12d Solutions Pty Ltd

Civil and Surveying Software

Course Notes

12dModel

STORMWATER DESIGN

12d Solutions Pty Limited

12d Solutions Pty Limited

ACN 101 351 991

Phone: +61 (2) 9970 7117 Fax: +61 (2) 9970 7118Email training@12d.com

12d Stormwater Design Course Notes

These course notes assume that the trainee has the basic 12d Model skills usually obtained from the "**12d Model Training Manual**"

These notes are intended to cover basic Stormwater Design. For more information regarding training courses contact 12d Solutions Training Manager.

These notes were prepared by
Robert Graham

Revised February 2006

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COURSE NOTES

STORMWATER DESIGN

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STORMWATER DESIGN

1.0 Stormwater Design - Introduction

The 12d drainage module contains functions to perform the following steps in the drainage design and documentation process:

- set drainage defaults and layout a drainage network,
- use the powerful 12d drainage network editor to avoid service clashes, grade pipes, align obverts, minimise depth and many other design tools,
- automatically assign names to the pit/pipes in the network,
- designate catchment areas and produce catchment plans,
- transfer data to and from electronic spreadsheets to enable the user to easily review the data and add user defined data to the 12d pipe network. This data may include such data as pipe bedding types and trench width,
- create pit layout schedules to export to spreadsheets or word processors for final formatting.
- produce long section drainage profiles including HGL data, flows, invert levels, service crossings
- create plan drawings with pipe sizes, flows, manhole symbols, linestyles for pipe sizes, design parameters for manhole and pipes and user defined data
- locate pits/manholes at exact chainage and offset locations

This user manual will lead the user through the steps itemised above.

In addition to this manual there is the *Advanced Stormwater Design* training manual which includes the following topics.

- drainage trench excavation volume calculations
- pipe and manhole quantity calculation
- customising the drainage.4d file
- design or evaluate the drainage system using 12d Drainage or create input files for the XP SWMM/RAT2000, Micro drainage, Drains and PCdrain drainage design packages,
- read the output from the drainage design packages (automatic if using 12d Drainage), update the drainage network and store the hydraulic data, such as hgl (hydraulic grade line) levels, peak pipe flows and pipe capacities,
- pit inlet capacity calculations and over land flow
- flooded width analysis
- surcharge volumes at SAG pits
- and detailed drainage plan labelling

The terms pit, catch basin and manhole are used interchangeably throughout this document. The type, dimensions and inlet capacities of the structures are set in the drainage.4d file.

2.0 Setup Files and Their Locations

The drainage module consists of the optional 12d Drainage engine, utilities, startup configuration files for RAT2000, XP SWMM and the 12d drainage configuration file (drainage.4d). Demonstration versions of Drains, RAT2000 and PCdrain have been included on the CD along with a copy of the ILSAX hydrology package. Manuals for the ILSAX program may be obtained from the Civil Engineering Department at the University of Technology Sydney.

All setup files have been configured for the training version. However, when you start working on real projects you may want customise the drainage module. **More - Customising the drainage module**

The **drainage.4d** file contains pipe types (RCP, Class 2 etc.) and example pit inlet capacity tables for RTA (NSW Road and Traffic Authority) standard pits. Detailed pit type descriptions and internal pit dimensions can be included in this file to be inserted into your pit schedules. For PCdrain users there is a routine to read your gully pit file and include these pit types in 12d **More**.

REVIEW THIS DATA CAREFULLY! The **drainage.4d** file may be customised for any additional inlet capacity data you may have.

To edit the **drainage.4d** file, from the main menu select

Design->Drainage-Sewer->More->Edit drainage.4d

Select the **Find** button to search the 12d path for the current **drainage.4d** file. Select the **More info** button and then **Edit** to edit the file.

You must restart 12d for these changes to become active. Select Project->Restart!

3.0 Survey data and design surfaces (TINs)

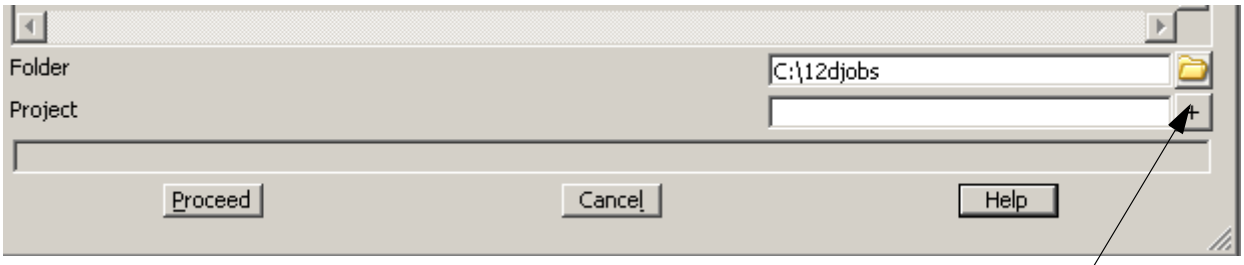
We will begin a 12d project from scratch by first creating the project and then reading in the survey design data. The design can then be triangulated so that we have a final surface profile to design the drainage for.

Start up the 12d model by selecting the courses icon from your desktop.

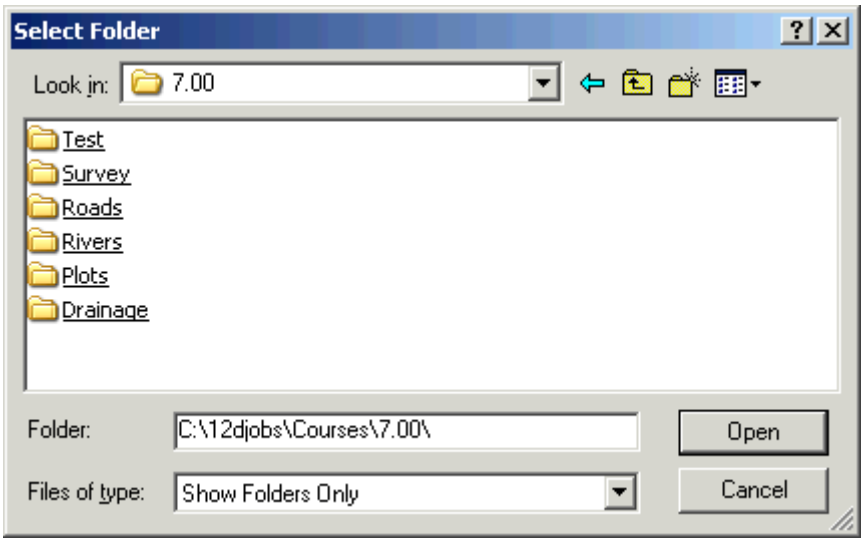
The project selection panel will appear. The bottom corner of the panel is shown below

Note: If you are using the practice version the folder will be:

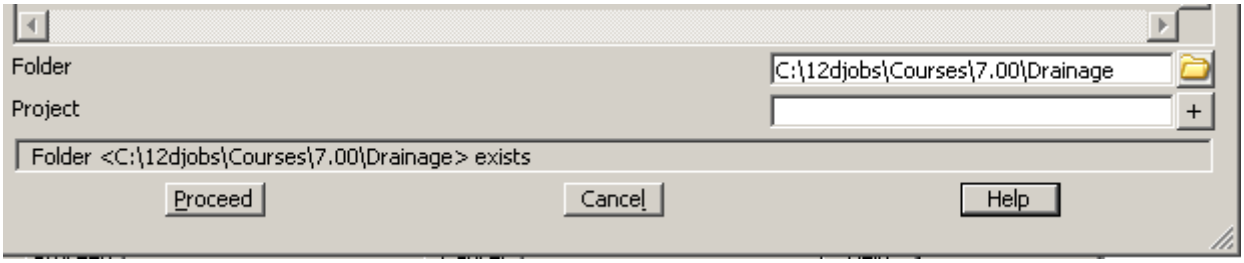
C:\12d Model v7.00 Practise\courses\7.00



LB select the icon and the following panel will appear.



12d works with a folder **NOT** a single file. Therefore, to open the folder we are going to work in, double click the **Drainage** folder and then select **Open**.

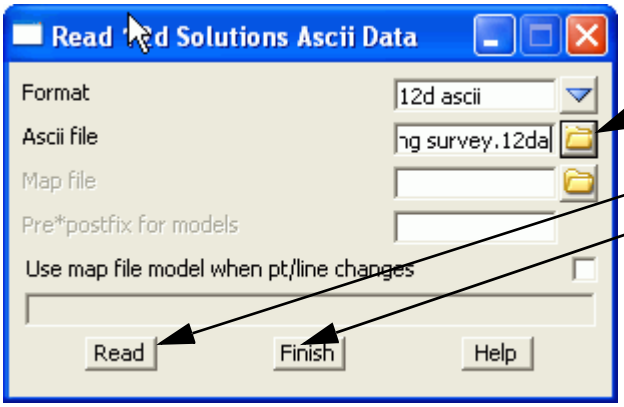


In the **Project** field type the name for your new project an then select **Proceed.** 12d will create a sub folder with this name. All of the 12d files that you should not touch will be created in this sub folder. Please stay out of the sub folder. All files created for the user will be kept in the folder that you opened (i.e. c:\12jobs\Courses\7.00\Drainage).

3.1 Importing the Raw Survey Data

You have created a new project into which we will import the survey data. From the main menu select.

File I/O => Data input => 12da/4da data



LB select to display the file list.
Select the file **existing survey.**

Select **Read** to read the data then
Select **Finish** to remove the panel

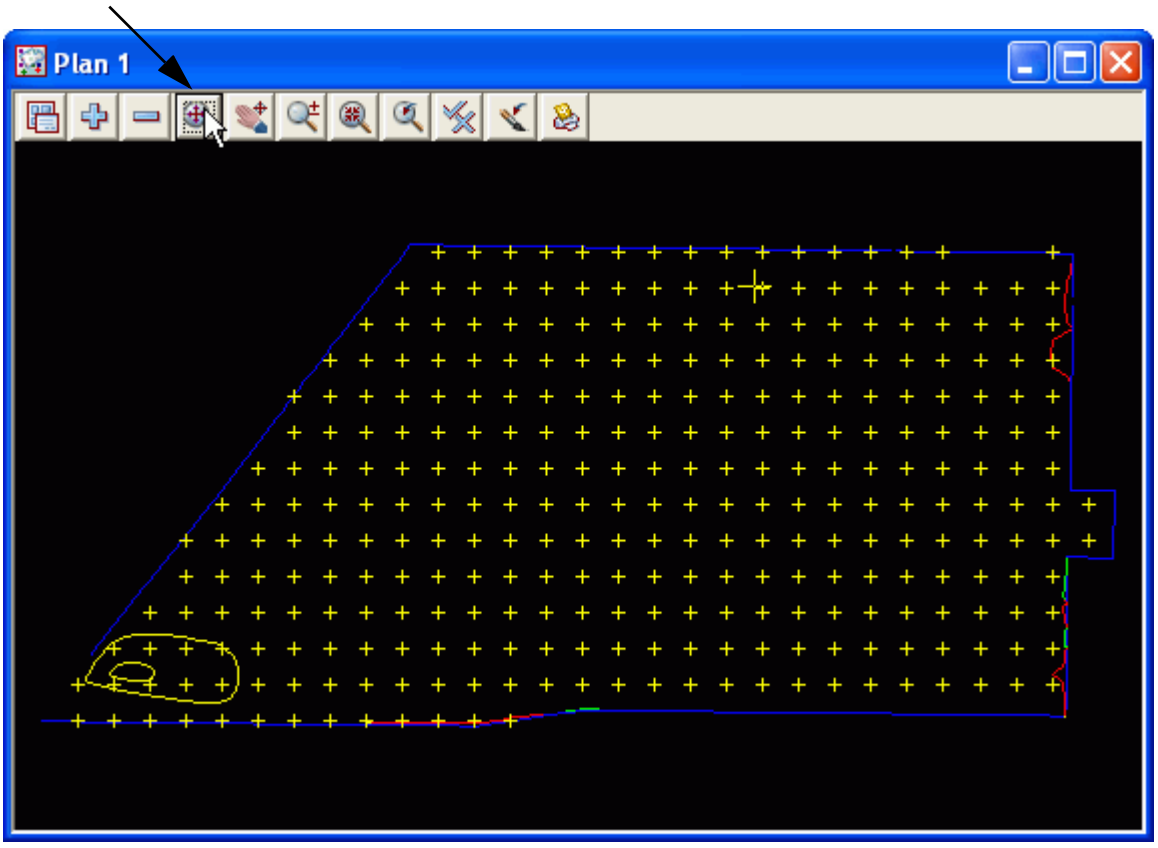
To add all of the data to the view select **Menu** icon in the **plan view title area** and then from the drop down menu select

Models=> Add all models

or

select this "+" icon and select **existing survey data**.

Next select **Fit** on the **plan view title area**. You should see the following data.

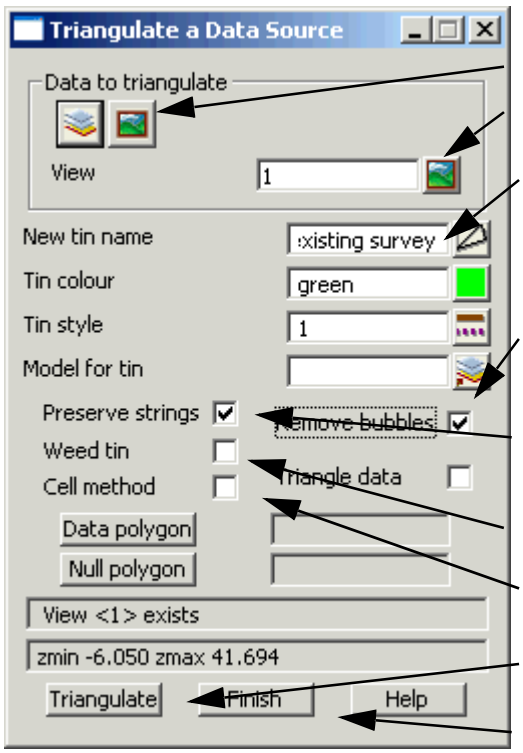


The view will contain survey data.

3.2 Creating the existing Ground Surface

From the main menu select

Tins=>Create=> Triangulate data



Select the **View** button

LB select then **LB** the view to be triangulated.

Type a new tin name, not the model for the tin. Remember a tin is like a string and it must reside in a model. Press enter and the **Model for tin** field will be filled in for you.

Select if creating a tin with contour data.

Preserve strings will make the string one side of the triangle thereby preserving the levels along the string

all duplicate points are removed from the tin database

The cell method is a good enhancement for data that is in a grid type pattern but it is not required.

Select **Triangulate** to create the tin.

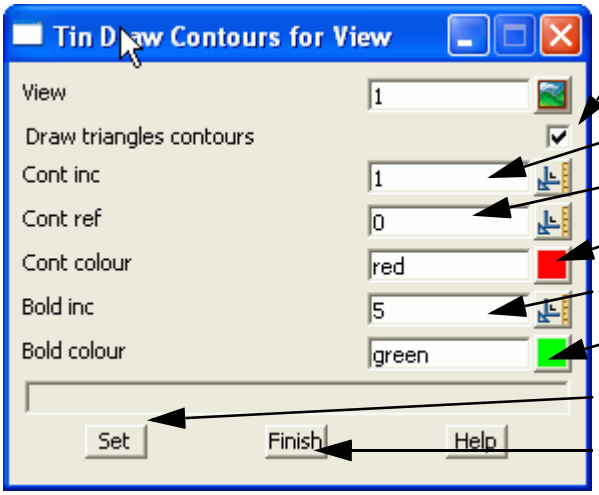
Select **Finish** to remove the panel from the screen.

Now we are ready to look at the existing surface tin. Place you pointer over the "+" sign on the **plan view title area** and press the **t** key. All of the models beginning with lower case t will appear. **Double click** on **tin existing survey** to add it to the view.

The tin will be shown with the tin edges turned on. This is the default when you have all tin display modes turned off. Let us now turn on the fast contours and the fast flow arrows. Select **Toggle** on the **plan view title area** and then **LB** on **Tin contours**. The contours will be shown on the view. LB **Toggle** on the **plan view title area** and then LB on **Tin flow.** Now the flow arrows will be shown on the view.

To change the contour intervals and the contour colours select the **Menu** button on the **plan view title area** and then select.

Settings=>Tins=>Contours and the following dialog will appear.



Turns the contours on or off

Minor contour interval.

Value for first bold contour (usually 0)

Minor contour colour.

Major interval.

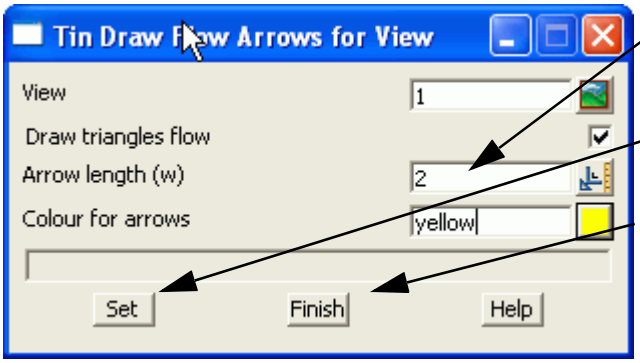
Major contour colour.

LB to observe the new settings on the view.

If you like the settings **LB** on **finish** to remove the select.

To change the length and the colour of the flow arrows select the **Menu** button on the **plan view title area** and then select.

Settings=>Tins=>Flow Arrows and the following dialog will appear.



A length of about 2 units looks very small now but it is good when you are zooming into the actual catchments.

LB to observe the new settings on the view.

When you like the settings **LB** on **Finish** to remove the panel.

3.3 Inquiring about Heights on the Surface

The elevation anywhere on the tin can be obtained by simply moving the pointer over the desired spot. To obtain the tin elevations select,

Tins=>Inquire=>Height

You will see that data in the panel change as you move the pointer around the screen,

3.4 Viewing the Surface Tin in a 3d Perspective

To create a 3d perspective view select

View=>New=>Perspective and a persective view will appear.

Add the model **tin existing surface** to the view and then **toggle** the **shading** on. You may also want to **toggle** the **contours** on as well.

Now remove the tin from the view as it is not needed for the next steps (Hint: use the "-" button).

3.5 Reducing the number of points for the 12d Practice Version

We can delete the survey data to save space for those using the practice version of 12d. If you have a full version of 12d this is not required. From the main menu select.

Models=>Delete=>Delete a Model and the following dialog will appear.

LB then select the model **existing survey data** and then **LB** to delete the model and then Select **yes** to confirm the deletion.

3.6 Importing the Road Design Data and Creating the Design TIN

Repeat the process of importing the 12da data.

File I/O => Data input => 12d ascii

(file is road design.12da).

Remove all of the models from the view and then add the road design models onto the view.

Road Centrelines
Road Strings
Road sections

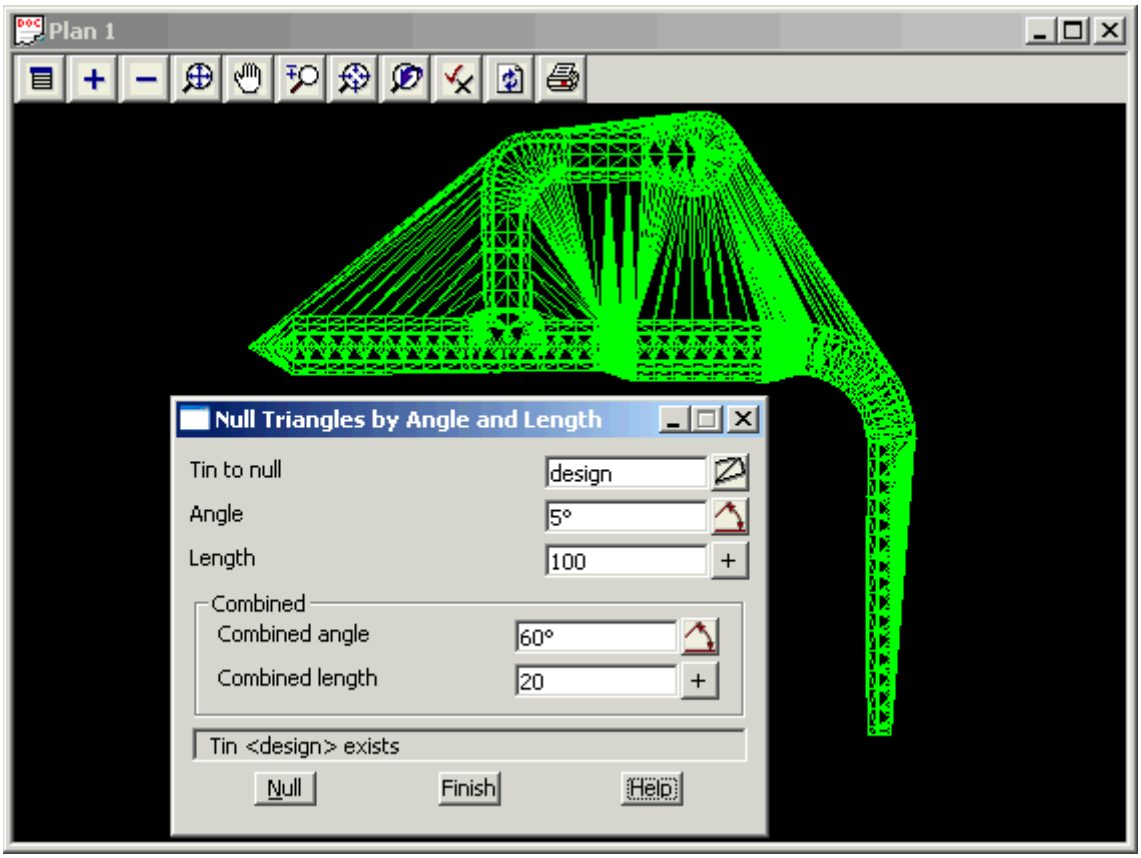
Now create a new tin called design using the **TINS->Create->Triangulate data** option.

3.7 Nulling the long Triangles

Add the tin that you just created onto the view. Toggle the **tin contours** off and the **tin flow** off. Now toggle the **tin edges** on. Notice the long triangles around the edge of the design.

To remove the long triangles select

Tins->Null->by angle/length



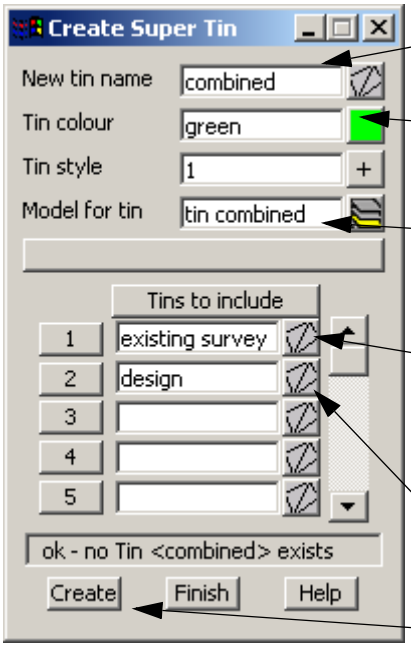
Select the design tin and then select **Null.** Using the default values removes most of the long triangles. Note that this option removes triangles from the outside inwards and it stops whenever it reaches a breakline.

Now reduce the **Length** value to 1 and then select **Null** again. Any exterior triangles with a length greater than 1 have now been removed!

3.8 Creating a Super Tin from the Survey and Design Data.

To create a tin that is the combination of the survey data and the design data you will need to create a super tin. From the main menu

Tins=>Create=>supertin



Enter a name for the super tin and press **Enter**.

Used only in section views.

The model field will be auto completed for you because you pressed **Enter** above. A new model will be created.

Now select the tins to combine. Tin 1 is the tin on the bottom (like the levels in a building) and tin 2 is above. i.e. wherever tin 2 exists it will be used. If there is no tin 2 at a location then tin 1will be used.

Select the tins using the icon and then

click **Create** to create the supertin.

3.9 Changing the Colour of a Tin

To change the colour of the design tin use

Tins->Colour->Colour of tin

Select the design tin and choose a new colour and then select **Colour** to change the tin colour (you may have to do a **Menu->redraw** on the view to see the new colour).

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4.0 Drainage Layout

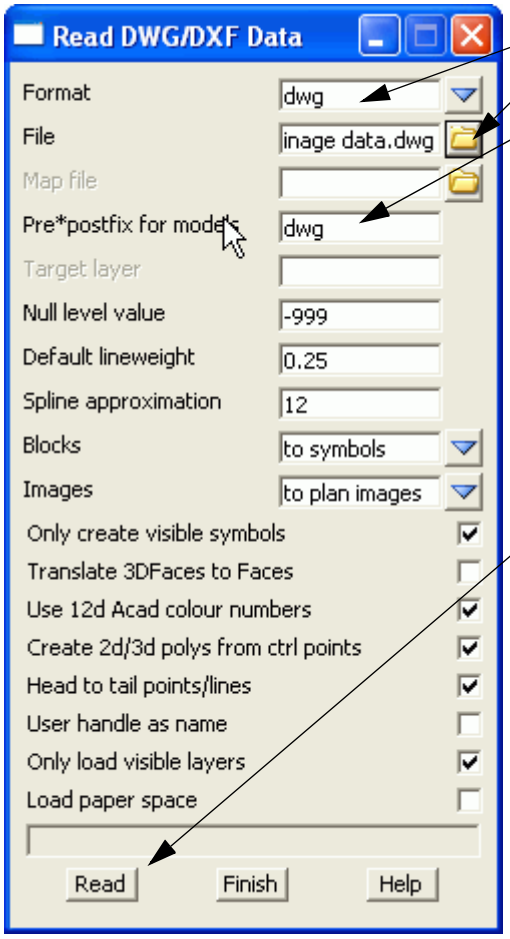
Where a drainage designer chooses to start their design is a depends a great deal on the project and the designer. Identifying overland flow routes is essential because it is on these routes that the manholes are to be placed. Inlet manholes are then placed at critical locations (sag points, upstream of pedestrian crossings etc.). and then the spacing of additional manholes is determined by the size of the catchments. Finally, the pipe drainage system can be created linking the drainage manholes.

However, during training, most users want to get straight to the manhole and pipes. Therefore, lets import a pipe layout that was drawn in AutoCAD along with the overland flow routes and catchment areas (These could have been created in 12d as well). When these were drawn the following rules were followed.

1.polylines were used
2.lines drawn from upstream to downstream (direction of flow)
3.a vertex was placed at every manhole location

From the main menu select

File IO->Data Input=>DWG/DXF.



Verify setting as dwg

Select the dwg file (drainage data.dwg)

Entering a prefix for the models will help organise the layers that will be read from AutoCAD. Every layer goes into a separate model in 12d. If you specify a prefix then all of the layer names will be prefixed with this text.The prefix used is dwg<space>.

The rest of the data can remain as the default value. Refer to the **Help** button if more detail is desired.

Select **Read** to import the data.**The data will not immediately appear on the plan view**. The new models have to be added to the view using the **"+"** on the view tool bar. Every time you press the **Read** button the data will be imported again and you will get duplicate, triplicate...etc data.
All of the models imported will begin with dwg.

The models that have been created are,

dwg d catchments
dwg d overland flow
dwg drainage network

Remove all of the models from the view and add the model **dwg drainage network**. This is a 2d drainage layout that we will use to locate the manholes in our drainage design.

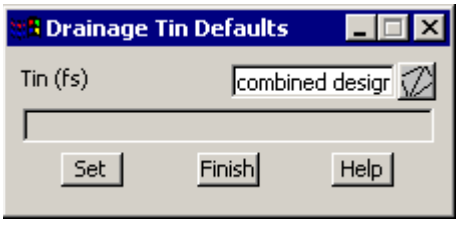
4.1 Setting Drainage Defaults

The defaults for the drainage network are accessed through three panels; pipe defaults, manhole defaults and Tin defaults. They may be accessed through the menu system as

Design =>Drainage-Sewer =>Defaults

Warning! You **must** click the **Set** button to set the default values. **Finish** alone will **not** set the defaults. If you plan to export to other drainage software packages you will have additional defaults to set before you export. See **Drainage Import/Export**.

4.1.1 Tin Default

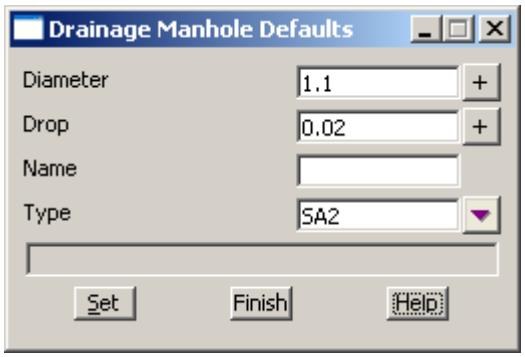


The default TIN is used to set the initial setout level of the manhole and the pipe invert levels. Super tins may b used if you want to place manholes on both the existing and the design ground surface (see Creating Super tins). Select the icon to choose from a list of existing TINS. Note that the panel will list the tins not the models that contain the tin. Remember a tin is like a string. It has a name and is stored in a model.

Warnings about using tins. If you place a manhole outside the tin boundary:

- then no elevation will be set for the top of manhole, (it can be set later manually or by linking it to a design string).
- Pipe invert levels cannot be set using the default cover. Pipe invert levels must be set manually as 12d cannot automatically determine cover levels without a TIN.
- Finally, if your drainage design package accepts surface levels along the string, then an error message will be displayed at export time. The message will say that the surface level string is shorter than the pipe length.

4.1.2 Manhole Defaults



The manhole diameter is specified in metres/feet **not** mm/inches. Although most stormwater manholes are rectangular, 12d uses circular manholes to eliminate problems showing the alignment of the manhole. If the actual dimensions and orientation of the manhole need to be drawn on the final construction drawings, a symbol may be used in the drainage plot annotations.

The actual internal manhole dimensions and a detailed manhole description can be added to your **drainage.4d** file so that they can be added to your manhole schedules.

The **Diameter** is used:

1. for visual service clash identification is long section drawings,
2. to clip the pipe lines drawn in the plan annotations,
3. maximum distance the bypass flow strings can be drawn from an inlet.

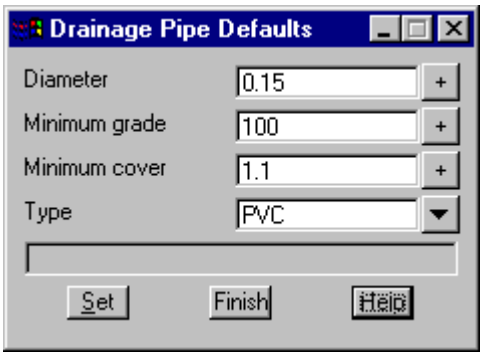
The **drop** will be used to set the invert level of the outlet pipe relative to the invert level of the inlet pipe. The drop should always be entered as a positive value.The **network editor** has many more options for aligning the pipe inverts at the manholes.

Generally, do not use a default name. Leave all of the manholes unnamed and then use the **Set Pit Names** function on the drainage network editor.

The manhole **type** is selected from a list by selecting the icon beside the **Type**. This list is obtained from the **drainage.4d** file. This manhole type will be used by ILSAX, PCdrain and RAT-HGL, RAT2000 and XP SWMM to identify the inlet capacity of the manholes. This value is not exported to the Drains program but it will be imported after a Drains design run. See **Drainage Import/ Export**. It is best to set this to the most common manhole type and then change the few that are different later in the **network editor**.

You **must** click the Set button to set the default values. Finish alone will **not** set the defaults.

4.1.3 Pipe Defaults



The pipe **diameter** is set in metres or feet **not** mm or inches. Set this to a minimum pipe diameter for your project and then your drainage design package can increase them if required. To model an existing system enter the most common pipe size and then alter as required in the **network editor**.

Allowing for Pipe Thickness

When 12d set the pipe inverts it checks the **minimum cover** from the obvert of the pipe to the finished ground surface at both manholes. If the grade of the pipe is less than the **minimum** grade, the grade of the pipe is increased. Finally, 12d checks if there is anywhere along the pipe length that has less than the **minimum cover**. If there is such a low point in the design surface, the pipe is shifted vertically downwards to achieve the cover required. 12 defines cover as

Cover = surface level - diameter - invert

Therefore, an allowance for pipe thickness may be added to the minimum cover.

When using the network editors to change the pipe diameters the invert levels will remain fixed and the obverts will change. The inverts may be reset using **Regrade Network** on the **network editor**.

Select the drop down icon beside the **Type** field to select from a list of pipe **types**. These pipe types will be sent to your drainage design package so make sure you use the same names in 12d as you plan on using in the design package. The list of available pipe types is set in the **drainage.4d** file.

You **must** click the **Set** button to set the default values. Finish alone will **not** set the defaults.

4.2 String Colour and manhole Label Text Size/location (string defaults)

12d can automatically label the manholes at a fixed offset from the manhole using **view text** OR you can use the network editor **Set Catchments** to create text labels that can be moved/rotated etc.

For view text, the default line colour and text size are set by selecting **Utilities =>Defaults.** The following panel will appear.

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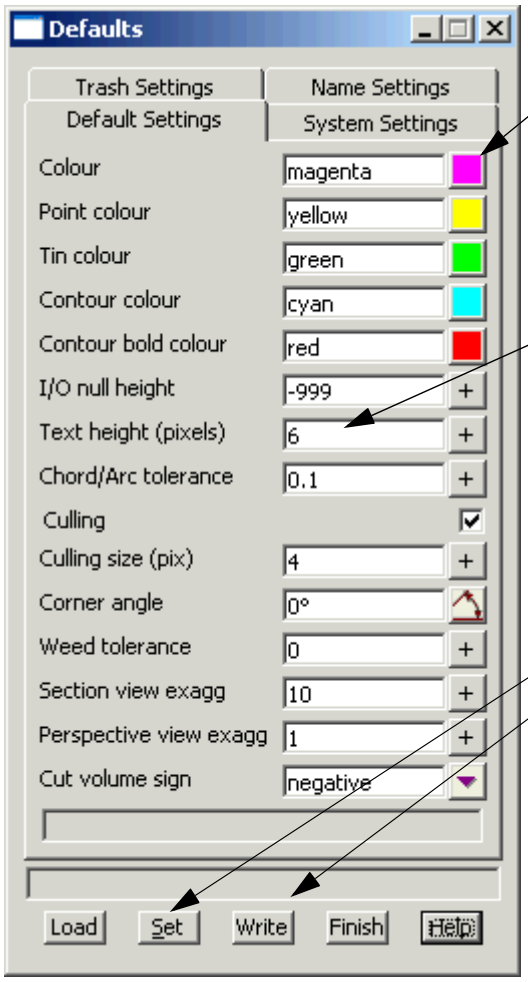


LB to set the colour of the drainage string and manhole labels.

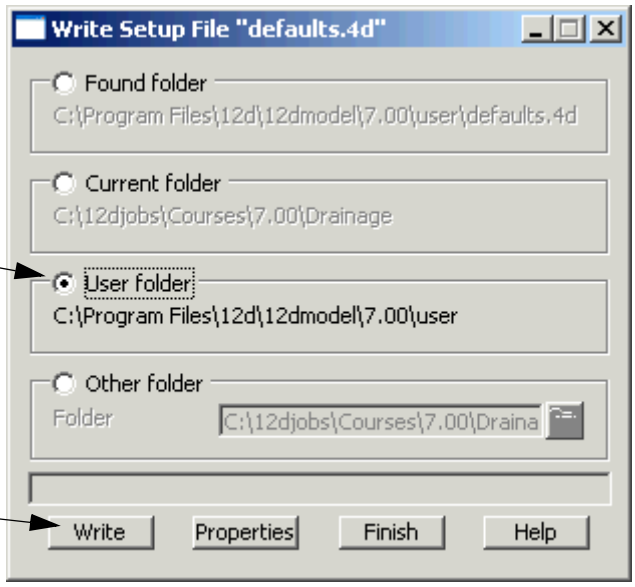
The default size of the text is set in the **Text height (pixels)** field. A text size of 6 to 8 pixels is generally adequate. Your choice will depend on your screen resolution and the age of your eyes.

Select **Set**
Select **Write**
the following panel will appear.

Selecting **Current folder** will save ALL these defaults for projects in this working folder only. The defaults set in the **user** or **setups** directories will not be used if you select this option.

Selecting **User folder** will save your defaults so that all other 12d projects will use this defaults. This is the most common option (unless your network administrator has not given you write access to this area (check **Properties**).

Select **Write** then **Finish**



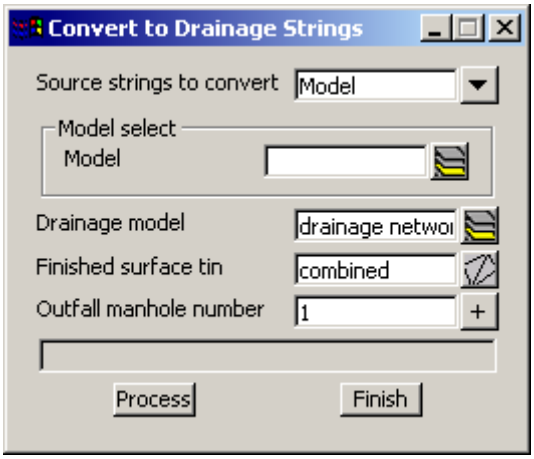
4.3 Create the drainage strings from the dwg strings

12d will convert the import strings into 12d drainage strings. The default pipe, manhole and tin data will be used to set the levels for the network

From the menu select

Design->Drainage-Sewer->Create drainage from strings

The following panel will appear.



The fields and buttons used in this panel have the following functions:

Field Description	Type	Defaults	Pop-Up
Data source	choice box	model	view,model,string
data source for strings to be converted			
Select		input box	
Model containing strings to be converted			
Drainage model	model box		
The new drainage strings will be added to this model. If it does not exist it will be created.			
Finished surface tin	tin box		
This tin should be the same as your tin default for the drainage strings.			
Outfall manhole number	real input box		
The network will be numbered using a numerical method. The most upstream manhole of the outlet line will be assigned this manhole number. This numbering system can be changed if desired.			
Process		button	
Coverts the strings to the drainage strings.			

Finish button

Removes the panel from the screen.

Important notes:

The imported strings must be drawn in the direction the water flows.

Manholes are created at all vertices on the strings.

Trunk lines must have a vertex where the branch lines join.

Integer string names can be used to control the order in when the drainage lines are numbered. These names will be transferred to the 12d drainage strings. **Naming the strings is highly encouraged.**

The drainage lines must have string names to use the **Set Pit Names** feature on the **network editor**.

Manholes can always be renamed in 12d after the import is complete.

4.4 Drawing the Drainage Network **in 12d**

The following method of drawing the drainage pipe systems has proved very efficient in the past. However, many people will have their own, "tricks of the trade". Therefore, the rational behind the following procedure will be important for the user to understand when they want to try out their own procedures.

Key Points

1. Draw the pipes where they actually are! Do not place the manhole centres at the setout point and have the pipes in the wrong location (pipe cover will be affected). Use setout strings for setout points!
2. Draw all drainage lines in the same direction. Either all uphill to downhill (flow in the direction of increasing/ascending chainage) or downhill to uphill (flow in the direction of decreasing/descending chainage). You choose but they all must be the same.

   If you choose **descending chainage** then you must select Pipe=>Default Grading then Grade to have the grading applied to the drainage string.

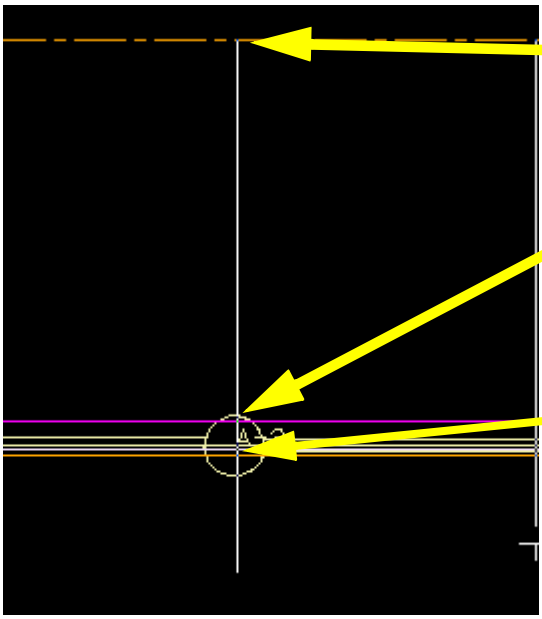
   The 12d drainage network editor and the drainage design software packages have sophisticated algorithms to set pipe inverts as well. Consider this grading a preliminary estimate.
3. If you create the trunk lines before the branch lines, you will have to select the **Regrade Network** later to adjust the trunk line levels.

4.5 Manhole Setout Point, setout strings and selecting the location for the manhole centre

The centre of the manhole (x,y and z) need not be the **manhole setout point** used in the setout tables.The setout location can also be set independently of the level. It is recommended that you place the manhole so that the pipes are shown in the desired location and then use the desired option for setout. With the pipe in their proper location the pie cover and service clashes will be calculated correctly. The default settings for the manhole setout location are found on the **network editor-defaults-pits-setout** data.

Key Points in Using Setout Strings

1. Enter the road models and the strings names (identifies) via the **Network Editor, Global-Utility Models** tab, **Road design file.**
2. Specify that these strings are to be used. Select **Setout string** for the XY or Z setout modes on the **Defaults->Pits setout** area or **Pits->Setout** tab.
3. Select the **Set Pit Details** button.



X,Y Option 1 Manhole Centre

The x,y location will be the centre of the manhole.

X,Y Option 2 Road Centre Line

The road chainage and offset are measured perpendicular to the road centre line out to the manhole centre or setout point.

X,Y Option 3 Setout string

The manhole centre is dropped perpendicular onto the set out string to obtain the x and y.

Z Option 1 FS tin

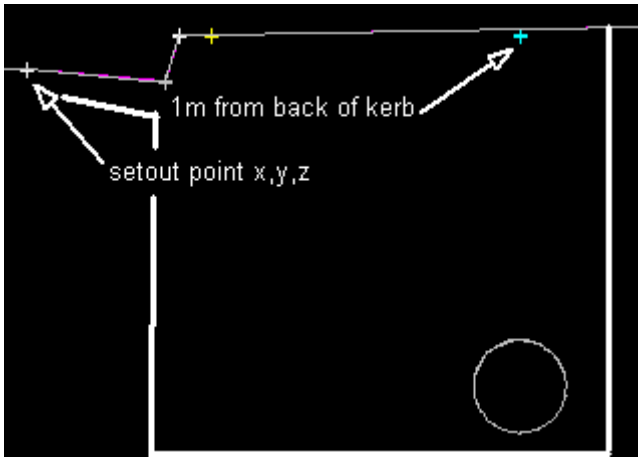
The manhole setout level is obtained from the finished surface tin at the manhole centre.

Z Option 2Setout String

The manhole centre is dropped perpendicular onto the setout string and the level is obtained from the elevation on the string.

Example

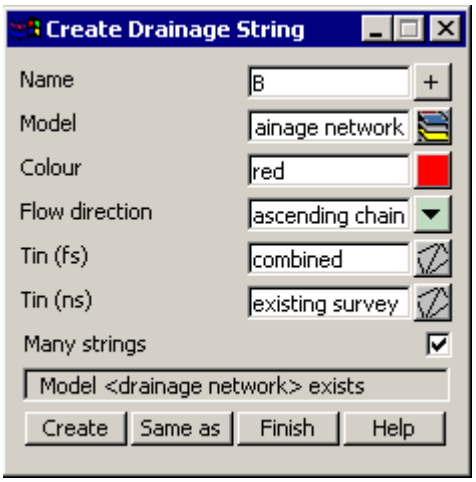
In the diagram below the setout point is lip of kerb. The setout x,y location level z will be obtained from the setout string and the pipe will be shown at its proper position.



4.6 Creating the Drainage Strings in 12d

Drainage strings can also be created in 12d. A drainage string is created by selecting

Design =>Drainage-Sewer =>Create

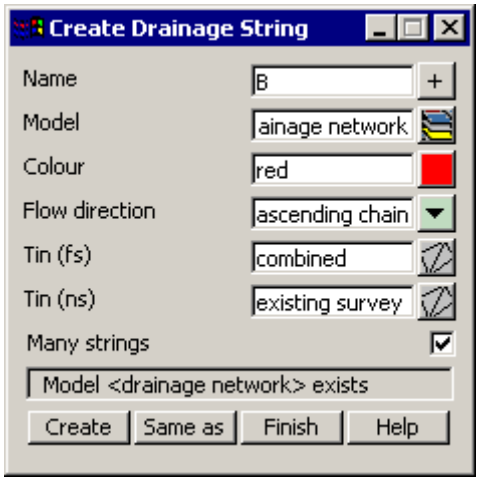


TIP: If you have already created a drainage string, click the **Same as** button and select the drainage string to obtain the panel values from that string. After selecting the string, change the string **Name.**

Each drainage string in the model must have a unique **Name** if you plan on using the **Set Pit Names** option after all of the strings have been drawn. The name of the string should be kept short, <B> for example, as it will be used as the prefix or suffix for the manhole names. Examples of manhole naming schemes available for a string labelled, <B>, are B1, B2, B3 … ,or 1B, 2B,3B…or 1/B,2/B, 3/B… etc.

Sequential numbering all of the manholes (1,2,3 etc.) is also an option. The manholes on the string named **1** will be labelled first and then **2** and so on. If you insert a new string with a name in the middle an existing series (i.e. add a new string 2 when strings 1,2 and 3 already exist) then name the new string 1.1 (for this example) and then use the **Strings=>User=>Set String Name by number** command.

Drainage String Create Panel



For auto manhole naming, every drainage string must have a different **name**.

All drainage strings for the one outlet should be in the same **model.** Only drainage strings should be created in this model. If the model does not exist it will be created.

Colour will be the colour used in the drainage longsection drawings.

Flow direction should be **ascending chainage** if drawing uphill to downhill or **descending chainage** if drawing downsteam to upstream. All of the strings in the model can have their direction changed later using the **Design=>Drainage-Sewer=>More=>Reverse all strings** com-

mand.To graphically check the flow direction of all strings see **Flow in the Wrong Direction.**

The **Tin (fs)** field will be completed for you with the default value you entered in **Design=>Drainage-Sewer=>Defaults=>Tin(fs)**. The finished surface levels on your long section plots will be obtained from this tin.

The **Tin (ns)** field is optional. By specifying a natural surface tin, natural surface levels can be shown on your drainage long section profiles.

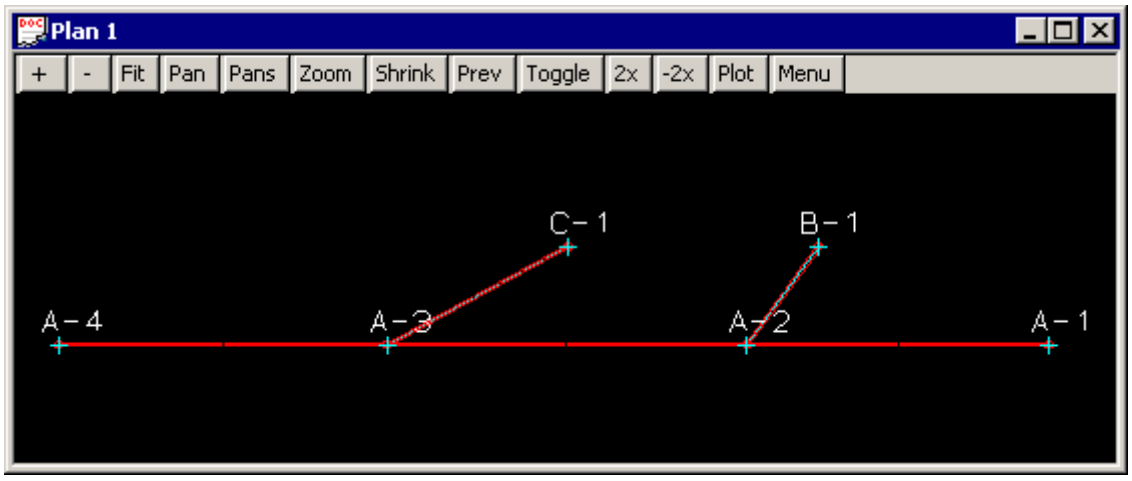
Selecting **Many strings** will have the panel re-appear, ready to go again, after creating each string.

Click the **Create** button to begin creating the drainage string. The following panel will appear.

To create your first manhole, select **Edits =>Append**. A + will appear with your pointer.

We are going to place our manholes on the vertices of the layout that we imported. **Toggle the vertices on** (just to help you see where the manholes are going to be placed), turn your **line snap** off and the **point snap** on.

The first line we will create is the branch line on the east (Line B) then the branch line to the west (Line C) and finally the trunk line running from east to west (Line A). The drawing below shows the manhole names. You will not see these as you draw the strings but we will create them later.



Click and accept the point labelled B-1 and then click and accept the point labelled A-2. Since this is the end of the branch line, select **Finish** from the **Drainage Edit** panel. If you have other edits to make to the string do not select **Finish** yet (i.e. set some specific invert levels) **RB** then select **Cancel** from the menu. This will leave the edit menu active for further changes.

The **Create Drainage String** panel will appear again for you to create additional drainage strings.

Create line C in a similar fashion. When this line is finished, start on line A but only place the first manhole, A-1. manhole A-2 is a junction manhole and requires some special attention.

4.7 Exact Methods for Placing Manholes

To place your manholes on a kerb line string, turn the **line snap on** and the **point snap off**,. Keep the **height snap off**.

For locating manholes at specific x, y coordinates, simply start typing the x coordinate instead of clicking onto a location. An input panel will appear for you to enter the x and y coordinate separated by a space.

To place the manholes at a specified distance from a point use the **RB** and select **SNAPS COGO=>Locate=>Offset**. Follow the prompts given in the message area (bottom left corner of the screen). You will need experience with the 12d "directional pick" to use this capability.

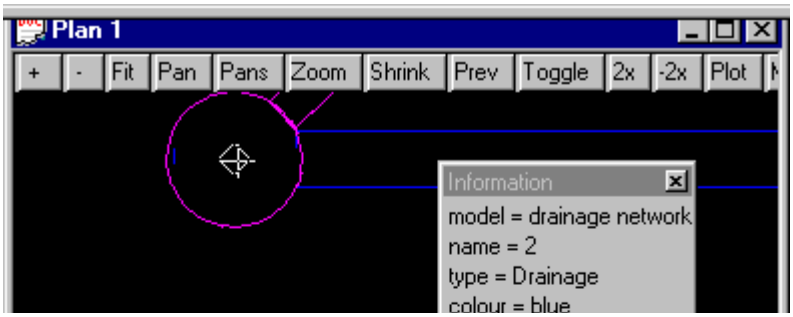
4.8 Junction manholes on Trunk Drainage Lines

Key Points

1. The branch line must **Point Snap** onto the centre of a manhole on the trunk line.
2. All strings must be in the same model.

Trunk drainage lines are created the same way as the branch lines except special care must be used when placing the junction manholes. When placing the junction manhole *on top of* the branch line turn the point snap on and the line snap off (the F3 and F4 keys are convenient for this). Zoom into the branch line junction manhole so that you can snap onto the centre of the manhole.

A manhole contains three points; one at each point where the pipes join (invert level points) and the one you want to snap onto at the centre of the manhole (setout level point). In the figure below, the blue line is being placed to join the magenta line. Note that the diamond indicates that there is a point snap and the information panel indicates that we are snapping to line 2. The information panel also indicates the snap was a point snap.



After snapping onto the branch line manhole click **Prev** on the **plan view title area** to return to the previous view and continue appending manholes.

You can tell that you have created a junction manhole correctly when you profile the trunk line

and you can see the branch lines joining at the junction manhole. If the branch lines are not shown then one of three things have gone wrong.

1) centre of the manholes did not align, **Use Strings=>Points Edit=>Move** to move the branch string manhole

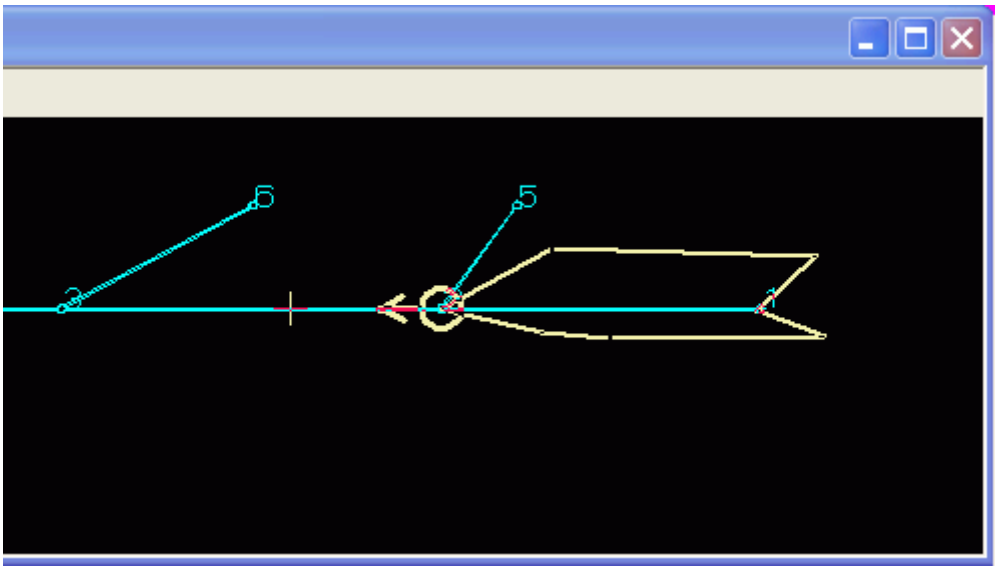
2) the "downstream end" of the branch line must be the junction manhole. With the direction of flow for the string set to "Ascending" the junction manhole must be at the high chainage end of the string. If the direction of flow for the string set to "Descending" the junction manhole must be at the low chainage end of the string. To check the flow direction see **Flow in the Wrong Direction.**

3) The branch string and the trunk string have not been created in the same drainage model. From the main menu select **Strings->Inquire (F2) and** select the strings to check their models. If this is the problem, use **Strings=>Edit=>Change** and specify the correct drainage model (enter the model BEFORE picking the string) or **Strings=>Edit=>Duplicate** to duplicate one of the strings into the correct model.

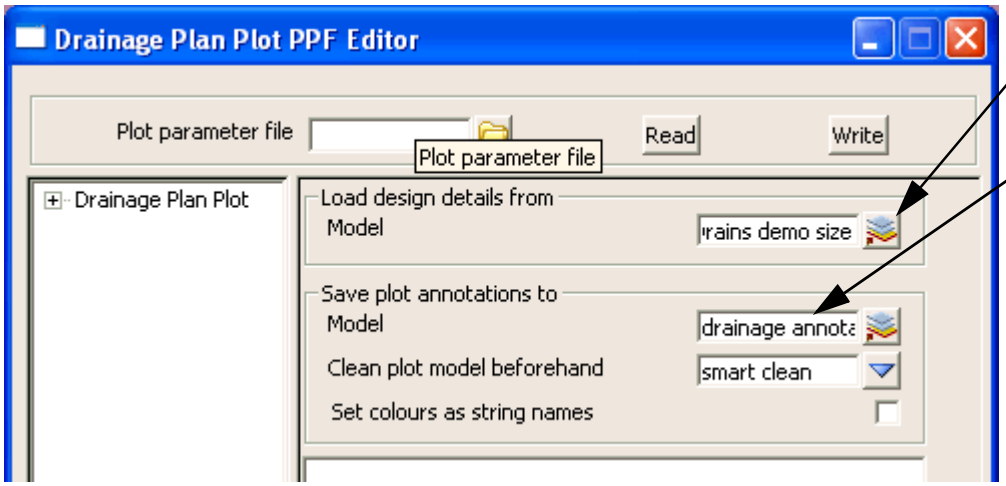
4.9 Flow in the Wrong Direction

The direction of flow is used by 12d to determine where the outlet is on the drainage line.

The direction of flow will be indicated with the arrow when using the **Drainage Network Editor** and you have selected an manhole (all but the outlet).



Also, the **Drainage=>Plot=>Plan annotation** option can be used to label the network with the direction of flow.



Select the drainage model.

Enter a model for the plan annotations.

Select **Plot** on the bottom of the panel and then add the model to a new plan view.

If one of the arrows in the plan annotations is going in the wrong direction then the direction of flow flag must be changed. From the main menu select

Strings=>Properties=>String

and change the **Flow direction** to the other value (there are only 2 options). You may replot the annotations if you want to confirm the change.

4.10 Drainage Section Views and Plots in the Wrong Direction

If the section views and the profile plots are running downhill in the wrong direction, the **reverse** function may be used to change the direction.

To reverse only one string, from the main menu select

Strings =>Strings Edit =>Reverse

and pick the drainage strings to reverse. This will also change the drainage flow direction attribute from **ascending chainage** to **descending chainage.**

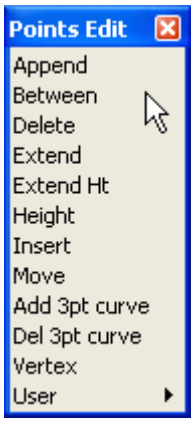
To reverse all of the strings in a model select the **Strings Reverse** option,

Design =>Drainage-Sewer =>More=>Reverse all strings

To confirm the direction of flow see **Flow in the Wrong Direction**

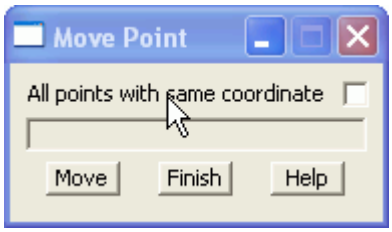
4.11 Moving, Adding and Deleting Manholes

The best way to edit the plan layout of the drainage is via the **Strings->Points Edit** commands.



The **Append, Between, Delete, Insert and Move** commands are the most common.

The **Move** command has an extra option for moving junction pits. Selecting **All points with the same coordinate** will move all points on the view that are at the same x,y coordinate. The point selected will move first and the others will follow **after** the new location has been accepted.



5.0 Drainage Network Editor

The drainage network editor is used to automatically or manually change the attributes of your drainage network. These abilities include:

General

- **Changing the vertical alignment of the network**
- **Setting manhole names**
- **Service Clash Checking**

Hydrology

- **Catchment Areas**
- **Checking the Automatic Catchment Linking**
- **Global and Defaults Tab for C values and Tc calcs**
- **Drainage Templates**
- **Bypass flow routes**

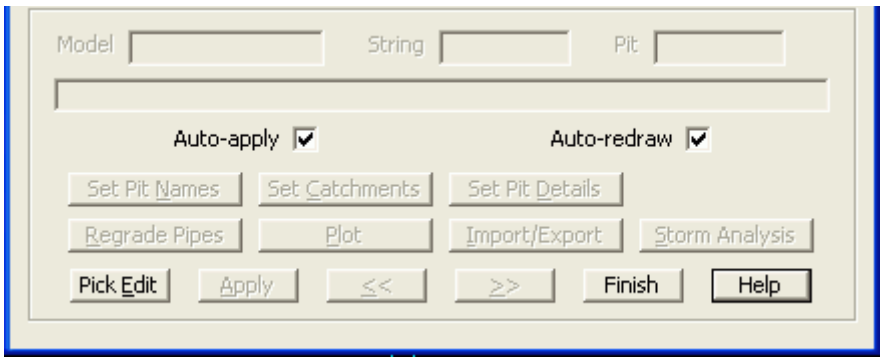
Hydraulics

- **Outlet and Tailwater Conditions**

The drainage network editor is accessed through the main menu by selecting

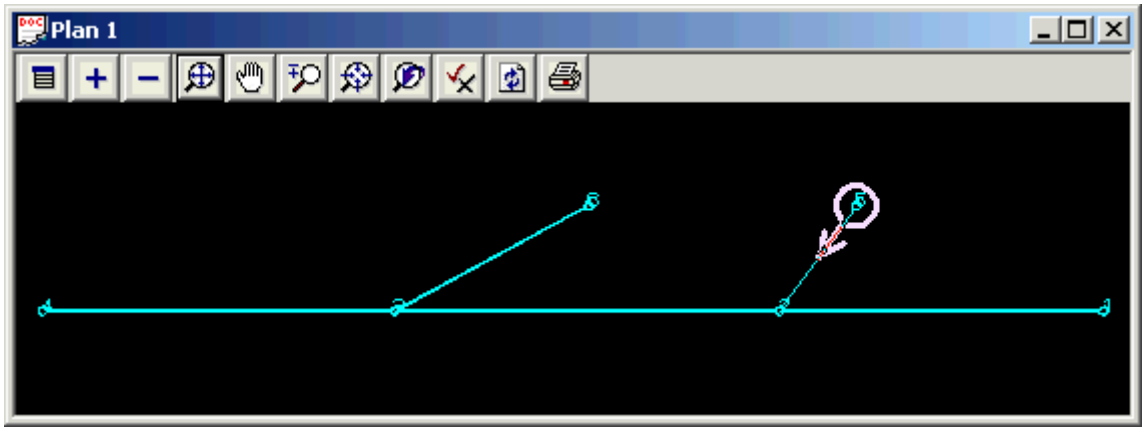
Design=>Drainage-Sewer=>Network Editor.

The bottom section of the network editor panel is shown below.



To begin select a 12d drainage manhole that is in your drainage model. In plan, **you must pick and accept the manhole and not the pipe! Pipes may be selected only in the section views.**

The manhole that was selected is highlighted with a circle and an arrow shows the direction of flow (see image below).

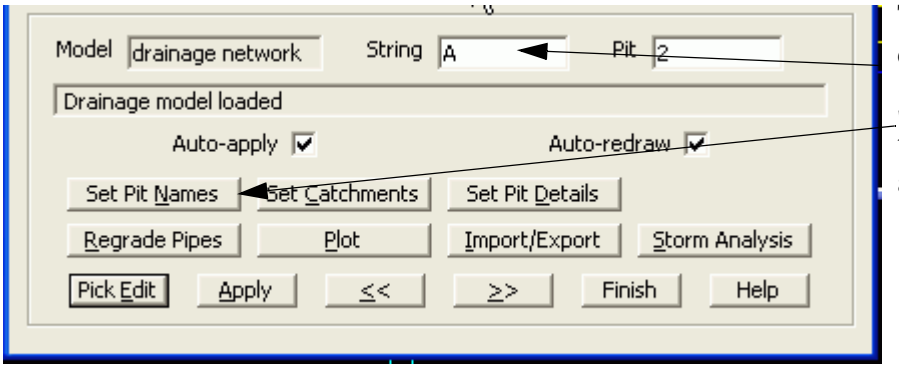


The option buttons on the drainage editor now become active.

5.1 Setting manholes names (and pipes)

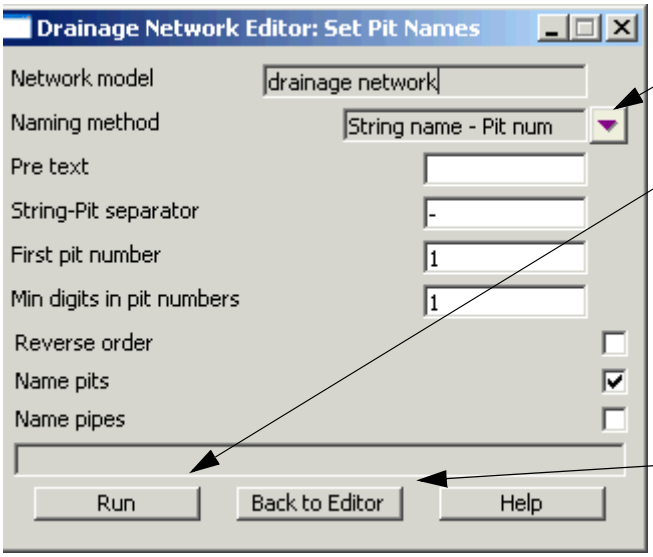
If your network was created from 2d strings the manholes will be named incrementally using integer numbers. Use the drainage **network editor** to manually change explicit ones or quickly change all the names using a different naming method.

The manhole names are based on the string names so make sure the string names are set. To view string names on the plan view, go to the Plan View tool bar and select **Toggle=>Names**. If they do not appear see Displaying View Text.



The string names may be changed **String** field.

Select **Set Pit Names** and the following panel will appear.



Field descriptions

After selecting the desired naming method and options.

Select Run to change/assign the manhole names. These names should be visible on the plan view with the drainage network model. If they do not appear, see the section below: **Displaying View Text**

To create larger text labels that can be moved see **Labelling the Manholes**

Select Back to Editor to remove the panel.

5.1.1 Displaying View Text

After you have named the manholes in your network, the names should appear beside each manhole in the plan views. If they do not appear check the following.

After you have named the pits in your network, the names should appear beside each pit in plan. You can change the text size for each string by selecting **Strings->Editor** and then pick-accept the drainage string. The text size is set from the selection **Utilities->Size.**

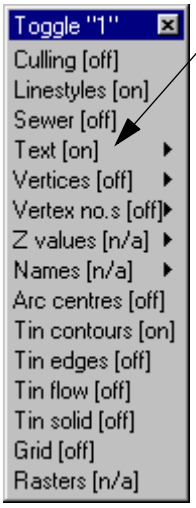
The offset from the pit is set by selecting **Strings->Properties->Strings**, picking the drainage string and setting the values for **Delta x**, and **Delta y**.

Note: Auto pit names are **NOT** shown in the section view.

Trouble shooting auto pit names not being displayed

Problem: Plan text is toggled off

Solution: select **Toggle** on the **plan view title area**

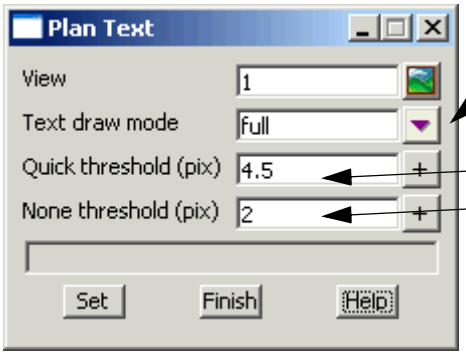


Check that the **Text** is toggles on. If it is on then walk right and ensure the text is turned on or n/a for your drainage network.

Problem: Small text is turned off

Solution: select the **Menu** button on the **plan view title area** and select **Settings =>Text => Text**

- if these values are too large the text will not appear on the screen. Either decrease these values or increase the text size.



Select drop down and change to **full**

Quick threshold and None threshold if these values are too large the text will not appear on the screen. Either decrease these values or increase the text size.

Problem: string text size is 0

Solution: Each drainage line can have its own size of the text. To change it, select **Strings=>Editor** then pick-accept the drainage string. The text size is set from the selection **Utilities=>Size**. If this is set to zero the labels are not drawn.

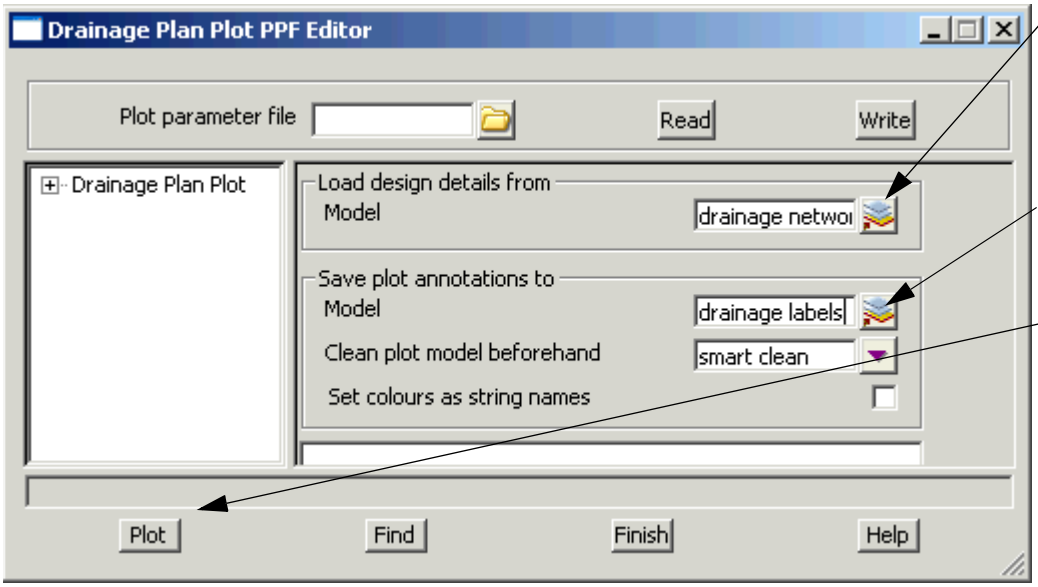
5.2 Labelling the Manholes and Pipes

To label the manholes and the pipes use Drainage Plan Annotations. This may be accessed from one of three locations.

Location 1: From the plan toolbar

Select the **plot** button and then **Drainage plan**

Note (The following panel has been reduced in size).



Select your drainage model

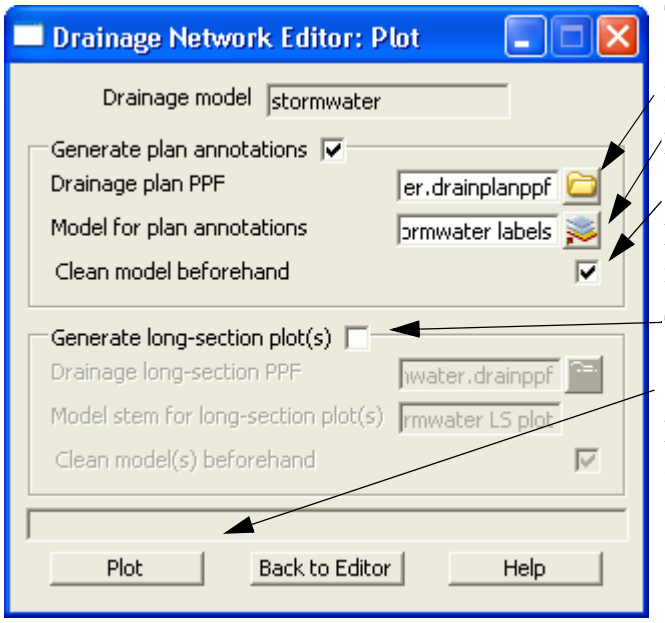
Enter a model name for the new labels

Select **Plot**

Now add the drainage labels model onto the plan view.

Location 2: The **Plot Button** on the **Drainage Network Editor**

The following panel will be displayed.



This option can plot both the long section and plan at the same time. Select a ppf file from the library.

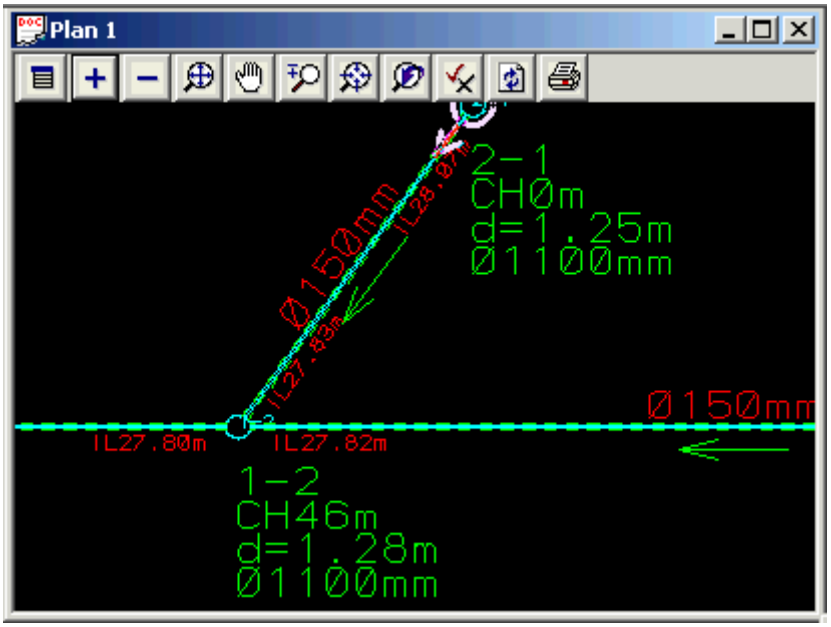
Enter a model for the plan annotations.

Select **Clean model beforehand** if you have not manually moved any of your manhole labels.

Turn off the long section plot for now.

Select **Plot.**

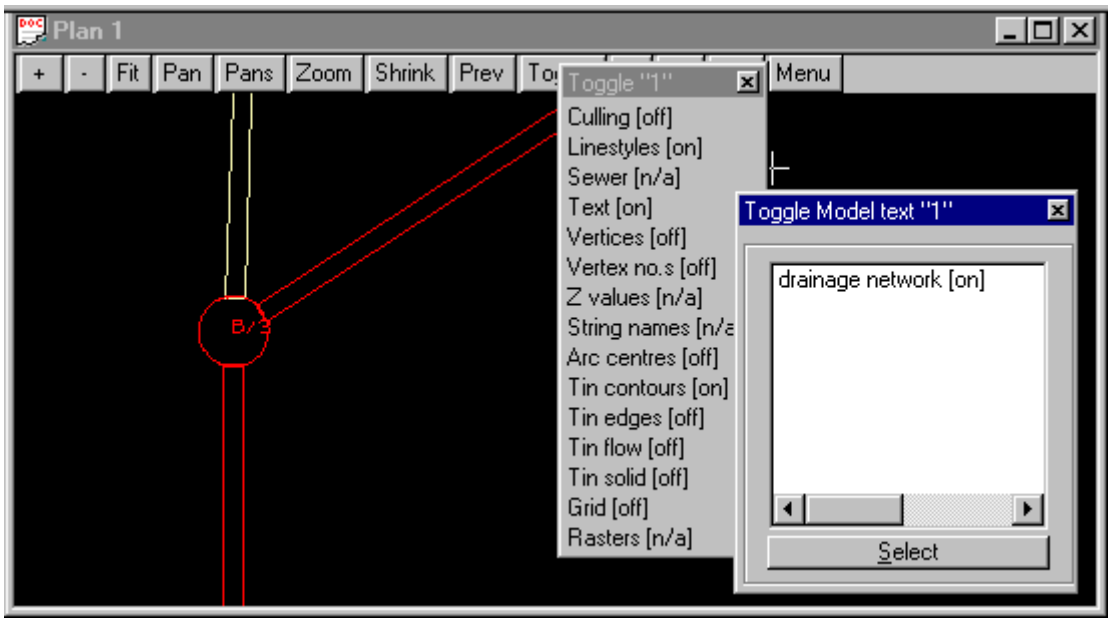
Now add the **Model for plan annotations** onto the plan view.



The text properties can all be customised using the plot parameter file but this will be discussed later in the plotting section. These labels are **not** automatically updated when you change the names or pipe diameters. You must rerun the labelling routine to update the labels.

5.2.1 Turn off View Text Manhole Labels

To turn off the automatic view text manhole labels for this view select Toggle=>Text and then walk right to select the drainage model. Do not click on **Text**, rather walk right. If you click **Text** you will toggle on/off all of your text on the view. Not just the drainage model.



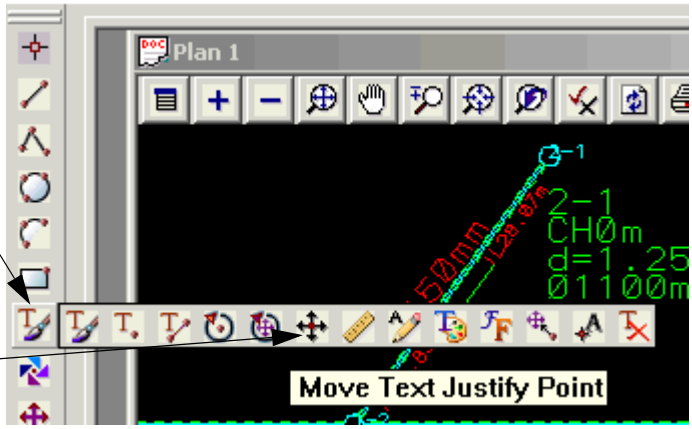
5.2.2 Moving Text

The labels created may be manually moved using the **CAD toolbar** but if the model is relabelled the text will return to its original location! Text moved via the **Drafting->Multi string translate** will remain in the moved position when **Smart Clean** is selected in the Plan Annotation panel.

Before selecting text turn on your **teXt snap.**

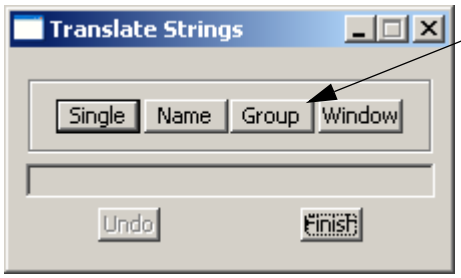
To move a single line a text use the **CAD** toolbar. Select the **Move text justify** button. To use this toolbar you must **DRAG** the **Create text** button to the right

and then release when the pointer is on the **Move Text Justify Point.**



To move a pre-defined **Group** of text select

Drafting->Multi string translate



Select **Group** and then pick and accept one of the text items in the group. Move it to its new location and accept.

Note: To move another group you must select the **Group** button again.

5.3 Catchment Areas

Key Points

1. Start near the manhole for auto linking.
2. Manual linking available via Network Editor->Catchments->Pick button.
3. Close the string for SAG pits.
4. You may fill the strings using "Utilities->Super strings->Fills"
5. You can disable the auto selection of a string via Right mouse on the pick button then select **Clear**.

Catchment areas for your hydrological model may be defined using a Super, 2d, 3d or polyline string to set the catchment boundaries. Other ways to set the areas are: manual entry in the **network editor**, via a spread sheet program, the **Top 10 Attribute Editor** or the **ILSAX pipe editor**.

Note that if a catchment string is created to define the area for a manhole then all other data entry types will be ignored and the area from the string will be used.

There are 3 sets of catchments and it is up to the user to decide how they are to be used. Often set 1 will be all the impervious areas and set 2 the pervious and set 3 for special areas. Each set has its own percent impervious. The 3 catchment sets are drawn in three different models.

If exporting to external drainage design programs they may note accept all three sets so check the interface notes before defining the catchments.

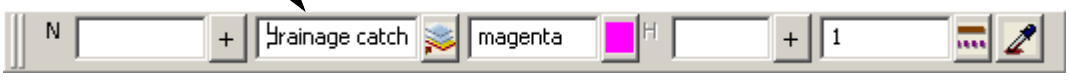
In each set/model, 12d will automatically link the catchment string to the manhole that is closest to the first point on your catchment string. This is the preferred method. If this is not possible, then a manhole may be manually linked to a catchment string using the **Catchment manual link**.

Also see **Checking the Automatic Catchment Linking**

Drawing Catchment Strings in 12d

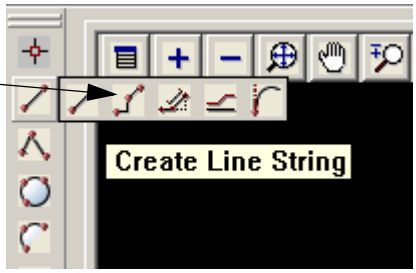
Before creating the catchment string set the **CAD control bar** data.

Type the name of a model for the catchment strings



Now to create the catchment string use the **Create line string** button on the CAD toolbar.

DRAG the **Create line** button and release at the **Create Line String** button.



The first point should always be placed near the manhole. 12d will assume that the catchment will drain to the manhole closest to this first point.

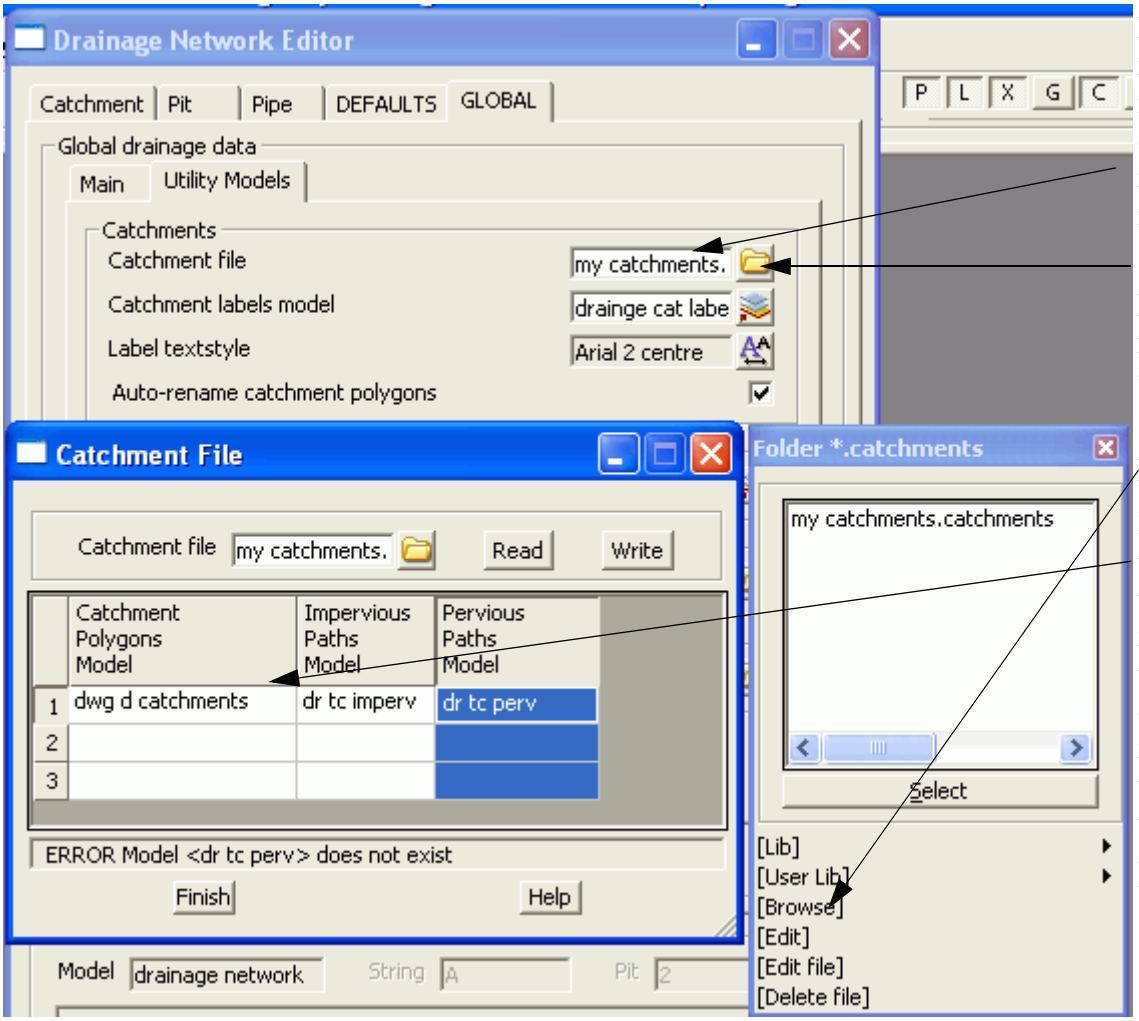
There is no need to go "overboard" with the accuracy of the catchment strings (except maybe with SAG pit catchments near the low points). From experience, it is more important to spend time verifying catchments in the field than spending a lot of time getting them "exactly" placed on the catchment plan. If you want to use the drawing as a catchment plan submission then the extra care in creating the strings may be warranted. Continue selecting and accepting the points on the catchment string and the press **ESC** to finish creating this string. You are now ready to create the next catchment string.

SAG inlet catchments: **DO NOT START AT THE INLET, just start nearer to this inlet than any other!** If you start at the inlet then move out to the crest of the catchment, the catchment overflow level cannot be determined from the catchment string.

For the last point on your catchment line select **Close** from the **CAD** toolbar. This function places the last point on the string over the first point on the string forming a closed polygon.

Once the catchments are drawn they become linked to the drainage network in the **Drainage network editor.** We will label the catchment with the manhole name and area at the same time.

Start the **Drainage network editor** and move to the **Global** Tab and then the **Utility Models** sub tab.



Enter a filename for the catchment models.

Select **More info** button.

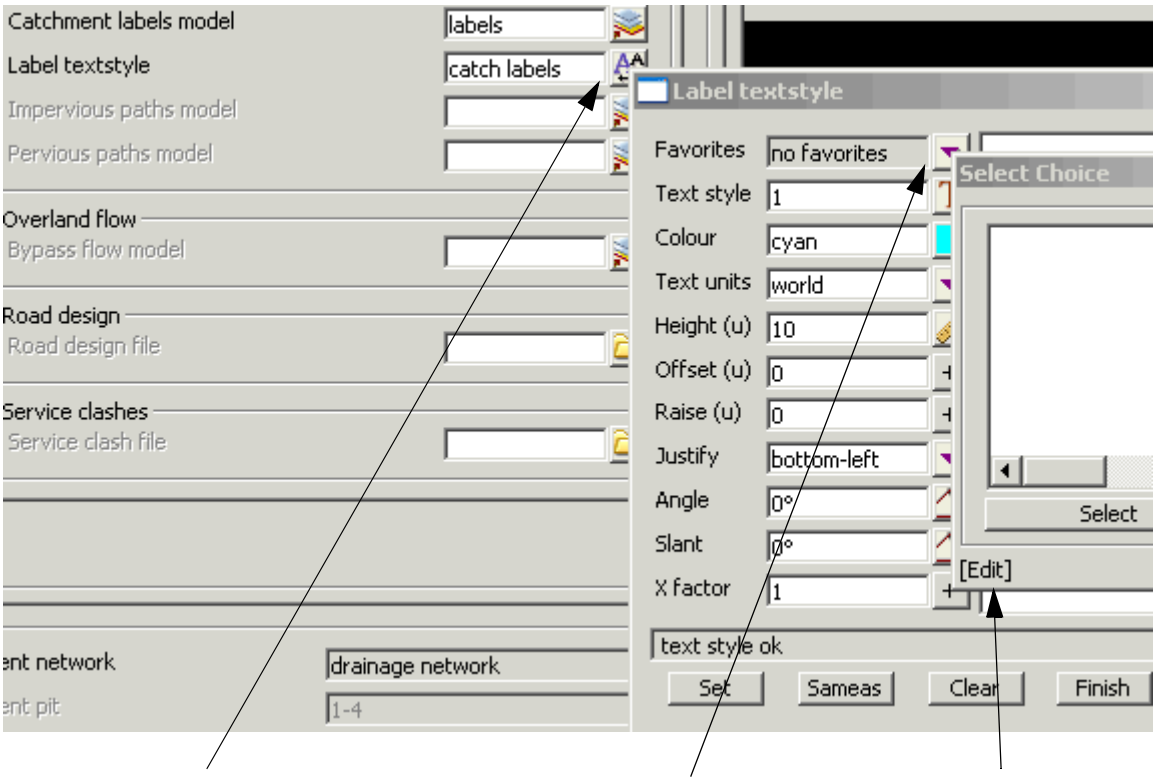
Select **Edit**.

RB click to select the model of the catchments used in the **CAD control bar** above.

Every manhole can have 3 catchments, row 1 is catchment set 1, row2 for catchment set 2 and row 3 for catchment set 3.

The **Auto-rename catchment polygons** will set the name of the catchment string to the pit name that it is linked to. If it is not linked to any manhole it will be named **"not used".** The model can be checked for **not used** strings by selecting **Models->String Info Table.**

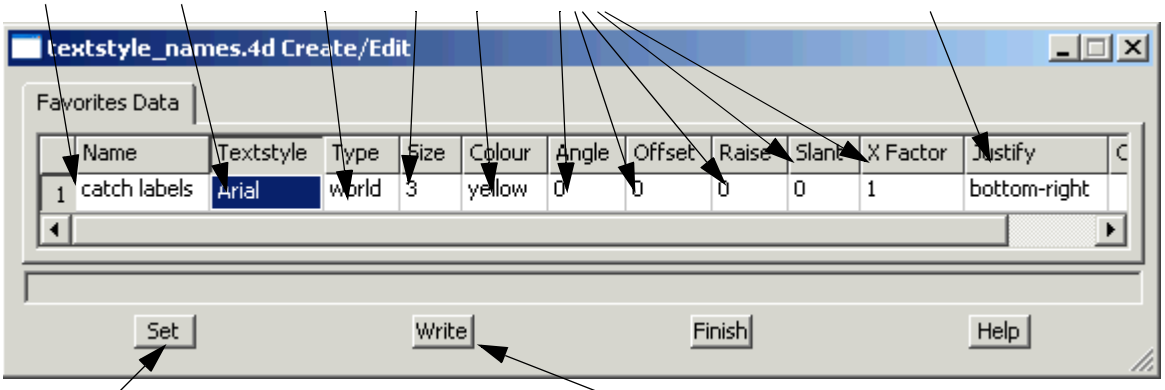
To label the catchment areas with the names of the manholes they are linked to we need a catchment labels model and a textstyle favourite. We need to create a label textstyle favourite if you do not have any favourites defined.



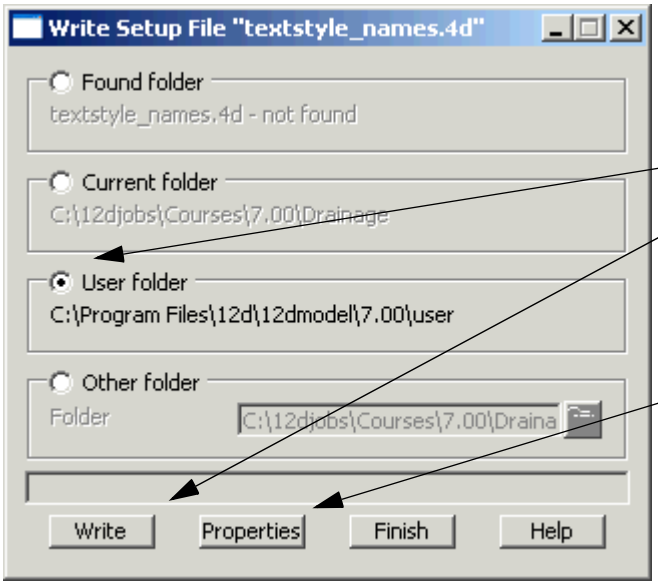
Select the **textstyle** button and then the drop down for **Favourites.** Now select **Edit.**

Enter the data as show. Some data you will have to type on the keyboard (**type**) and other you may use the right mouse button (**RB**) and then select browse.

Type RB RBTypeRBType RB



Select **Set** to store the textstyle favourite for this session only. To permanently save this text-style favourite and have access to it in all of your projects select **Write** and the following

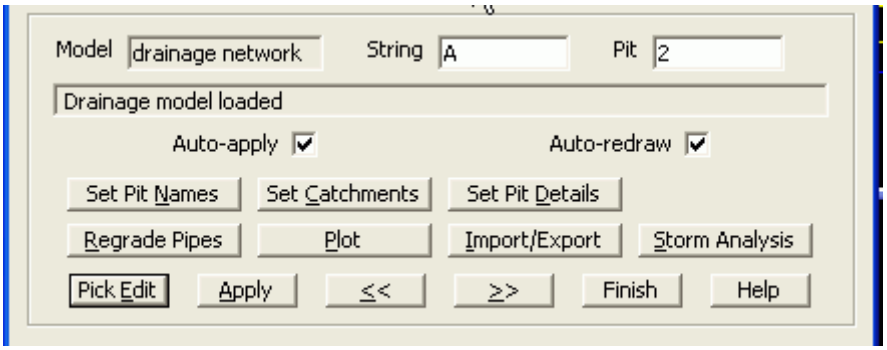


Select the **User folder.**

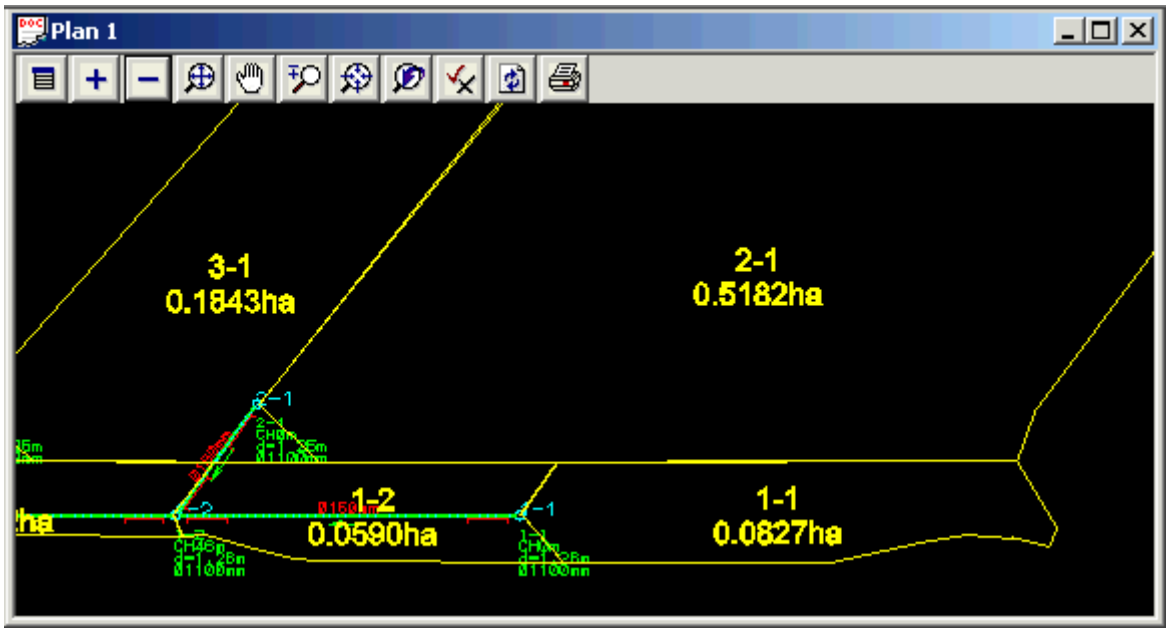
Select **Write** to save the favourite to the **User folder.**

If you are in a network environment and want to see if you have write access to this files select the **Properties** button.

Label Catchments



Finally select **Set catchments**. This will link the catchments to the manholes and label the catchments. Now add the model **labels** onto the plan view.

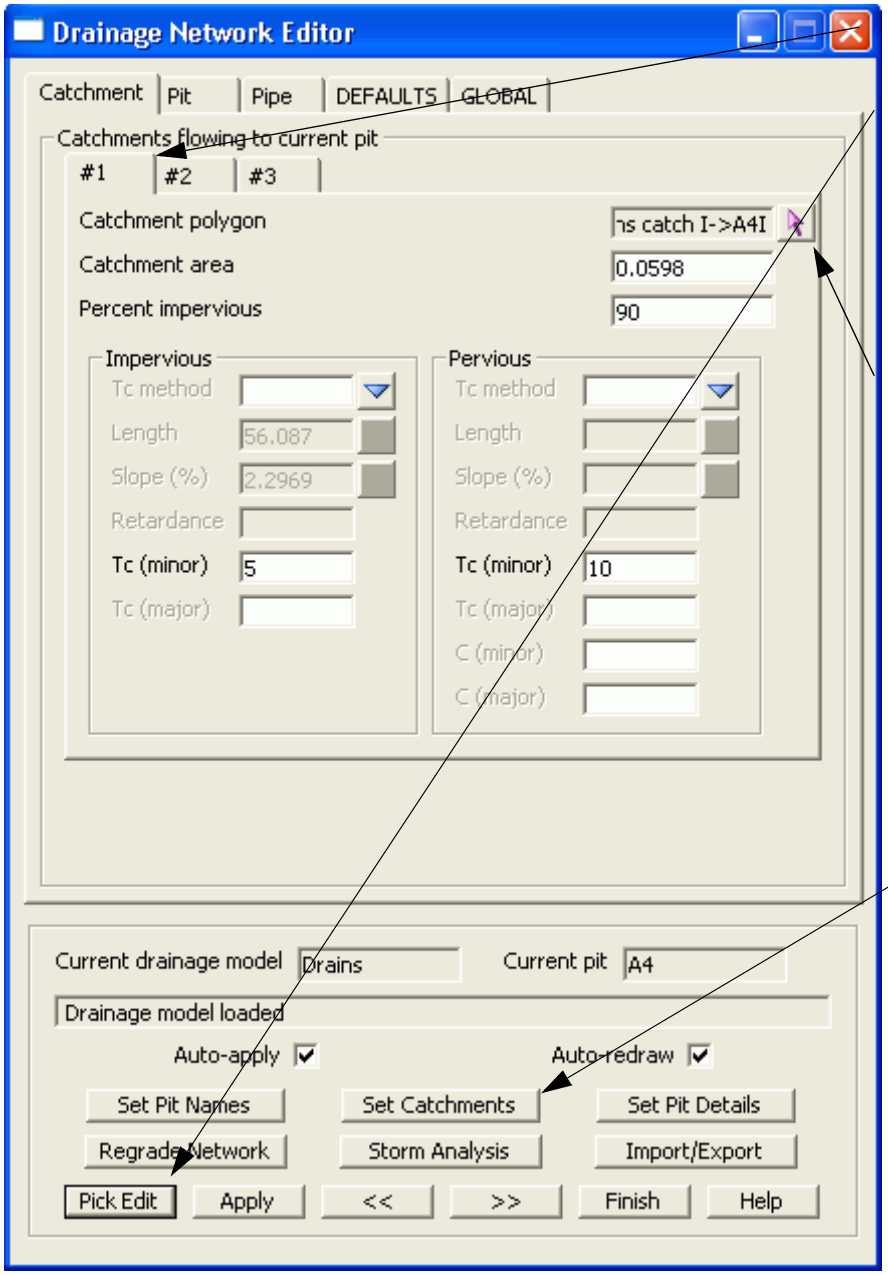


There are some cases where linking the closest manhole to vertex 1 is not feasible. In these cases you may manually link the manhole to a catchment.

Catchment manual link

The manual links are used when the first point on the catchment string is closest to the wring manhole. Note that the following restrictions still apply.

1. The string selected for catchment 1 must be in the model for set 1. To check if you have selected a valid string select the **Set Catchments** button.
2. If the catchment string has already been linked to another manhole (automatic or manual) then the new link will be created and the old link erased.
3. If you change the catchment model for one of the sets on the **Network Editor->Global->Utility Models->catchments** than all of the manual links in that set will be erased.



First change to the **Catchment** tab.Now either use the **Pick Edit** button to select the manhole or use the >> (next) or << (prev) buttons to move to the desired manhole. The manhole will be circled in the plan view and its name shown in the **Current Pit** field.

Now select the **Catchment polygon** button and pick the desired catchment string.

NOTE! If you decide to enter a value and NOT use the selected string **RB** on the button and select **Clear.**

If the **Auto apply** tick box is not selected then you will have to select the **Apply** button for the manual link to become active.

After the **Set Catchment** button is selected the measured catchment area will be shown in the **Catchment area** field using the units specified in the **Global-Utility models-Units** field.

Checking the Automatic Catchment Linking

The automatic manhole-catchment linking is easily checked by specifying a **Catchment labels model** with **Labels textstyle** on the **Global->Utility models** tab and selecting the **Set Catchments** button on the network editor. Also once the **Set Catchments** has been selected, the catchment is indicated when the manhole is selected using the network editor. Since there may be three catchments per manhole the catchment data last viewed in the editor is the catchment that is highlighted.

The catchment strings may be drawn in a CAD package and then imported into 12d or drawn inside 12d. The strings may be easily drawn in 12d with the tin contours and/or flow arrows displayed in the plan view.

5.4 Network Editor - Global, Default Settings and Explicit Settings

Design values for the hydrology and hydraulics calculations are set either globally (one value for the entire network) or via Defaults for the manholes or pipes. Defaults values may be overridden by explicit settings found on the **catchment, pits** or **pipes** tab. Explicit manhole/pipe settings need only be specified if the default value is not desired.

5.5 Drainage Templates

The default and global settings may be saved as a template for other projects/networks. After setting the defaults for a network follow these steps.

1. Save the project. We are going to do a clean where there is no undo.
2. Clean the drainage model so that all of the strings are deleted but the model attributes will remain. DO NOT SAVE YOUR PROJECT.
3. Export the model using **File IO->Data output->12da/4da data**.
4. Restart 12d, **Project->Restart** and DO NOT SAVE because you have cleaned your drainage network.

The 12d ascii file may now be imported to another project via **File IO->Data input->12da/4da data.** Since the global and default values are stored as model attributes, they will be imported with the network.

5.6 Network Editor - Hydrology

The **network editor** edits both the network and catchment data and it has already been introduced in the previous sections. This section will discuss the Hydrology **Global**, **Defaults** and **explicit setting** for the hydrology parameters. The parameters described on the **defaults** tab will also be found on the **Catchment** or **Pit** tabs.

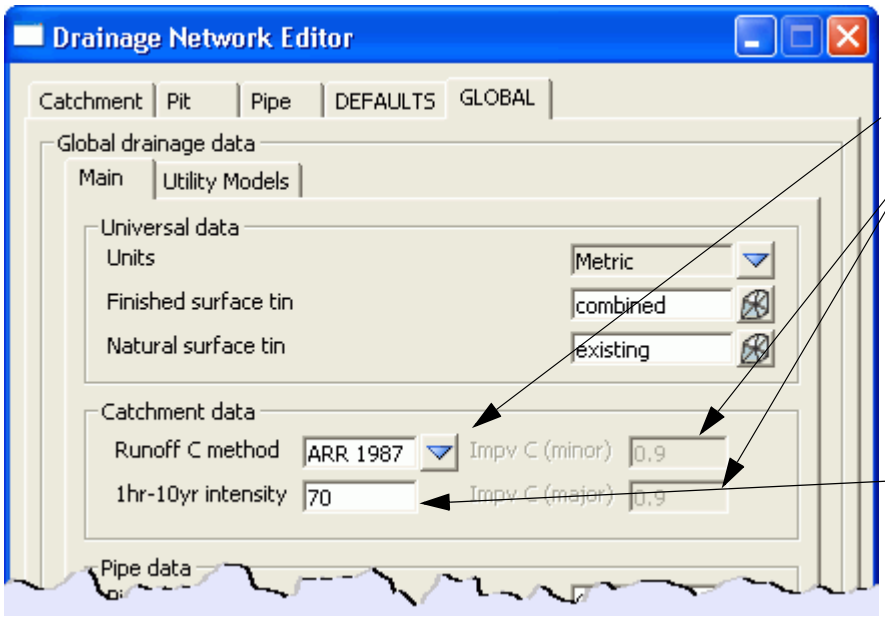
5.6.1 Catchment Areas

The catchment areas have already been discussed in the previous section. There is no default catchment area to apply to all catchments (as would be expected).

> **Note!** If a catchment string is linked to the manhole and the Set catchments button is selected, this string area will override any manual value that you type into the drainage area field. To ensure manual entry is maintained, RB select the string selection button and select Clear.

5.6.2 Coefficients of Runoff

Global Settings

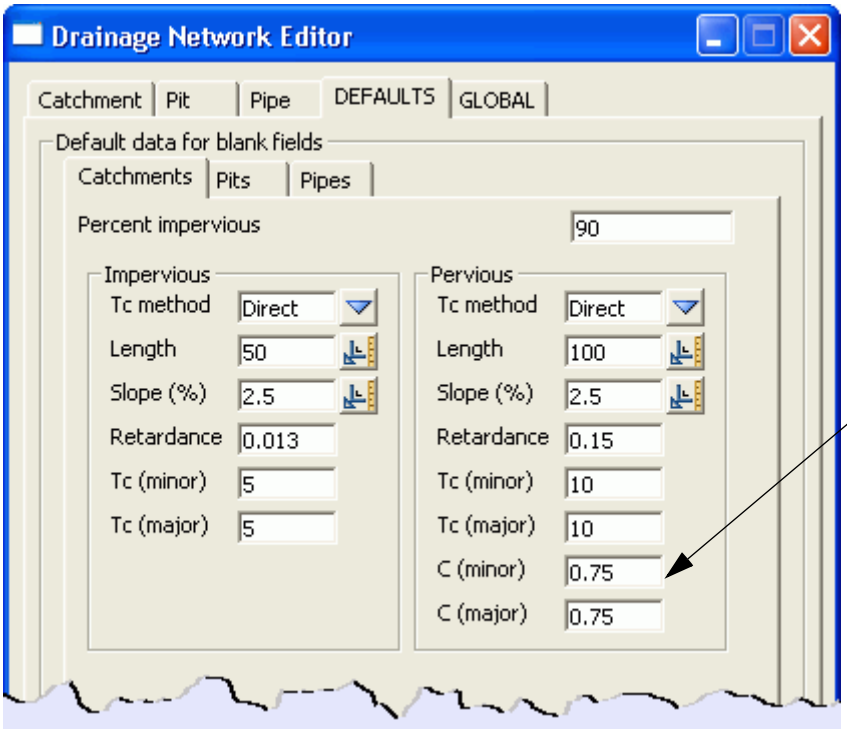


Runoff C methods include **Direct** and **ARR 1987.** For the **ARR 1987.**

Direct: There is a global impervious C value for both the minor and major storms.

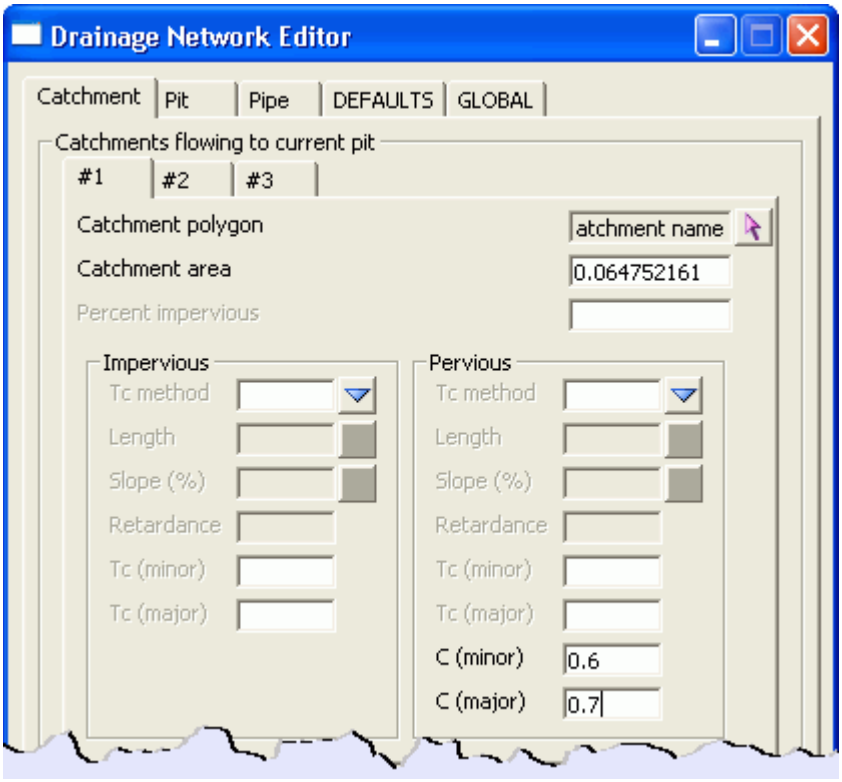
ARR 1987: The composite C value is calculated using the **1hr-10yr intensity,** the percent impervious**,** ARR frequency factors and the return period specified when hydrology runs are made. **No C values are entered if this method is used!**

Default Settings



The **Direct** method has both **defaults** and **explicit settings** on **Catchment** tabs (see below).

Implicit Settings

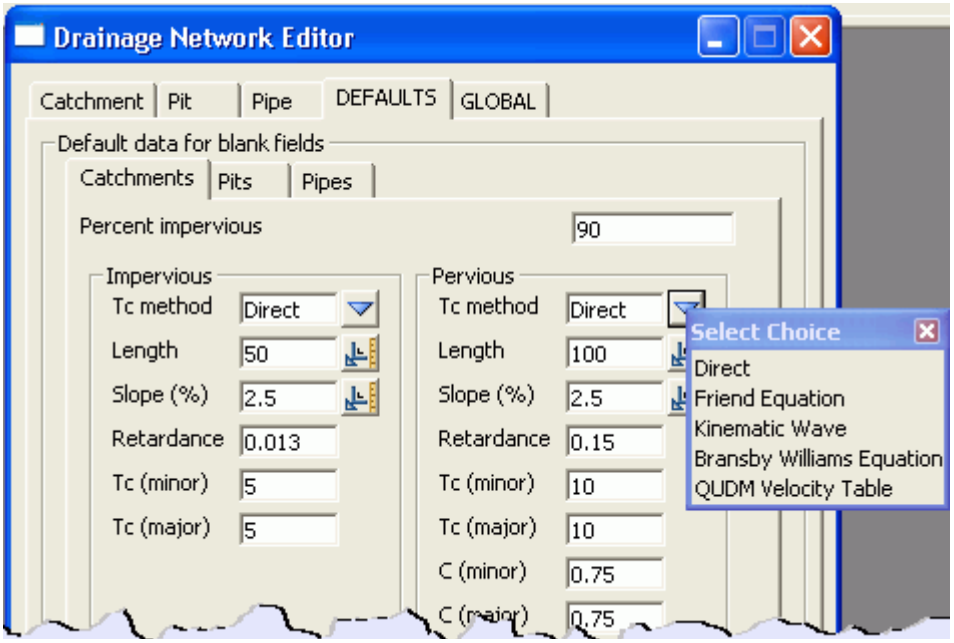


5.6.3 Percent Impervious

The default percent impervious for the network is set on the **Defaults->Catchment Defaults** tab and the **explicit settings** are on the **Catchment** tab (see above). The percent impervious is used to determine the area for the impervious and pervious components and the composite C value if using the **ARR 1987** method for calculating runoff coefficients.

5.6.4 Times of Concentration

There are several methods for entering times of concentration for the catchment areas (see list below). Default and explicit settings (catchment tabs) are entered/calculated for both the methods and values for the pervious and impervious areas. Since each catchment may use a different tc method all of the tc parameter fields on the defaults tab are active. They must be filled in even if you do not plan on using that value.



1. **Direct method** requires minor and major tc values.
2. **Friend**, **Kinematic Wave, Bransby Williams** and **QDUM** methods require the retardance, length and slope of the catchments to be entered. Default values must be entered but the optional **explicit settings** for slope and length can be entered on the catchment tabs or a catchment characteristic strings may be drawn (see **Catchment Tc path strings**). The length of this string is used for the length parameter and the design tin is used with the string to calculate the slope using the equal area method.
3. Data for the remaining methods is entered in a similar fashion.

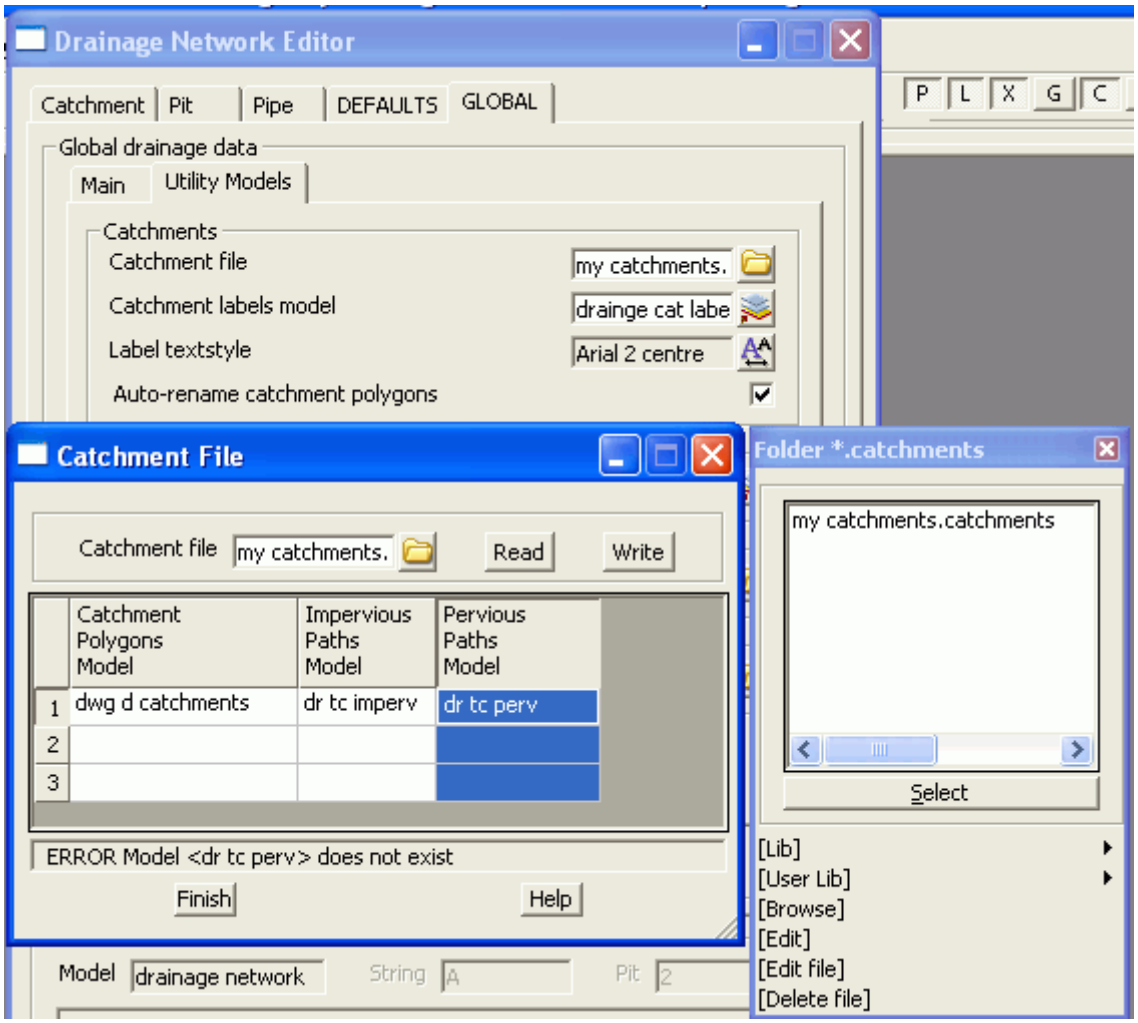
5.7 Tc Path Strings

These strings are used to calculate the time of concentration for the impervious and pervious areas. They are drawn in two models; one for the impervious paths and one for pervious paths. The models are specified using the **Catchment file** field on the **network editor** (Global->Utility model tab). The 3 rows in the **catchment file** correspond to the 3 catchments available for each manhole. Therefore it is possible to have a maximum of 6 Tc paths models!

Key Points

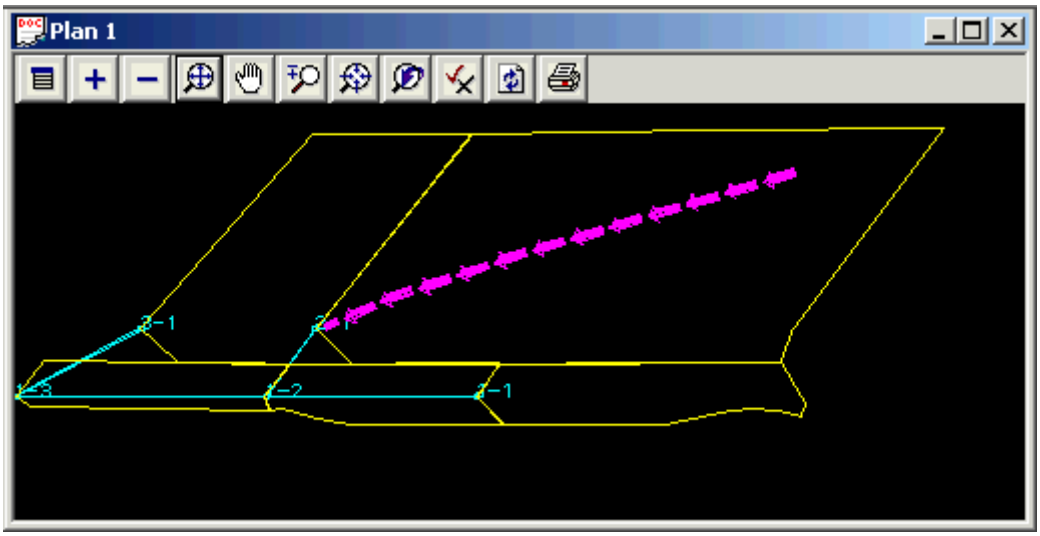
1. Each Catchment set may have 2 Tc paths models. Pervious and impervious paths are kept in separate models.
2. End the Tc path string at the manhole that it is to be linked to.
3. Enter the paths models via **Catchment file** field on the **network editor** (Global->Utility model tab)
4. You must select a Tc method (explicit or implicit) via the **Defaults->Catchments tab** or the **Catchments Tabs**. Just specifying the models is NOT enough!

The tc strings can be drawn in the same way as the catchment strings but make sure that you change the model name first! The tc string model is then entered in either the impervious or pervious paths model columns (You could have up to 6 tc string models!).

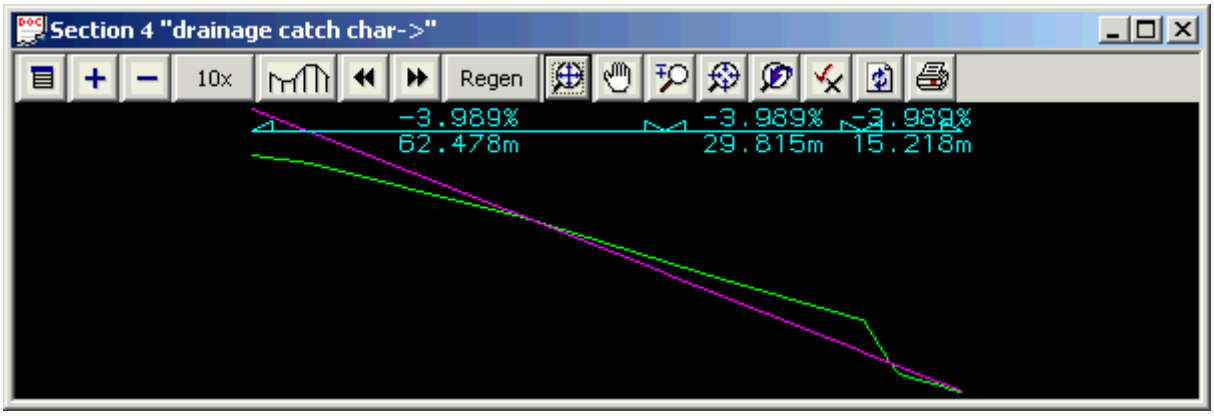


5.7.1 Catchment slope (equal area)

The length of this string is used for the length parameter and the design tin is used with the string to calculate the slope using the equal area method. These strings are drawn from upstream to downstream, finishing nearest to the manhole they are to be linked to. The line style for these strings must be the **flow line** style found under **Drainage 12d** in the linestyle drop down list.



The equal area slope is calculated at export time. After the export the slope string, it may be profiled to see the slope (see below).



5.8 Network Editor - Hydraulics

This section will discuss the hydraulic **Global**, **Defaults** and **explicit settings** for the hydraulic parameters. The **explicit settings** for the parameters described on the **defaults** tab will also be found on the **Pit** or **Pipe** tabs.

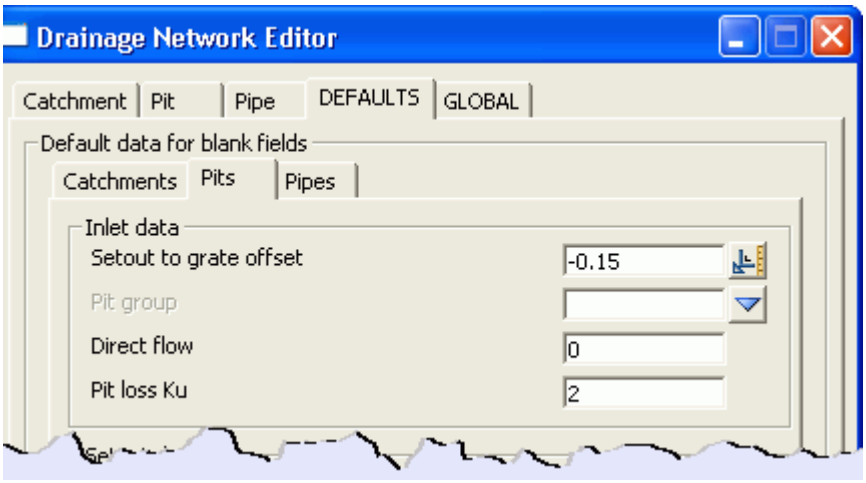
5.8.1 Setout to Grate Offset

The grate level is used by 12d when determining the freeboard and when calculating depth of flooding at SAG pits. The grate level is often exported to other design packages. The grate level is calculated as

Grate Level = Setout z + Setout to grate offset

The setout to grate offset is generally zero or negative and implicitly set on **Network Editor->Defaults->Pits->Setout to grate offset** or explicitly on **Pits->Main->Setout to grate offset.**

5.8.2 Pit Losses Ku, and Direct Flow

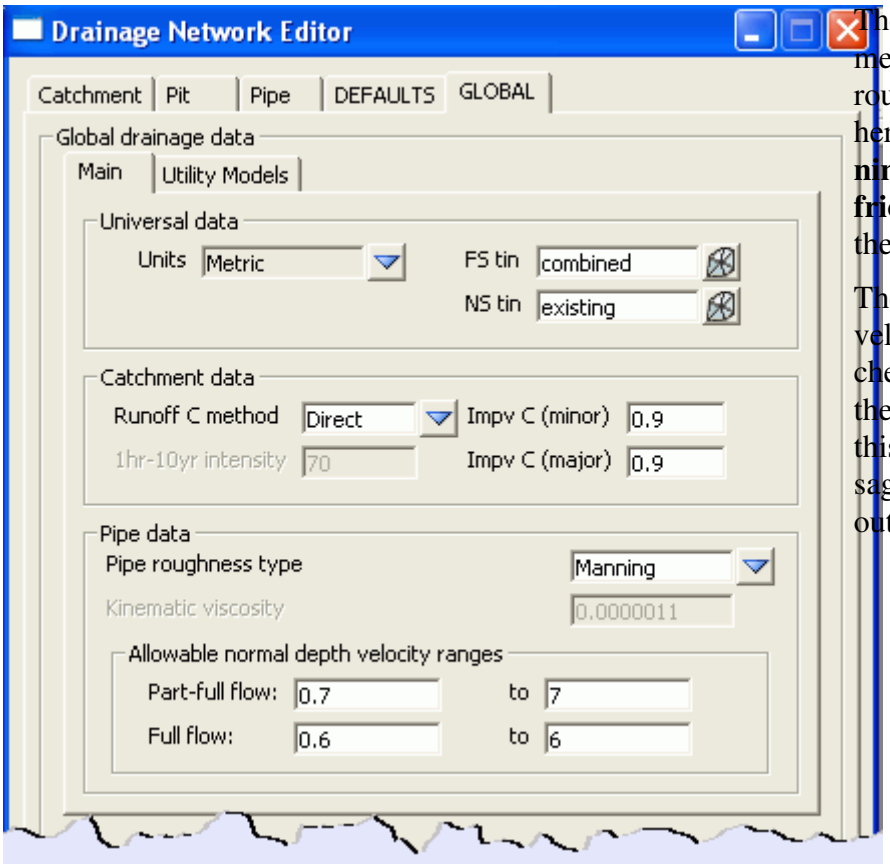


If the setout point was on top of the kerb, enter the **Setout to grate offset** so that the overflow level of the manhole can be determined.

The **Direct flow** (cms/cfs) is water flowing into the manhole. It is not added to the approach flow and therefore is not affected by manhole inlet capacity.

The **Pit loss Ku** is used to model the energy losses through the manholes.

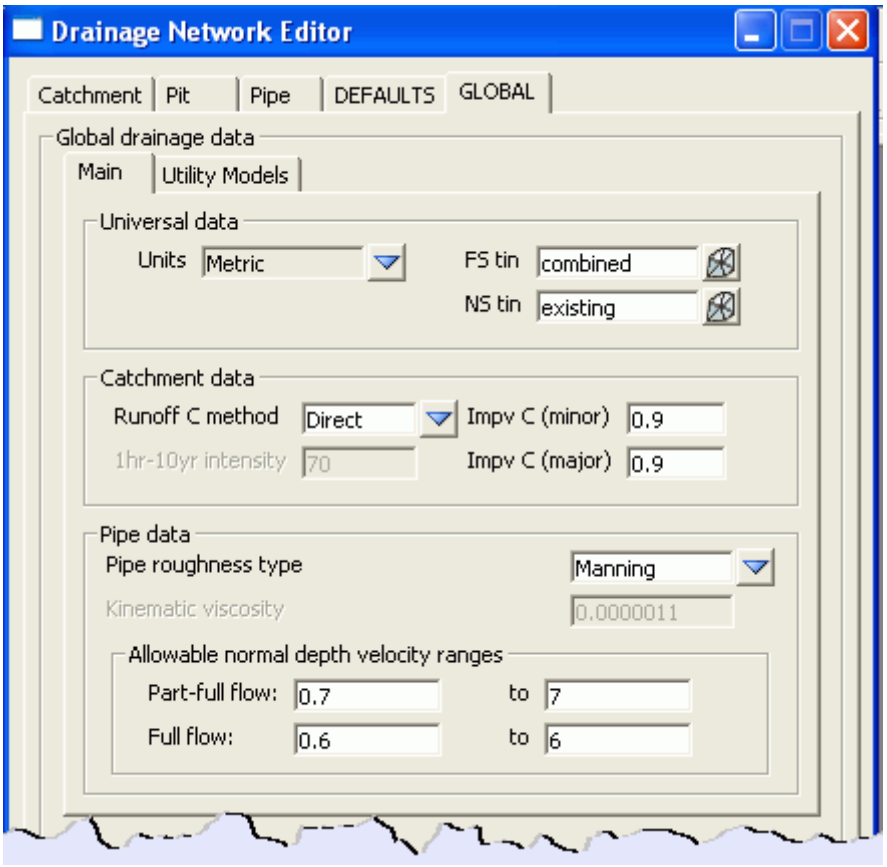
5.8.3 Pipe Friction Method



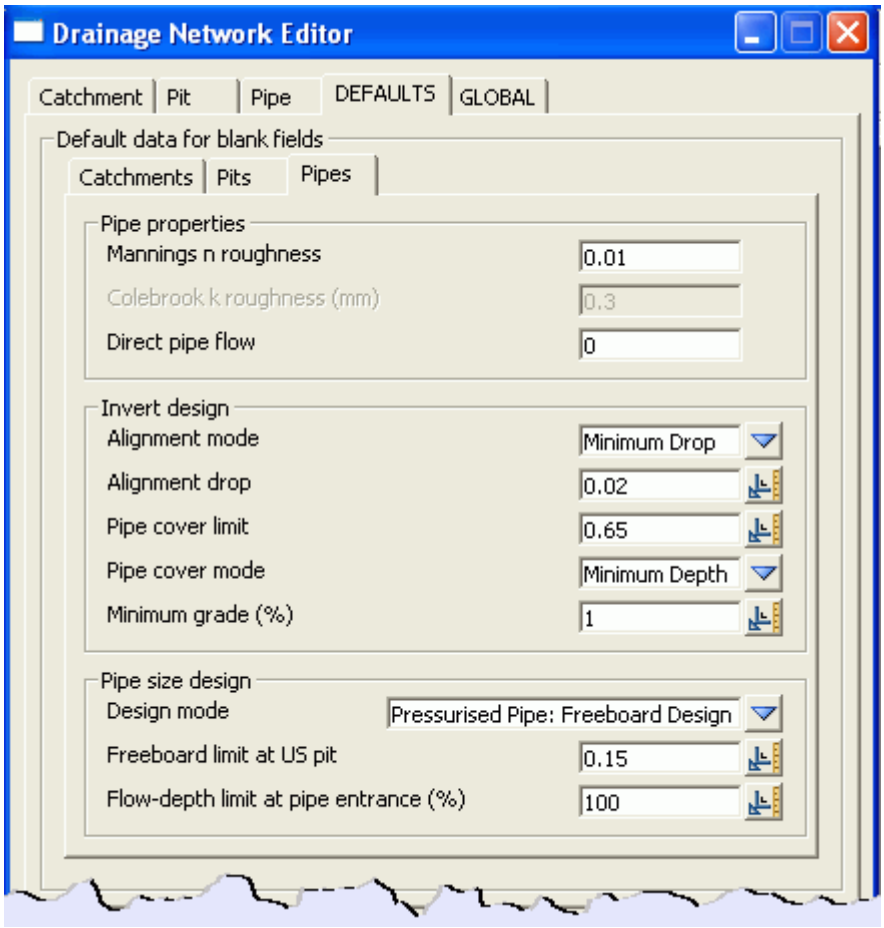
The **Global** friction loss method for the pipe roughness method is set here (**Colebrook** or **Manning**). The default **pipe friction values** are set on the **Defaults->Pipes** tab.

The ranges for pipe peak velocities are used for checking purposes only. If the velocities are outside this range, warning messages will be given in the output window.

5.8.4 Pipe Friction Values and Freeboard Limit



The global **pipe friction method** on the **Global** tab determines which fields are active, **Colebrook k** or **Mannings**. The default roughness values are entered on the following **Defaults-Pipe** tab.



The **Design mode** has 4 options.

Pressurised Pipe: Freeboard Design does not use partial depths in the pipes and pipe sizes selected by checking the pit freeboard.

Part-full Pipe: Freeboard Design is similar to option 1 except gradual varied flow and hydraulic jumps are calculated in the pipes. Critical depth is the minimum depth at the upstream end of the pipe.

Part-full Pipe: Flow-depth Design is the similar to option 2 except the pipe sizes are selected by checking the normal depth in the pipe against this value. Freeboard is also checked in this mode and if required the pipe will increase in size.

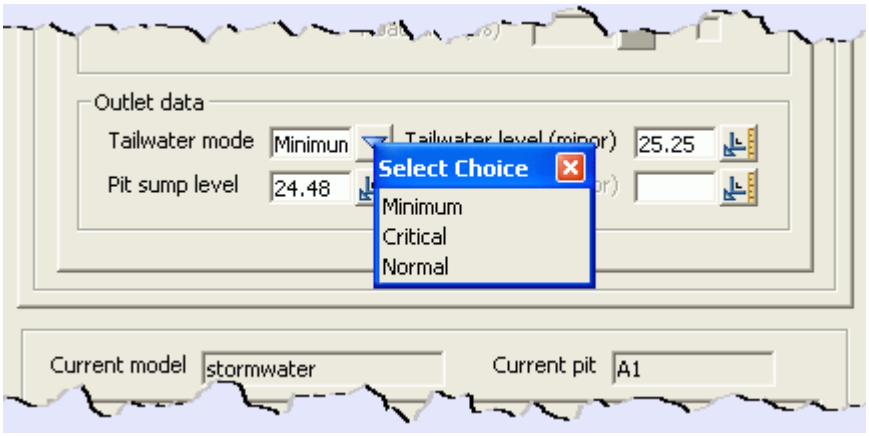
Open Channel: Freeboard Design is similar to option 2 except depths at the upstream end of the pipe may be less than critical depth for steep pipes (supercritical flow at the entrance).

The **Freeboard limit** is used for all **Design modes**. The freeboard is measured down from the grate level (**setout level** minus **setout to grate offset**).

The **Flow-depth limit at pipe entrance (%)** is used in **Design mode** 3. If the normal depth in the pipe is greater than this value the pipe size is increased.

5.8.5 Outlet and Tailwater Conditions

The most downstream manhole on each network requires tailwater conditions. Often the invert level on the downstream end of the last pipe also needs to have the level locked to either discharge into a waterway or join into an existing drainage system. When the most downstream manhole is selected the following fields will become active on the **Network Editor - Pit - Main** tab**.** If these field are not active and you think you are at the outlet see **Flow in the Wrong Direction**.

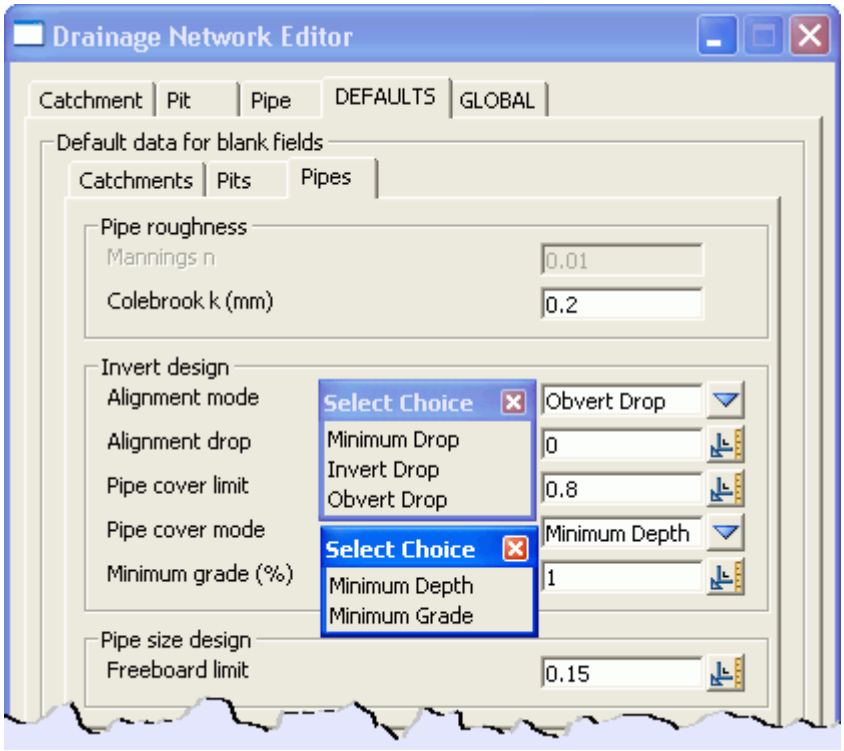


Minimum will use the least of the **Critical** or **Normal** depths. If a fixed level is available for the minor and/or major storms, these value may be entered here.The **Pit sump level** is used to enter the sump level of the network that is being connected to (Optional).

5.9 Pipe Design Parameters - Sizes, Invert alignment, Min Cover, Max Height

The invert levels during design are controlled by the **pipe sizes**, **max pipe height**, min pipe cover and **invert alignment** mode.

5.9.1 Invert Alignment Modes



12d has 3 design modes for setting the pipe inverts upstream and downstream of the manholes. These work together with the 2 pipe cover modes as follows.

The tin specified in the **Global-Main Finished Surface Tin** field is used for these calculations. The description below assumes that none of the inverts have been manually locked.

NOTE! Invert design parameters are set on the **Pipe-Design** tab not the **Pit** tab. The **Alignment mode refers to the DOWNSTREAM INVERT ONLY.**

1. The initial pipe grade is set as the **Minimum grade** (**Minimum Grade** mode) or the grade

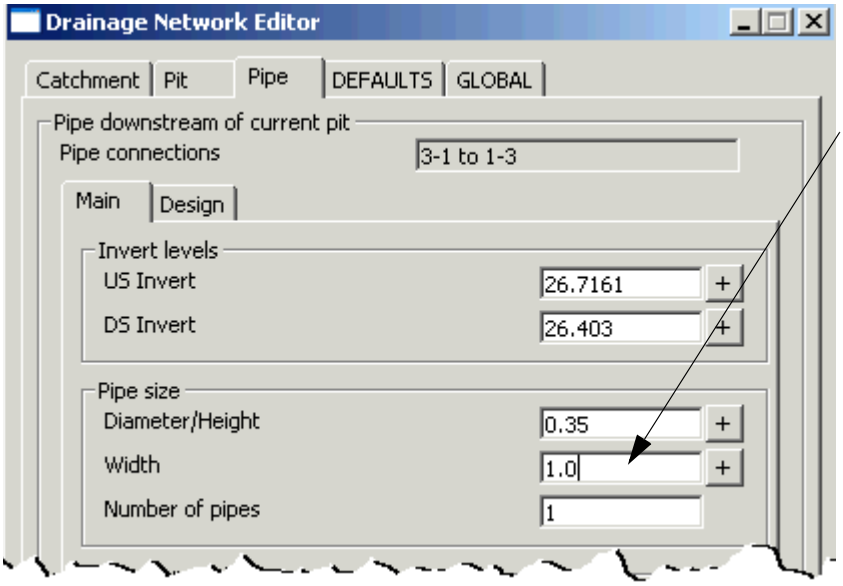
between the ground levels at the manholes (**Minimum Depth** mode). Even in the **Minimum depth** mode the minimum grade constraint is checked.

2. 12d shifts the pipe down so that there is at least the **Pipe cover limit** along the pipe. The **Pipe cover limit** should include an amount for the pipe thickness.
3. Inverts are moved down if required according to the setting in **Alignment mode.** Obverts are aligned using **Obvert Drop** with a zero **Alignment drop** and similarly the inverts are aligned with the **Invert drop** mode. **Minimum drop** ensure that the inverts drop a minimum of the specified drop but the drop may well be more than the **Alignment drop** specified. As the inverts are moved down the minimum pipe grade is maintained.

   NOTE! If **Obvert Drop** is selected and the downstream pipe is a smaller pipe then the inverts will be aligned!

5.9.2 Pipe sizes, Max pipe height and Multiple Pipes and Box Culverts

The 12d design engine will select pipe sizes from the file specified on the **Drainage Network Design** panel, **Preferred pipes file** field list. See **selecting pipe sizes**. However, the maximum pipe height allowed before multiple pipes are used and the selection of box culverts is set on the **pipe->main** and **pipe >design** tabs respectively.

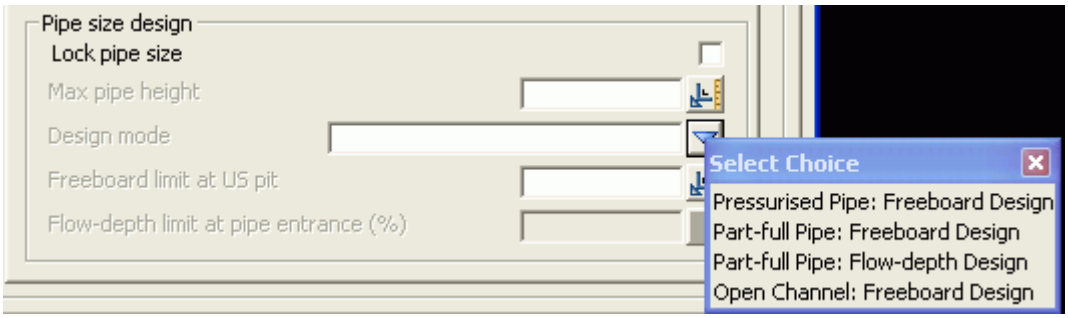


To specify a box culvert in your network, select the pipe segment and enter a width for the pipe.

For box culverts, the design engine increases the widths and maintains the height through the available sizes. Once the maximum height has been reached, the next culvert height and minimum width is checked.

5.9.3 Pipe Size Design

On the **Pipe->Design** tab the **Lock Pipe size** prevents the 12d design engine from resizing the pipe. **Max pipe height** can be set for each pipe segment (there is no default for this value). If the 12d design engine requires a larger pipe, then multiple pipes will be selected.



The figure above shows the 12d pipe design modes.

Pressurized Pipe: Freeboard Design

When solving the gradually-varied-flow equations in the upstream direction of a pipe, if the HGL is ever below the obvert, the US-pipe HGL is set to the obvert. This is the simple and conservative method in the example shown in the ARR 1987. The pipe-size design/analysis is based only on the resulting Freeboard in the US-pit.

Part-full Pipe: Freeboard Design

When solving the gradually-varied-flow equations in the upstream direction of a pipe, if a hydraulic jump occurs the US-pipe HGL is set to critical depth. This method is good where part-full pipe analysis is allowed, but pressurized pipes are also acceptable. The pipe-size design/analysis is based only on the resulting Freeboard in the US-pit.

Part-full Pipe: Flow-depth Design

Same as above but pressurized pipes are NOT acceptable. The pipe-size design/analysis is based BOTH on the resulting percentage depth of flow in the pipe entrance, and the resulting Freeboard in the US-pit.

Open Channels: Freeboard Design

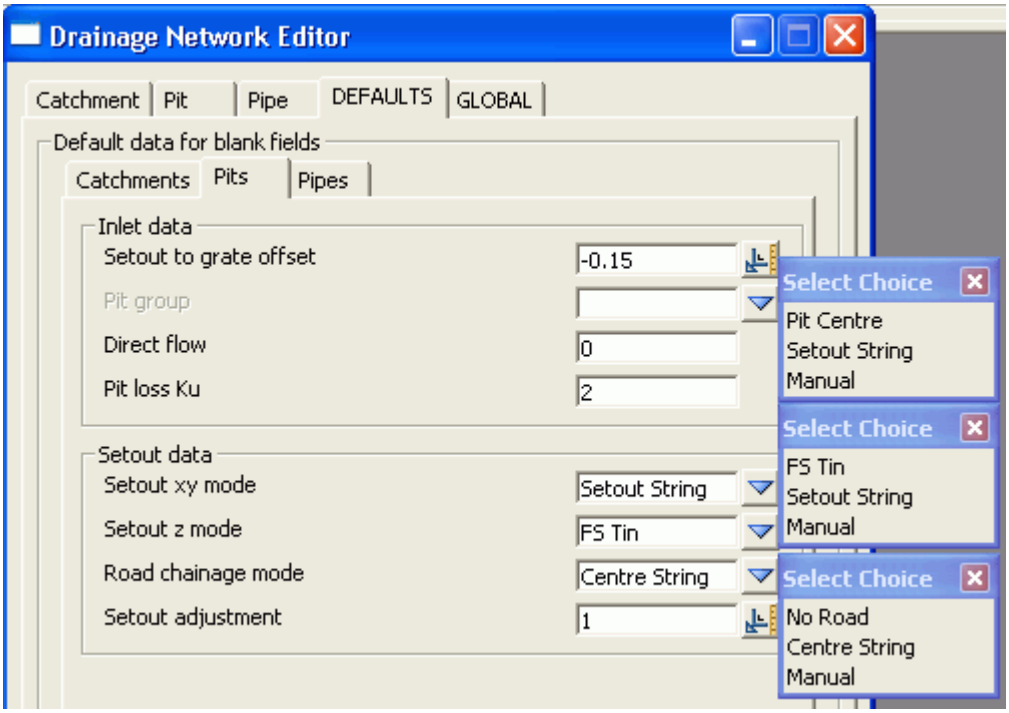
When solving the gradually-varied-flow equations in the upstream direction of a pipe or open channel, if a hydraulic jump occurs the US-pipe HGL is set to normal depth. This method is good for open channels or pipes where the “pit” directly upstream is a dummy pit with minimal losses. The pipe-size/channel size design/analysis is based only on the resulting Freeboard in the US-pit.

5.10 Road Design File for Pit Setout - x,y, level, road chainage and setout offset

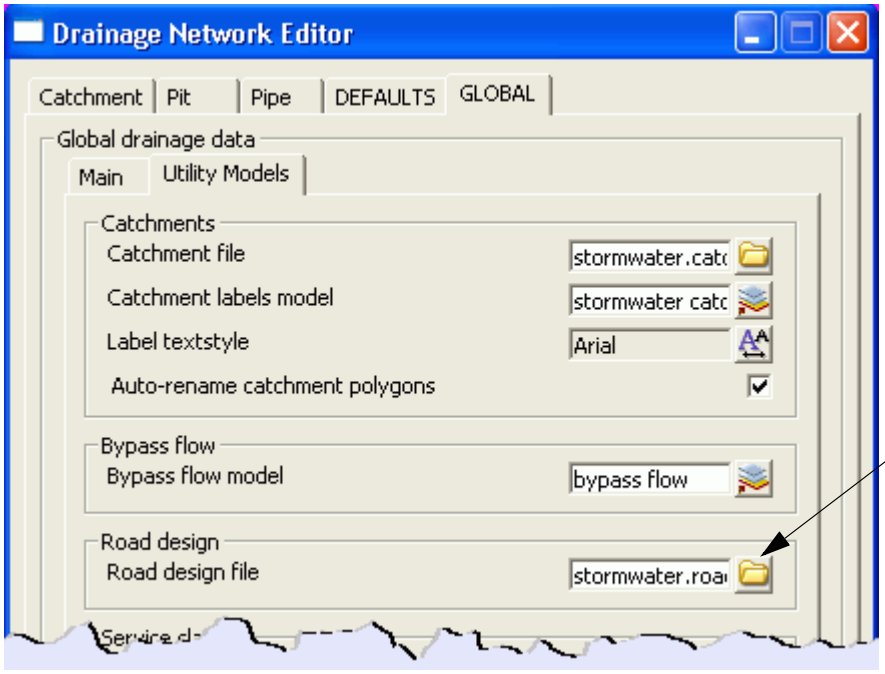
The road design file is used to automatically link the manhole to a road setout string and a road centre line string. Explicit picking of these strings may be found on Pits->Setout->String selection. These strings may be used calculate road grades and crossfalls (bypass model required) and/or construction setout data.

The construction setout point defines the location on the manhole to be printed in the **manhole schedules**, plotted on the **plan annotations** or listed on the **drainage long sections**. The setout point and level can be set to the centre of the manhole or it can be linked to a road design string. The setout level plus the **Setout to grate offset** determines the grate level for surcharging calculations.

The centre of the manhole or setout point can also be dropped perpendicular onto the road centre line to obtain the road chainage and offset distance.

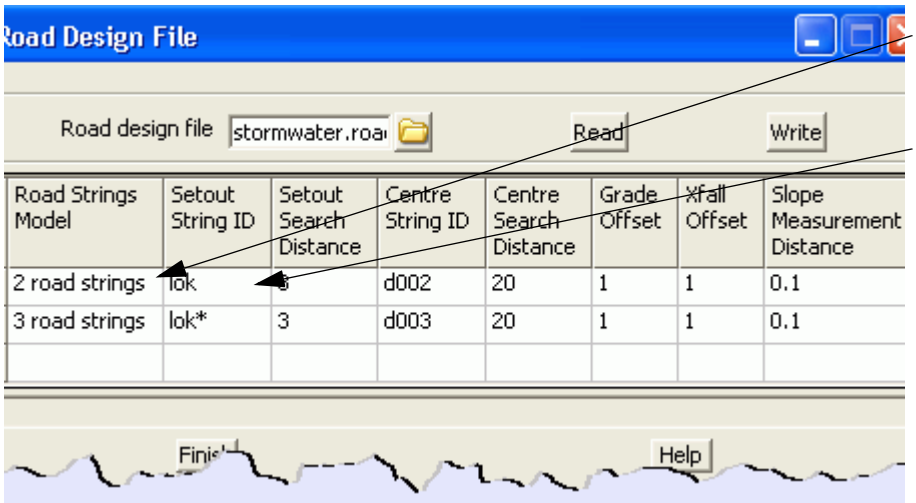


Pit centre is the centre point of the manhole (the intersection of the joining pipes). Often the setout point for a manhole or catch basin is not the centre of the manhole but rather a point on the kerb or back on the foot path. The **setout string** option will drop the centre point of the manhole onto the closest string in the **Road design** model list specified on the **Global->Utility models** tab. The manhole cover level will be set to **level on this string**.



Type a file name, select the folder icon and then select **Edit** from the drop down. NOT **Edit file.**

The following editor will appear.



RB select this box and choose the models containing the setout strings. In the **Setout string ID** box enter the string name prefix (wild card * allowed) to limit the selection for setout string. If no **ID** is entered then this model will NOT be searched!

The **Centre string ID** is used in the same way to find the centre line string. If needed, this string is used for road chainage and to determine which direction to measure the crossfall (between the setout string and the centre string).

The distances and searches are optional. The **setout** and **centre search distances** are the maximum distance that the routine will look when trying to locate the setout and centre line strings respectively.

The **grade offset** it the distance upstream from the setout point that the road grade measurement will start and the **Xfall offset** is the distance from the setout point to the start of the crossfall measurement. The measurements will be taken over a distance of **slope measurement distance** with the actual levels taken from the finished surface tin specified on the Global-Main tab.

Repeat this for each road string model used in the design. **Remember to select Write when fin-**

ished!

Select the **Set Pit Details** button on the bottom of the panel the calculate these values.

Explicit settings for the setout strings and the auto calculated values are found on the **Pit-Setout** tab. If the **manual** mode is selected the Easting and Northing locations may be picked in plan view or typed into the input boxes.

The setout level defines the level on the manhole to be printed in the manhole setout tables and in the drainage longsection plots. The **FS Tin** selection obtains the level from the FS tin, specified on the **Global-Main** tab, at the centre point of the manhole.The **Setout String** location obtains the z level from the setout string as described in the section above. **Explicit settings** and the auto calculated value are found on the **Pit-Setout** tab.

If **Road chainage mode** is set to **Centre string**, then the **Centre String ID** in the **Road design file** (shown above) is used to select the road string to measure the chainage and offset from. The values and **explicit settings** for the road chainage and offset are found on the **Pit->Setout** tab.

5.11 Calculate Bypass flow routes

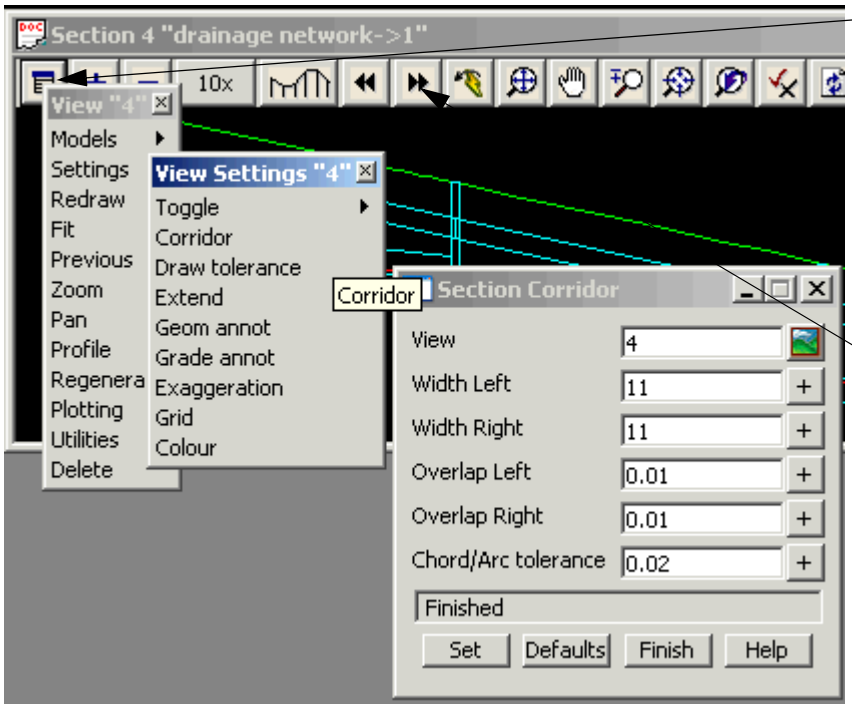
This option is required for manhole inlet capacity calculations and is covered in the advanced drainage training.

As an introduction, the overland flow parameter routine determines the road grade, crossfall, manhole inlet capacity and downstream bypass manhole for each manhole. To achieve accurate measurements for the road grade and crossfall, the manhole is linked to a setout string (see below).

6.0 Service and Utility Clashes

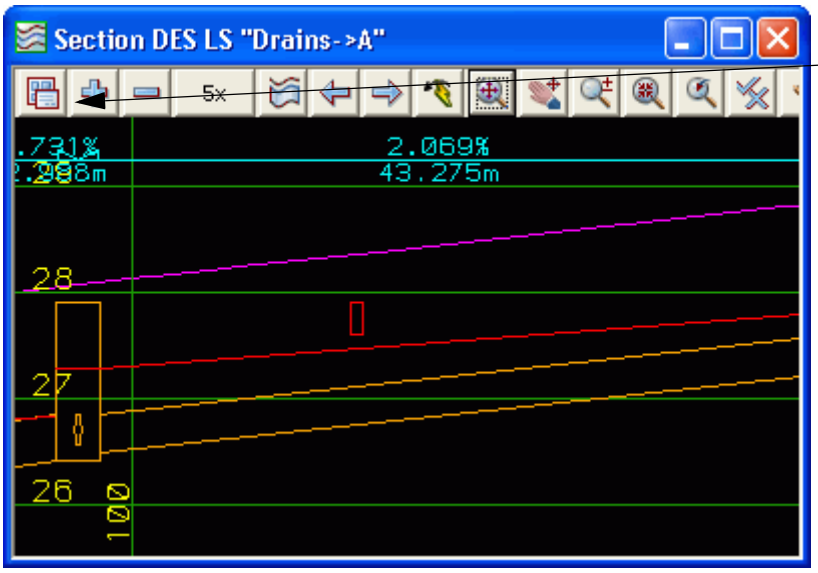
WARNING!

12d service clash routines notify the user of crossing services but not parallel services that are close to each other. To view parallel services, add the services model onto a section view, profile a drainage string and then set the corridor value for the section view.



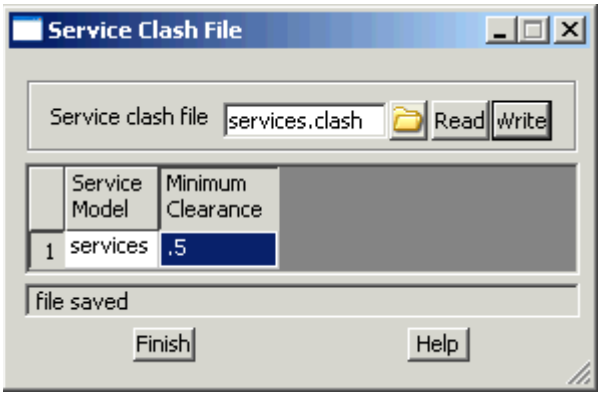
Settings->Corridor and then set the **Width left** and **Width Right** to the desired clearance. If the service can be seen then it is within the tolerance. 11 is used in this example only so that you can see the service on the other side of the road.

Use the **Next** and **Prev** button to switch drainage strings.



To obtain a report of all strings inside or crossing the drainage string profiled, select the **View menu** button then **Utilities->Report**

The service clash model list is entered on the **Global-Utilities Model** field.



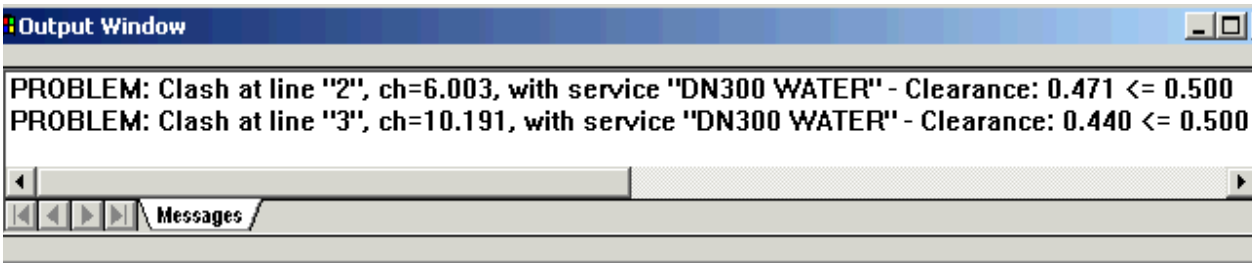
To create a list enter a list name, select the folder icon and then select edit.

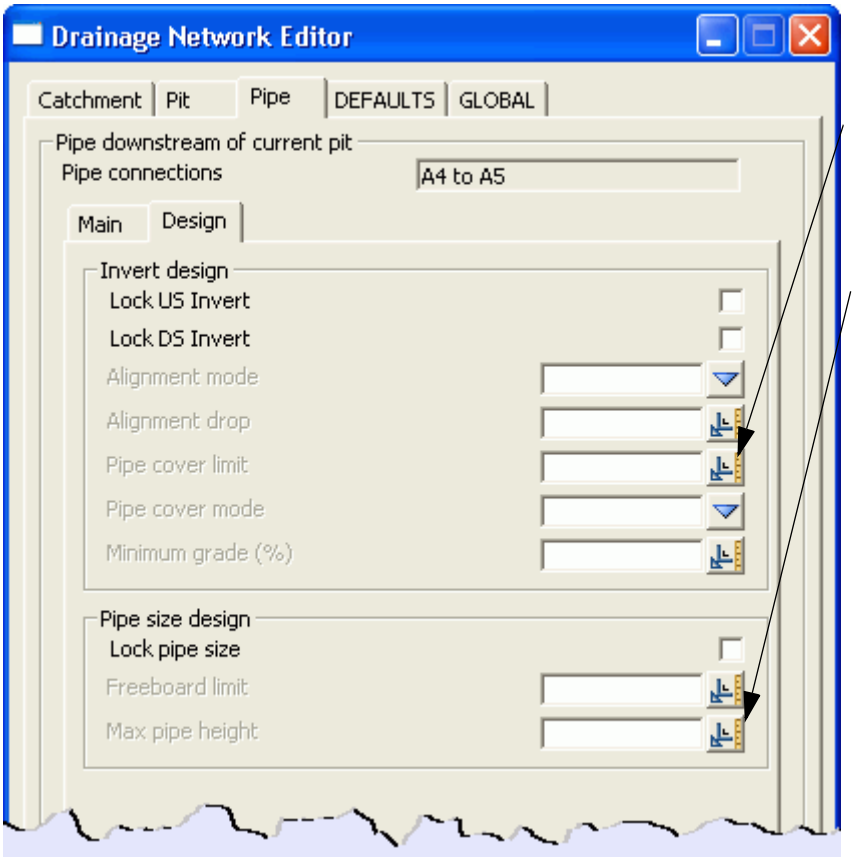
In the **Service model** column **RB** to select the model. Enter **Minimum Clearance** for the services in this model. If different clearances are required for different services then place the services in different model. Warnings will be issued at design time. Cover levels or fixed inverts can be used to avoid the services.

Service clashes are listed in the output when the **Set pipe inverts** is selected on the **Drainage Network Editor**. If the output window is not visible then from the main menu select

Window->Output Window

and make sure it is selected.





The most common method to avoid the clash is to increase the **Pipe cover limit** for this pipe segment so that the pipe is pushed down. If the clash problem is above the pipe then the **Max pipe height** may be used and multiple pipes are selected.

This method is preferred over locking the inverts as this leaves more flexibility for aligning the inverts.

Once the invert levels have been reset by selecting **Regrade pipes,** the output window will indicate the final clearance.

After a pipe design run in **Storm Analysis**, details of the service clash data will again be listed in the output window.

7.0 Drainage Design in 12d Drainage Design

12d has a sophisticated rational method hydrology and hydraulic grade line pipe design engine. In addition it has the capability to export this data to several other popular drainage packages. Regardless of the design method selected the drainage network in 12d is updated from the design so that drainage plans, long sections and manhole schedules can be quickly produced.

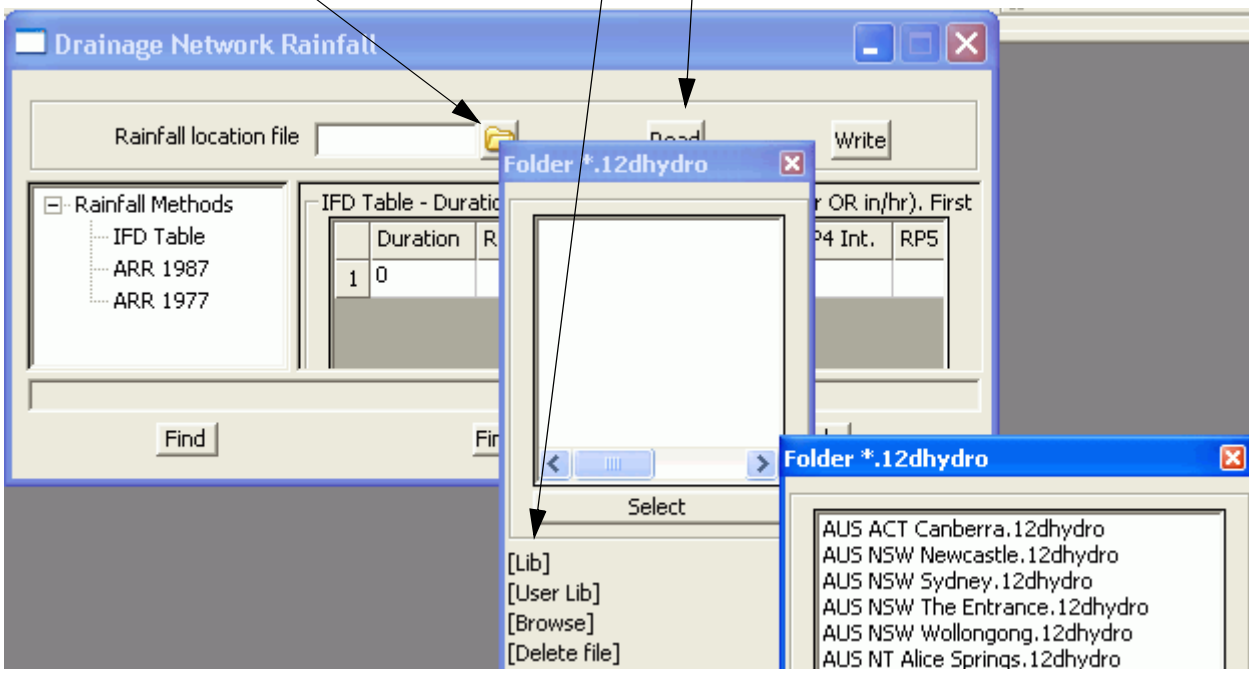
7.1 12d Rational Method Hydrology - Drainage Rainfall Editor

The **Drainage Rainfall Editor** is used to input rainfall IFD data using several methods. The data is stored in Meteorology files (each file is for a specific location) that can be shared between 12d projects. The data is edited using an editor similar to those used for the plot parameter files (ppf). Seven methods for entering/calculating the rainfall intensities are shown in the panel below. From the main menu select,

Design->Drainage-Sewer->Rainfall Editor

Data is entered using one (or more if desired) input methods and then saved by entering a **Meteorology file** name and selecting **Write.** The standard 12d system file search paths are used (project folder, user library folder and then library folder).

Select the folder icon and then walk right on the **Lib** item to display a list of sample files. Select a file the select **Read. YOU MUST SELECT THE READ BUTTON!**

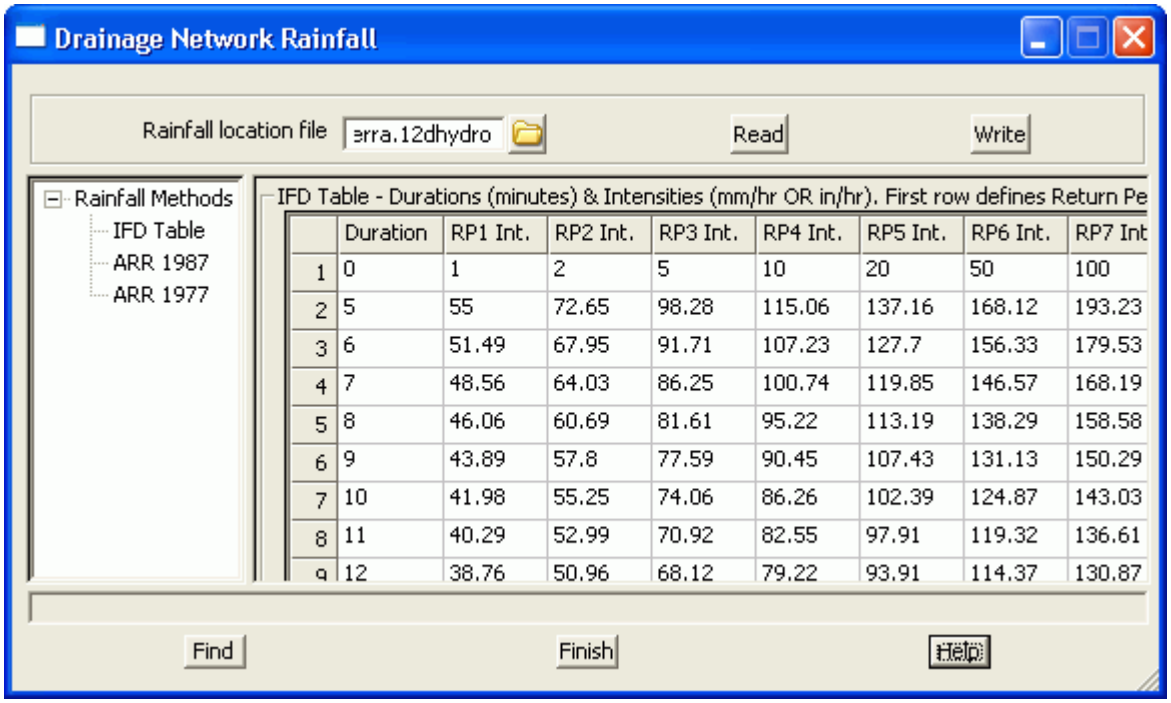


7.1.1 IFD Tables

IFD tables are often available from meteorological services. The table input format follows. The first row is used to define up to 9 return periods and the following rows list the rainfall intensities

for the duration entered in the first column.

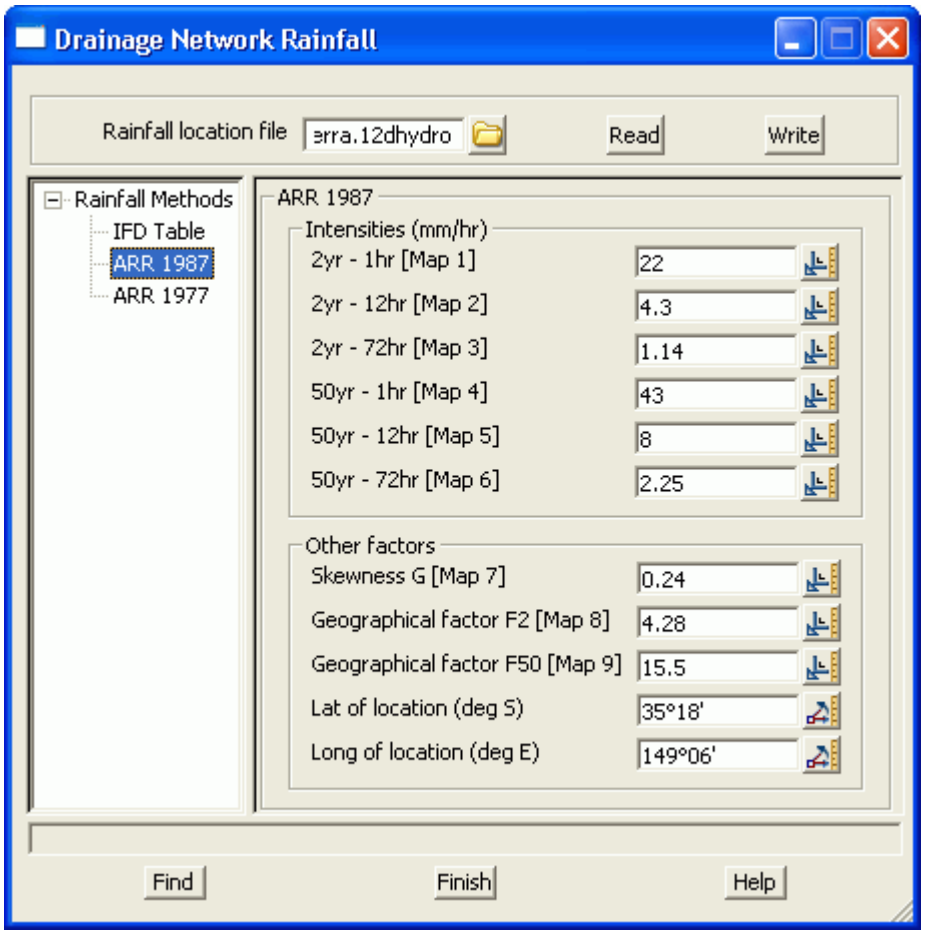
Hint: to increase the size of the grid control select another method, ARR 1987 for example, and then select IFD table again.



	Duration	RP1 Int.	RP2 Int.	RP3 Int.	RP4 Int.	RP5 Int.	RP6 Int.	RP7 Int
1	0	1	2	5	10	20	50	100
2	5	55	72.65	98.28	115.06	137.16	168.12	193.23
3	6	51.49	67.95	91.71	107.23	127.7	156.33	179.53
4	7	48.56	64.03	86.25	100.74	119.85	146.57	168.19
5	8	46.06	60.69	81.61	95.22	113.19	138.29	158.58
6	9	43.89	57.8	77.59	90.45	107.43	131.13	150.29
7	10	41.98	55.25	74.06	86.26	102.39	124.87	143.03
8	11	40.29	52.99	70.92	82.55	97.91	119.32	136.61
9	12	38.76	50.96	68.12	79.22	93.91	114.37	130.87

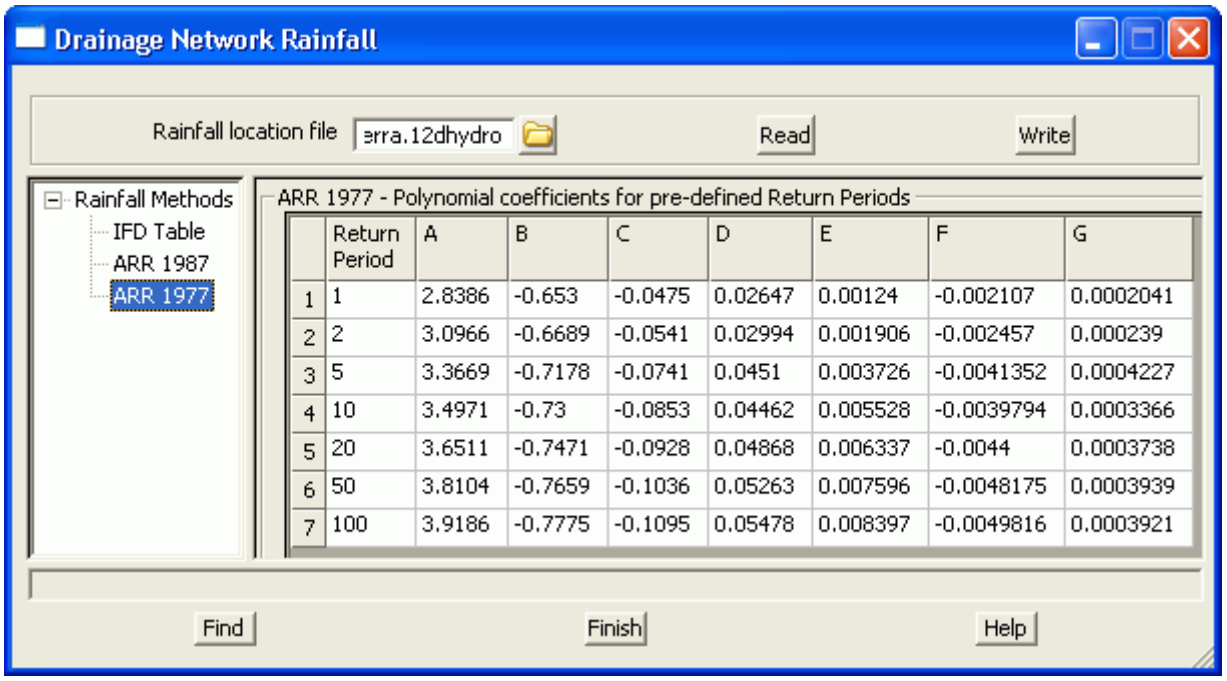
7.1.2 Australian Rainfall and Runoff 1987 Method

The rainfall intensities and other factors from Volume 2 of ARR 1987 are entered in this table.



7.1.3 Australian Rainfall and Runoff 1977 Method

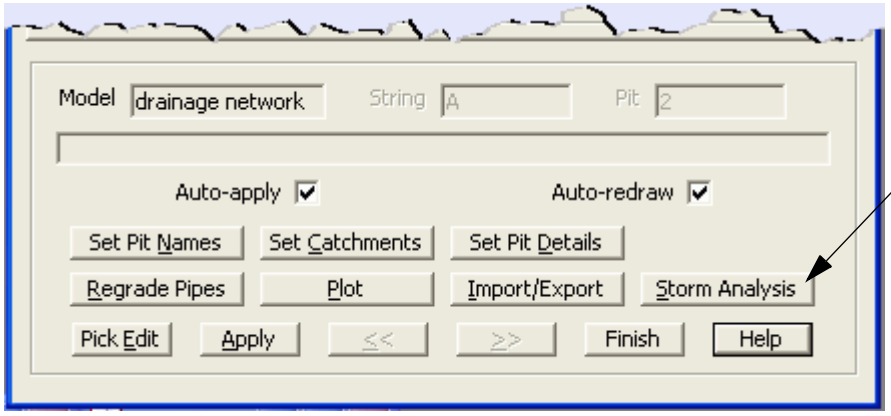
The seven coefficients for each return period from ARR 1977 are entered in this table.



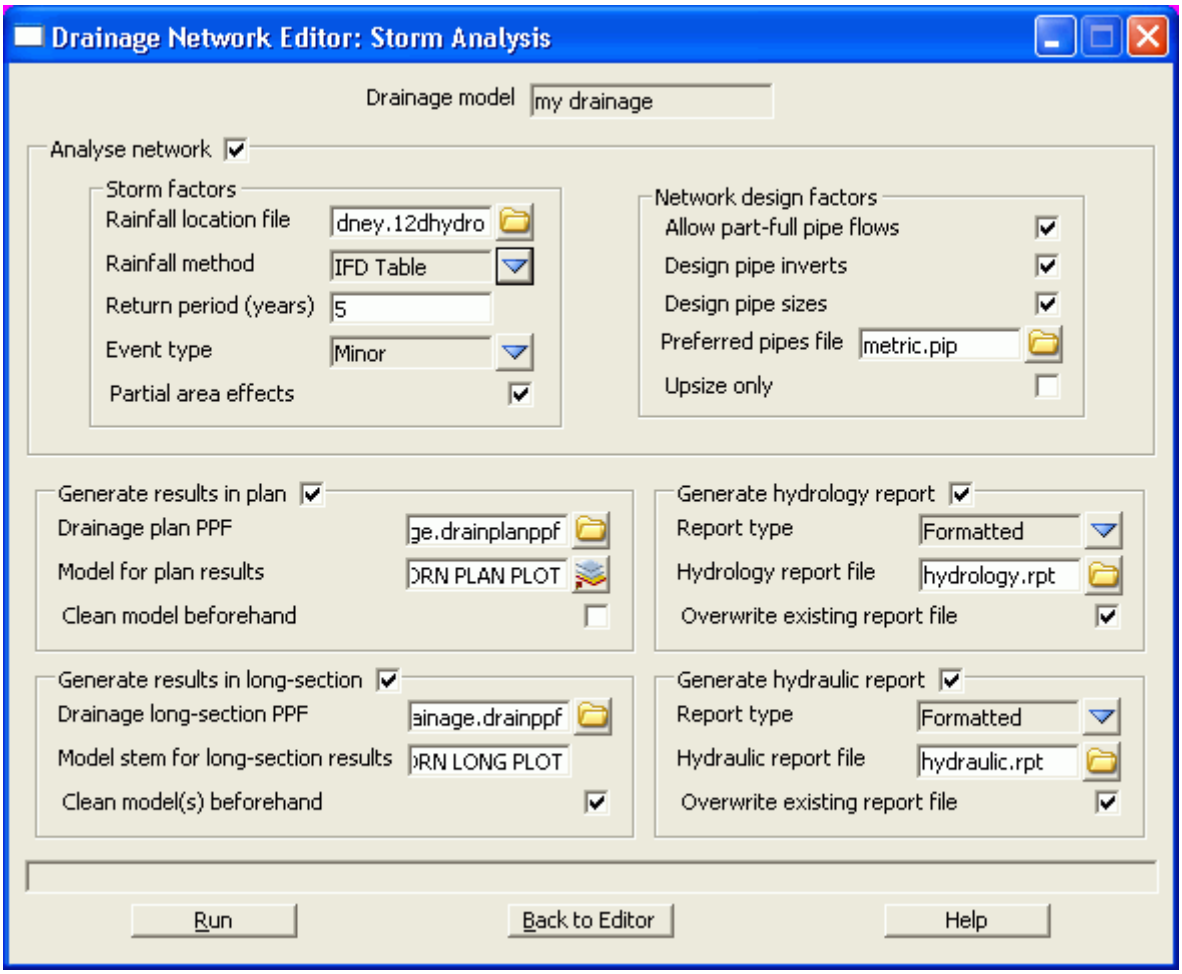
	Return Period	A	B	C	D	E	F	G
1	1	2.8386	-0.653	-0.0475	0.02647	0.00124	-0.002107	0.0002041
2	2	3.0966	-0.6689	-0.0541	0.02994	0.001906	-0.002457	0.000239
3	5	3.3669	-0.7178	-0.0741	0.0451	0.003726	-0.0041352	0.0004227
4	10	3.4971	-0.73	-0.0853	0.04462	0.005528	-0.0039794	0.0003366
5	20	3.6511	-0.7471	-0.0928	0.04868	0.006337	-0.0044	0.0003738
6	50	3.8104	-0.7659	-0.1036	0.05263	0.007596	-0.0048175	0.0003939
7	100	3.9186	-0.7775	-0.1095	0.05478	0.008397	-0.0049816	0.0003921

7.2 Drainage Network Design

The **Storm Analysis** button on the **Network Editor** executes the 12d drainage design, plots the drainage long section and plan annotation and prepares the hydrology and hydraulic design tables.



From the **Drainage Network Editor** select **Storm Analysis.** The following design panel will appear.



In general the **Analyse network** is always selected. If you only want to plot or create the reports then remove the tick.

Storm Factors

Select the folder icon on the **Rainfall location file** and then walk right on the **Lib** line to select one of the rainfall files in the 12d library. If the file has only one type of rainfall definition then the **Rainfall method** field will be completed. Otherwise select the **Rainfall method** desired. The valid **Return period** will depend of the method selected but you cannot extrapolate beyond your data.

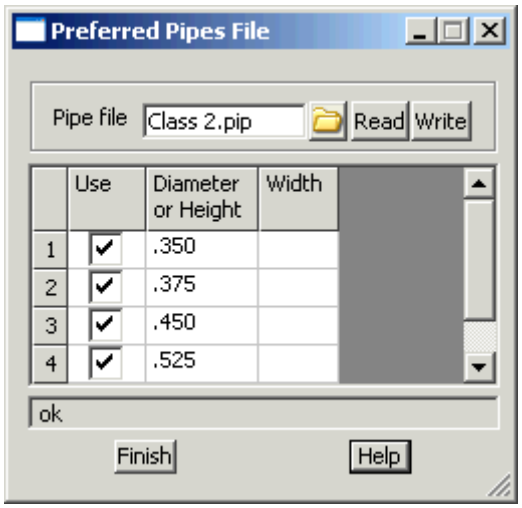
Event type determines which set of design values (**minor or major)** will be used for this run. Enable the 12d rational method engine partial area calculations by selecting the **Partial area effects** box.

Network Design Factors

Selecting Pipe Sizes

These values control the values to be designed in the run. If **Design pipe sizes** is selected then a files containing the available pipe sizes must be supplied. The pipe sizes in this file are in the

Units specified in the drainage network editor. To create a new file, enter the file name and then select the folder icon followed by the **Edit** line. The following panel will appear.



The diameters/heights are required and the width is optional to specify a box culvert.

YOU MUST SELECT THE WRITE BUTTON!

The **Upsize only** selection will stop pipes in the system from being reduced in the design. Regardless of this selection, the 12d design engine will not allow a smaller pipe to be selected in the downstream direction.

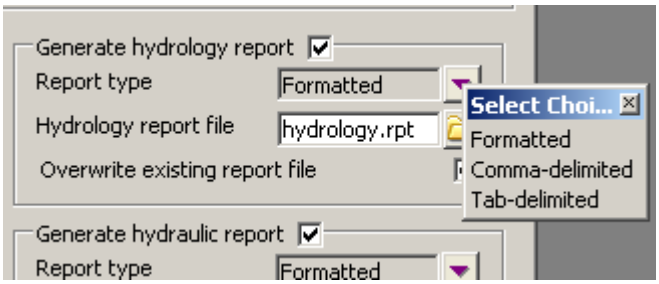
Generate Results in Plan

This selection automatically runs the drainage plot annotation function. A **Drainage plan ppf** must be entered and samples are supplied in the 12d library. A **Model for plan results** is required if this option is selected. The **Clean model before hand** tick box forces the model to be cleaned before the labels are created. When not selected a "Smart clean" is performed.

Generate Results in Long Section

This selection automatically runs the drainage long section plotter. A **Drainage long section ppf** is required and examples are found in the 12d library. A **Model stem for long section results** is required if this option is selected. In almost all cases the **Clean model before hand** tick box should be selected.

Generate hydrology report

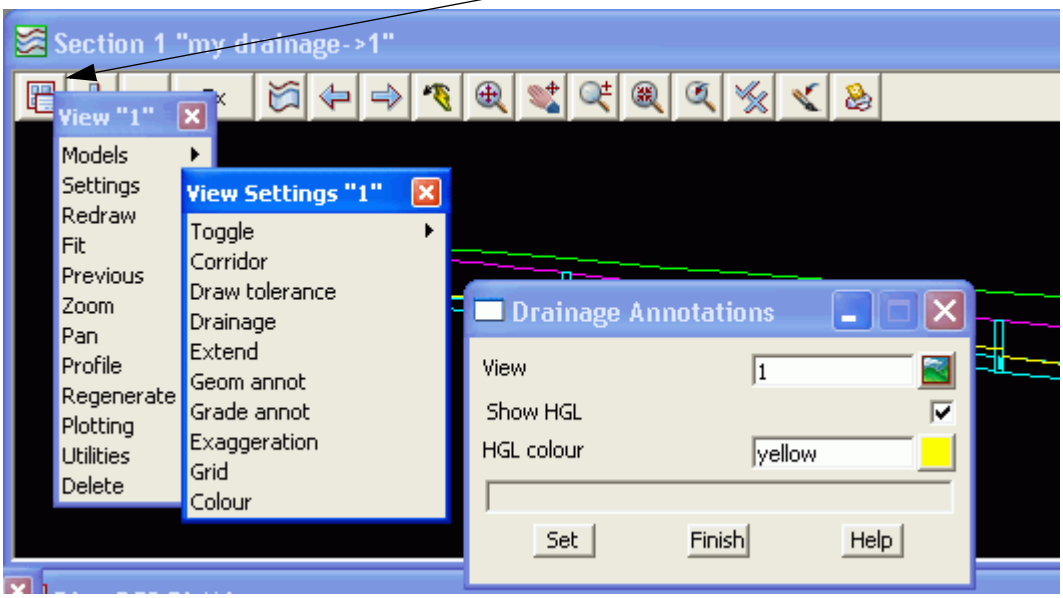


The **hydrology report** may be formatted for inserting into a 12d model/text editor (formatted) or spreadsheet (comma or tab delimited). In almost all cases **Overwrite existing report file** will be selected.

7.3 The Run Button and HGL data on the Section View

When the **Run** button is selected the discharges are calculated, the HGL check is performed and the pipes sizes and inverts are designed (if selected). The plan and long section drawings will also be updated with the new data (if selected).

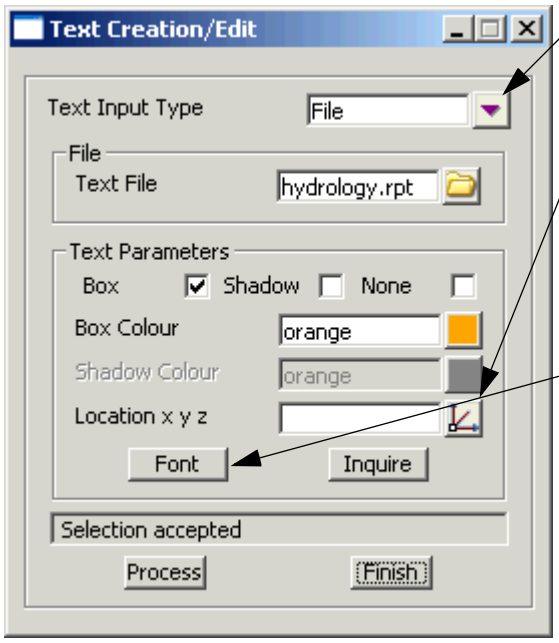
The HGL values will also be available on the 12d section views when profiling the drainage strings. The colour of the HGL line may be changed via the view's menu button then **Settings->Drainage**.



7.4 Importing Text into a 12d model

Formatted text may be inserted into a 12d model by selecting

Drafting->Text and Tables->Create edit paragraph text



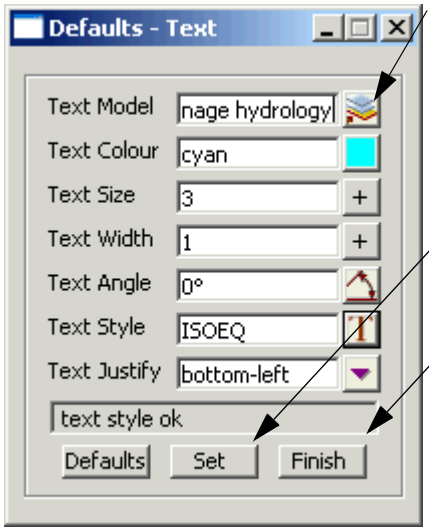
Change to **File.**

Select the folder icon and then pick the formatted text file. It will be displayed then select **Set**.

Next select the location in plan for the text.

The font selected must be a fixed space font or the data will not align properly.

Select the **Font** to display the following panel.



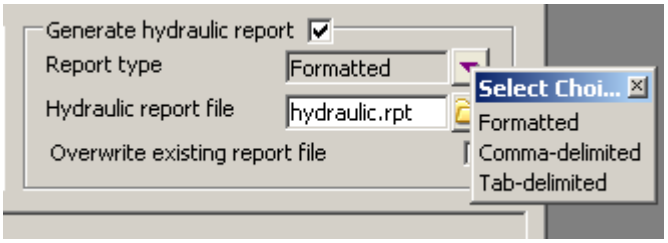
Enter a **Text Model** for the report.

The **Text Style** must be a fixed space font.

Select **Set** then **Finish.**

Now add the **Text Model** onto the

Generate hydraulic report



The **hydraulic report** may be formatted for inserting into a 12d model/text editor (formatted) or spreadsheet (comma or tab delimited). In almost all cases **Overwrite existing report file** will be selected.

If you want both the hydrology and hydraulic report in the same file, enter the same file name in both file fields but turn of the **Overwrite existing report file** for the hydraulic report.

7.4.1 Design Results

Results from the design runs are shown in several forms:

1. Hydrology and hydraulic reports
2. **Drainage plan annotations**
3. **Drainage longsections**
4. Hydraulic Grade line on the Section view
5. Output window data - Service/utility clashes

Samples of the hydrology and hydraulics report are shown below.

File: C:\12djobs\Courses\7.00\Drainage\hydrology.rpt 22/06/2004, 12:09:26AM

12D MODEL - HYDROLOGICAL DESIGN SHEET
Minor 2 Year Storm Event

Project: 1
Drainage Network: drainage network
Location File: $LIB\AUS ACT Canberra.12dhydro
Tc Method: Direct
Rainfall Method: ARR 1987
Pervious C Method: ARR 1987

Pit ID	Land Type	Time Tc	Intensity I	Runoff C	Tot Area & [%Imp]	Component Areas	Full CA	Full Sum CA	Full Q=CIA	Partial CA	Partial Sum CA	Partial Q=CIA	Max Q=CIA	Inlet Type	Inflow Q
(-)	(-)	(min)	(mm/hr)	(-)	(ha)	(ha)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(-)	(L/s)
1-1	Pervious	10.00	55.25	0.53	0.0827	0.0083	0.0044	0.0714	11.0	0.0022	0.0692	14.0	14.0	MH	14.0
	Impervious	5.00	72.65	0.90	[90]	0.0745	0.0670			0.0670					
1-2	Pervious	10.00	55.25	0.53	0.0590	0.0059	0.0031	0.0510	7.8	0.0016	0.0494	10.0	10.0	CP	10.0
	Impervious	5.00	72.65	0.90	[90]	0.0531	0.0478			0.0478					
1-3	Pervious	10.00	55.25	0.53	0.0532	0.0053	0.0028	0.0459	7.0	0.0014	0.0445	9.0	9.0	CONC COVER	9.0
	Impervious	5.00	72.65	0.90	[90]	0.0478	0.0431			0.0431					
2-1	Pervious	10.00	55.25	0.53	0.5182	0.0518	0.0275	0.4472	68.6	0.0137	0.4335	87.5	87.5	MH	87.5
	Impervious	5.00	72.65	0.90	[90]	0.4664	0.4197			0.4197					
3-1	Pervious	10.00	55.25	0.53	0.1843	0.0184	0.0098	0.1591	24.4	0.0049	0.1542	31.1	31.1	MH	31.1
	Impervious	5.00	72.65	0.90	[90]	0.1659	0.1493			0.1493					

File: C:\12djobs\Courses\7.00\Drainage\hydraulic.rpt 22/06/2004, 12:09:26AM

12D MODEL - HYDRAULIC DESIGN SHEET
Minor 2 Year Storm Event

Project: 1
Drainage Network: drainage network
Mannings n Roughness: 0.01
Pipe Cover Limit: 1.1 m
Simulation Time: 24 minutes

Pipe ID	Pipe Type	Pipe Length	Pipe Size	US-Pit Inflow	Pipe Flow	Capacity Flow	Pipe Vel	Capacity Vel	US-Pit Ku	US-Pit Cover RL	US-Pipe IL	DS-Pipe IL	DS-Pit Cover RL	US-Pit HGL	US-Pipe HGL	DS-Pipe HGL	DS-Pit HGL	Pipe Grade	HGL Grade	Cover Min	Depth US	F'board US
(-)	(-)	(m)	(mm)	(L/s)	(L/s)	(L/s)	(m/s)	(m/s)	(-)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(%)	(%)	(m)	(%)	(m)
1-1 to 1-2	RCPRJ X	45.93	350	11.9	11.9	189.6	1.01	1.97	2.0	30.09	28.10	27.64	29.08	28.17	28.17	27.70	27.21	1.00	1.01	1.10	19	1.92
1-2 to 1-3	RCPRJ X	54.65	350	8.5	95.2	189.7	1.65	1.97	2.0	29.08	26.99	26.44	27.88	27.21	27.21	26.62	26.14	1.00	1.09	1.10	64	1.87
1-3 to 1-4	PVC	49.91	350	7.7	129.5	189.6	1.73	1.97	2.0	27.88	25.84	25.34	26.78	26.14	26.14	25.56	25.56	1.00	1.16	1.10	84	1.74
2-1 to 1-2	RCPRJ X	18.44	350	74.8	74.8	408.3	1.86	4.24	2.0	29.32	27.86	27.01	29.08	27.97	27.97	27.21	27.21	4.64	4.11	1.14	31	1.35
3-1 to 1-3	RCPRJ X	31.31	350	26.6	26.6	189.6	1.19	1.97	2.0	28.49	26.78	26.46	27.88	26.88	26.88	26.55	26.14	1.00	1.06	1.10	31	1.60

8.0 Drainage Data Input and Output to Spreadsheets

Spreadsheets are an effective method to manage the numerous variables urban drainage designers create in the modelling process. Spreadsheet data can be transferred to and from 12d in tab delimited files and stored within 12d as “user definable attributes”. These attributes are linked to the pit and pipes within a network. Drainage long section plots can display the pipe attributes in the “arrows” data area and pit attributes in the bubbles area. Drainage plan drawing can also show these pit and pipe attributes.

Drainage strings will be created if they do not exist in the model but manholes cannot be added to existing strings.

See also

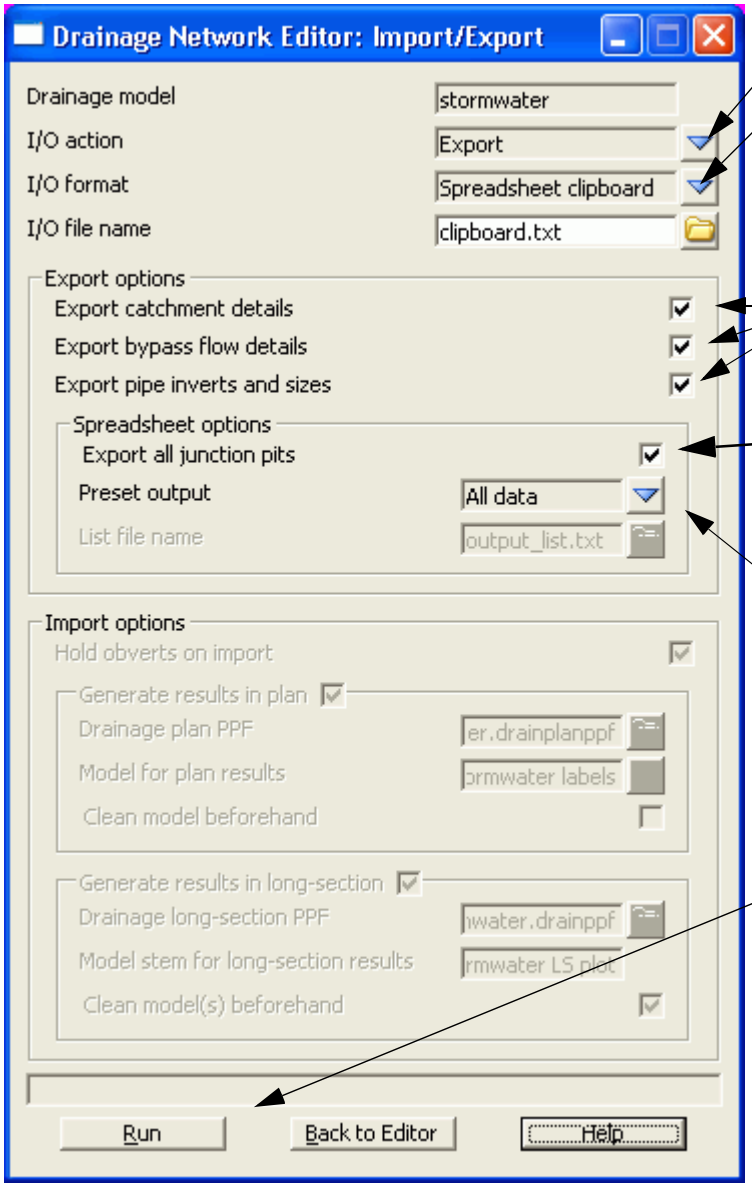
12d to spreadsheet transfers

Spreadsheet to 12d update and create

Spreadsheet options

8.1 12d to spreadsheet transfers

This interface is accessed the **Import/Export** button on the Drainage **Network Editor**.



Select **Export**

Select **Spreadsheet clipboard**

These options are not used for spreadsheet export.

Usually leave this off! Select to export the junction pit at the end of all drainage lines (very rarely needed).

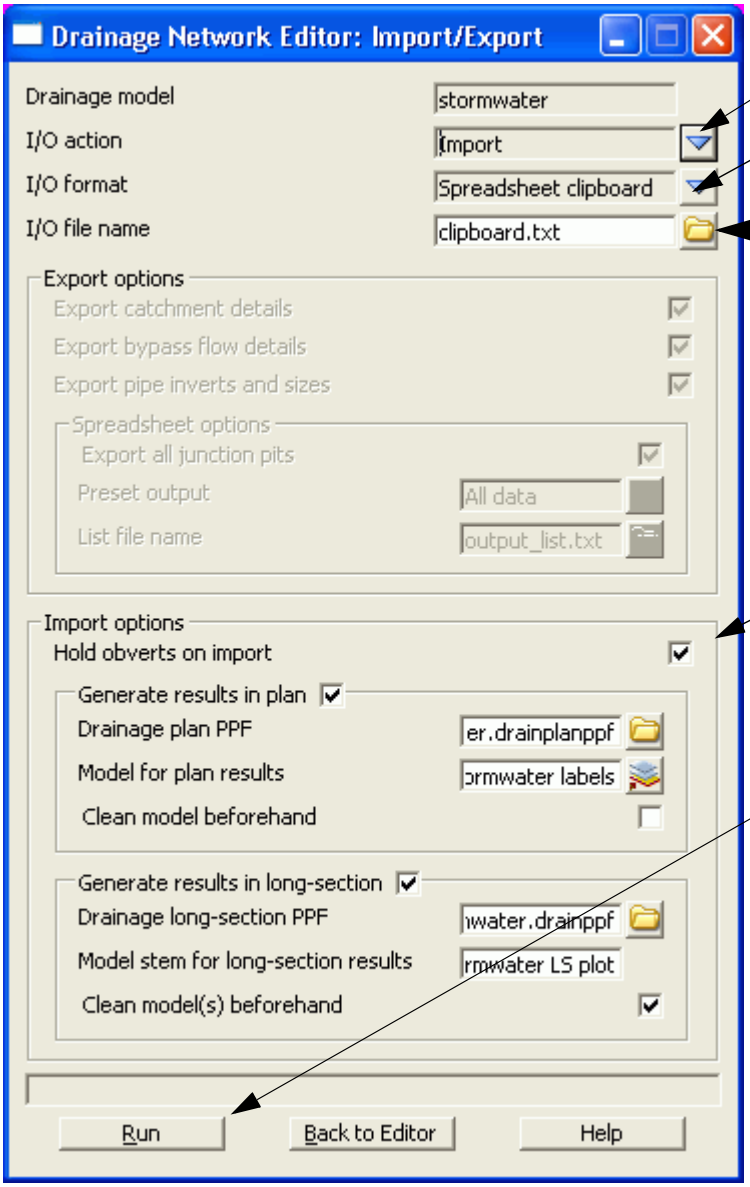
You may also select to limit the output if desired. If you like using spreadsheets for data entry, the PCdrain data and ILSAX data formats are useful for adding data for the first time for either program.

Select **Run** to place the data on the clipboard.

8.2 Spreadsheet to 12d transfers

This item is accessed from the **Import/Export** button on the **Drainage Network Editor**.

The following panel will appear.



Select **Import**

Select the **Spreadsheet clipboard** format**.**

The file field is ignored.

This is ignored on spreadsheet imports.

Select **Run** to update the drainage model.

Tab delimited, "12d drainage spreadsheet" format or "from to" format data must be on the clipboard in order to update a 12d drainage model or create a new model. These format are described below.

8.2.1 Updating an Existing Model

The data usually is generated by 12d using the **Export** option, pasted into a spreadsheet and then copied back to the clipboard so that 12d can be updated.

When 12d exports the drainage model to a spreadsheet it includes a column for the unique string identifier and a unique manhole identifier (unique to the drainage model not the 12d project). The names of the strings and manholes may be changed via the spreadsheet if these columns are present at import time.

If the manhole id column is not present, 12d will search the drainage model for a matching man-

hole name. When the manhole is a junction between drainage lines, only the trunk line will be the data updated.

8.2.2 Creating a New Model

It is possible to create a new string or an entire drainage network using this format. However, manholes cannot be added to an existing string. The entire drainage string must be created at once. Two formats are available, the “from-to manhole” format and the “12d drainage spreadsheet” format.

At present the network editor must select a drainage string to become active. Therefore, if you are not adding strings to a network, you will have to great a drainage network with one “dummy” manhole. Select this one “dummy” manhole to activate the editor. After importing the data and the new drainage lines are created the “dummy” manhole may be deleted.

12d drainage spreadsheet Format

The top left cell in the clipboard data must be the text “12d” to specify this format. The minimum amount of data required to create a new string is the string name, manhole name, x and y coordinates. You can add as much additional data as you have available. This would include pipe diameters inverts etc. The manholes must be listed from upstream to downstream order. If the string is to join a trunk line, the junction manhole must be included for both the tributary and the trunk line.

An example file exists called **new_network.txt** is supplied in the library. Open this file in a spreadsheet or a text editor and copy it to the clipboard. Set the **I/O Action** to **Import** and select **Run**. The new drainage lines will exist in the model currently being edited.

From-to Manhole Format

The top left cell in the clipboard data must be the text “from to” to specify this format. The minimum amount of data required to create a new string is the upstream pit name "*pit name), the downstream pit name (*ds pit name) and the x(x location) and y(y location) coordinates of the upstream pit. If the string is to join a trunk line, the junction manhole must be included for both the tributary and the trunk line.

An optional column for the manhole cover elev (cover elev) may be specified. Once the network has been created additional pipe and manhole data may be added using the “12d drainage spreadsheet” format described above.

An example file exists called **new_from_to_network.txt** is supplied in the library. It is shown below. Open this file in a spreadsheet or a text editor and copy it to the clipboard. Enter a new model name in the **Drainage model** field and select paste. The new drainage model will now exist.

from to	pit	pit	pit	pit
*pit name	*ds pit name	x location	y location	cover elev
text	text	real	real	real
E/1	A/3	5309.458	7336.935993	29.2173
D/1	A/4	5277.189	7336.935989	28.5071
C/1	B/3	5251.238738	7423.99485	31.5257
A/1	A/2	5354.629222	7336.935998	30.2115
A/2	A/3	5340.019987	7322.035996	29.89
A/3	A/4	5293.458002	7322.035991	28.8652
A/4	A/5	5250.182625	7322.035986	27.9127
A/5	A/6	5217.194202	7322.035983	27.1867
A/6	A/7	5183.458002	7322.035979	26.4442
A/7		5152.698693	7322.035975	25.7672
B/1	B/2	5289.42875	7422.289079	32.7197
B/2	B/3	5264.638564	7393.947083	30.7948
B/3	B/4	5249.738564	7384.207593	30.4187
B/4	B/5	5249.738564	7351.201545	29.1444
B/5	A/5	5233.426685	7336.935984	27.544

8.3 “12d drainage spreadsheet” Format

Each column of data is used for a 12d drainage variable or a user defined attribute. Each row represents a manhole and the downstream pipe (controlled by the direction of flow variable) within the drainage network. A sample is shown below.

12d	pit	pit	pit	pit	pit	pit
*string Name	*pit name	pit type	pit low ch invert	pit high ch invert	pit id	string id
text	text	text	real	real	integer	integer
E	E/1	SA2	28.108	28.108	1	67389
E	A/3	SA2	27.7559	27.7559	2	67389
D	D/1	SA2	27.3961	27.3961	3	68100
D	A/4	SA2	26.8018	26.8018	4	68100
C	C/1	SA2	30.67	30.67	5	72072
C	B/3	SA2	29.563	29.563	6	72072
A	A/1	SA2	29.1026	29.1026	7	82469
A	A/2	SA2	28.7811	28.7311	8	82469
A	A/3	SA2	27.7652	27.7059	9	82469
A	A/4	SA2	26.8127	26.7518	10	82469
A	A/5	SA2	26.0867	26.0244	11	82469
A	A/6	SA2	25.3442	25.2942	12	82469
A	A/7	SA2	24.6672	24.6672	13	82469
B	B/1	SA2	31.2759	31.2759	14	192066
B	B/2	SA2	29.351	29.301	15	192066
B	B/3	SA2	29.123	29.073	16	192066
B	B/4	SA2	28.0444	27.8951	17	192066
B	B/5	SA2	26.3447	26.2947	18	192066
B	A/5	SA2	26.0744	26.0744	19	192066

Duplicate Definitions

Strings Variables such as “direction” are may be defined for numerous manholes on the same string. Searching in a top down direction through the file, the last definition found for the string will be set.

Invert levels may be set via pipe data or pit data or combined. It is recommended that the user only use one method and not combine them. Both are exported so delete the ones you are not going to use. The variables are processed from left to right, so if duplicate definitions of an invert level or found the right most data will be set.

The format definition

1. Row1, column 1 must contain either “12d”, or “from to”. Therefore, the first column must be a 12d drainage variable (cannot be a user defined attribute).
2. Row 1. The text <pit> at the top of the column indicates the column contains a user defined pit attribute and similarly <pipe> indicates a user defined pipe attribute.
3. Row 2. This row contains the names of the 12d drainage variable names and the pit/pipe attributes. All names are case sensitive so be careful where you use capital letters. A list of 12d drainage variables is found below.

   Names beginning with an asterix (*) will not be processed (except pit/string names when unique identifiers are present in the data). 12d drainage variables names beginning with an asterix indicate that this data was calculated at export time and cannot be read back into 12d (for example, pipe length, pipe grade and deflection angle).

Prefixing an user defined attribute name with "DELETE " (no quotes, note the space after the DELETE) will cause the attribute to be deleted from all pits/pipes within the model.

4. Row 3. The text in this row define the type of attribute to be stored within 12d. The only valid choices are;

   integer
   real
   text

   If you want to change an attribute type you must delete the attribute and create it again. If you simply change the attribute type in the third row then that attribute will not be updated.

5. Blank lines may be inserted as desired.

6. You are not required to fill in all of the cells in the spreadsheets. Blank cells are ignored (you must use a space to remove all data from text attributes (the space will not be stored).

7. Pipe names are included in the data so that they can be changed but they are **not** used to identify the pipe. Pipe data will always be assigned to the pipe following the pit in the direction of **ascending** chainage. If flow directions is ascending then the pipe data will be for the downstream pipe. If the flow direction is descending then the pipe data will apply to the upstream pipe.

8.4 12d Drainage Variable Names

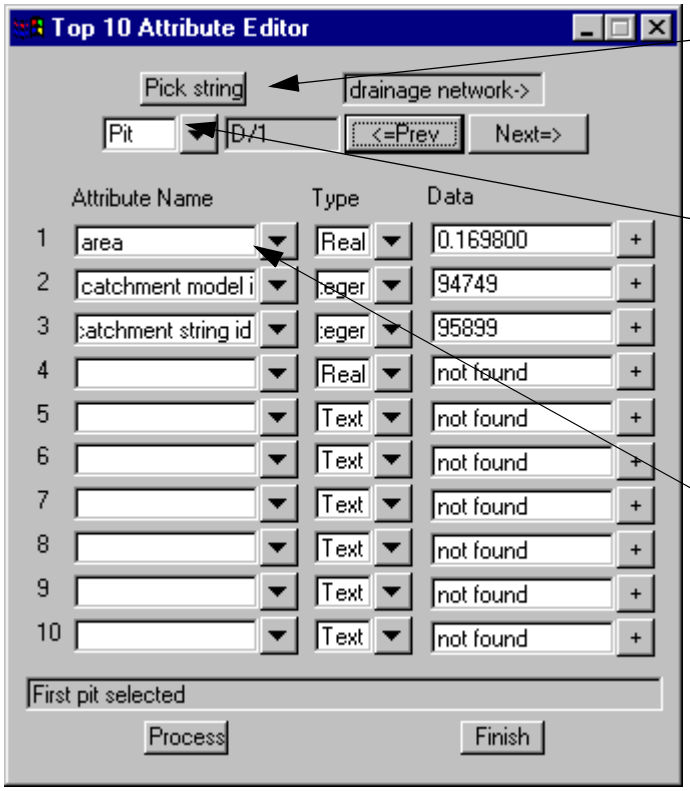
Manhole Variables	Pipe Variables	String Variables
*string Name	pipe name	direction
*pit name	pipe type	fs tin
pit type	low ch invert	ns tin
pit diameter	high ch invert	string id
pit low ch invert	diameter	
pit high ch invert	*length	
pit road chainage	*grade	
pit road name	low hgl	
*pit angle	high hgl	
*pit drop	pit hgl	
*pit depth	flow	
*pit chainage	velocity	
x location		
y location		
cover elev		
*fs elev		
*ns elev		
pit id		

9.0 Reviewing, Changing and Creating User Defined Attributes

The catchment data is stored within 12d as user defined attributes. These attributes are automatically created by 12d when required but you are free to change them or add more as desired. The attributes may be exported to a spreadsheet and edited and then imported back into 12d. To work with the user defined attributes within 12d select

Design=>Drainage-Sewer=>More=>Top 10 Attribute Editor.

.



First **S**elect **Pick** to select the string that contains the user attributes (the drainage string). The strings will be highlighted in white when they are selected.

All catchment data is store with the manholes in drainage strings. To access the manhole attributes, select the drop down icon and then select **manhole**. A circle will be drawn around the manhole selected. **Next** and **Prev** will now move you from manhole to manhole.

Select the drop down icon and then select the **Attribute Name** from the list of existing user defined attributes. These attributes include all of the attributes in the model that the string exists in.

They may not be defined for the manhole you are editing. **Not found** will be displayed in the **Data** field if the manhole does not have that attribute defined.

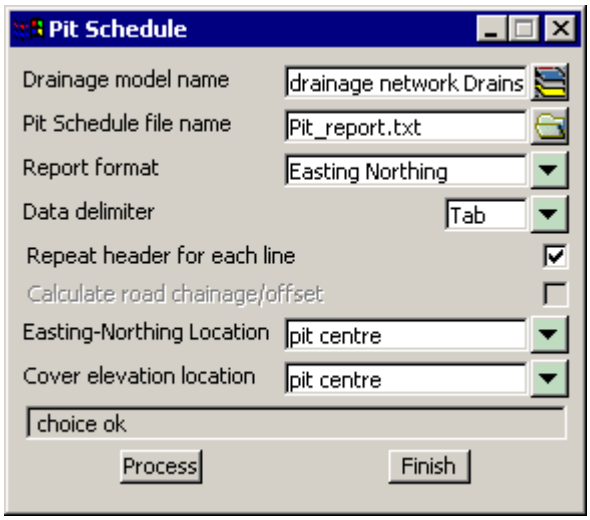
To change the value for the attribute enter the new value in the **data** field. If the attribute does not exist, deleting the **not found** text and adding data will create it. The message on the right will be displayed whenever you are creating a new attribute.

10.0 Manhole/Pit Schedules

Manhole/pit schedules or construction tables are generated in tab or space delimited formats.

This panel is accessed from the menu selection

Design => Drainage => More Drainage => Pit schedule



The fields and buttons used in this panel have the following functions.

Field Description	Type	Defaults	Pop-Up
Drainage model name	input box	drainage network	
model containing the drainage strings			
Pit schedule file name	input box	pit report	
file to be created			
Report Format	choice box	Road chainge.,Easting...	
file format			
Data delimiter	choice box	Tab, Space	
tab delimiters are best for spreadsheets and space for some text editors			
Repeat header for each line	tick box	selected	
when selected, the column headings will be printed each drainage line			
Calculate road chainage/offsets	tick box	selected	
only used for road chainage-offset format. When selected, the road chainages and offset calculation panel will be displayed so that the this data can be updated before the report is generated. (see below)			
Easting Northing Location	choice box	pit centre, road design string	

easting northing data can be from the manhole centre or the x,y location on the road design string that the manhole has been linked to

Cover elevation location choice box pit centre, road design string

*the cover level elevation can be from the manhole centre or the elevation on the road design string that the manhole has been linked to (if a link has been made then these values should be the same). Note that the road design string data is **NOT** calculated at this time. These are the values calculated from the Drainage Misc Utilities or the last drainage data export.*

Process button

Create the pit report

Finish button

remove the panel from the screen

Notes:

The columns of data may be separated by spaces or a tab. (tab is used for spreadsheet transfers). The internal width and length data are retrieved from the **drainage.4d** file for the pit type specified. If you want a longer description for the pit then the type used inside 12d this can also be entered in the drainage.4d file. The remarks for each pit are entered as user defined pit attribute named **remarks** and may be set using the attribute editor (on the drainage menu) or via a spreadsheet.

Easting Northing Sample

.PIT SCHEDULE

Pit				INTERNAL		INLET		OUTLET		PIT		
No	TYPE	EASTING	NORTHING	WD	LEN	DIA	INV LEV	DIA	INV LEV	FIN RL	DEPTH	REMARKS
B1	SA2	5302.458	7336.936	450.000	900.000			375	28.210	29.387	1.177	
A2	SA2	5264.372	7322.036	450.000	900.000	375	27.470			28.646	1.226	
C1	SA2	5224.155	7336.936	450.000	900.000			375	26.690	27.863	1.173	
A3	SA2	5187.910	7322.036	450.000	900.000	375	25.930			27.158	3.628	
A1	SA2	5309.458	7321.100	450.000	900.000			225	28.550	29.577	1.027	
A2	SA2	5264.372	7322.036	450.000	900.000	225	27.470	375	27.420	28.646	1.226	
A3	SA2	5187.910	7322.036	450.000	900.000	375	25.930	375	23.530	27.158	3.628	
A4	SA2	5157.411	7321.332	450.000	900.000	375	23.090			26.714	3.624	outlet to existing system

NOTE:
1. ALL SETOUT POINTS QUOTED TO CENTRE OF PIT

Road Chainage Offset Example

DRAINAGE LINE A

PIT	PIT LOCATION		LOCATION OFFSETS			
No.	EASTING	NORTHING	STATION CTRL	OFFS	TYPE	REMARKS

A/1	5354.629	7336.936	231.171	d002	-7.450
A/2	5340.691	7320.911	217.233	d002	8.575
A/3	5293.458	7320.886	170.000	d002	8.600
A/4	5250.131	7320.886	126.673	d002	8.600
A/5	5217.194	7322.036	93.736	d002	7.450
A/6	5183.458	7322.036	60.000	d002	7.450
A/7	5152.699	7322.036	29.241	d002	7.450

Notes

The Set pit details must be run at least once to before printing the report. If the pits are moved or the designed strings changed then this option must re rerun.

The Road Chainage and Offset Pit Schedules use two user defined attributes for each pit. The first is **ctrl string** which identifies the string that the pit will be offset from and the second is **ctrl model** which contains the model name for the control string. These may be manually created/modified using a spreadsheet or the attribute editor.

The easting northing data obtained for the **road design string** option is obtained by dropping the manhole centre perpendicular onto the selected road design string. This data is stored as pit attributes **setout x** and **setout y**. It is calculated when the manhole cover levels are recalculated (drainage misc utilities and during drainage export (recalc level option must not be turned off)).

The cover elevation data obtained for the **road design string** option is obtained by dropping the manhole centre perpendicular onto the selected road design string and obtaining the elevation at this point. This data is stored as pit attribute **level z**. It is calculated when the manhole cover levels are recalculated (drainage misc utilities and during drainage export (recalc level option must not be turned off)).

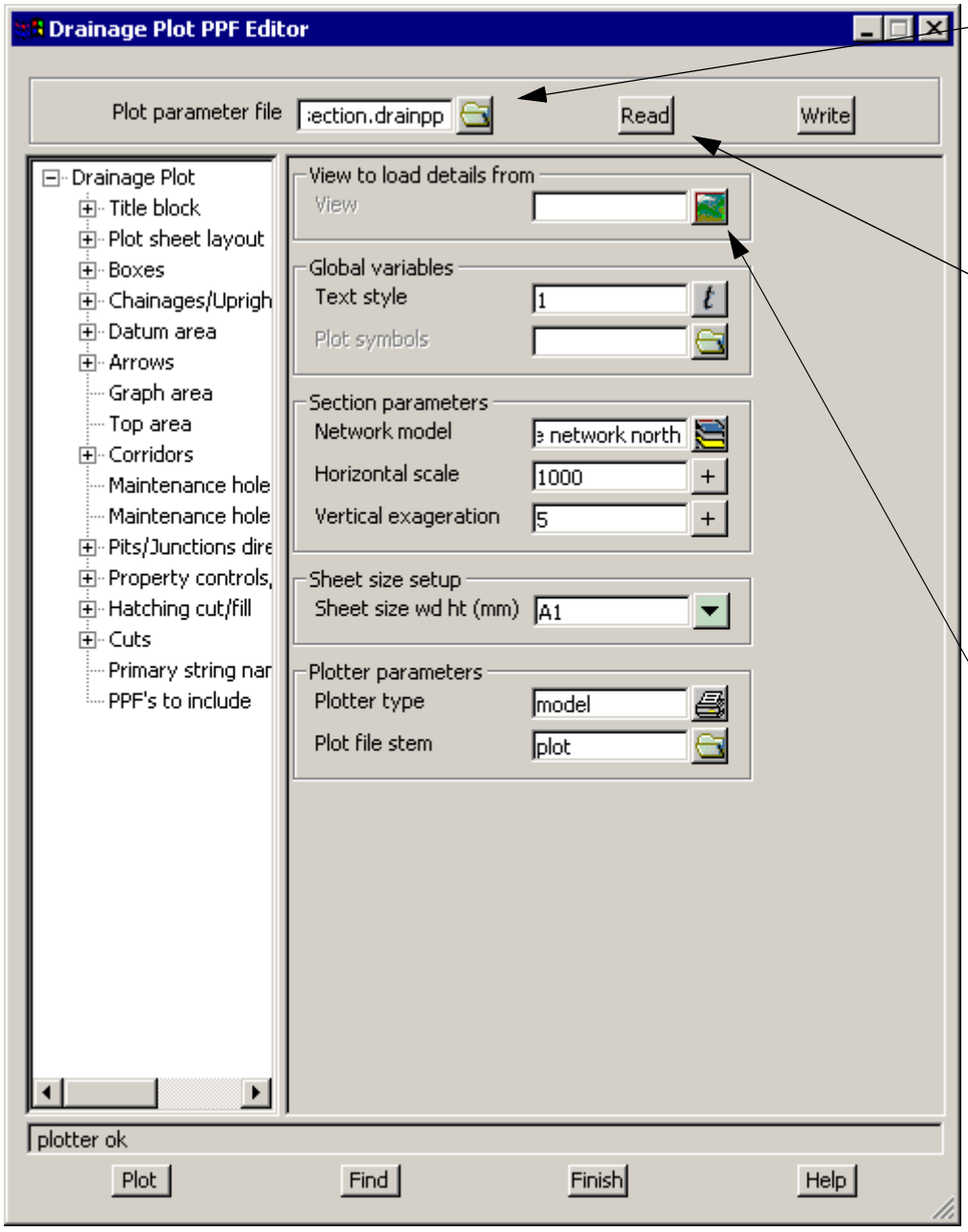
11.0 Long Section Plotting

Detailed description of the 12d drainage long section plotting may be found in the 12d Reference manual. The long section plots are customised using the drainage plot parameter files (drainppf). Title blocks, user defined text may be added and then plotted directly or to various file formats (dwg, dgn etc.). From the main menu

Design=>Drainage-Sewer=>Plots=>Longsections

See Also

manhole Schedules to set road chainage and name data



To access the drainppf files supplied select the icon and then walk right on **Lib** to select this drainppf file.

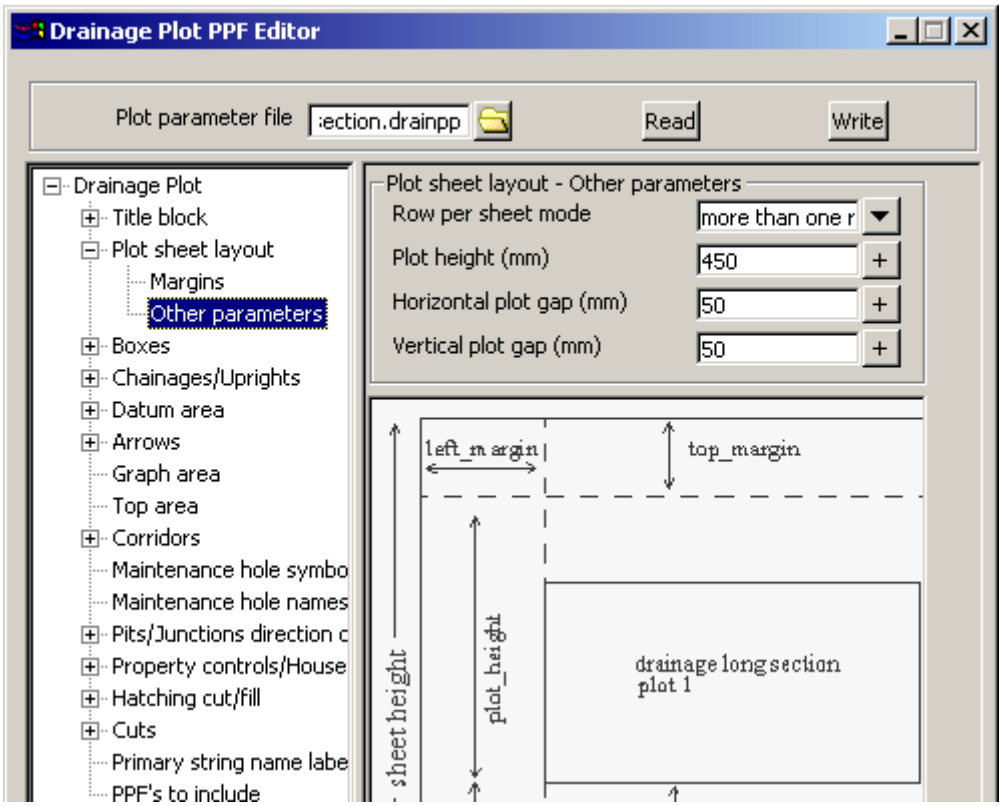
Select **Read**

Enter a new name for this drawing and select **Write**. This will save the setting we are about to make should you want to replot this long section.

This section view determines the additional models (such as services) to show plot. These are referred to as corridor models. The vertical exaggeration is also obtained from this view.

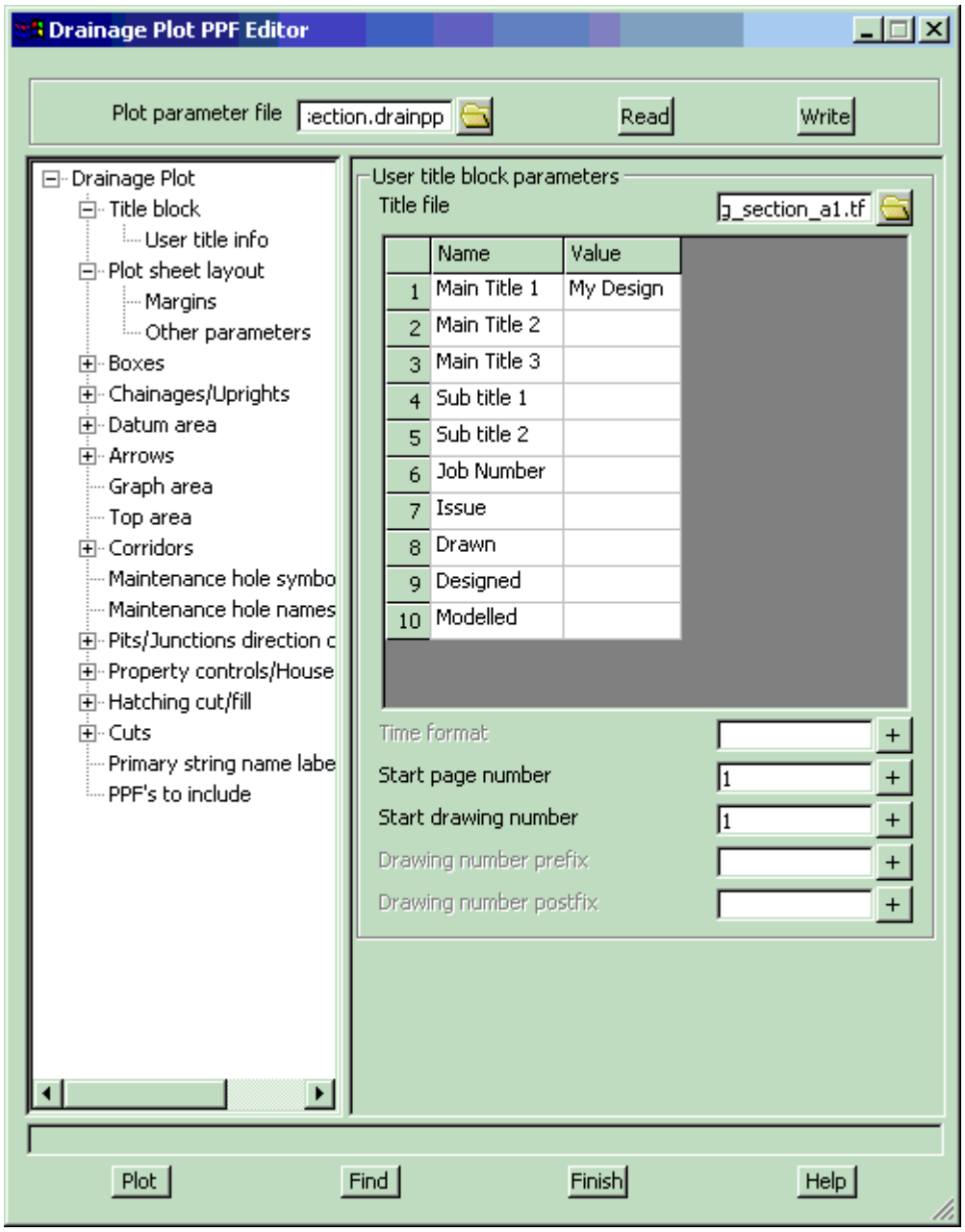
The **network model** field will be completed with the model of the string being profiled. If this is not your drainage network model then select it now.

When **Plotter Type** is set to model then **plot file stem** is the model name prefix for plots that will be created. The first sheet of plots will be in model **plot1**, the second in **plot2** etc.



The **plot height** determines how much room is left vertically for the actual plot. This specifies the total height of the plot. 12d then constructs the box area and arrow area on the bottom and then arrow area on the top. The amount left over is used for the long section itself.

To stop datum breaks from occurring increase this height, increase your plot scale or decrease your vertical exaggeration. If there is too much white space in the graph area then reduce this value.

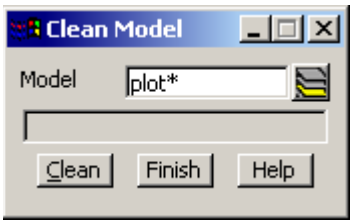


The **+Drainage plot+title block+User title info** allow you to enter the text for the title block. The list displayed is retrieve from the **title file** selected above. Enter the data for the plot and then select **Write** to save the changed to the local drainppf file you entered earlier.

Select **Plot** and the plots will be send to the **plot file stem** entered. These models may be added (one at a time) to a plan view to inspect them before plotting to paper or exporting to other drawing packages.

If changes are to be made and then plotted again you must delete the drawings in the model. These models may be cleaned out using

Models->Clean



The asterisk may follow the plot file stem to clean all of the models at once. You will be shown the model list before they are cleaned.

12.0 Working with Kerb/Lip Strings

The reference point for kerb inlet manholes is usually on the kerb lip string or a fixed distance off the string. The rest of the strings only complicate the picture so we will take copies of the kerb strings to be placed in another model. Isolating the kerb strings into a separate model and joining them together is the recommended way to work with them. This may take a few minutes but sometimes you have even less time than that. So first lets look at how to pick kerb strings quickly.

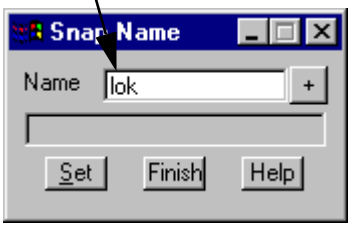
12.1 Picking kerb strings - name snap

Strings generated by 12d have specific names attached to them. The lip string is often called “lok”. Therefore, if we could restrict our string selection to those strings named “lok” it would make placing the manholes very efficient. We are going to do this with the **Name snap.**

There are 3 types off snap tool bars available. Standard, vertical and horizontal. To obtain the standard snaps toolbar select, **Utilities=>Snaps=>Snaps** and the following snap toolbar will appear.

Select **Name** and the following panel will appear.

Enter lok and select **Set.** Now only strings with this name will be selected.

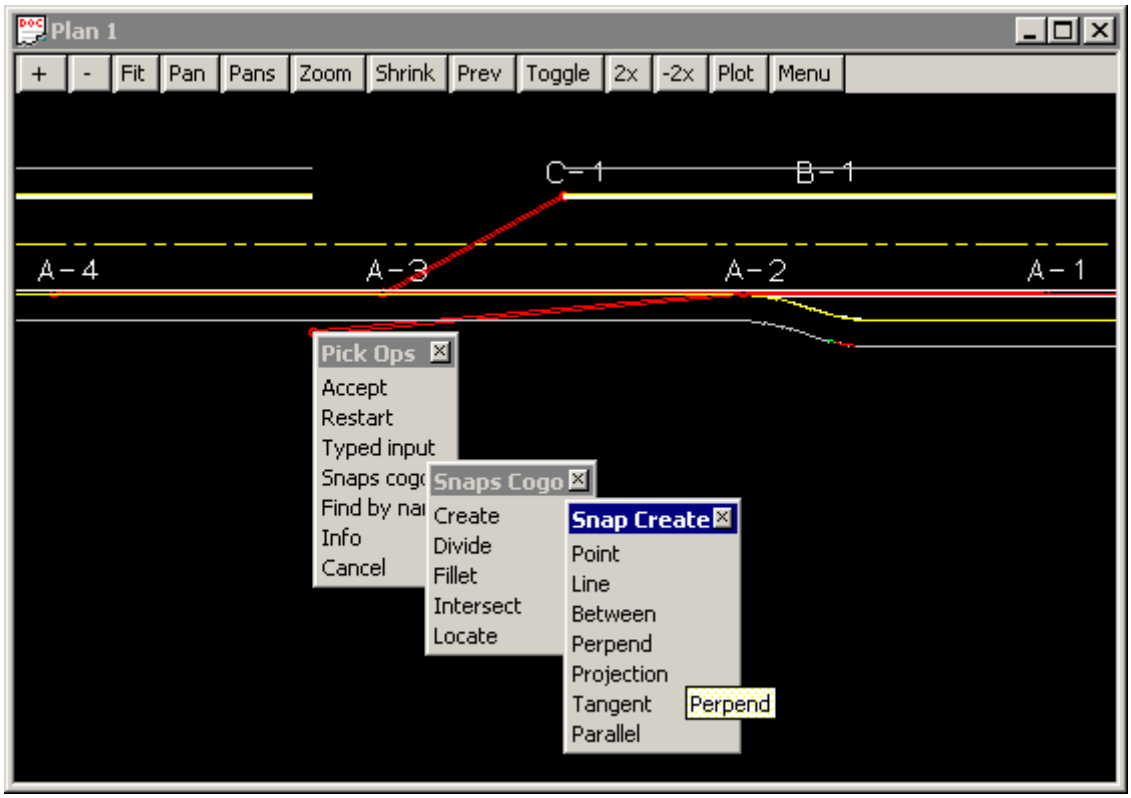


Leave the panel up to remind your erase the lok entry and select **Set** again so that you will once again be able to pick any string.

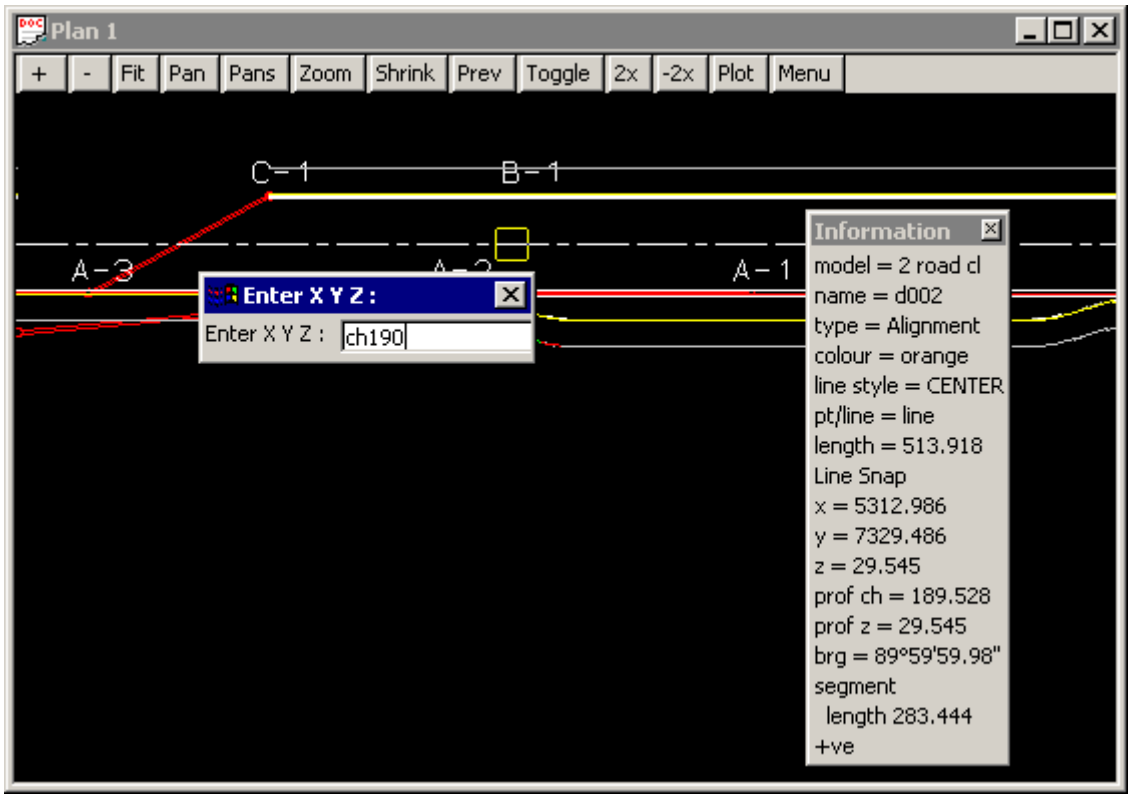
12.1.1 Placing a manhole at a Specific Control String Chainage

When appending or moving drainage manholes, the following steps will place the manhole at a specific chainage along the control string.

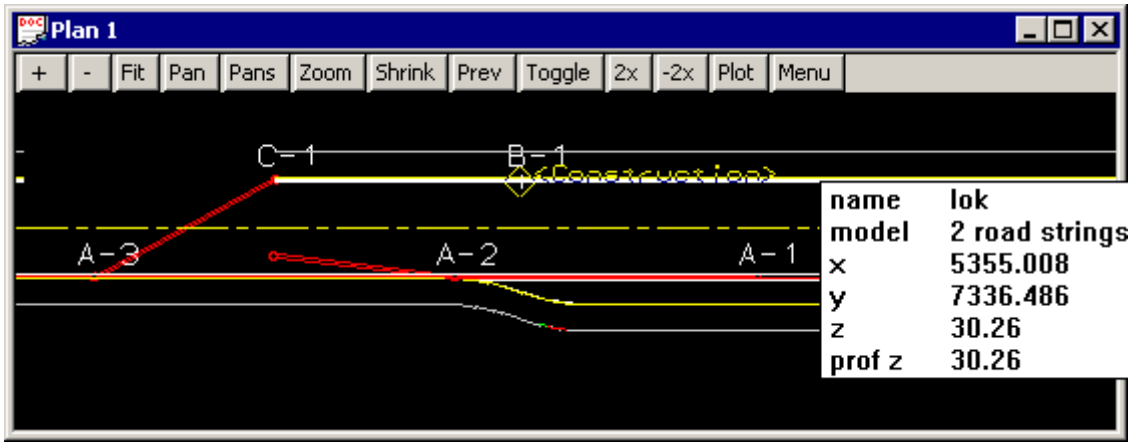
1. **RB** and then select **Snaps cogo=>Create=>Perpend** from the menu. Messages indicating what to be done next are given in the bottom left corner of the 12d window.



2. **LB** select but **do not** accept the road centre line (control string).
3. To place the manhole across from chainage 2100 Type ch2100 then press enter.



4. **MB** accept the inserted point. This identifies the point on the control string. Next
5. **LB** select the lip line then **MB** accept. The construction point will be displayed on the lip line



6. **MB** accept the construction point to place the manhole.

12.1.2 Placing a manhole at a Specific Distance/Offset along the kerb string

When appending drainage manholes, the following steps will place the manhole at a specified distance along a string and if desired an offset.

1. RB and then select Snaps cogo=>Locate=>Offset from the menu. Messages indicating what to

be done next are given in the bottom left corner of the 12d window.

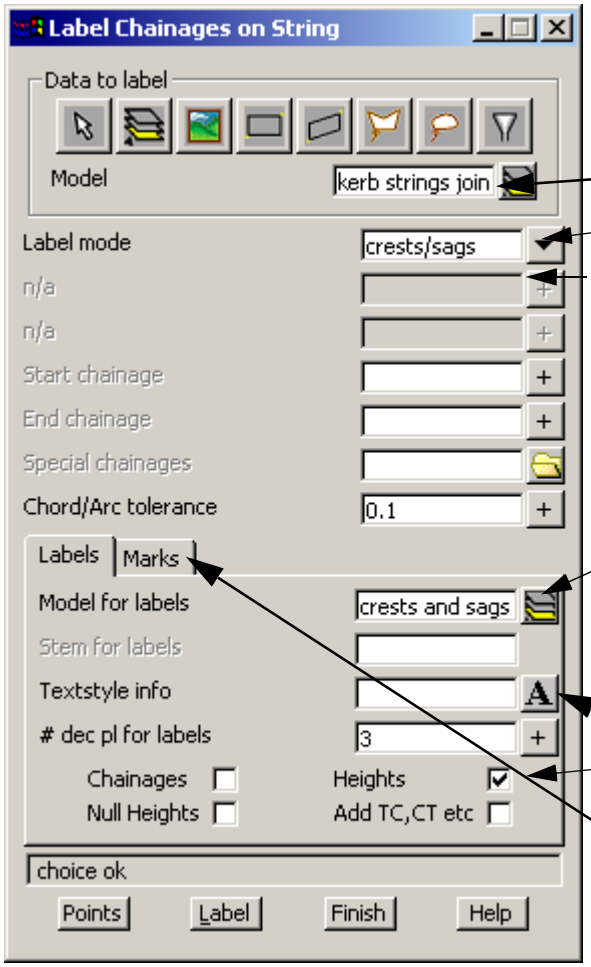
2. When you select the string to measure the distance along, do not click but rather drag in the direction you want to offset. Next MB accept
3. LB select then MB accept the control point to measure the distance from. (If this point is not on the string selected in step 2 the point will be dropped perpendicularly onto that string).
4. Type the distance along the string then press Enter (a negative value would go in the opposite direction to the drag in step 2).
5. Type the offset distance from the string then press Enter (positive is defined using a right hand rule method from the direction in step 2).
6. MB accept the construction point to place the manhole.

12.2 Locating Crests and Sag Points

This step will place tick marks at the crest and sag points of your kerb strings. It is an optional step but it will help ensure that a drainage manhole is always placed at SAG manhole locations.

If your road designer has given you kerb inverts strings split into numerous sections, use the "head to tail" feature described in section 4.2 above before using this section. The crests and sag locations along the design string can be identified using the selection

Strings =>Label => Chainages



Enter the model name for the kerb strings.

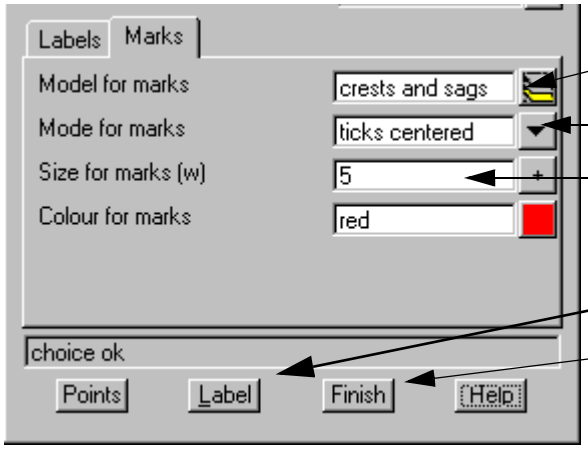
Select **crests/sags** from drop down list**.**

Enter a model to contain the text labels. A **,1** after the model name, requests that the model be added to view 1. This saves you adding the model to the view later to see the labels.

Select icon to define the text style.

Optionally select heights and not chainage.

Select the **Marks** property sheet



Type the same model name as above for the tick marks.

LB to select **ticks centred** from the drop down list**.**

5m white marks stand out well on the screen.

Select **Label** to create the labels.

Select **Finish** to remove the panel.

To get a clear picture of what the kerbs look like in profile lets create a section view and profile the kerb string.

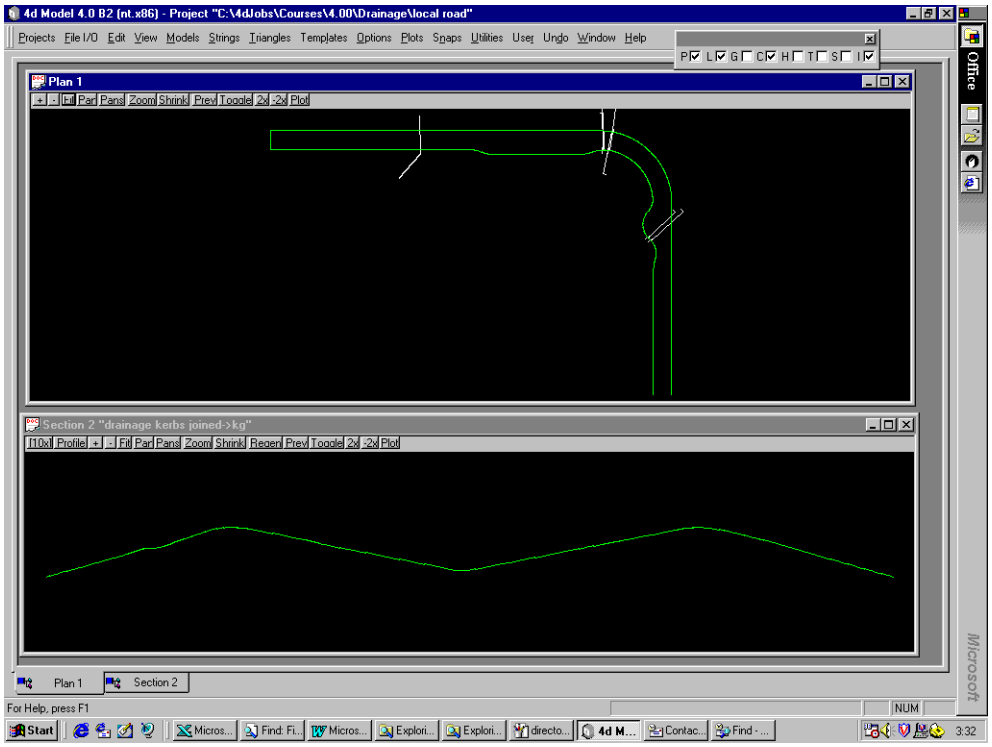
To obtain more working area, hide the **Output Window** (Window=>Output window).

From the main menu select,

View=>New=>Section View

Now Select **Profile** on the **section view title area** and then pick the kerb string in the plan view. Your screen should now look like the following.

x



Place your pointer in the section view and notice how the cross in the plan view indicates your position in plan.

THE END