000 ft	1

HW at specified flow (ft)							
HW El (ft)	**HW/D Ratio**	**Discharge (ft/s)**	**TW Depth (ft)**	**dc**	**dn**	**Inlet Ctrl**	**Outlet Ctrl**
100.0000	0.00	0.0000	0.0000	0.0000	0.0000		
100.3448	0.11	0.5000	0.0649	0.2183	0.2410	-----	100.3448 (M1)
100.4927	0.16	1.0000	0.0981	0.3091	0.3351	-----	100.4927 (M1)
100.6081	0.20	1.5000	0.1255	0.3790	0.4069	-----	100.6081 (M1)
100.7064	0.24	2.0000	0.1489	0.4387	0.4677	-----	100.7064 (M1)
100.7940	0.26	2.5000	0.1704	0.4915	0.5211	-----	100.7940 (M1)
100.8736	0.29	3.0000	0.1899	0.5394	0.5702	-----	100.8736 (M1)
100.9474	0.32	3.5000	0.2085	0.5834	0.6152	-----	100.9474 (M1)
101.0165	0.34	4.0000	0.2251	0.6244	0.6573	-----	101.0165 (M1)
101.0819	0.36	4.5000	0.2417	0.6632	0.6969	-----	101.0819 (M1)
101.1439	0.38	5.0000	0.2573	0.6998	0.7350	-----	101.1439 (M1)

When the Compute button is pressed, the Current View will display a table that lists the Elevations, HW/D ration, discharge, associated TW depth the critical and normal depth of flow and Inlet and Outlet Control information as appropriate.

> The above table was obtained by using the mouse in the Current Report View and highlighting the table, the right mouse clicking and selecting the copy menu item. It was then pasted in this manual.

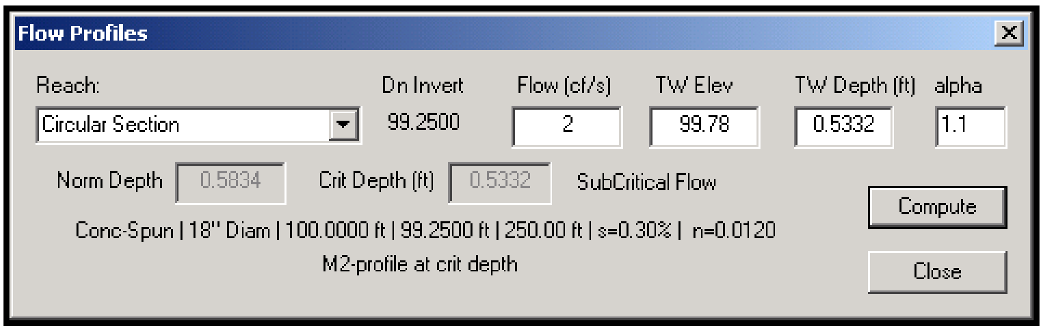
The Compute HW at specified Q can also be selected if a rating curve is not necessary. The second question that is usually asked assumes that the TW elevation is somehow magically maintained at a constant elevation. This seems to be how most culvert calculators operate. When the TW option is selected and a constant TW is entered, a much simple table will appear. If the tail water elevation is higher than the upstream invert, the rating curve starts at the tail water elevation. Reverse flow is not addressed.

The calculator support all culverts that can be defined by the program, circular, arch, elliptical and box.

Flow Profiles

Don't know that we have ever seen a flow profile calculator, but this is it. The Flow Profile calculator is designed to answer the question, "Given a reach of some type, a flow rate, and a tail water elevation, what does the backwater profile look like?"

The program uses the direct step method to compute a backwater profile.



When a previously defined reach is selected, the program will return some useful information to help the use enter useful parameters. For example, if a pipe reach is selected, the program will report back the material, size, up and downstream invert elevations, the length, slope, and roughness coefficient.

When a flow rate is entered, the program will immediately compute the normal and critical depth for the given flow. The intent is to provide an indication of the flow regime that can be expected. Generally, the tail water is entered as an elevation. The program will let the user enter either an elevation or a depth. It is possible to change the energy coefficient too, but there is rarely enough real information to do anything with that other than leave it at the default (1.1).

When the 

button is pressed, the program will return the relevant information. It will look like:

Appended on: 19:58:08 Sunday, March 31, 2002

Computation of Flow Profile for: Circular Section

TW depth is lower than critical depth, assume critical depth for computation								
Q (cfs)	**Mann**	**slope**	**Dc (ft)**	**Dn (ft)**	**alpha**	**length (ft)**	**Step (ft)**	**TW El (ft)**
2.00	**0.0120**	**0.30%**	**0.5332**	**0.5834**	**1.10**	**250.00**	**-0.0020**	**99.7800**

Subcritical, M2 Profile											
y	**A**	**R**	**V**	**E**	**dE**	**Sf**	**Savg**	**So-Sf**	**dx**	**x**	**Elev ft**
0.5332	0.5630	0.29	3.5526	0.7488	0.0000	0.004192	0.000000	0.000000	0.00	0.00	99.78

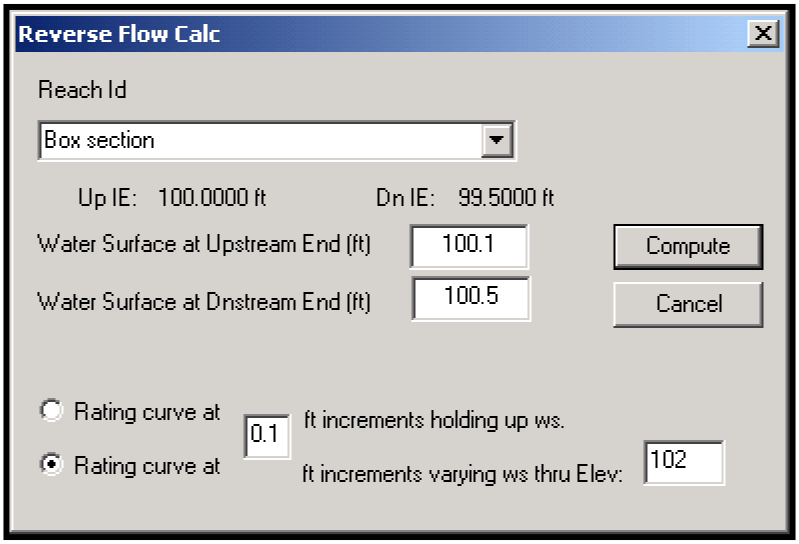
0.5352	0.5658	0.29	3.5345	0.7486	0.0002	0.004133	0.004163	0.001163	0.16	0.16	99.79
0.5372	0.5687	0.30	3.5166	0.7484	0.0002	0.004076	0.004104	0.001104	0.14	0.30	99.79
0.5392	0.5716	0.30	3.4988	0.7483	0.0001	0.004019	0.004047	0.001047	0.12	0.41	99.79
0.5412	0.5745	0.30	3.4812	0.7482	0.0001	0.003963	0.003991	0.000991	0.09	0.51	99.79
0.5432	0.5774	0.30	3.4638	0.7482	0.0001	0.003909	0.003936	0.000936	0.07	0.57	99.79
0.5452	0.5803	0.30	3.4465	0.7481	0.0000	0.003855	0.003882	0.000882	0.04	0.61	99.80
0.5473	0.5832	0.30	3.4293	0.7481	0.0000	0.003803	0.003829	0.000829	0.00	0.61	99.80
0.5493	0.5861	0.30	3.4124	0.7482	0.0000	0.003751	0.003777	0.000777	0.03	0.65	99.80
0.5513	0.5890	0.30	3.3955	0.7482	0.0001	0.003700	0.003725	0.000725	0.07	0.72	99.80
0.5533	0.5919	0.30	3.3789	0.7483	0.0001	0.003650	0.003675	0.000675	0.12	0.83	99.81
0.5553	0.5948	0.30	3.3624	0.7484	0.0001	0.003601	0.003626	0.000626	0.17	1.00	99.81
0.5573	0.5977	0.30	3.3460	0.7485	0.0001	0.003553	0.003577	0.000577	0.23	1.23	99.81
0.5593	0.6006	0.30	3.3298	0.7487	0.0002	0.003506	0.003530	0.000530	0.30	1.53	99.81
0.5613	0.6036	0.31	3.3137	0.7489	0.0002	0.003460	0.003483	0.000483	0.38	1.91	99.82
0.5633	0.6065	0.31	3.2978	0.7491	0.0002	0.003414	0.003437	0.000437	0.48	2.39	99.82
0.5653	0.6094	0.31	3.2820	0.7493	0.0002	0.003369	0.003392	0.000392	0.60	2.99	99.82
0.5673	0.6123	0.31	3.2663	0.7496	0.0003	0.003325	0.003347	0.000347	0.74	3.73	99.83
0.5693	0.6152	0.31	3.2508	0.7498	0.0003	0.003282	0.003303	0.000303	0.93	4.65	99.83
0.5714	0.6182	0.31	3.2354	0.7502	0.0003	0.003239	0.003261	0.000261	1.17	5.82	99.84
0.5734	0.6211	0.31	3.2202	0.7505	0.0003	0.003198	0.003218	0.000218	1.50	7.32	99.85
0.5754	0.6240	0.31	3.2051	0.7508	0.0003	0.003156	0.003177	0.000177	1.97	9.29	99.85
0.5774	0.6269	0.31	3.1901	0.7512	0.0004	0.003116	0.003136	0.000136	2.73	12.02	99.86
0.5794	0.6299	0.31	3.1752	0.7516	0.0004	0.003076	0.003096	0.000096	4.09	16.11	99.88
0.5814	0.6328	0.31	3.1605	0.7520	0.0004	0.003037	0.003057	0.000057	7.29	23.39	99.90
The depth of flow at the **upper** end of the reach is **0.5834 ft**. Flow has returned to normal.											

The program reports back all the information that was previously shown in the dialog along with a step, which is the step the program decided to use for the Direct Step computation. Depending on the direction of the computation, (sub critical flow starts at the bottom of the reach and progresses upstream, whereas supercritical flow starts at the upstream end and moves downstream) the elevation will either increase or decrease with each row. At the bottom of the table, a note will appear summarizing the finding. In the case of where a backwater is computed upstream, there are several possibilities. The curve could be either M1 or M2, or the pipe reach could be submerged. It the pipe is either M1 or M2, if the pipe is hydraulically short, the depth of flow will not have returned to normal at the upstream end of the pipe. Otherwise, there is the possibility that the flow depth has already returned to normal at the upstream end.

Reverse Flow

Come to think of it, we have never seen a reverse flow calculator anywhere either. The program needs to estimate flow reversal for most reaches and control structures because StormShed2G offers Interdependent Pond Routing (IDPR). This calculator deals with the reach part of the problem because IDPR mostly will deal with culverts that connect the upper and lower ponds. Reverse flow through control structures like an orifice doesn't represent a computational challenge.

The easy way to do IDPR is to assume that there are flap gates preventing reversal, then the program could just do the computation based on downstream tail water at each time step. But then the design engineer would always have to install those flap gates.



This feature works in a similar fashion to the other calculators. The reach is first defined elsewhere in the program then referred here by selecting from the drop down. The program then reports back the up and downstream inverts.

The next two input fields specify the water surface elevations that will cause the flow reversal. In order for flow reversal to occur, the upstream water surface elevation must be lower than the water surface elevation at the downstream end.

There are two options for the computation. The first is the ask the program to compute a rating curve holding the upstream water surface and incrementing the downstream water surface from level with the upstream water surface up to the downstream elevation.

The second is to ask the program to maintain the head differential between the up and downstream water surfaces and compute a rating curve at the interval specified up to a certain elevation. If the edit box in the lower right corner is left a zero (0) then the elevation will be to the downstream water surface elevation, otherwise it will be to the specified elevation. If an elevation is specified, then the rating curve will progress to that elevation.

Appended on: 21:03:47 Sunday, March 31, 2002

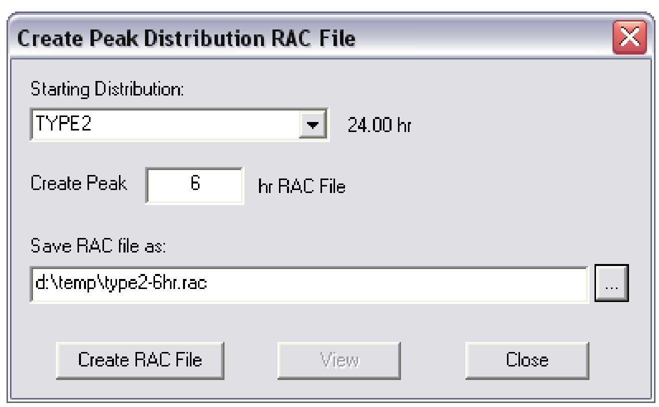
Reverse Flow Computation: Box section

Length (ft)	slope (%)	Manning's	Rise (ft)	Span (ft)	UpIe (ft)	DnIe (ft)
100.0000	0.50	0.0120	4.0000	2.0000	100.0000 ft	99.5000 ft
UpWs (ft)	**DnWs (ft)**	**Discharge (ft/s)**	**Comments**			
100.1000	100.5000	0.4107	Open Channel condition.			
100.2000	100.6000	1.1215	Open Channel condition.			
100.3000	100.7000	1.9362	Open Channel condition.			
100.4000	100.8000	2.7986	Open Channel condition.			
100.5000	100.9000	3.6874	Open Channel condition.			
100.6000	101.0000	4.5930	Open Channel condition.			
100.7000	101.1000	5.5109	Open Channel condition.			
100.8000	101.2000	6.4385	Open Channel condition.			
100.9000	101.3000	7.3744	Open Channel condition.			
101.0000	101.4000	8.3174	Open Channel condition.			
101.1000	101.5000	9.2668	Open Channel condition.			
101.2000	101.6000	10.2220	Open Channel condition.			
101.3000	101.7000	11.1826	Open Channel condition.			
101.4000	101.8000	12.1481	Open Channel condition.			
101.5000	101.9000	13.1182	Open Channel condition.			
101.6000	102.0000	14.0925	Open Channel condition.			
101.7000	102.1000	15.0708	Open Channel condition.			
101.8000	102.2000	16.0528	Open Channel condition.			
101.9000	102.3000	17.0383	Open Channel condition.			
102.0000	102.4000	18.0270	Open Channel condition.			

The sample report maintains the same differential in head and produces a rating curve from the upstream elevation of 100.1 feet through elevation 102.

RAC File Maker

Over the years, we have received requests for short duration storms. This feature will create a short duration storm based on a longer rainfall distribution. For example, it can be used to create a 6 hour type 2 rainfall distribution. All distributions that are created will be at 5 minute intervals.

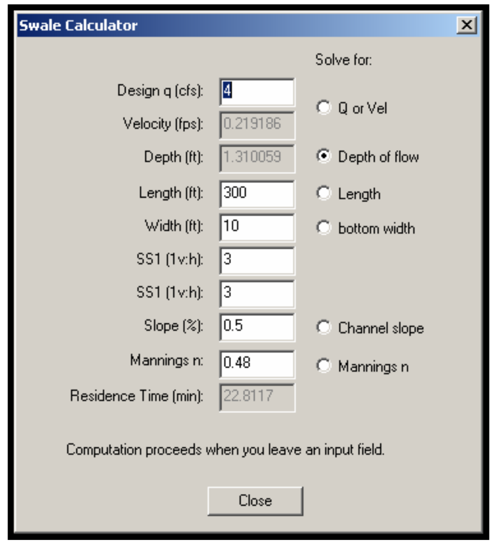


How does the program do it? It just takes the peak x hour interval of the given rainfall type. If you specify a type 2 rainfall distribution and ask it to give you a 6 hour distribution, the program will identify the inflection point in the type 2 distribution and back up 3 hours, then isolate the points associated with the next 6 hours. It then normalizes the curve so that it starts at zero and progresses to one.

The view button becomes active after the RAC file type is created. It assumes that the editor is configured properly. (Data/Config then Application Links tab).

Swale Calculator

Unlike the other calculators, which are based on other StormShed2G data records, the Swale Calculator is completely standalone. It relies on no reaches.



To use the calculator, first select the variable to solve for. A different combination of fields will become inactive based on the selection. Fill out active fields with the relevant data. The program attempts to solve for the answer whenever the cursor LEAVES a field.

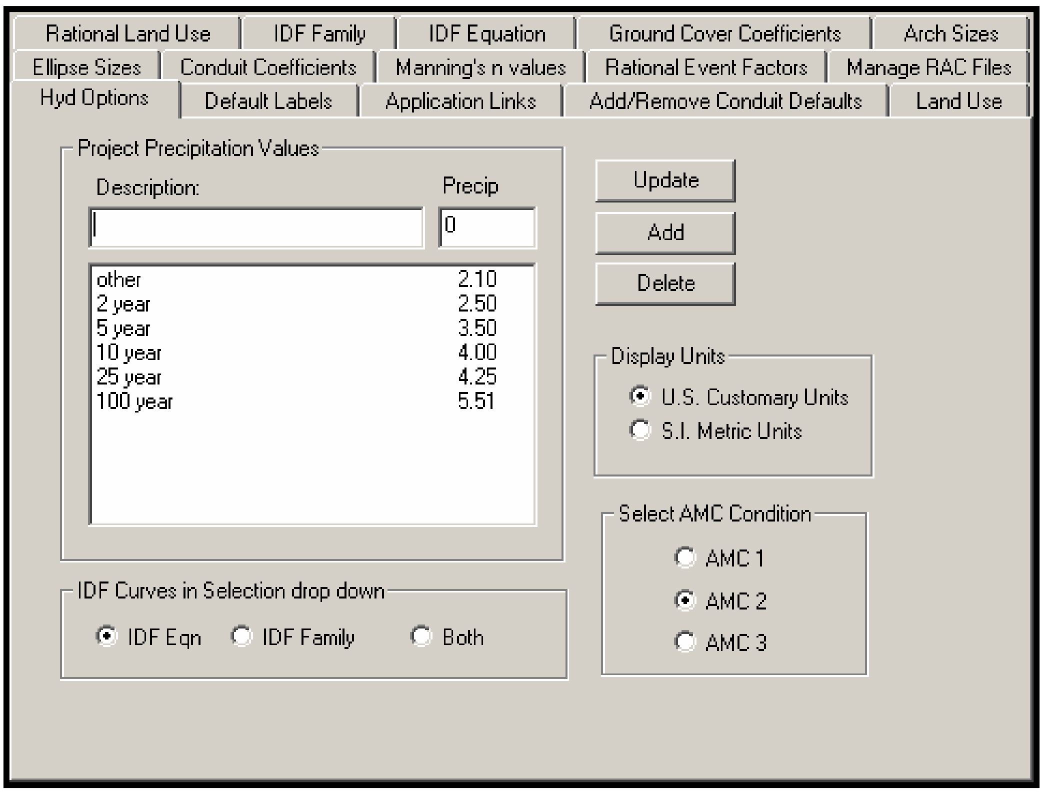
This calculator was designed to quickly display residence time in a swale. The program uses Manning's formula to solve for the requested variable.

Chapter 6

Configuration

The configuration dialog is accessible only through the **Data/Config** menu selection. It provides all configuration options that other sections of the program rely on. There are 15 categories of customization associated with the program.

Hyd Options



Hyd Options is the customization that initially appears when the dialog is selected. It is potentially used for every project because it specifies the precipitation rates for the project.

The dialog allows for the definition of design events. The program already comes with the common evens already defined. Each project will need to modify the precipitations to reflect the project location. While it is tempting to delete design events that are not part of the analysis, don't. The design event may be required in the future and also, it doesn't hurt to leave it.

Should the decision be made to clean up the design events, remember that the SCS and SBUH method uses the **2 year** precipitation to compute sheet flow. If the **2 year** design event is removed from the list and the program specifies sheet flow as one of its travel time reaches, the program will either croak or not find it and return zero for the computation.

When defining design events, keep the description short. There is a 20 character limit on the description length.

There is a selection for either US customary units or SI units.

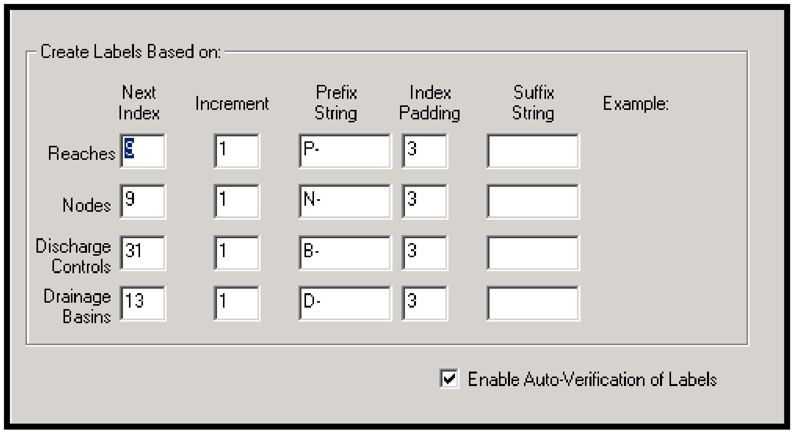
Internally the program stores the all values in US units. When changing the Display Units setting, the program simple translates from the US units that are stored internally to the units that are specified. The Display Units setting affects the entire project.

Since the program primarily uses the SCS methodology for runoff generation, the selection of AMC condition to be applied for each project is globally controlled at this location. What this means is that all Curve Numbers are entered as AMC2 in the program. Based on this setting, the program will convert to the designated AMC condition for the project computations.

The radio buttons for IDF curve selection determine where the program will obtain the IDF curves for design selection. Generally, there are two sources for IDF curves available to the program. The first is the IDF family, which is a use defined table that specifies the IDF values versus time. The second method is the IDF equation form that is used in Washington State. There is also a third form that is specific to King County Washington, but that is a highly customized feature. The radio buttons determine what IDF curves are made available to the project for selection.

Default Labels

Whenever a new record is created, an AutoLabel Dialog appears. The dialog normally has a default label already entered in the Edit field. The pre-selected label can be accepted or changed depending on the users preference. The Default Labels configuration dialog determines the format of the pre-selected label.



There are for category of labels, Reaches, Nodes, Discharge Controls, and Drainage Basins. The first column indicates the current record counter. The second column indicates the increment between labels. The third column is a prefix string that is to be appended to the beginning of the counter.

The fourth column, Index Padding indicates to the program the padding to apply to the count. If the count is three (3) there are several ways to display the number in the label. It can be displayed as a 3, or as a padded number, 003. This is useful in developing a labeling system that can be displayed in a numerical order even though the labels are alphanumeric in nature.

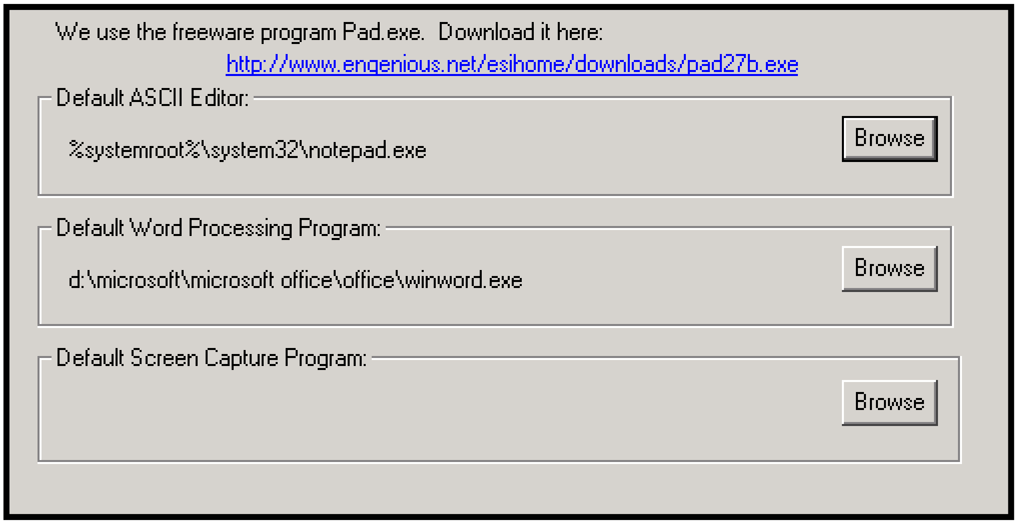
The fifth column is a Suffix String. The program will append a suffix to complete the label. The overall format of a record label is:

Prefix+padded counter+suffix

There is a five (5) character limit to the length of the prefix and suffix strings for each record. Theoretically, there isn't a limit to the length of padding that can be specified.

Application Links

There are three (3) outside programs that StormShed2G will use. The first is an ASCII editor. The default editor that comes with the Windows operating systems is Notepad. Over the years, Notepad has changed in that it only recognizes files with a txt extension. ASCII editors are not the same as word processing programs. Word processing programs embed hidden symbols that specify formatting. ASCII editors have no formatting other than line feed and carriage returns. There are numerous free ASCII editors available. We encourage users to select one that they are comfortable with and that will recognize multiple file extension types.



When an appropriate ASCII editor is selected and installed on the computer workstation, use the Browse button to make StormShed2G aware of it.

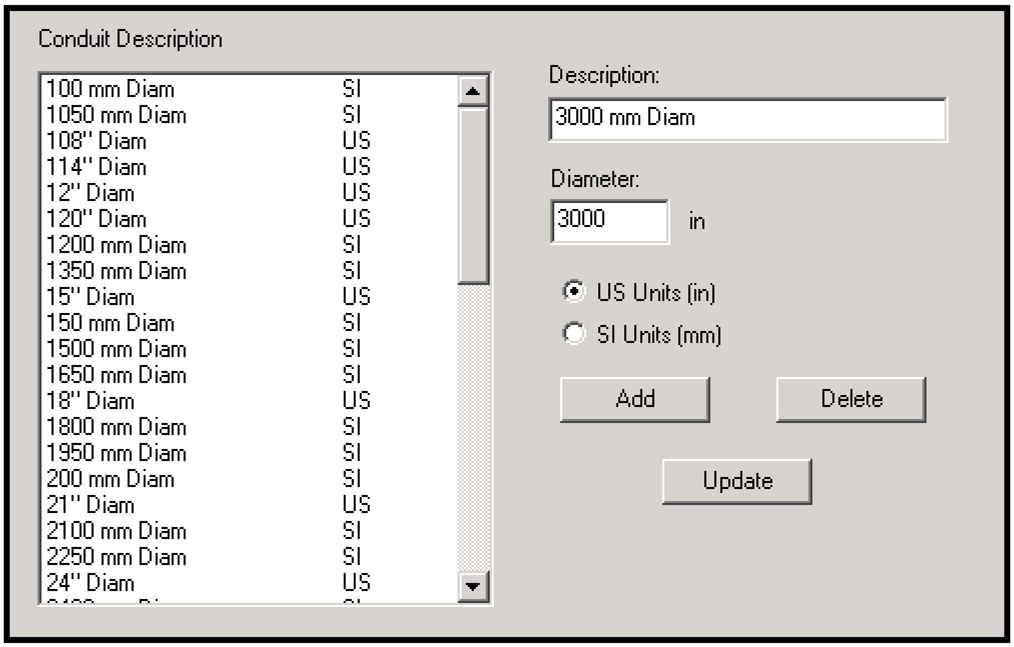
The program wants to know which word processing program to use. The default is Microsoft Corporations Winword program, however another can be selected. The only criteria is that the word processing program is able to open and edit a standard HTML document without showing the HTML codes. As part of the installation process, the program attempts to identify the location of Microsoft Word program. In some cases, it may be necessary to press the Browse and re-select the winword.exe file in order for the program to correctly call it up.

The last item in the Applications tab is the default screen capture program. Two screen capture programs are provided with the program installation. One is shareware and the other is a freeware program. There are many screen capture programs available and its use is really a matter of preference. Install any screen capture program that you are comfortable with and specify its location here.

The intent of the screen capture program is to capture the layout for inclusion in reports.

Add/Remove Conduits Defaults

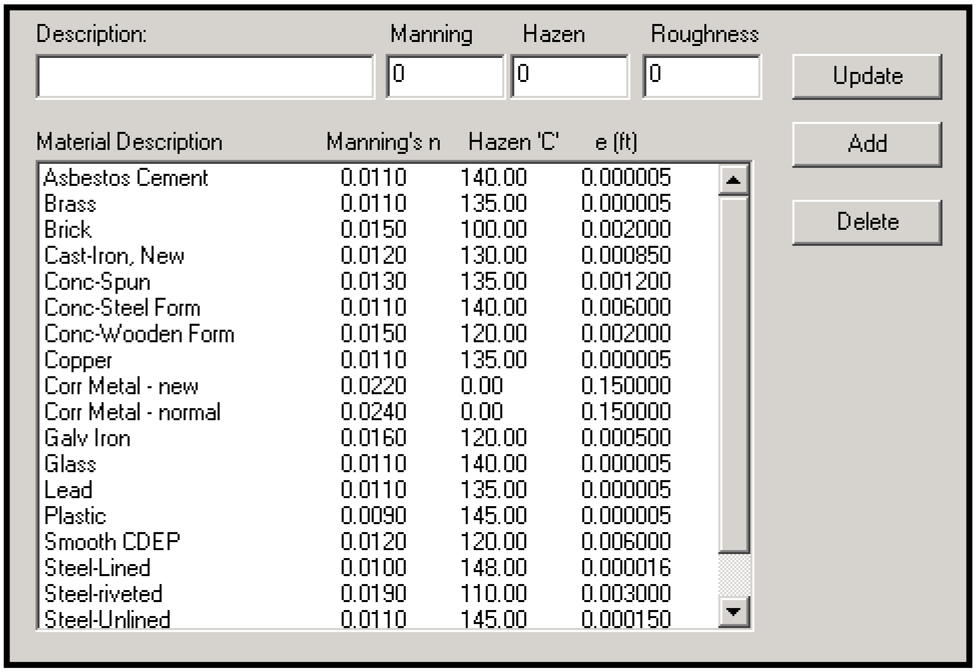
The program supports all standard size conduits. Use this dialog to add or remove conduits that the program should recognize. This dialog support unique conduit sizes for US and SI pipes. From the standpoint of the program, is the design calls for a 12 inch diameter pipe (or a 12 inch diameter pipe is specified), it will be 12 inches in diameter OR 304.8 mm in diameter if the metric units are displayed. The computations are based on the converted units. Likewise, if a 300 mm pipe is specified, computations are performed for a 300 mm pipe or a 11.811 inch diameter pipe.



If the US Units radio button is selected, the program expects that the entered data is in US units, inches. If the SI units radio button is selected, the program expects that the diameter that is entered is in mm.

Conduit Coefficients

When computing uniform flow in reaches, the program supports four (4) computational methods. They are the Manning's equation, Kutter formula, Hazen-Williams, and the Darcy Weisbach with the Colebrook-White solution.



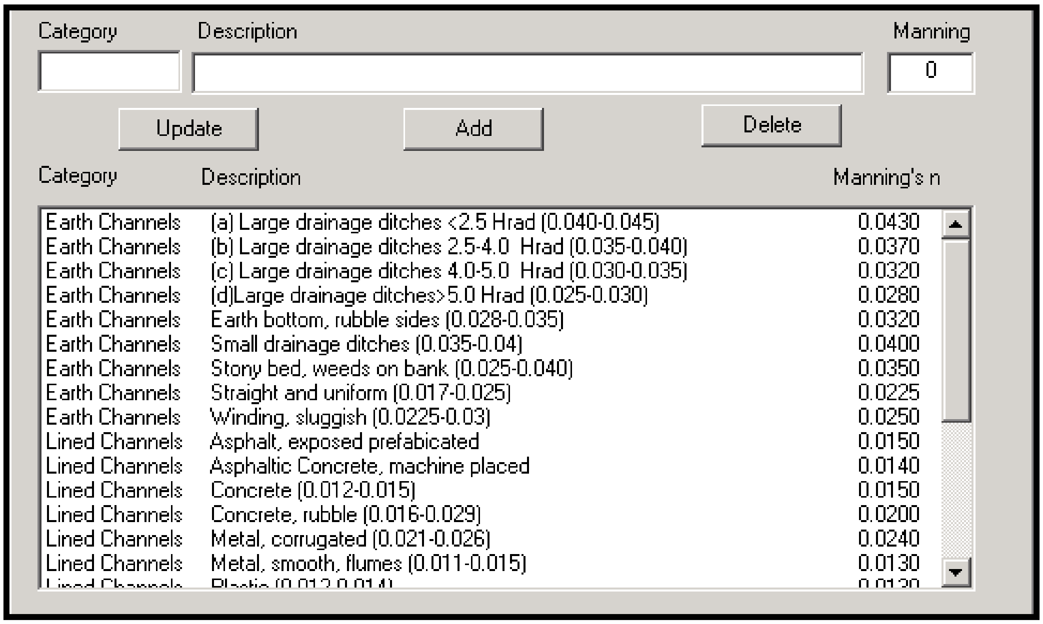
Material Description	Manning's n	Hazen 'C'	e (ft)
Asbestos Cement	0.0110	140.00	0.000005
Brass	0.0110	135.00	0.000005
Brick	0.0150	100.00	0.002000
Cast-Iron, New	0.0120	130.00	0.000850
Conc-Spun	0.0130	135.00	0.001200
Conc-Steel Form	0.0110	140.00	0.006000
Conc-Wooden Form	0.0150	120.00	0.002000
Copper	0.0110	135.00	0.000005
Corr Metal - new	0.0220	0.00	0.150000
Corr Metal - normal	0.0240	0.00	0.150000
Galv Iron	0.0160	120.00	0.000500
Glass	0.0110	140.00	0.000005
Lead	0.0110	135.00	0.000005
Plastic	0.0090	145.00	0.000005
Smooth CDEP	0.0120	120.00	0.006000
Steel-Lined	0.0100	148.00	0.000016
Steel-riveted	0.0190	110.00	0.003000
Steel-Unlined	0.0110	145.00	0.000150

The Conduits coefficient configuration table is used to relate equivalent coefficient for the different methodology to material descriptions. There is not limit to the number of material descriptions that can be defined.

Manning's Values

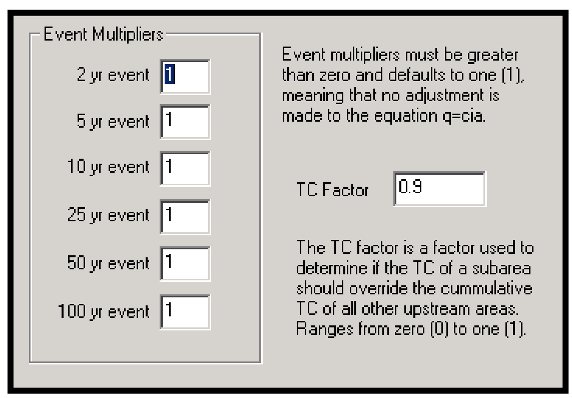
This table is used to create a selection list of Manning's numbers with the description that is appropriate for the project location. The default list of descriptions can be changed or amended as necessary.

The selection is available when the ditch option is selected for a reach.



Rational Event Factors

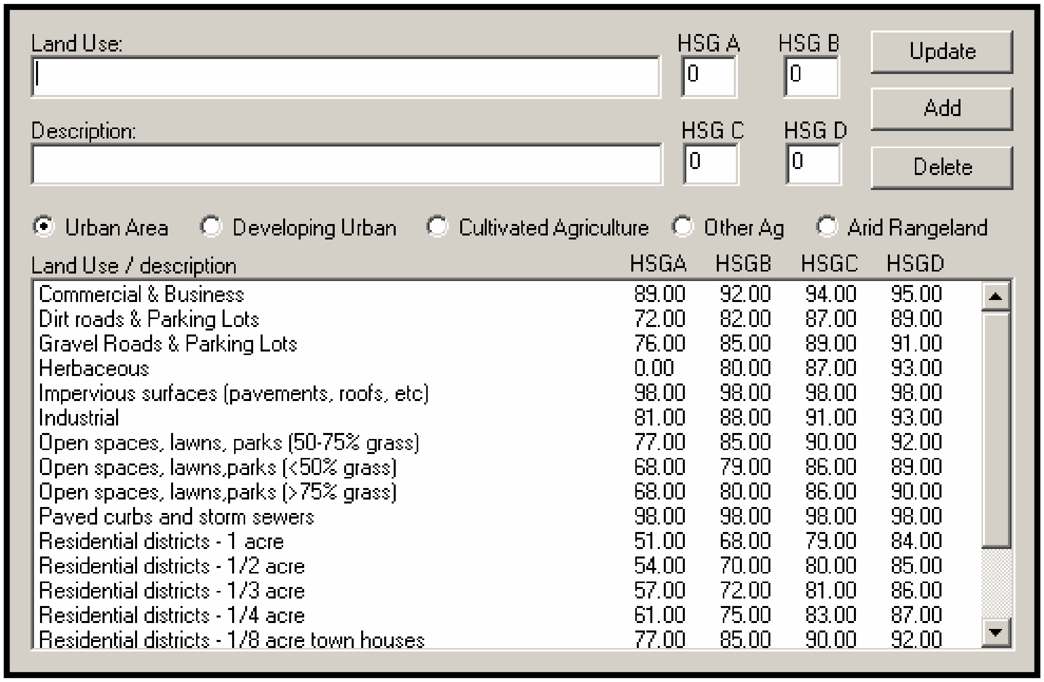
The Event Multipliers do exactly what it says. The default for each design event is one (1) but if there is a need to apply a multiplier to the successive design events, this is where the multiplier is defined.



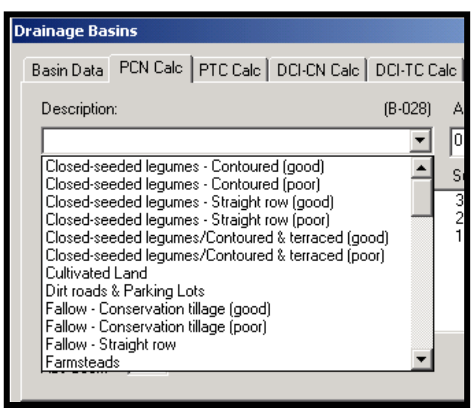
The TC Factor is used to determine if the TC of a sub area should override the cumulative TC of all other upstream areas. This is provided to make sure that a situation doesn't arise where a small area with a very long TC would override the intensity from a large area with a shorter TC. The default threshold is 0.9 meaning that the current area must be at least 90% of the total cumulative area before the program to allow the longer TC to take precedence over the cumulative upstream travel time when selecting an intensity.

Land Use

Generally, the soils in a municipality are fairly consistent. It has been the practice of some agencies to simplify the selection of SCS curve numbers by generalizing land use types and hydrologic soils groups (HSG) based on the regions soils characteristics. The generalized land use descriptions are not usually universal and probably vary in different parts of the country.



This configuration table allow for customization/correlation of land use and HSG values for the project region. The defaults are taken from a number of sources, including TR-55, NEH-4. As we have said, the HSG for the same categories can vary in different parts of the country depending on the underlying soils types. This is particularly true for the Urban and Developing Urban categories. **Program users should verify that their locality recognizes the same HSG values for similar land uses.**

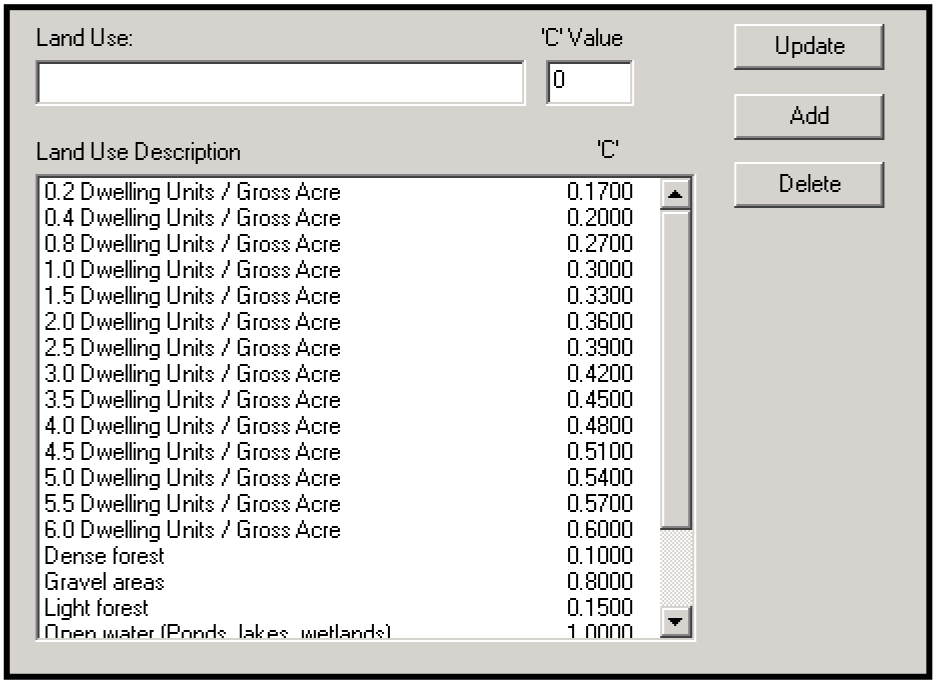


Most often, different localities will expand this list to include land uses that are more representative of modern development practices.

The values are presented in the PCN and ICN drop down when entering Basin data. Reflect the current category selection.

Rational Land Use

The rational land use configuration is similar to the previous section. The representative values in the default implementation of the program were taken from Western Washington guidelines and may not be applicable in other parts of the country. Likely, they will be similar. Check with the local jurisdiction to see what values they assign land uses with similar descriptions.

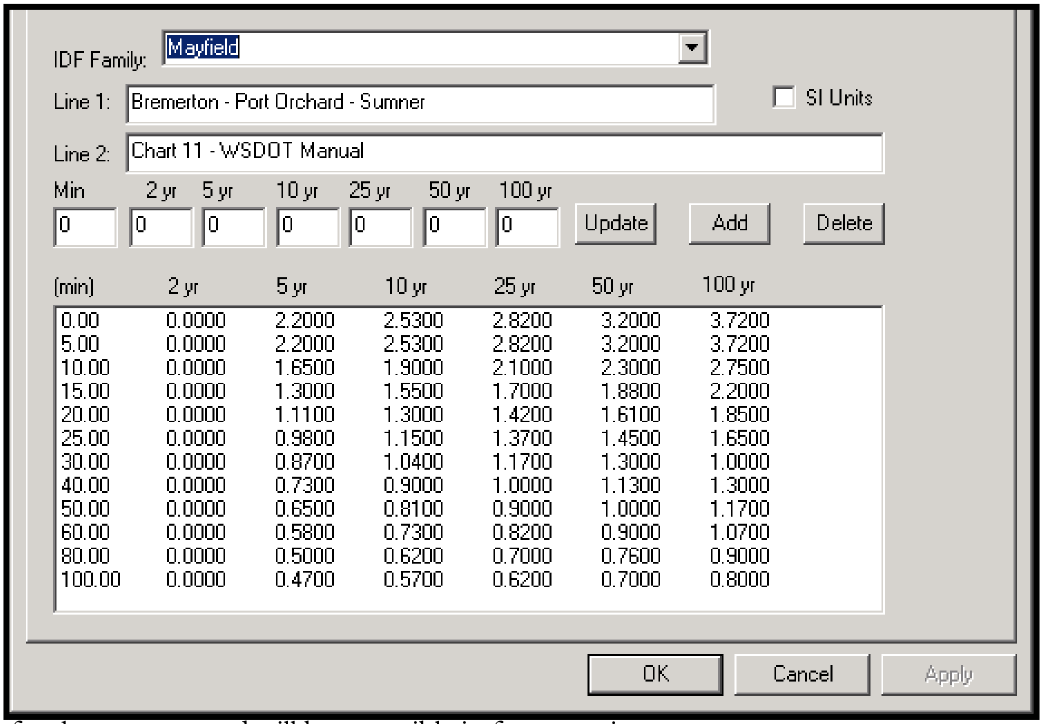


The land use type are listed in the Composite C Calculator for Rational Basins.

IDF Family

Use this dialog to define Intensity Duration Frequency (IDF) curves for your Rational Method Project. There is no limit to the number of families that can be created and there is no limit to the number of entries for each family.

When defining an IDF curve, enter all design events unless absolutely sure that the design event will never be used in any project. The IDF curves will remain as defaults for the program and will be accessible in future projects.



(min)	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
0.00	0.0000	2.2000	2.5300	2.8200	3.2000	3.7200
5.00	0.0000	2.2000	2.5300	2.8200	3.2000	3.7200
10.00	0.0000	1.6500	1.9000	2.1000	2.3000	2.7500
15.00	0.0000	1.3000	1.5500	1.7000	1.8800	2.2000
20.00	0.0000	1.1100	1.3000	1.4200	1.6100	1.8500
25.00	0.0000	0.9800	1.1500	1.3700	1.4500	1.6500
30.00	0.0000	0.8700	1.0400	1.1700	1.3000	1.0000
40.00	0.0000	0.7300	0.9000	1.0000	1.1300	1.3000
50.00	0.0000	0.6500	0.8100	0.9000	1.0000	1.1700
60.00	0.0000	0.5800	0.7300	0.8200	0.9000	1.0700
80.00	0.0000	0.5000	0.6200	0.7000	0.7600	0.9000
100.00	0.0000	0.4700	0.5700	0.6200	0.7000	0.8000

IDF Equation

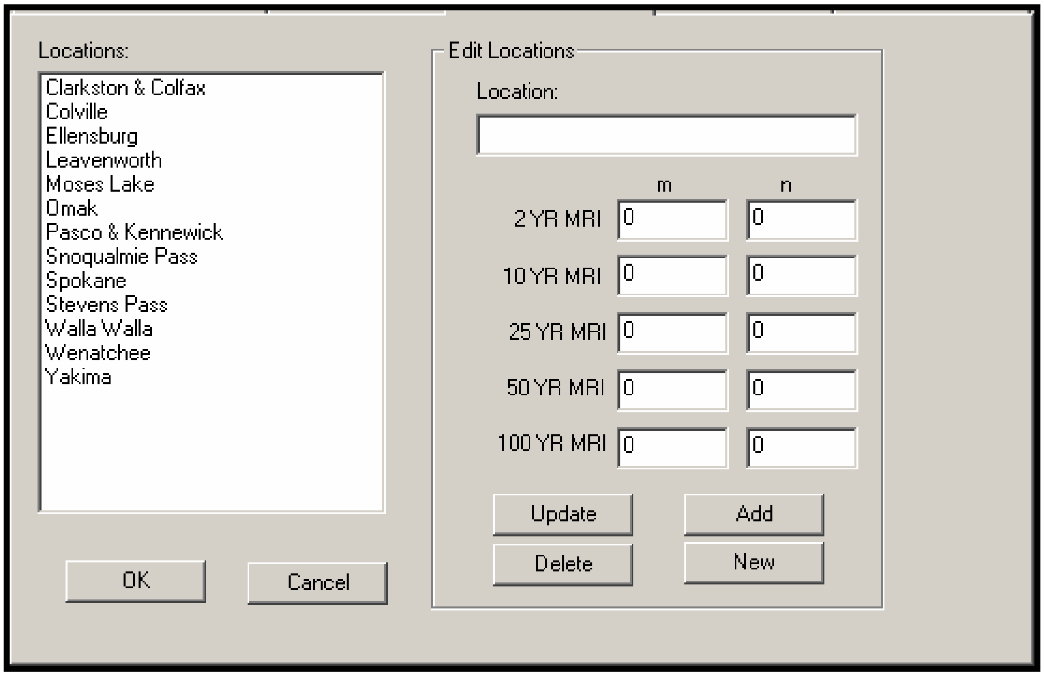
The second method 2G uses to compute the rainfall intensity based on the general relationship:

$$i = KF^{x} / (T + b)^{n}$$

Where F is frequency, K, B, x and n are constants for a particular location. Specifically, StormShed2G uses the following variation of the equation.

$$i = m / (T_c)^{n}$$

Where m and n are coefficients for a particular location.

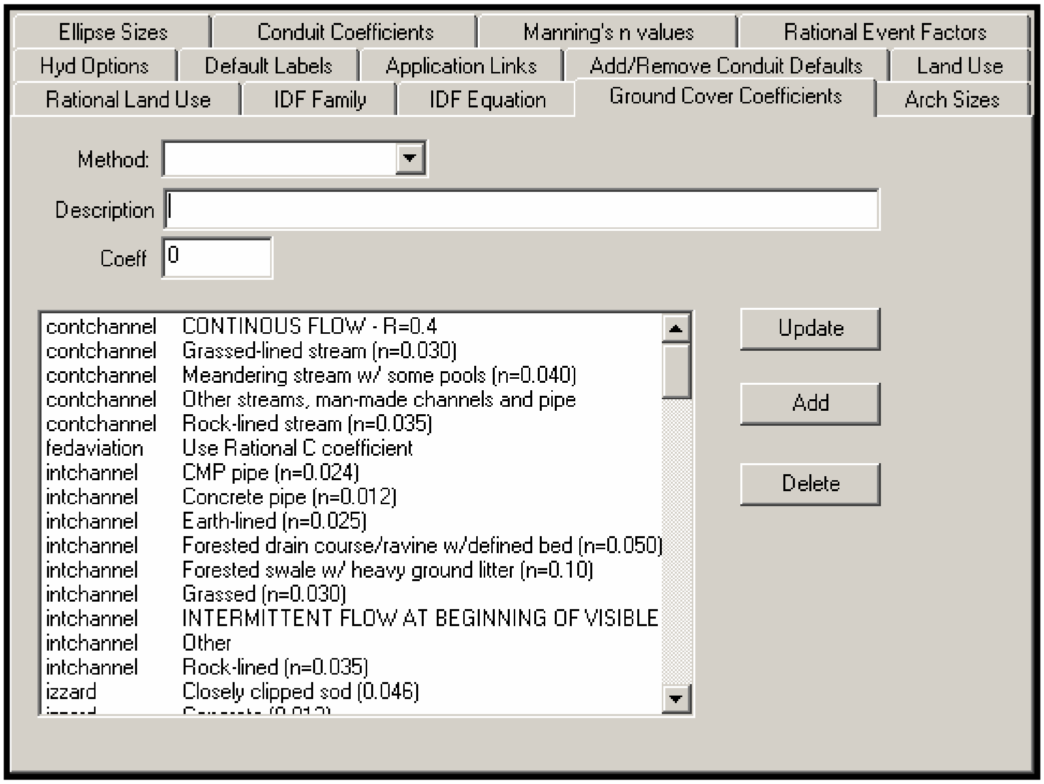


The IDF Equation input dialog allows for the definition of a complete library factors. The dialog works as similarly to other dialogs. To add a new set of coefficients, fill in the fields and press the Add button. To edit the values for a location, select the location, edit the values, and press the Update button. The delete button deletes the selected location.

Note that the program does not verify that IDF locations are unique. It is possible to define an IDF Location and an IDF Family with the SAME names! The program will default to the IDF Equation selection. Generally, we don't recommend that IDF Families and IDF Equation names duplicate each other.

Ground Covers Coefficients

The Basin and the Rational basin time of concentration calculators to compute travel time use the ground cover coefficients. As discussed in an earlier section, 2G supports numerous velocity equations. This configuration dialog allows users to customize the coefficient choices associated with each equation.

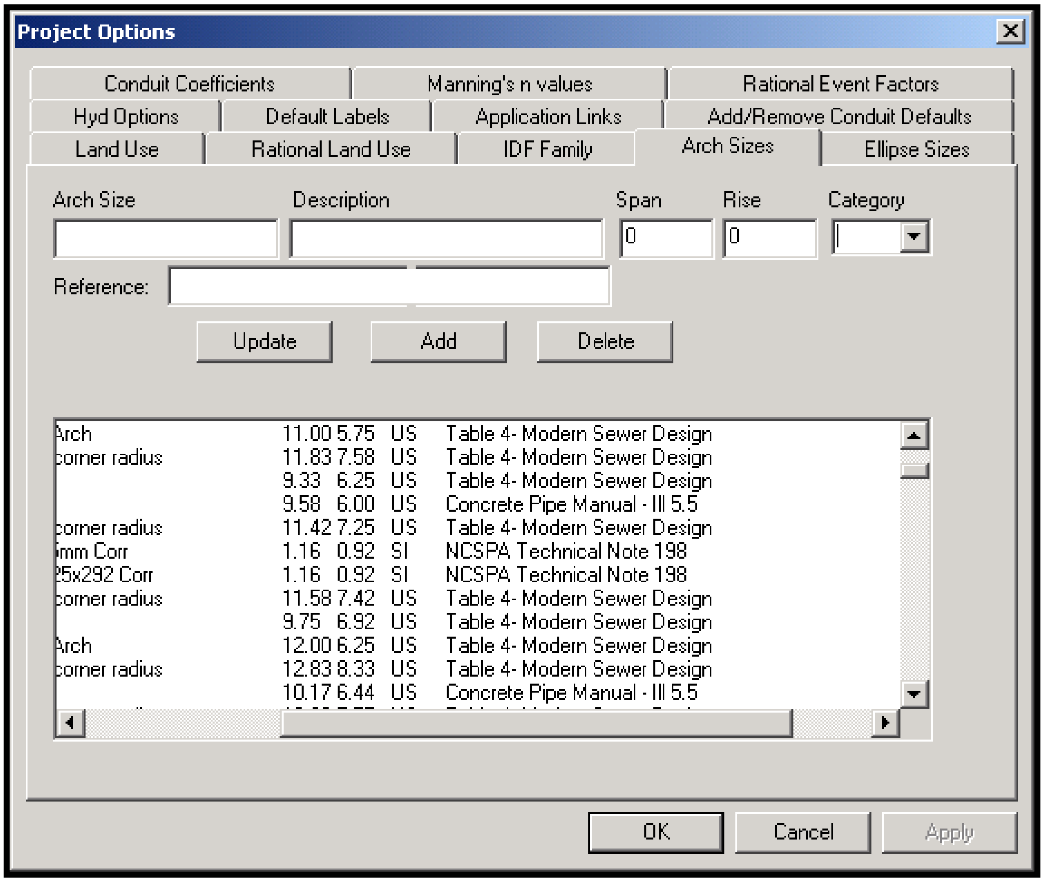


The Method drop down defines the velocity equation, the description field is used to descrip the ground cover. Note that we generally include the coefficient in the description as a reminder its values. The last field is the coefficient to be used by the equation. It should be noted that the methods distinguishes between intermittent flow channels and continuous flow channels because of the hydraulic radius assumption.

Also, it should be noted that the Kinematic and the Morgali-Linsley equations use the same coefficients. However, since they are different equations, the coefficients for those equations are duplicated for consistency.

Arch Sizes

Use this table to add or remove Arch Pipe sizes. This configuration dialog permits the creation of both US dimensioned and SI dimensioned Arch pipes. The data entered here will be available in the Reach dialog when arch pipe is selected as the section shape.



Arch pipes that are created will be available to the program, in other projects. This is a program configuration item and not a project configuration item.

Ellipse Sizes

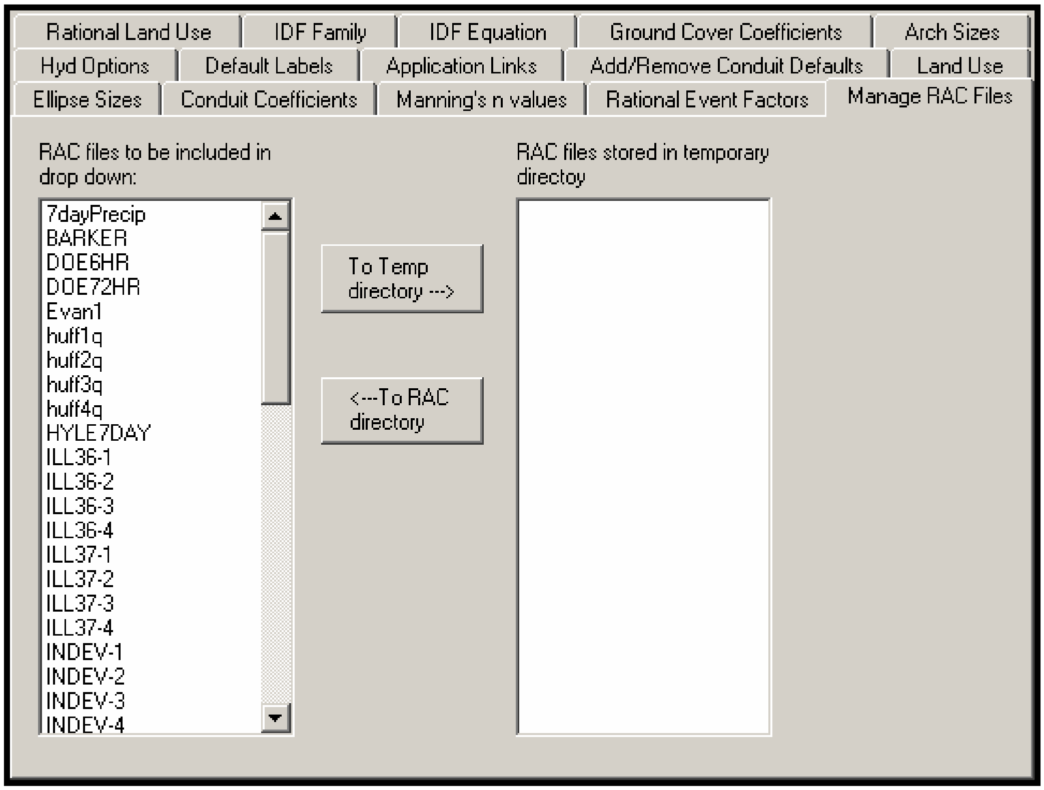
Identical to Arch Sized but for Ellipse pipes.

Manage RAC Files

This is a simple utility that will help you manage the number of RAC files that are available for selection in the Rain Type drop down of the Basin Dialog. Generally, the rainfall distributions that are available to the program are placed in the RAC subdirectory under the program installation directory. This is a very neat arrangement, however, there are probably lots of RAC files that most engineers will never use.

Most engineers will simply delete the RAC files that they don't anticipate ever using, so they are generally left with moving them out themselves or living with a huge selection list.

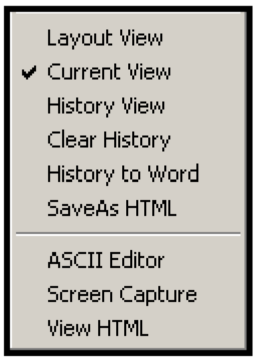
This utility simple moves the ones that are not commonly used to a subdirectory. When you need it, move it back.



Chapter 7

View Menu Options

View Menu



The view menu has a number of choices that are not completely obvious. This section attempts to explain the menu choices.

Layout View

This is obvious; it just switches the right view to the Layout View. Is exactly the same as the  button.

Current View

Switches the right view to the current View. It is what you get when the  button is pressed from the toolbar. This view displays the results of the most immediate computation.

History View

In many ways the History view is similar to the Current View, except when this menu is selected, the Current View will display the entire history of computations since the last time the project view data was cleared out. The contents of the History view can become very large. To help remind users to clear out the history contents occasionally, when the view contents reaches 1.5 megabytes, the current view reports will include a message at the top.

Clear History

After reading the explanation of the History view, select this to clear the contents of the History view buffer. Incidentally, if you let this become too large, it will definitely impact the speed that the program will load.

History to Word

We encourage the active maintenance of the History view. We do so by only letting you open the contents of the History view directly into Microsoft Word. You cannot selectively just open the contents of the Current view in MS Word. If you Clear History, then do a computation, the contents of the History will be identically to the contents of the Current view. Once the view is opened in Word, you can add, edit modify and in general, write your report around it. From Word save it as a Word document.

We might add that the program does not require MS Word to operate. Any wordprocessing program can be used as long as it can open documents with the html extension. To specify an alternative wordprocessing editor, select the **Data/Config** menu item and press the Application Links tab.

SaveAs HTML

This feature will save the contents of the Current view into it's own file with an html extension. This is handy if you want to compare the results of several computations. Once the contents are saved, you will have another file that will be associated with this project. It is up to you to delete unnecessary data file.

ASCII Editor

This will open the default text editor and let you view pure text files. 2G uses text files for several program features. They are:

- RAC extension – used to store rainfall types.
- PGM extension – program macros.
- IDF extension – stores idf families

The program comes with a freeware editor that can be replace by one that you like better. You can customize it by going to the **Data/Config** link again and selecting the Application Links tab.

Screen Capture

Like the ASCII Editor, the program provides a freeware screen capture program. We recommend that you use it to capture the layout view for pasting into your reports. You can customize it to one that you like at the same location as the ASCII editor.

Incidentally, we provide one even though Windows comes with Notepad. The reason is that Notepad is fairly limited in the size of files that it can open. It also is inflexible in the file extension that it expects.

View HTML

This feature compliments the SaveAs HTML menu selection. It will let you open a file with the HTML extension to view it. The program will open the file using your default HTML viewer. If you want to open the same file and import it into a word processor, there are two alternatives. The first is to open your word processor and use it to select and open the HTML file. The second is to open your work processor and cut and paste from the viewer to it

Chapter 8

Appendix

RAC Files

The program ships with numerous files identified by RAC file extension. These files contain the rainfall types used by the program. Included are the standard types defined by the SCS TR-20 program. The format of the files are plain text files (ASCII), which allows editing/customization of the files as well as the creation of region specific files.

Standard SCS Distributions:

- TYPE1.RAC SCS Type 1, 24 hr duration, 30 min interval.
- TYPE1-48.RAC SCS Type 1, 48 hr duration, 30 min interval.
- TYPE1A.RAC SCS Type 1a, 24 hr duration, 30 min interval
- TYPE2.RAC SCS Type 2, 24 hr duration, 15 min interval
- TYPE2-48.RAC SCS Type 2, 48 hr duration, 30 min interval
- TYPE3.RAC SCS Type 3, 24 hr duration, 20 min interval

Distributions specific to Washington State:

- BARKER.RAC 7 Day distribution use in KC Washington
- PC7DAY.RAC Pierce County 7 Day distribution.
- SEA100YR.RAC City of Seattle 100 yr, 24 hour distribution
- SEA25YR.RAC City of Seattle 25 yr, 24 hour distribution
- SEA2YR.RAC City of Seattle 2 yr, 24 hour distribution
- THUR100YR.RAC Thurston Cty 100 yr, 24 hour distribution
- THUR10YR.RAC Thurston Cty 10 yr, 24 hour distribution
- THRU25YR.RAC Thurston Cty 25 yr, 24 hour distribution
- THUR2YR.RAC Thurston Cty 2 yr, 24 hour distribution
- THUR50YR.RAC Thurston Cty 50 yr, 24 hour distribution
- THUR6MO.RAC Thurston Cty 6 month, 24 hour distribution
- THUR7DAY.RAC Thurston Cty 7 day, 24 hour distribution
- USER1.RAC Original King County 24 hr distribution

Distributions specific to Indiana:

Indiana uses the Huff rainfall distributions. The following are the RAC files. Indiana is divided into four regions, Evansville, Fort Wayne, Indianapolis, and South Bend. Each region is characterized by four quartiles. They are all 24 hour distributions.

- INDEV-1.RAC Evansville, first quartile
- INDEV-2.RAC Evansville, second quartile
- INDEV-3.RAC Evansville, third quartile
- INDEV-4.RAC Evansville, fourth quartile
- INDEVFW-1.RAC Fort Wayne, first quartile
- INDEVFW-2.RAC Fort Wayne, second quartile
- INDEVFW-3.RAC Fort Wayne, third quartile
- INDEVFW-4.RAC Fort Wayne, fourth quartile
- INDEVIN-1.RAC Indianapolis, first quartile
- INDEVIN-2.RAC Indianapolis, second quartile
- INDEVIN-3.RAC Indianapolis, third quartile
- INDEVIN-4.RAC Indianapolis, fourth quartile
- INDEVSB-1.RAC South Bend, first quartile
- INDEVSB-2.RAC South Bend, second quartile
- INDEVSB-3.RAC South Bend, third quartile
- INDEVSB-4.RAC South Bend, fourth quartile

Distributions specific to Illinois:

The program provided the Illinois Bulletin 70 tables 36 and 37 24 hour distributions. Like Indiana, the distributions are given in quartiles

- ILL36-1.RAC Illinois, bulletin 70, Table 36, first quartile.
- ILL36-2.RAC Illinois, bulletin 70, Table 36, second quartile.
- ILL36-3.RAC Illinois, bulletin 70, Table 36, third quartile.
- ILL36-4.RAC Illinois, bulletin 70, Table 36, fourth quartile.
- ILL37-1.RAC Illinois, bulletin 70, Table 37, first quartile.
- ILL37-2.RAC Illinois, bulletin 70, Table 37, second quartile.
- ILL37-3.RAC Illinois, bulletin 70, Table 37, third quartile.
- ILL37-4.RAC Illinois, bulletin 70, Table 37, fourth quartile.

Distributions specifc to Anchorage Alaska:

Taken from Section 2, Drainage. Anchorage DCM Draft Update 12/11/02

- ANC-2YR6HRA.RAC Table 2-1 (Record 1952-1990
- ANC-5YR3HR.RAC Table 2-1 (Record 1952-1990
- ANC-10YR3HR.RAC Table 2-1 (Record 1952-1990
- ANC-100YR3HR.RAC Table 2-1 (Record 1952-1990

- ANC-2YR6HRB.RAC Table 2-2

Huff Distributions
Huff distributions.

- HUFF1Q.RAC First quartile.
- HUFF2Q.RAC Second quartile.
- HUFF3Q.RAC Third quartile.
- HUFF4Q.RAC Fourth quartile.

South Florida Water Mgmt District:
South Florida Water Management District 72 hour distribution

SFWMD72HR.RAC Per Section 8.2, Aug 2000 release.

Format of RAC file
The RAC file is an ASCII file with the following format:

- Line 1: A description line describing origin of data
- Line 2: Interval of data in hours, remainder of line can contain other non-essential information.
- Line 3: The values. There are two options, the first option is to just put a single value on each line. The second option is to place multiple values on each line. If placing multiple values on each line, there is a limit of six (6) values per line.

The in the case were there is one value per line, the number of lines minus three (3) times the interval is the rainfall distribution duration.

For an example, open any RAC file with an ASCII editor.

Modifying Program Defaults
The question is often asked "how do I change the default Rainfall type from Type2 to Type 1A?"

Each new project is created by making a copy of the template.mdb file located in the installation directory and by renaming it as an untitled project. To change any default, all that is required is to open the template.mdb file as a project.

In StormShed2G, each project consists of three files. They have the file extensions ".wwk", ".mdb" and ".hmp". To open the template.mdb file and make modifications to the default data structures, all that is needed is to supply "template.wwk" and "template.hmp" files. Do this by renaming the "Untitled.wwk" and "Untitled.hmp" files that are temporarily created.

Once the complete set of "template.xxx" files are created, use StormShed2G to open the "template" project and make the modifications to the PROTOTYPE records in the dataset.

We recommend that the "template.wwk" and "template.hmp" files are deleted when changes are complete. That prevents inadvertent deletion and modification of the defaults by an inexperienced member of the design team.