

Tutorials

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1 Tutorials

The purpose of these tutorials is to have you enter a small, yet complete irrigation system, have it designed and costed, and the plans prepared. You will simply be asked to do things, explanation as to 'why?' will be limited - enough to show the process without getting involved in possible alternatives. The intention is to illustrate how IRRICAD works and to do this as simply as possible. Consequently, the system layouts used have been devised with this in mind and the siting of some componentry may not be ideal from an irrigation designer's viewpoint.

1.1 INTRODUCTION TO DESIGN TUTORIALS

The types of tutorials are listed:

Very Basic Design	Section 1.1.4
Placement Aids and Tips	Section 1.1.5
A Simple Turf Design	Section 1.1.6
Methods to Lay Out Sprinklers	Section 1.1.7
Applying a Specific Amount of Water to an Area	Section 1.1.8
Simple Drip Tape Design	Section 1.2.1
Simple Drip Tape Design Using Block Entities	Section 1.2.2
A Simple Orchard Design	Section 1.2.3
Working with Multi-Valve Designs	Section 1.2.4
Using Computer Selection of Fittings	Section 1.2.5
Solid Set Sprinkler Design	Section 1.2.7
Residential Design	Section 1.2.8
Wheel Line Design	Section 1.2.9
Using Demand Points	Section 1.4.1
A Quick Rural Water Supply	Section 1.4.2
Customizing Your Database	Section 1.5.1
How IRRICAD Selects Fittings and Understanding the Fitting Selection Rules	Section 1.5.2
Correcting Fittings Errors	Section 1.5.3
Creating and Modifying Assemblies	Section 1.5.4
Creating and Modifying Symbols	Section 1.6
Printing Using Plot Layouts	Section 1.3
Digitizing Plans	Section 1.7
Plot Templates	Section 1.8
Tips for Advanced Users	Section 1.9

There is no rigidly prescribed method of carrying out IRRICAD designs; you should use these examples as a guide only and try to develop a procedure which best suits your situation.

Only those options needed to produce these designs are described. References to the Help Topics are made where appropriate.

The exercises in this manual are set up to show specific features of IRRICAD, so please complete each section even if the type of design is not in your general line of work. Work through the exercises at your own pace and please feel confident with each exercise before moving on to the next one. These exercises can be completed at an IRRICAD training course or at your own computer in your office.

The database that is necessary for the tutorials is supplied with the program.

When directed to select a command from a menu, the menu name, menu option and sub menu option (if applicable) will be listed. For example, select *Settings|Digitizer|Scale*. This refers to selecting the Scale option from the Digitizer submenu that is found in the Settings menu. The Settings menu is found on the Menu bar at the top of the IRRICAD window. All button names will be displayed with square brackets such as [OK] etc and all dialog field names will be displayed with double quotation marks such as "Description". All entries you need to enter, select or are editable if automatically entered for you are in bold such as 'Enter the "Width" as **32** and the "Height" as **50**.'

1.1.1 HELPFUL HINTS

Before you begin any designs on your own, please note the following:

1.1.1.1 TERMINOLOGY

The following terminology is used in IRRICAD:

Block:	An option for laying out an area of equally spaced spraylines (Spray Block) or tapes (Tape Block). The spraylines may be connected or unconnected (see below). Immediately after entry, each sprayline or tape becomes an independent item. Use of Block does not define an irrigation block. This means that the Block tools may be used to layout all of the spraylines for a design at one time. The Zones only become defined when these Spraylines are connected to Control Valves.
Control Valve:	Any device which can be used to control the flow of water to an outlet or group of outlets.
Irrigation Block Entity:	An option for laying out an area of equally spaced spraylines or tapes, with automatic placement of submains, flushing manifolds and control valves. The spraylines may be connected or unconnected (see below). Each block entity is defined as an irrigation zone. These are dealt with as a complete entity and can be subdivided using the <i>Tools Sub-Divide Block</i> option.
Mainline Pipes:	Pipes used to connect control valves to water supplies.
Mainline Outlets:	Outlets on a mainline. Each outlet is treated as a zone and is assumed to also perform the function of a zone control valve. Valve-in-head sprinklers are mainline outlets.
Misc. Hydraulic Items (mainline):	Items such as isolating valves, back flow preventers, air release valves that are connected into or onto a mainline pipe.
Misc. Hydraulic Items (zones):	Items such as isolating valves, backflow preventers, air release valves that are connected into or onto a Zone pipe.
Outlet:	Any device that discharges water from an irrigation system.
Sprayline (connected):	A zone pipeline containing equally spaced external outlets, also known as a lateral. A connected sprayline is maintained as a single unit. Typically the emitter connection is small (such as a barb) and therefore the minor losses are calculated using a different method. The pipe selected for connected spraylines has the L usage code. Always use if there are 30 or more emitters per lateral size. Turn on the “ Connected ” option in Sprayline/ Spray Block, Spray Irrigation Block dialog.
Sprayline (unconnected):	A method of spacing outlets uniformly along a Zone or Mainline pipe. As soon as the sprayline has been entered it is converted into individual pipes and outlets, i.e., it is not maintained as a single unit. For Zone spraylines use ‘unconnected’ when there are 10 or less emitters per lateral size. The pipe selected for unconnected zone spraylines is the Z or U usage code. Always use if there are 10 or less emitters per lateral size. Turn off the “ Connected ” option in Sprayline/ Spray Block, Spray Irrigation Block dialog.
Management:	The process of telling IRRICAD which valves will be running at any one time.
System Duty:	A situation in the mainline (resulting from the turning on or off of control valves) in which the flows are fixed for a particular time period. Also known as stations, sets or groups.
System Flow:	Also known as stations, sets or groups. Zones are assigned to system flows for the system duty to be determined for a particular duration when specific control valves are designated to be running. The process of assigning system flows is referred to as “Management”.
Tapes:	A lateral with internal emitters (drippers), commonly called dripline.
Water Supply:	A point of supply for the irrigation system.
Zone:	Items downstream of control valves (including the valves themselves). A zone becomes defined when control valves are entered, and zone pipes or spraylines connected to it, regardless of how or when those spraylines, pipes and outlets were entered.

Zone Outlets:	Outlets within a zone.
Zone Pipes:	Pipes used to connect zone outlets to control valves. Also known as submains.

Designs in IRRICAD consist of Mainline Pipes (pipes connecting a water supply or water supplies to Zone Valves), on/off Control Valves, Zone Pipes (pipes connecting Zone Valves to laterals or outlets, e.g., submains), and Spraylines/Tapes (equivalent to laterals).

A Zone becomes defined when a Zone Control Valve is entered and Zone Pipes, Spraylines and / or Outlets are connected to it.

Spray Block and *Tape Block* (options in the *Zone* menu) are options for laying out an area of equally spaced spraylines or tapes, nothing more. Use of Block does not define an irrigation block.

This means that *Block* may be used to layout all of the spraylines for a design at one time. The Spraylines may then be modified using *Tools/Cut Lasso* to remove areas that are not required, *Modify/Delete* to take out unwanted rows and so on. The Zones only become defined when these Spraylines are connected to Zone Control Valves.

A *Tape Irrigation Block* or *Spray Irrigation Block* does define an irrigation block. These are dealt with as a complete entity and can be subdivided using the *Tools/Sub-Divide Block* option.

1.1.1.2 ELECTRONIC HELP

The on-line Help is available through the Help menu, select *Help Topics*. It contains all the topics and chapters available in the manual and is divided into five main divisions:

- The Overview contains information about using Help and comments and tips for new users.
- The User Manual describes how to approach a particular task, using IRRICAD tools and options.
- The Database Editor section describes the function of the database and how to enter hydraulic items into the database.
- Tutorials – this section.
- The Tool and Command Reference describes each menu item and describes how to mechanically use the tool.
- The Technical References contains the Appendices and provides information such as Hazen-Williams C Values for pipe friction loss, Fitting Selection Rules, Keywords for Labels and Plot Templates and Screen Messages help and explanations.

In addition, the *Help* menu also contains a *Release Notes* section which chronologically lists new features added and also details addenda to the manuals.

Use Search or Find to enter a key word and find the sections the key word appears in.

1.1.1.3 TUTORIALS

It is a good idea to run through a few of the tutorials when first learning IRRICAD. The tutorials will describe a number of the new tools and options using a step by step process. Though you may know how to use IRRICAD for design purposes, the tutorials help you to navigate around the new program and help you to develop a process for the new version. There are more tutorials available in the manual and the on-line help. The tutorials may also give you a fuller picture of IRRICAD's capabilities and introduce new features and functions for you to try.

1.1.1.4 USING THE INTERNET

Upgrades are available from our website (www.IRRICAD.com). You are able to download and upgrade your current version of IRRICAD. If you have an older version of IRRICAD please contact your distributor for the upgrade.

Email contact is available on the website. Email us any requests of what you would like to see in IRRICAD in the future.

For any support, please contact your distributor.

1.1.1.5 IRRICAD USERS FORUM

The IRRICAD Users Forum, accessed through [Help/Support Forum](#), is a great tool to find answers to your questions or issues as others may have had the same question or issue in the past. The forum is fully searchable.

You can subscribe to the forum to be notified of the latest topic posts as they happen. You can ask your own questions here or reply to someone else's question or query.

The Tip of the Week will also be posted on the IRRICAD Users Forum. Subscribe to receive notifications of posts.

1.1.1.6 MOUSE OPERATION

IRRICAD uses the mouse installed with Windows operating systems.

Clicking the left mouse button selects or places. Clicking the right mouse button will bring up additional menus of choices for aiding or finishing tasks when using tools.

In most circumstances do not hold down the left mouse button after placing the first click of a line, pipe, select window or similar. Simply left-click then move the mouse and left-click again.

1.1.1.7 DRAWING PIPES

When drawing pipes, click for the first point, click the end point or click when there is a change in direction. To finish a pipe, [Right-click](#) and select [Restart](#) and press the <Esc> key.

1.1.1.8 NAVIGATIONAL, MODIFICATION, SELECTION TOOLS & DRAWING TOOLS

IRRICAD incorporates a number of keyboard and mouse shortcuts that help to speed up the operation of various tools. Here is a selection of these that you may find useful:-

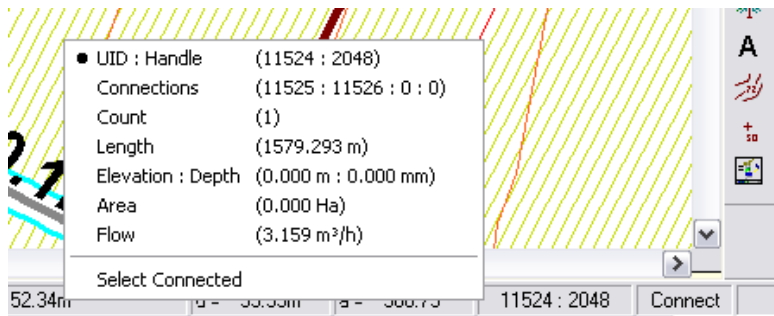
- Double-clicking on an item when in [Select Object](#) operates the change tool on the item.
- To bring up the dialog for a Block Entity, hold down the <Alt> key while clicking on any child component of the block entity.
- To select an item where there may be several item in that location or near that location hold down the <Ctrl> key while clicking. Then select the required item from the list – a single click to select or a double-click to bring up the dialog.
- If you using the [Select Object](#) tool in “Single Select” mode, (see [Settings/Mouse](#)) you can hold down the <Shift> key to highlight subsequent items.
- In “Single Select” mode clicking empty space clears the current selection.
- Pressing the <Esc> key twice in quick succession clears the current selection and returns you to the default [Select Object](#) tool.
- Redrawing a large design may be stopped by pressing the <Esc> key.
- To place control valves and mainline outlets without having to view and “OK” the Zone Name dialog, hold the <Shift> key down when clicking to locate them. The default zone name will automatically be accepted and the dialog will not appear.
- All [Copy](#) tools have a “no dialog” shortcut, which repeats the last copy without showing the dialog each time. To action, hold the <Shift> key for the 2nd and subsequent copies.

1.1.1.9 STATUS BAR

Three panels are available on the right-hand side of the status bar. All the panel options can be selected by right-clicking the panel to access a pop-up menu, or left clicking to cycle through the available options.

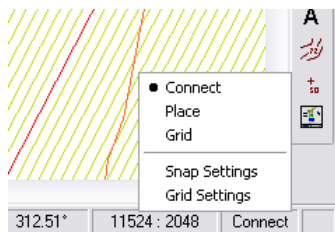
Info Panel

This panel displays a variety of information about the currently selected objects. This includes UID, connections, selected item count, cumulative length of selected items, elevation and depth, cumulative area, cumulative nominal flow and Z Coord. The menu also allows the user to select the items connected to the current item. The options may also be cycled with the shortcut key combination <Ctrl>+<Shift>+<I>, while <Ctrl>+<Shift>+<C> will select the connected items. Note that the current values of all options are displayed on the popup menu.



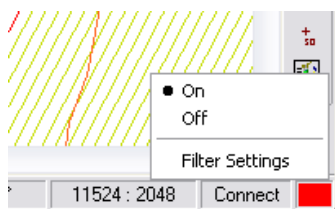
Snap Panel

This panel shows the currently selected default snap mode (Connect, Place or Grid) and, through the popup menu, allows quick access to the *Snap* and *Grid* settings. May be cycled with <Ctrl>+<Shift>+<S>.



Selection Filter Panel

This panel shows the status of the selection filter - a red panel indicates that the filter is active. The user can also access the filter settings through the popup menu and flip the filter status using <Ctrl>+<Shift>+<F>



1. Practice drawing and finishing pipes.
2. Practice some of the above tools and modes.

1.1.2 THE FIRST STEPS

Before starting a design:-

1. Select [Settings/Company](#) and enter your company details. To avoid having to re-enter your company information, in future designs, click the [\[Save As Defaults\]](#) button.
2. Set display properties for hydraulic items. Select [Settings/Irrigation - Design Specific](#) to customize pipe line widths. Again click the [\[Save As Defaults\]](#) button to retain these settings for all future designs. Select [Settings/Irrigation Items](#) to customize the display properties for other hydraulic symbols. These are contained in the “Lines” and “Symbols” sections of this tab.
3. Select [Settings/Units](#) to select the units to use for each type of value.
4. If you know approximately what size your design will be, you can select a “Design Size” from [Settings/Miscellaneous](#). This option makes the symbols, on the screen, an appropriate symbol size relative to the area the design covers. It can be altered at any time by selecting another “Design Size” or typing in a “Base Database Symbol Size”. Note if the “Update Database Symbols” checkbox is checked, all hydraulic symbols, currently in the design, will be updated to the new size.
5. Design headings can be entered at any time. However, it is advantageous to specify these at the beginning to avoid any confusion if several copies of the base design are made. Select [Settings/Design Details](#).
6. You are now ready to enter your design. Note that all Management and Design options are available from the [Design](#) menu and all Zooms are available from the [View](#) menu. Remember that if you cannot find a particular menu item or tool, the Find or Search functions in [Help/Help Topics](#) can be used to locate it.

Remember that you can enter items and information at any time and in any order. Ensure only [Mainline](#) items are used upstream from a control valve, and only [Zone](#) items are used downstream from a control valve.

7. Design the zones first ([Design/Zone Design/...](#)) to be able to use actual flows in the management process (step 8).
8. You must tell IRRICAD how the system is to operate before you can design the mainline. Select one of the management options from the Design menu: Assign Zones to System Flows (or one of the two partly automated options) or Zone Operating Times before designing the mainline ([Design/Mainline Design/...](#)).

Happy Designing!

1.1.3 IMPORTANT RULES TO REMEMBER

There are two main rules for IRRICAD. Neither can be broken, and if you remember them then designing with IRRICAD is made easier.

- You cannot connect zone items to mainline items. Only a control valve can join zone and mainline
- The order in which you draw items is flexible but Design is not. You must first tell IRRICAD how the system is to run (Management), then design the zones, analyze the valves and then design the mainline as listed below:

Process List for Designing with IRRICAD

1. Enter background information
2. Layout the irrigation system
3. Design / Analyse the Zone. Check the reports
4. Finalise Zone Design via Detailed Analysis (if non-pressure compensating emitters)
5. Management – tell IRRICAD how the system is to run – what zones are operating when
6. Design / Analyse the Mainline. Check the reports
7. Finalise Mainline Design via Detailed Analysis (for non-pressure compensating mainline outlets only)
8. Computer Selection of Fittings and Bill of Materials Report
9. Place a Plot Layout and then Print.

BASIC START

1.1.4 VERY BASIC DESIGN

Tasks covered in this tutorial:

- Entering Zone and mainline items
- Drawing a simple system
- Turning valves on
- Sizing pipes based on required pressures
- Reading reports

This design illustrates the very basic concepts entailed in an IRRICAD design. Understanding these concepts and principles will allow them to be applied to larger and more complex designs.

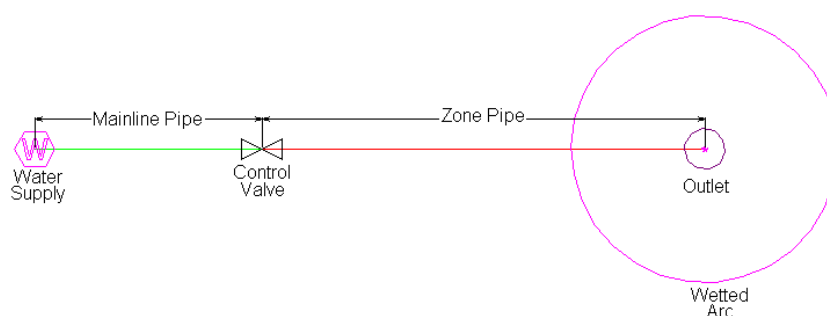


Figure 4-1

1.1.4.1 STARTING THE TUTORIAL

1. Double-click on the IRRICAD desktop icon or select Start|All Programs|IRRICAD|IRRICAD Pro to start IRRICAD. If IRRICAD is already running, select *File/New* to start a clean design.
2. Go to *Settings/Irrigation - Design Specific* and browse [...] for the Tutorial.mdb database. Highlight and select *[Open]*.
3. Go to the *Units* tab and click the *[US]* (*[Metric]*) button to restore the default units for this tutorial. These settings can be retained for each design by clicking the *[Save As Default]* button.
4. Select the *Misc* tab (*Settings/Miscellaneous*) and select the **Medium** "Design Size" (center of dialog). Click *[OK]*.

1.1.4.2 DRAWING THE LAYOUT OF THE SYSTEM

5. Select *Mainline/Water Supply* and place a water supply on the screen, near the left-hand side. Leave the "Calculate pressure?" option enabled, so that IRRICAD will calculate the system duty for the system you draw. Click *[OK]* to accept and close the dialog.
6. Select *Mainline/Pipe*. Leave the pipe as **Computer Selected** so that IRRICAD will size the pipe for you. Click *[OK]* and click in the center of the water supply to place the start point of the pipe (left-click on the screen). The pipe will rubberband with the cursor until you place the end point or next point of a pipe (if the pipe is bent). The pipe tool is like a continuous line tool and will rubberband between points until you end the pipe by right-clicking and selecting *Restart (Right-click/Restart)*. *Tip:* By pressing the Ctrl key you will get a straight pipeline.
7. Between mainline and zone items there always needs to be a control valve. Items upstream from the control valves are always designated as *Mainline* whilst items downstream of a control valve are always designated as *Zone* items. You can select a control valve from both the Mainline and the Zone menu (*Mainline/Control Valve* or *Zone/Control Valve*). Select the

¾" (20mm) Electric Valve, click **[OK]** and place it on the black junction (square) at the end of your mainline pipe. Once placed, IRRICAD will assign a default name of **Zone no. 1** to this control valve. This is because valves need to be identified so they can be referred to later in the design process. Click **[OK]**. The black junction will disappear when the control valve connects to the pipe.

8. Now select **Zone/Pipe**. Leave the pipe as **Computer Selected**, click **[OK]** and place the start point on the control valve. Click to place the end point of the zone pipe. When you have completed your zone pipe, **Right-click/Restart**. **Tip:** By pressing the Ctrl key you will get a straight pipeline.
9. Select **Zone/Outlet**. Select the **Big Impact Drive Sprinkler**. In the "Nozzle" field you can select the nozzles associated with this sprinkler. Select the **4.9mm** nozzle. Leave the "Pressure" and "Flow" as the default values. Click **[OK]** and place the outlet on the end of the zone pipe in the center of the black junction. The black junction will disappear when the outlet connects to it.

We have drawn the layout of the system (see [Figure 4-1](#)), selected valves and sprinklers and allowed IRRICAD to select pipe sizes and calculate the required system duty.

1.1.4.3 CHECKING CONNECTIONS

10. First, select **Design/Check Outlet Connectivity**. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. (These can be removed by selecting **Design/Clear Connectivity Marks**.)
11. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use **View/Zoom Window** and draw a window where you want to zoom in). If you see a black junction at either of these points it is an indication that the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply or outlet (**Modify/Select Object** and click on the item) and move the item to the center of the junction (**Modify/Move** and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in **Settings/Snap** is set to "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.1.4.4 ZONE DESIGN

12. Now we can size the pipes for the zone. You will see that the **Zone Design** menu has four options. **Analyze** is used when you have selected the pipe sizes or after you have made further changes to the design. **LP Design** is used when you wish to size zone pipes based on the pressure required at the outlets. **Velocity Design** is used when you wish to size pipes based on a maximum velocity or when the pipe system is looped. **Detailed Analysis** is normally used at the completion of design and iteratively adjusts the flow at each sprinkler based on the calculated pressures giving a more accurate analysis than that based on nominal flows. Select **Design/Zone Design/LP Design**. You should now see the pipe change colour. The colours assigned to various pipes are stored in the database.

IRRICAD also checks that the flow through the valve is within the manufacturers' specification and calculates the valve headloss.

1.1.4.5 ZONE REPORTING

13. Select **Reports/Zone Design Reports/Zone Design Summary**. This report summarizes what is happening in the zone – from the outlets to the control valve as seen in [Figure 4-2](#).
14. Possibly the most useful reports are the **Full** and **Pipe** reports. The **Full** report will tell you the length of a pipe, its head difference and its velocity (as seen in [Figure 4-3](#)) whereas the **Pipe** report will tell you the pressure in the pipe and elevation of the start and end point. Both reports will tell you the pipe size and flow.

Zone Name :	Zone no. 1	Valve Description :	3/4" (20mm) Electric Valve
Zone Head (D/S) :	54.77 (psi)	Zone Head (U/S) :	56.89 (psi)
Total Zone Flow :	7.46 US gpm	Valve Headloss :	2.12 (psi)
	Allowable Flow	Actual Flow	Allowable Pressure
	US gph	US gph	(psi)
Minimum Outlet	425.17	427.08	44.77
Maximum Outlet	469.93	427.08	55.07
Outlet Variation (%)	9.52	0.00	18.70
Outlet Locations (X,Y)	Minimum:	123.0 , 50.5	Maximum: 123.0 , 50.5

Figure 4-2

Zone Name :	Zone no. 1	Valve Description :	3/4" (20mm) Electric Valve
Zone Flow :	7.46 US gpm		
Zone Head (D/S) :	54.77 (U/S) :	56.89	Valve Headloss: 2.12 (psi)
Pipes			
From	To	Size	Code
X Y	X Y		
(ft) (ft)	(ft) (ft)		
73.9 165.7	403.4 165.7	0.75	PV2
		Flow1	Flow2
		US gpm	
		7.5	7.5
		Max. Vel	Length
		(ft/s)	(ft)
		3.5	329.5
		Headloss	(psi)
			9.58
Outlets and Inflows			
Location (x,y,z)	Out Loss	Flow	Pressure
(ft)	(psi)	US gph	(psi)
		Min Pressure	Max Pressure
		(psi)	(psi)
403.4 165.7 0.0	Outlet	0.0	427.1
73.9 165.7 0.0	C.valve	0.0	-447.6
			45.2
			54.8
			44.8
			55.1
			0.0
			0.0

Figure 4-3

1.1.4.6 ENTERING MANAGEMENT REQUIREMENTS

15. IRRICAD needs to know how the system will be operated, we call this Management and there are several ways to accomplish this task. Management gives us the ability to specify when control valves are on and off. In our simple example there is only one valve so the simplest method is to select *Design/Assign All Zones to One System Flow*. This option automatically assigns "Zone no. 1" to operate on **System Flow 1**. Click [OK].

1.1.4.7 MAINLINE DESIGN

16. We can now size the mainline. You will notice that the four options here are the same as were available in the *Zone Design* submenu. The only differences are that *LP Design* will size pipes based on the pressure required at the control valve and that *Velocity Design* must be used if the system has more than one water supply connected. Select *Design/Mainline Design/LP Design*. You should see the pipe change colour. Again, the colour for pipes is stored in the database.

1.1.4.8 MAINLINE REPORTING

17. Now open the *Reports/Mainline Design Reports/System Duty Report*. Here we see the system duty required to run the system you have designed (Figure 4-4).

Water Supply : Supply no. 1				
Duty Number	On time	Off time	Pressure (psi)	Flow US gpm
1	1 : 0 : 0	1 : 1 : 0	58.32	7.46

Figure 4-4

1.1.4.9 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

- When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure in *Design/Zone Design Configuration*. In the “D/S Valve Pressure” column enter the pressure stated in the “Actual Valve Pressure” column.

Zone Design Configuration

Zone Name	Process	Flushing	Manifold	Allow For Minor Losses	Change Diameter At Outlet	Number Of Lateral Sizes	Number of Submain Sizes	D/S Valve Pressure (psi)	Actual Valve Pressure (psi)	Min/Max Emitter Pressures (psi)	Minimum Allowable Pressure (psi)	Maximum Allowable Pressure (psi)	Don't Use Database Envelope
Zone no. 001	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	0	0.0	45.92	45.21 :: 45.21	0.0	0.0	<input type="checkbox"/>

Set Selected Unset Selected Paste Selected

OK Cancel

Figure 4-5

- Now run *Design/Zone Design/Detailed Analysis* to finalise the zone design results. Check the Zone reports by selecting *Reports/Zone Design Reports*.
- If the Zone reports are good re-run Mainline Design. Because there is only a control valve in this design there is no point in running *Mainline Detailed Analysis*. *Design/Mainline Design/Mainline Analysis* to analyse the changes. Check the Mainline reports.

1.1.5 PLACEMENT AIDS AND TIPS

The following placement aids are provided to simplify and speed up some tasks:

- Circular Cursor: *Settings/Drawing Items* – “Circular Cursor”
- Direct Entry: Keyboard
- Connecting Hydraulic Items: *Settings/Snap* – “Default Snap Mode”
- Place vs Connect: *Settings/Snap* – “Default Snap Mode”
- Grid: *Settings/Grid/Origin/GIS*
- Snap to Grid: *Settings/Snap* – “Default Snap Mode”
- Ortho Mode: *Settings/Drawing Items* – “Ortho Mode”
- Entity or Object Snaps: *Settings/Snap* – [Running Snaps].

1.1.5.1 CIRCULAR CURSOR

The circular cursor is a tool that can be used to position items a particular distance from an existing item. A radius is specified, at the required distance, and the cursor is used as a visual locator to place the next item.

This tool can be used for all geometric and hydraulic tools.

An example of the use of this tool would be drawing in a block of tapes a set distance from the fence line.

1.1.5.2 DIRECT ENTRY

Distances, angles and co-ordinates can be entered directly by using the keyboard. As the characters are typed they are displayed on the left-hand side of the status bar. Pressing the <Enter> key executes the command.

A single number is always a length; angles require a length first, and co-ordinates are two numbers divided by a comma. E.g.:

Length	34	<Enter>
Length & angle	34,<90	<Enter>
Co-ordinates	0,0	<Enter>

This feature can be used for all geometric objects.

1.1.5.3 CONNECTING HYDRAULIC ITEMS

During the management, design, analysis, and fittings selection processes IRRICAD needs to “know” how hydraulic items in the system are connected to each other and subsequently back to control valves or Water supplies. This list of connections is referred to as the “Connectivity” and gives rise to a number of rules and mechanisms that help ensure the correct arrangement of a system.

Pipes, spraylines, and tapes must always directly connect to a point hydraulic item and not another pipe, sprayline or tape. In the cases where a water supply, control valve, outlet or miscellaneous hydraulic item is not present the connection is denoted by a “Junction”, which is typically displayed as a black square symbol. For example, when a pipe line changes direction a junction will exist between the two pipes. Free ends of pipes, spraylines, and tapes are also required to connect to a junction or a point hydraulic item. Junctions are normally inserted automatically by the IRRICAD tools and simply serve as internal nodes for the design process, placeholders for fittings selection, and a location to display information.

Some consequences of this system are:-

- Junctions cannot be deleted individually unless unattached. They will be removed automatically when all connected items are removed.
- Junctions will be removed when point hydraulic objects are connected to them.
- When a point hydraulic item is deleted from a pipe, sprayline, or tape it will be replaced by a junction.

Hydraulic items can only connect to items of the same class (Zone or Mainline). The exception is Control Valves which may connect to both Zone and Mainline pipes.

To assist the user and ensure the correct connectivity the hydraulic entity creation tools, by default, employ a visually based “connect mode” (snap). This method uses a user-defined (in [Settings/Snap](#)) screen distance to determine how connections are made to items near the point clicked. If the screen distance (i.e. in screen millimeters or inches) between the point clicked, and the nearest hydraulic item, is less than the setting a connection will be made. Additionally clicking on a pipe, sprayline or tape, within the setting distance from the end of the item, will result in the connection being made at the end exactly.

Using this method helps to avoid unwanted small pieces of pipe being created beyond connections and situations where pipes are not quite connected to items that they were intended to be. Note that zooming in before clicking will allow closer (in real terms) connections to be made.

1.1.5.4 GRID / SNAP TO GRID

A grid can be set up to be any spacing desired along the X and Y-axis. Enter a value for the spacing along the “X”-axis (horizontal) and the “Y”-axis (vertical). Check the “**Display Grid Points**” if you wish to see the grid points on the screen. If you have an existing item on the screen and you wish grid points to be positioned on this item (or corner of the item) enter the co-ordinates of the item (or corner) into the X and Y fields for “**Grid Origin**”.

Snap to Grid

Once a grid has been established you have the option to use **Settings/Snap** “**Snap to Grid**”. Once “**Snap to Grid**” is enabled, the cursor is restricted to only moving between grid points.

This is a very useful tool for drawing straight pipelines, positioning sprinklers at a specific spacing (without using the Sprayline tool) and for positioning and drawing geometric objects.

1.1.5.5 ORTHO MODE

Ortho Mode aligns each new point horizontally or vertically with the previous point placed for geometric items and pipes. The angle of alignment can be changed from horizontal and vertical to any specified angle with the **Settings/Drawing Items** “**Ortho Angle**” setting.

Ortho mode works for both geometric and hydraulic items.

Holding the <Ctrl> key down when in Ortho Mode will disengage Ortho Mode. Holding the <Ctrl> key down when not in Ortho Mode will engage Ortho Mode using the angle set in the “**Ortho Angle**” dialog field..

1.1.5.6 SNAPS AND RUNNING SNAPS

Snaps give you the ability to place or constrain points in relationship to other objects in your drawing. When you use a Snap command while locating a point, the point snaps into position.

Snap tools that are used frequently can be set as running snaps so that they don't have to be selected repeatedly. Running snaps remain activated until turned off in the “**Running Snaps**” dialog. If the “**Show Preview**” option is selected, then when the cursor moves within range of a point for which a running snap is set, an icon for that snap is displayed beside the cursor. Running Snaps is now available for drawing and hydraulic items. Go to **Settings/Snap** and click the **[Running Snaps]** button. You can select any or all to be on. Remember to check the “**RN Snaps On**” check box.

Select the **Right-click/Snap** tool before placing first or subsequent points in a tool if Running Snaps are not on. The **Right-click/Snap** tool is only active for the next mouse click. For placing an item or point in the center of an existing closed object, use **Right-click/Snap/Center**.

When drawing hydraulic items on the screen (including Contours and Spot Heights), the **Right-click/Snap/Place** tool is the same as setting the “**Default Snap Mode**” to “**Place**” (rather than “**Connect**”) but is only active for the next mouse click. Very useful if placing hydraulic items close the existing hydraulic items and not wishing them to connect.

The Snap tools work in much the same way as Connect does. IRRICAD uses a tolerance range. If an item is within this range then IRRICAD assumes you wish to snap / connect to this item. The tolerance range is determined by zoom factor, distance on the screen and world distance.

Try the above tools to see how they work.

1.1.6 A SIMPLE TURF DESIGN

Tasks covered in this tutorial:

- Entering Zone and mainline items
- Drawing simple background information
- Setting pipe line widths
- Drawing a simple turf system
- Setting required outlet pressures
- Selecting outlet connectors (risers)
- Resizing database symbols to suit design size
- Using the Change tool
- Orientating arcs manually
- Turning valves on
- Sizing pipes based on pressure
- Reading reports

This tutorial shows a simple method for laying out several sprinklers and connecting them to the water supply. It is for demonstration purposes only and hence is of a relatively small size.

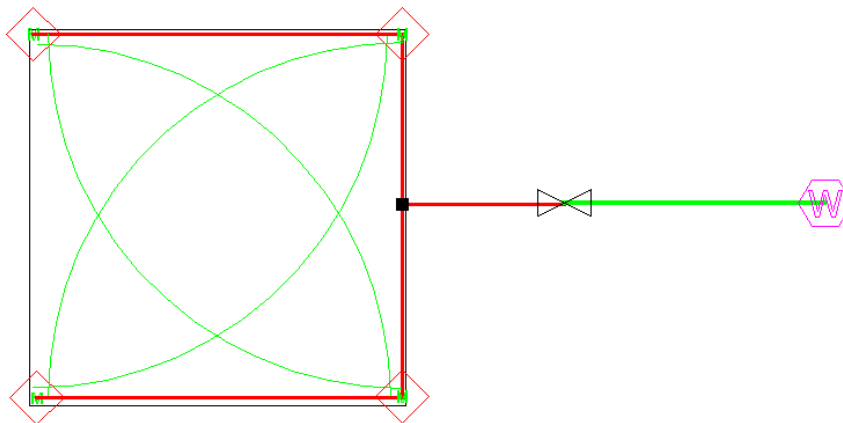


Figure 4-6

1.1.6.1 GETTING STARTED

1. Double-click on the IRRICAD desktop icon or select *Start/All Programs/IRRICAD/IRRICAD Pro* to start IRRICAD. If IRRICAD is already running select *File/New* to start a clean design.
2. In *Settings/Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select *[Open]*. Change the “Zone Pipes Line Width” to **2** and the “Mainline Pipe Line Width” to **3**.
3. Go to the **Units** tab and click the **[US]** (**[Metric]**) button to restore the default units for this tutorial. Note - Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the *[Save As Default]* button.
4. In the previous tutorial we did not draw in any background information. This is not usual, since in most cases you need to have the area, fence lines etc laid out before you can draw in the hydraulic system. We will enter some basic background information in this design. Select *Draw/Rectangle/2 Point* and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point). Select *Modify/Change* and click on the boundary of the rectangle. In the dialog change the “Width” and “Height” to **11.5ft (3.5m)** as in Figure 4-7. Click *[OK]*.

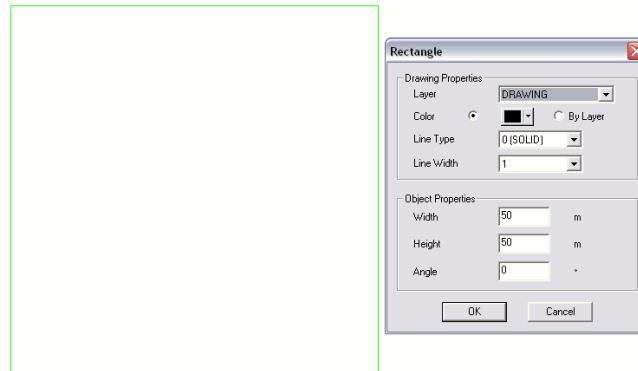


Figure 4-7

5. Select *View/Zoom All* then *View/Zoom Out*.

1.1.6.2 LAYING OUT THE SYSTEM

6. Select *Mainline/Water Supply* and place the water supply to the far right of the square, some distance away (left-click to place). Ensure the “Calculate pressure?” check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK].
7. Select *Settings/Miscellaneous* and type in **1.6 (0.5)** for the “Base Database Symbol Size”, making sure that “Update Database Symbols” is enabled. Click [OK]. The hydraulic symbols on the screen will now appear smaller.
8. Select *Zone/Outlet*. In the dialog select the **Garden Spray Sprinkler** by clicking on the down arrow and highlighting the required item. The “Nozzle” field will show the **10 garden** Nozzle. Change the “Pressure” to **28psi (20m)** and the arc to **90°**. In the “Riser” field select the **½” x ½” Flexible Swing Joint** (the riser determines how the sprinkler is connected to the pipe). Click [OK].
9. Place an outlet at each corner of the square by left-clicking. You will notice that the arcs are not oriented to water inside the square. We will manually fix this by selecting *Modify/Change* and clicking on a wetted arc. In the dialog change the “Start Angle” to be **0, 90, 180** or **270** as required (bottom left = 0, top left = 270, top right = 180 and bottom right = 90) as in Figure 4-8. Click [OK].

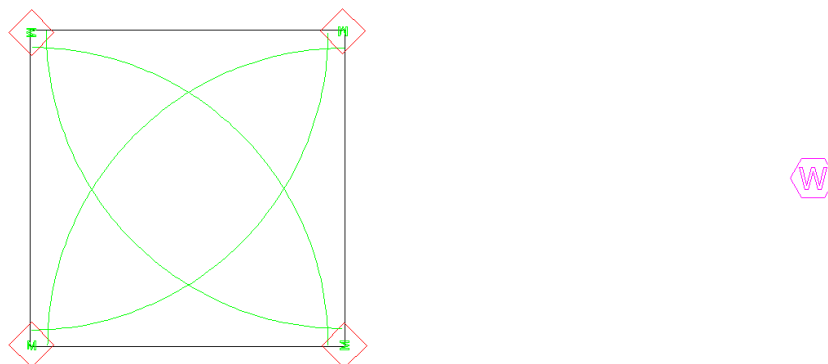


Figure 4-8

10. Repeat for each arc.
11. Connect the outlets by selecting the *Zone/Pipe* tool (**Computer Selected** pipe) and clicking on each item to connect to the pipe. Start at the top left outlet then the top right, then the bottom right and last the bottom left. *Right-click/Restart*. *Right-click/Snaps/Midpoint* and click on the pipe joining the top right sprinkler and the bottom right sprinkler. Draw this pipe out a

little to the right about half way towards the water supply. Left-click to place the end point of this pipe then *Right-click/Restart*.

12. Select *Zone/Control Valve* and select the **1" (25mm) Electric Valve**. Place the valve on the zone pipe end. The black pipe junction should disappear. Select *Mainline/Pipe* and left-click on the valve, then left-click on the water supply. *Right-click/Restart*. See [Figure 4-9](#).

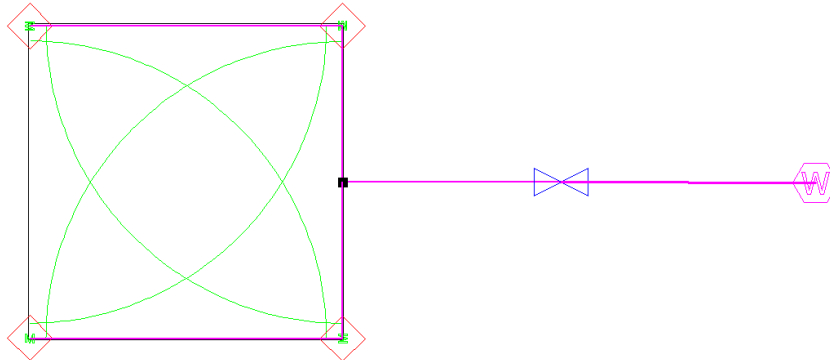


Figure 4-9

1.1.6.3 CHECKING CONNECTIONS

13. First, select *Design/Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design/Clear Connectivity Marks*.
14. If any outlets or control valves are marked as unconnected, ensure that you cannot see a black junction where the outlet, control valve, or water supply connects to the pipes (use *View/Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply, or outlet is not connected to the pipe. Select the valve, water supply, or outlet (*Modify/Select Object* and click on the item) and move the item to the center of the junction (*Modify/Move* and click on the junction). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Settings/Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

Tip: If you are zoomed in too much then this can also hinder the connection. Zoom out a little and let IRRICAD's snap tolerance do the work for you.

1.1.6.4 ZONE DESIGN

15. Now we can design the zone by sizing the pipes and analyzing these pipes. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design/Zone Design Configuration* and simply click **[OK]** on the dialog to clear this). Select *Design/Zone Design/LP Design*. You should see the pipe change colour. The colour for pipes is stored in the database. Note that if the pipe selected has the same colour as the computer selected pipe you will not see a colour change.

1.1.6.5 ZONE REPORTING

16. Select *Reports/Zone Design Reports/Zone Design Summary*. This report summarizes what is happening in the zone – from the outlets to the control valve as seen in [Figure 4-10](#).

Zone Name :		Zone no. 1		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		27.80 (psi)		Zone Head (U/S) :		28.53 (psi)			
Total Zone Flow :		1.83 US gpm		Valve Headloss :		0.72 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		26.09		26.30		26.64		26.92	
Maximum Outlet		28.83		26.30		30.27		26.92	
Outlet Variation (%)		9.52		0.01		11.99		0.01	
Outlet Locations (X,Y)		Minimum :		4.0 , 53.6		Maximum :		7.4 , 50.1	

Figure 4-10

The total zone flow is reported. The minimum and maximum allowable outlet pressures are calculated based on the pressure entered in the Outlet dialog and the flow tolerance specified for the Garden Spray Sprinkler in the database. This tolerance allows a pressure variation of 11.99%. The actual outlet pressure variation in this system is close to 0%. IRRICAD calculates the required downstream valve pressure and the resulting minimum and maximum outlet pressures in the zone. If your results are different this will be due to the length of pipes you have drawn.

1.1.6.6 ENTERING MANAGEMENT REQUIREMENTS

- Once again IRRICAD needs to know how the system will be operated. We call this Management and there are several ways to accomplish this task. Management gives us the ability to specify when control valves are running. In our simple example there is only one valve so the simplest method is to select *Design|Assign All Zones to One System Flow*. This option is automatic, IRRICAD assigns "Zone no. 1" to operate on **System Flow 1**. Click [OK].

1.1.6.7 MAINLINE DESIGN

- We can now design the mainline. Select *Design|Mainline Design|LP Design* to size pipes and analyse them. You should see the pipe change colour. Again the colour for pipes is stored in the database.

1.1.6.8 MAINLINE REPORTING

- Now open the *Reports|Mainline Design Reports|System Duty Report*. Here we can see the system duty required to run the system you have designed.
- Open *the Reports|Mainline Design Reports|Mainline Design Full* and *Reports|Mainline Design Reports|Mainline Design Pipe Report*. The "Full" and "Pipes" reports also exist for the zone design.

1.1.6.9 FINALISE THE DESIGN

- When you are happy with the zone design results and do not need to make any changes run *Design|Zone Design|Detailed Analysis*. In order to do this first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
- Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.
- If the Zone reports are good re-run Mainline Design. Because there is only a control valve in this design there is no point in running *Mainline Detailed Analysis*. Run *Design|Mainline Design|Mainline Analysis*. Check the *Reports|Mainline Design Reports*.

1.1.7 METHODS TO LAY OUT SPRINKLERS

These tutorials illustrate the different methods available to lay out sprinklers. There are three main methods:-

- Placing sprinklers individually (as shown in the previous tutorial, [A Simple Turf Design](#), Section [1.1.6](#))
- Placing sprinklers at a fixed or even spacing along a pipe length – see Section [1.1.7.2](#) and Section [1.1.7.3](#)
- Automatically placing sprinklers in irregular areas Section [1.1.7.4](#).

Before we look at these different methods it is useful to note that you do not need to orientate the arcs, of part circle sprinklers, manually. The previous tutorial detailed the manual method since there were few sprinklers and the required orientation was easy to determine. The *Area* tool (short for Irrigation Area) is used to automatically orientate arcs. This tool will be explained when we look at the different ways to layout sprinklers.

1.1.7.1 GETTING STARTED

1. Double-click on the IRRICAD desktop icon or select *Start|All Programs|IRRICAD|IRRICAD Pro* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.
2. In *Settings|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select *[Open]*. Change the “Zone Pipes Line Width” to **2** and the “Mainline Pipe Line Width” to **3**.
3. Go to the *Units* tab and click the *[US]* (*[Metric]*) button to restore the default units for this tutorial. Note that Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the *[Save As Default]* button.

1.1.7.2 PLACING SPRINKLERS AT A FIXED SPACING – 1ST METHOD OF PLACING SPRINKLERS AT A FIXED SPACING

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Adding pipe and fixed spaced sprinklers in one action
- Snapping to a point

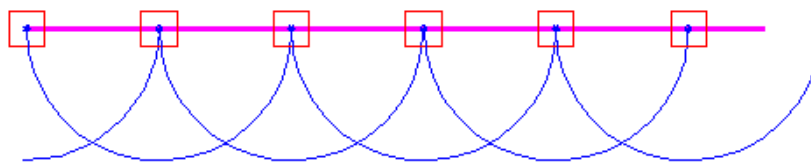


Figure 4-11

1. This method allows pipe and sprinklers, at a fixed spacing, to be placed in one action.
2. Draw a rectangle **82 x 49ft (25 x 15m)** on the screen using *Draw|Rectangle|2 Point*. You can draw out the rectangle any size and then select *Modify|Change* and click on the border of the rectangle. Change the “Width” to be **82ft (25m)** and “Height” to be **49ft (15m)**.
3. Select *Mainline|Water Supply* and place the water supply to the right of the rectangle. Leave all fields set to **0**. Click *[OK]*. Select *View|Zoom All*.
4. Select *Zone|Area* and draw a lasso around the outside of the rectangle by clicking at each point that you wish to change direction. To close the boundary *Right-click|Close*. In the dialog ensure the “Set Arc Orientation Using Area” check box is checked. See [Figure 4-12](#).

Figure 4-12

5. Select **Zone/Sprayline** and leave the pipe as **Computer Selected**. Select the **Low Flow Garden Sprinkler** as the sprinkler. This sprinkler has only one nozzle (**Low Flow Nozzle**) which will automatically appear in the “**Nozzle**” field. Leave the “**Pressure**” as the default pressure of **29.869psi (21m)**. Leave the “**Riser**” field as **No Component Selected** and enter **14.5ft (4.5m)** as the “**Outlet Spacing**” (for head-to-head spacing). Uncheck the “**Connected**” check box, as we want these items to be treated as separate outlets and pipes. Click [OK].
6. **Right-click/Snaps/Endpoint** and click on the top left corner of the rectangle. **Right-click/Snaps/Endpoint** again and click on the top right corner of the rectangle. **Right-click/Restart**. A line of pipe has been drawn with the sprinklers at fixed spacing.
7. Starting from the left-hand side, draw another line so that the pipe will touch the extents of the wetted radii from the previous line of outlets as in **Figure 4-13**.

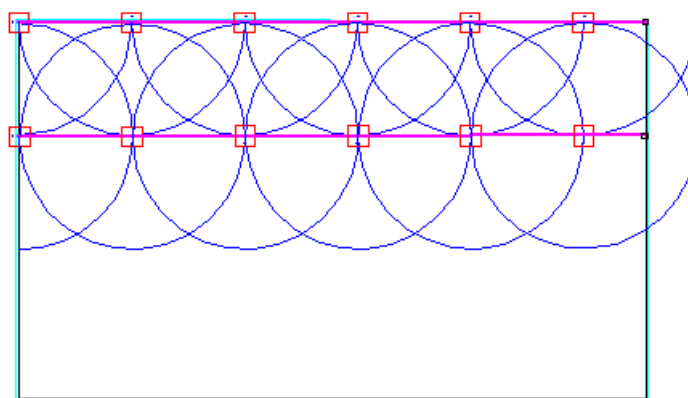


Figure 4-13

1.1.7.3 EVEN SPACING ALONG A PIPE LENGTH – 2ND METHOD OF PLACING SPRINKLERS AT A FIXED SPACING

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Adding pipe and evenly spaced sprinklers in one action
- Snapping to a point

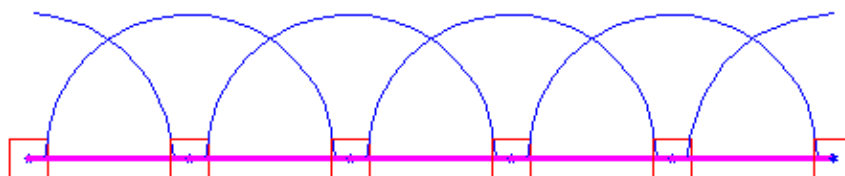


Figure 4-14

This method is similar to the one above but uses the length of the sprayline drawn (i.e. the length of pipe) and places sprinklers at the start and end of the line. Sprinklers, at approximately the spacing you have specified, are then placed evenly between the start and the end.

1. Do the above tutorial ([Placing Sprinklers at a Fixed Spacing – 1st Method of Placing Sprinklers at a Fixed Spacing](#)). Now select [Zone|Sprayline](#). This tool should remember the sprinkler, nozzle, pressure and outlet spacing from before. Click the [\[Options\]](#) button and uncheck the “[Fixed Spacing](#)” check box. Click [\[OK\]](#) on both dialogs.
2. [Right-click|Snaps|Endpoint](#) and click on the bottom left corner of the rectangle. [Right-click|Snaps|Endpoint](#) again and click on the bottom right corner of the rectangle. [Right-click|Restart](#). A line of pipe has been drawn with the sprinklers at fixed spacing.
3. Starting from the left-hand side, draw another line so that the pipe will touch the extents of the wetted radii from the previous line of outlets as in [Figure 4-15](#).

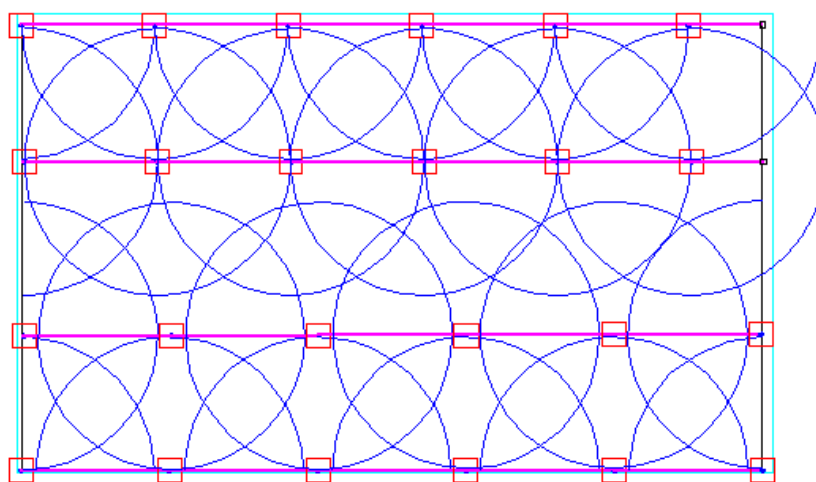


Figure 4-15

4. IRRICAD determines that the sprinklers should only water within the [Area](#) lasso, which is just outside the rectangle boundary. The appropriate arc will be selected in most cases, depending on placement of the sprinkler. Any arcs outside the Area can be altered by using [Modify|Change](#). Click on the wetted radii and adjust the “[Include Angle](#)” as described in the above tutorial ([A Simple Turf Design](#)).
5. Connect the spraylines together with zone pipe on the right-hand end of the laterals using [Zone|Cut Pipe](#). This pipe tool will connect to any zone item it crosses so that you do not have to click on pipe you want to connect to. Simply start the pipe at the top junction and finish the pipe after clicking on the bottom junction.

6. Select a **1" (25mm) valve** and connect the valve to the zone pipe end. Select *Mainline|Pipe* and connect the valve to the water supply to complete the system. See [Figure 4-16](#). Follow the same design procedure as in the previous tutorials. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design|Zone Design Configuration* and simply click **[OK]** on the dialog to clear this).

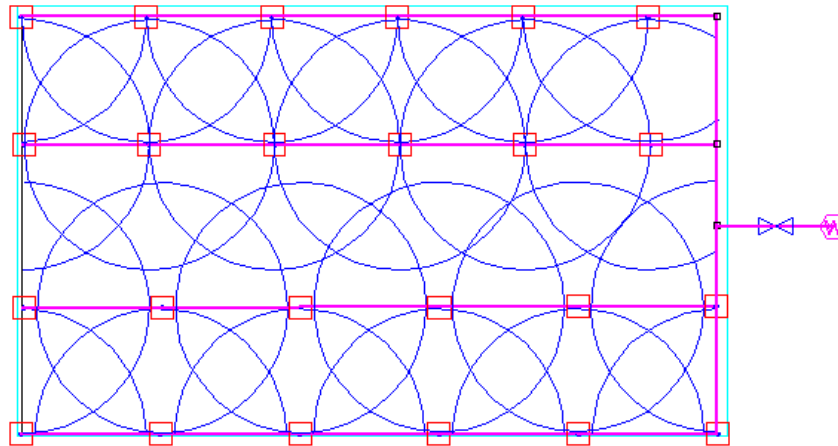


Figure 4-16

The sprayline tool can be used to place sprinklers evenly and the pipes subsequently deleted when the pipes need to be connected in a different way. This tool can also be used without the *Area* tool, without having the arcs or wetted radii showing, without using *Snap*s and can be used in any application where even spacing or fixed spacing of outlets is required. It can be used in conjunction with "Grid", "Snap to Grid" or "Circular Cursor" as placement aids. See [Figure 4-17](#) for the difference of having "Fixed Spacing" on and "Fixed Spacing" off on the same length of pipe.

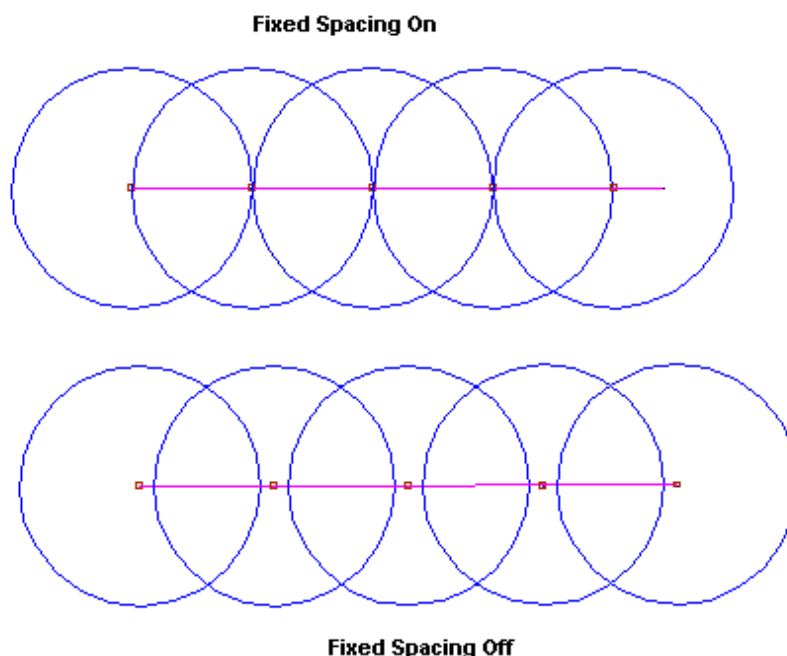


Figure 4-17

1.1.7.4 AUTOMATICALLY PLACING SPRINKLERS IN IRREGULAR AREAS

Tasks covered in this tutorial:

- Drawing simple background information
- Orientating arcs automatically
- Automatically determining spacing and arcs in an area
- Moving an item
- Connecting pipe to more than one item quickly

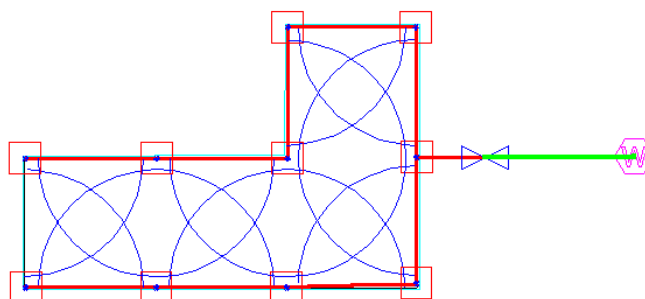


Figure 4-18

The third method used for placing sprinklers is a tool called *Autohead*. Note that *Autohead* is normally used for small irregular areas.

Autohead attempts to maintain a uniform precipitation over the area. Because of this best results are achieved when matched precipitation sprinklers or fixed sprinklers with a combination of nozzles for the different arcs that are used. *Zone/Area* is used alongside *Autohead* to orientate the wetted arcs.

1. To keep straight horizontal and vertical lines turn on ortho mode by going to *Settings/Drawing* and enabling the “*Otho Mode*” option at 0° degree. Select *Draw/Polygon/Irregular*. Place the first point in the lower left of the screen, move the cursor to right to achieve a straight horizontal line, and type **48 (15)** on the keyboard and press <Enter>. Move the cursor upwards to achieve a straight horizontal line and type **32 (10)** and press <Enter> on the keyboard. Using this method continue to draw another line to the left for **16ft (5m)**, downwards for **16ft (5m)**, and to the left for **32ft (10m)**. Now select *Right-click/Done* to finish the polygon. Select *View/Zoom All*.
2. Highlight the shape from step 1 and action *Zone/Area*. Click [OK] on the message “Create irrigated area from select items?”. In the dialog ensure that “*Set Arc Orientation Using Area*” is enabled. It should look something like Figure 4-19. Select *View/Zoom Out*.

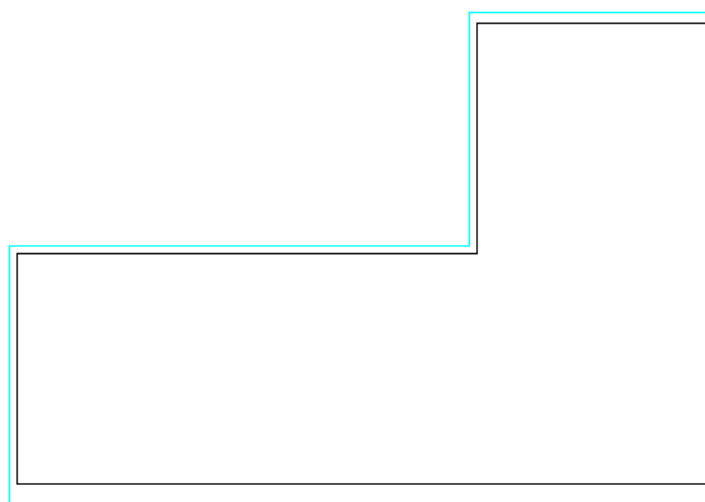


Figure 4-19

3. Select *Mainline|Water Supply* and place the water supply to the right of the polygon. Ensure the "Calculate pressure?" check box is enabled so that IRRICAD will calculate the system duty for the system. Click [OK] to accept and close the dialog. To decrease the size of the water supply and subsequent hydraulic symbols go to *Settings|Miscellaneous*. Change the "Base database symbol size" to 3 (1) making sure that "Update database dymbols" is enabled. Click [OK]. The hydraulic symbols on the screen will now appear smaller.
4. Select the Area boundary and then action *Zone|Autohead*. Select the Sprinkler as the **Low Flow Garden Sprinkler**. This sprinkler has only one nozzle (**Low Flow Nozzle**) which will automatically appear in the "Nozzle" field. Leave the "Pressure" as the default pressure of **29.869psi (21m)**. Leave the "Riser" field as **No Component Selected**. Click [OK].
5. Draw the Autohead lasso around the inside border of the polygon. To close the lasso *Right-click|Close*. Once the polygon has been closed it will be filled with sprinklers. See [Figure 4-20](#). (Note: if the *Area* lasso is on the polygon boundary and so is the *Autohead* lasso, you may find that some arcs do not orientate inside the area. Simply move the sprinkler by selecting *Modify|Select Object* and then *Modify|Move* and move the sprinkler slightly inside the boundary and left-click to place. This method can also be used for moving any sprinkler to a more appropriate place.)

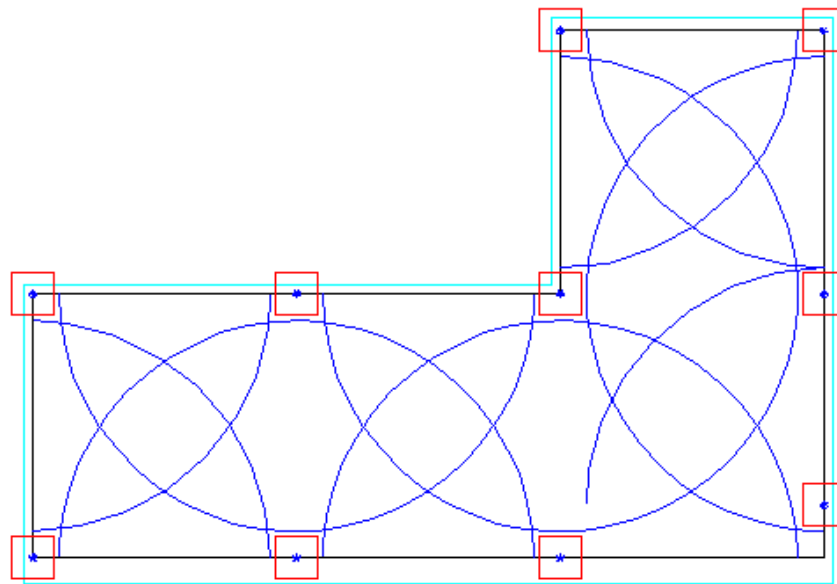


Figure 4-20

6. Select *Modify|Move* and click on the bottom right sprinkler. To move the sprinkler click to place it in its new position in the bottom right corner.
7. Select *Zone|Cut Pipe*. This tool is similar to *Zone|Pipe* and is a tool to put in a straight pipe with quick connections to each zone item the pipe crosses without having to click on each item to connect to it. Click on the top far left sprinkler. Now click on the sprinkler where the area goes upward. Click on the top left sprinkler then the top right sprinkler. Now click on the bottom right sprinkler and then the far-left sprinkler. *Right-click|Restart*. Your design should look like [Figure 4-21](#).
8. Follow the same design procedure as in the previous tutorials. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design|Zone Design Configuration* and simply click [OK] on the dialog to clear this).

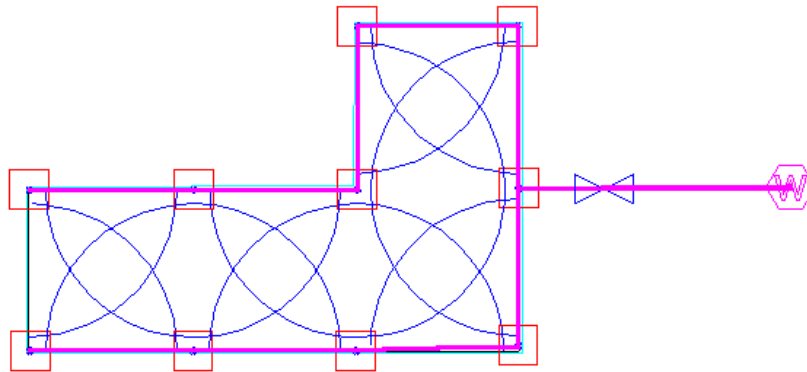


Figure 4-21

1.1.8 APPLYING A SPECIFIC AMOUNT OF WATER TO AN AREA

Tasks covered in this tutorial:

- Changing an item
- Using Irrigation Areas
- Determining run times
- Determining water application

In many cases a specific amount of water is required. This may differ depending on the type of plants or soil, and whether the location is lawn, garden, shady or sunny.

Previously we have used the Irrigation Area tool (*Zone|Area*) to simply orientate wetted radii within a boundary. This same tool allows us to specify the amount of water we wish to apply and subsequently calculate the run time. The Area tool has two purposes that are unrelated. You do not need to have arcs to use the Area tool for water requirements.

An *Area* lasso can be drawn around an entire section which has the same water requirements even if there are different sprinklers or several zones (control valves) in this section.

If you have not completed the above tutorial (*Automatically Placing Sprinklers in Irregular Areas*) do so now. If you have, open the saved design.

1. Double-click on the Area lasso (double-clicking does the same as *Modify|Change*). The *Area* dialog will appear. See [Figure 4-22](#).

Irrigated Area [X]

Drawing Properties

Layer: IRR_IRRIGATION_AREA [v]
 Color: Cyan [v]
 Line type: Continuous [v]
 Line width: 0.00 mm [v]

Area Properties

Name: Area no. 001 [v]
☐ Set arc orientation using area
 Max intensity: 0 mm/h [v]
 Required Quantity of Water:
☐ Specify by volume
☒ Specify by depth 0 mm [v]

[OK] [Cancel]

Figure 4-22

1.1.8.1 THE AREA DIALOG

2. The maximum intensity can be specified in in/hr (mm/hr). This is the maximum amount of water per hour that can be applied to that area or soil type. Enter **0.2 (5)** as the **"Maximum Allowable Intensity"**.
3. The required quantity of water to be applied can be expressed by volume (US gallons or litres) or depth (inches or mm). Select **"Depth"** and enter **0.08in (2mm)**. See [Figure 4-22](#). Click [OK].

1.1.8.2 CALCULATING ZONE RUN TIMES

4. When Areas are used you can still use the default running time of 1 hour in *Design/Assign Zones to System Flows* options (Management).
5. After management has been completed the Zone Flows report (*Reports/Management Reports/Zone Flow Report*) will specify the time we need to run the zone in order to achieve the required depth or volume entered in the Area dialog. This report has 26 minutes as the required running time. The *Zone Flow Report* will report the run time and the applied precipitation to the area per zone. The *Water Requirements* report will list the applied volumes and depths based on the current run time (which is 1 hour). See [Figure 4-23](#) (*Zone Flow Report*) and [Figure 4-24](#) (*Water Requirements Report*).

Cycle Time is 1 day		Times are per cycle			
Zone Name	Number of Outlets	Flow US gpm	Operating Time d:hh:mm	Precipitation Rate (in/h)	Max. Precipitation Rate (in/h)
Zone no. 1	10	2.018	0: 0: 26	0.18	0.20

Figure 4-23

Zone/Area Name	Flow US gpm	Area acres	Depth Applied (")	Depth Required (")	Vol. Applied US gal	Vol. Required US gal
Zone no. 1	2.018	0.02	0.1804	0.08	121.06	52.83
Area no. 1	2.018	0.02	0.1804	0.08	121.06	52.83

Figure 4-24

You can set the run time in *Assign Zones to System Flows* to be that which is reported in the *Zone Flow Report* (26 minutes). Open the *Water Requirements* report with the updated run time of 26 minutes.

6. Complete Mainline Design.

1.1.9 IMPORTING OTHER FILE TYPES

Files from other CAD programs can be imported into IRRICAD. File formats supported are:

- .vcd Visual CADD files – Use *File|Import*
- .dxf DXF files – Use *File|Import*
- .dwg Autocad drawing files – Use *File|Import*
- .gcd Generic CADD files – Use *File|Import*
- .shp ESRI maps – Use *File|Import*
- .mif Mapinfo maps – Use *File|Import*
- .csv, .txt, .xyz CSV files – Use *File|Import*
- .kml/kmz Google Earth Keyhole Markup Language files – Use *File|Import*
- .jpg JPEG files – Use *File|Import Image*
- .bmp Bitmap files – Use *File|Import Image*
- .tif TIFF files – Use *File|Import Image*
- .wmf Windows metafile – Use *File|Import Image*
- .emf Windows metafile – Use *File|Import Image*
- .amp Windows metafile – Use *File|Import Image*
- .pcx Paintbrush – Use *File|Import Image*
- .png PNG – Use *File|Import Image*

After importing a file, such as a DXF or DWG, sometimes the drawing is not centered on the screen or nothing appears. Use ZOOM EXTENTS for the drawing to appear full size in the screen.

For importing other file types change the “File Type” in the dropdown box on the bottom right of the *Import* or *Import Contours* dialog.

1.1.9.1 IMPORTING FAQs

Drawing is Very Small on Screen

After importing a file, such as a dxf or dwg, sometimes the drawing appears very small in one corner. Zoom into the imported drawing and using the *Select Window*, draw a window around the drawing. Now go to *Modify|Invert Selection*. The reason you see what you see is because the drawing also contains a point or object far away from the rest of the information. We have effectively now selected this object (which in some cases cannot be seen or selected via traditional methods). Now select *Delete* (accept [Yes] if asked) and now *Zoom All*. Your drawing should now fill the screen.

Large Co-ordinates in Your Design?

For those of you who work with a lot of imported drawings this tip will make navigating around, and manipulating, these types of designs much easier.

Many imported drawings use a world coordinate system, typically UTM, to accurately reference the location to a particular part of the world. The resulting X and Y coordinates are often very long and therefore difficult to read both onscreen and in reports. Additionally they may also exceed the formatting limits in some parts of Irricad and not be displayed.

Setting a “User Origin”, in *Settings|Grid|Origin*, simply displays all X and Y values relative to the specified origin point. For example let's say you have a design containing objects having coordinates ranging from 20000 to 20500 in X and 10000 to 10300 in Y. After setting a user origin of 20000,10000 all coordinates displayed would now range between 0 and 500 in X and 0 and 300 in Y.

An easy method to set a user origin is:-

1. Place a point, using *Draw|Point*, at the lower left corner of the extents of the drawing. The exact position isn't important.
2. Bring up the *Object Info* dialog for the point (select the point then “Object Info” on the Right Click menu).

3. Now select the coordinates by dragging your mouse and highlighting them, ensure you don't highlight "P1".
4. Copy the coordinates (Ctrl +C or click the Copy button) and close *Object Info* dialog.
5. Go to *Settings|Grid/Origin* and Paste the coordinates into the "User Origin" edit fields by highlighting the "0" in the "X" field and pasting using Ctrl +V. The coordinates will automatically be inserted into the X and Y fields.
6. Tick the "Enable User Origin" check box and click [OK] on the dialog. Now the coordinates displayed on the screen, in reports and warning messages will now be much more manageable.

Notes:

The original world coordinates are still retained internally in IRRICAD. This means that when importing another drawing (with the same coordinate system) into the same design, or exporting the design, the world coordinates will be used.

You can toggle between the world coordinates and your user coordinates by using the "Enable User Origin" check box.

The coordinate "Copy and Paste" method, described in 3. and 4. above, may also be used to insert coordinates into the *Goto Coords* dialog. Note in versions older than Pro Version 10, each coordinate will need to be copied in to their box individually.

The exact position of the user origin can be set to a specific item on the plan e.g. end or corner of a fence line. In this way the coordinates on the design will reflect the distance from this item on the plan.

1.1.9.2 IMPORTING ELEVATIONS

Elevations can be imported into IRRICAD as contours and spot heights from DXF, DWG, SHP, CSV, TXT, XYZ, or KML/KMZ files. The dxf file must contain 3-D polylines or point objects that have a Z vertex. Any layer imported as an Elevation layer (*File|Import Contours*) will automatically be placed on the ELEVATIONS layer.

Tips for Importing Elevation Information

Tip #1: Sometimes when importing elevations, it is not clear which layer(s) to select. To find the name of the layer(s) containing elevations, import the complete drawing using *File|Import*. By using *Change* or *Object Info*, on items which look like they could be contours or spot heights, view the layer name. You now know which layer(s) to import using *File|Import Contours*.

Tip #2: To avoid a double-up of points or lines beneath the spot heights or contours turn off or delete the imported layers, which you determined are the layers containing the elevation information, prior to actioning *File|Import Contours*.

Tip #3: When required to select the relevant elevation layer(s) in the *Import Contours* dialog, you can highlight more than one by holding down the Ctrl key. In this way more than one layer can be selected before clicking OK.

Tip #4: If you are running Pro Version 9 through to Pro Version 10.5 IRRICAD can only handle 32,750 contour segments and spot heights. You can reduce the number of segments by enabling the "Simplify Contours" check box in *Settings|Irrigation Items*. Start a new design and re-import the elevation layers. If the message still occurs, increase the "Contour Simplification Tolerance" and re-import into a new design. Note simplification only works on polylines. If you have IRRICAD Pro Version 11 or later, IRRICAD no longer has a limit for the number of contour segments or spot heights (using the default ABOS method).

Tips For Checking Elevation Data

To help you locate any errors in imported elevation data here are some quick tips:

1. You can use *Delete Type* to delete erroneous contours or spot heights. If you have elevations at zero (where this is in correct) or at the Irricad 'no elevation' value of -3280000ft (-

- 1000000m), simply use *Select All*, then action *Delete Type* and click on a 'bad' contour or spot height. Match on "Height" and all contours or spot heights with the same height will be deleted (Note this must be done separately for contours and spot heights).
2. A great way to check for errors in the imported elevation data is by using *Tools|Highlight Elevations*, where IRRICAD will colour code the highest through to the lowest elevations. This will show up any obvious errors in the data.
 3. The *3D DEM View* found in the *Reports* menu will also show up even small errors in the imported elevation data.
 4. Running *Design|Calculate Elevation Errors* will show the maximum error between the elevation inputs and the surface of the calculated DEM (see below). If the error is significant, click on the coordinate link to take you to that location. This method typically shows up inconsistencies in the elevation data, such as crossed contours or doubled spot heights. These problems can be fixed by deleting the erroneous data point(s). You may repeat this until the maximum error reported is acceptable, or check *Reports|View Errors* to see a list of the ten largest elevation errors.

Trim Elevations Tool

Preparing a design often requires that elevation data is imported from an external file. In some cases (from some government websites for example) the data you obtain may cover a much larger area than what is required for your particular design.

The *Trim Elevations* tool enables contours to be trimmed to a specified polygon. Contours, and spot heights, may then be deleted within or outside the lasso.

Advantages of reducing the quantity of elevation data in this way are:-

- If using the "AEI Method" there is a limit on the number of contour segments that can be processed. Decreasing the number of contour segments by trimming the elevations, so that they just span the hydraulic design area, will help to comply with this limit. Note that Pro Version 11, due for release shortly, can handle an unlimited number of contour segments.
- Decreasing the number of contour segments will increase the speed of redrawing, and interpolation of, elevation data.
- Increasing the accuracy and performance of the Digital Elevation Model (DEM). The DEM grid is calculated over the area spanned by the elevation data and therefore a larger area of contours requires a larger DEM grid size to maintain the same accuracy. The calculations for DEMs with large grid sizes can take some time.
- *Zoom All* will zoom only to the extents of your irrigation design area.

Trim Elevations is accessed from the *Tools* menu, instructions for its use may be found in the Tool and Command manual under *Help|Help Topics*.

Understanding Elevation Method Settings

When preparing a design many plans contain elevation data. Various settings in IRRICAD control how elevation data is interpolated and utilised during the design process. The following information will help to understand the effect and use of some of these settings.

The ABOS method which is generally faster and better represents likely topography for non-uniform slopes and in situations where elevation data is sparse. Some points to note for this method are:-

- Unlike the AEI method there is no limit on the number of contour segments or spot heights that can be processed.
- Continuing to simplify contours, during *Import Contours*, is however desirable as this will improve both general graphical performance and the speed of interpolation.

- If this method is used, it may be best to set the “[Contour Simplification Tolerance](#)” to a lower value (for example 0.2 m) to ensure that imported contours are reasonably smooth ([Settings/Irrigation Items "Contours"](#))
- Using the ABOS method means that every elevation, used in a design, is calculated from the DEM grid.
- If the “[D.E.M. Grid Size](#)” is set to **0** the grid size will be determined automatically so that a reasonable level of accuracy is maintained. Note that in some circumstances this may result in a large grid and consequently interpolation may be slow on low powered machines.

Some other useful tips are:-

- ABOS or AEI methods can be selected in [Design/Design Parameter/Analysis Parameters - "D.E.M. Options"](#). The ABOS method is the default for all new designs.
- Regardless of the elevation method used (ABOS or AEI), the grid spans the area covered by elevations. Therefore if the extents of the elevations are much greater than the hydraulic design, care should be taken that effective grid size is sufficient.
- Trimming elevations to the extents of the hydraulic design will also increase accuracy as the grid will be finer over the smaller area.
- The “Max Error” reported in the “[Elevation Limits](#)” dialog is a useful indication if the grid size is acceptable and/or there are some inconsistencies in the elevation data. The top 10 inconsistencies will be listed in the [View Errors](#) Report, if any of these errors are significant then the elevation data at the specified location should be checked. Some typical problems with elevation data include: contours crossing or very close together; spot heights inconsistent with neighboring contours or spot heights. If no elevation inconsistencies are found, increase the grid size and re-run.

1.1.9.3 IMPORTING IMAGES

Images can be imported in 3 different ways:-

- Import and scale image manually
- Import image and scale automatically
- Import and scale automatically from Google Earth.

Import and Scale Image Manually

Using [File/Import Image](#) select an image file and click [\[Open\]](#). Click to place the bottom left and the top right corners on the screen. Then select the image and action [Modify/Scale Image](#). Draw a line on the plan of a known landmark. Enter the “[Scaled length](#)” as the real length of the item and click OK. The image will now be scaled accordingly.

Import Image and Scale Automatically

Some files contain geo-referencing information. If this information is in WGS84 format that IRRICAD can place the image at the correct UTM coordinates and scale. If you have a geo tif image, use [File/Import Image](#), select it, and click [\[Open\]](#). A message appears asking if you would like IRRICAD to position the image for you. Click [\[Yes\]](#). The image has been placed at the correct coordinates and scale.

Import and Scale Automatically from Google Earth

Once you have obtained a API key from Google (see our How To forum post [How To Acquire a Google Maps API Key](#)) you can use [File/Import from Google Earth](#) and [File/Import from Google Earth with KML](#). Browse to the required location and click the [\[Import\]](#) button and OK the disclaimer message. By clicking on the screen specify the bottom left and top right corners of the area of interest – a red rectangle will depict the extents of your selection. Once the 2nd point is placed the image, and elevations if enabled, will be imported into IRRICAD.

1.2 DESIGN TUTORIALS

1.2.1 SIMPLE DRIP TAPE DESIGN

Tasks covered in this tutorial:

- Drawing a block of tapes
- Changing symbol size on the screen
- Connecting to multiple zone items quickly
- Snapping to the midpoint of an object

This tutorial shows the steps required for drawing and designing a drip tape irrigation scheme. Read the notes below and then proceed with the exercise. This exercise designs a drip tape block with no pressure regulation within the block.

1.2.1.1 TAPES - AN OVERVIEW

A drip tape is a thin walled pipe tube with emitters built into the wall of the pipe. Tapes are treated differently in IRRICAD because their hydraulic characteristics are different to a standard pipe with a sprinkler or dripper attached. Reasons for this are primarily because of the low operating pressures and the extent of flow variations down a tape run with varying lengths and input pressures. Some hard wall tubing products are also treated as tapes because of these reasons.

1.2.1.2 STARTING THE TUTORIAL

1. Double-click on the IRRICAD desktop icon or select *Start|All Programs|IRRICAD|IRRICAD Pro* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.
2. In *Settings|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select **[Open]**. Change the “Zone Pipes Line Width” to **2** and the “Mainline Pipe Line Width” to **3**.
3. Go to the **Units** tab and click the **[US]** ([Metric]) button to restore the default units for this tutorial. Note Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the **[Save As Default]** button.
4. Select the **Misc** tab and click the “Medium Design Size”. Change the “Base Database Symbol Size” to **10ft (3m)**. This determines the size of the symbols according to the size of the design. When you are finished click **[OK]**.
5. Select *Draw|Rectangle|2 Point* and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point). Select *Modify|Change*, or if in *Select|Object* mode double-click, on the boundary of the rectangle. In the dialog change the “Width” to **60m** and “Height” to **50m** as in Figure SD1. Click **[OK]**. Select *View|Zoom All* then *View|Zoom Out*.
6. Using *Modify|Select|Object*, highlight the rectangle border by clicking on it once and then select *Zone|Tape Block* and click **[Yes]** on the message about converting the object.
7. Select *Zone|Tape Block* and select the **Drip tape** from the dropdown list of tapes. Leave the depth as **0**, as the tapes will be at ground level. Leave the default “Inlet Pressure” as **12psi (8.5m)** and ensure that “Regulated” is unchecked. Checking this option would mean that you have PRVs at the start of each tape, which we do not have in this case. Type in **6ft (2m)** for the “Lateral Spacing” and leave the “Number of Laterals” as **0**. Ensure the “Determine Automatically” option for the “Lateral Direction” is selected as in Figure 4-25. Click **[OK]**.
8. Now we need to select the lateral direction. Because “Determine Automatically” was selected, we can just click on the boundary we wish to align the laterals with. The block will automatically fill with tapes 2m apart. Select *View|Zoom All*. The block should look similar to Figure 4-26.

Tape Block

×

Drawing Properties

Layer

IRR_IRRIGATION_AREAS

▼

Line width

0.00 mm

▼

Tape Properties

Tape

Drip tape

▼

Depth

0

mm

Inlet Pressure

8.5

m

☐ Regulated

Submain Min Pressure

0

m

Nominal SDR

240

lph/100m

Scope

Design + BOM

▼

Lateral Properties

Spacing

2

m

Number of Laterals

0

Group Spacing

1

m

No. Laterals/Group

0

Lateral Direction

☒ Determine Automatically

☐ User Defined

☐ Polyline

OK

Cancel

Figure 4-25

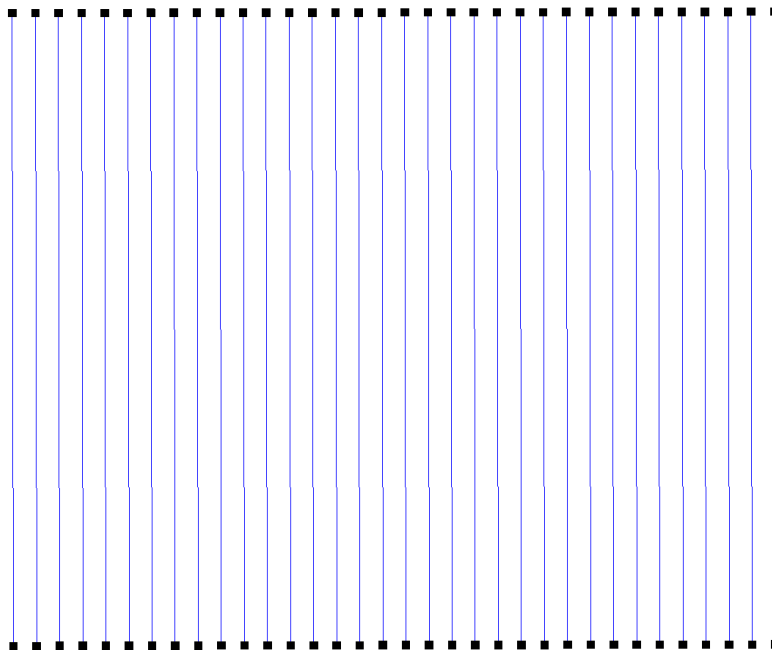


Figure 4-26

9. Now select *Settings/Snap* and then click the *[Running Snaps]* button. Check the "RN Snaps On" option and check the "Show Preview" option. Click the *[Enable All Snaps]* button. Now click *[OK]* and *[OK]* on the *Settings/Snap* dialog to close it.
10. Now select *Zone/Cut Pipe*. We wish to place a submain through the middle of the block. In the *Cut Pipe* dialog leave the "Layer" as **[DEFAULT]**. Ensure the pipe selected is **Computer Selected**. Leave the "Depth" as **0**, and click *[OK]*.
11. Click near the middle of the left outer lateral (the preview of the Running Snaps should show you when you are in the middle). Now click near the middle of the right outer lateral. IRRICAD will draw in the submain and connect to each lateral it crosses. Continue the pipe for approximately **13ft (4m)** past the last lateral. *Right-click/Restart* to finish the pipe.
12. Select *Zone/Control Valve*. From the dropdown list select the **1" (25mm) Electric Valve**, leaving the "Depth" as **0**, and place this on the end of the submain on the right side of the screen. Accept the default zone name.
13. Now select *Mainline/Pipe*. Leave the pipe as **Computer Selected** at **0 "Depth"**. Click *[OK]*. Connect the mainline pipe to the control valve with a left-click and draw upward for approximately **33ft (10m)**. Left-click to place the end then *Right-click/Restart*.
14. Select *Mainline/Water Supply* and place on the end of the mainline pipe with a left-click as in [Figure 4-27](#). Leave the Water supply details as the default; simply click *[OK]*.

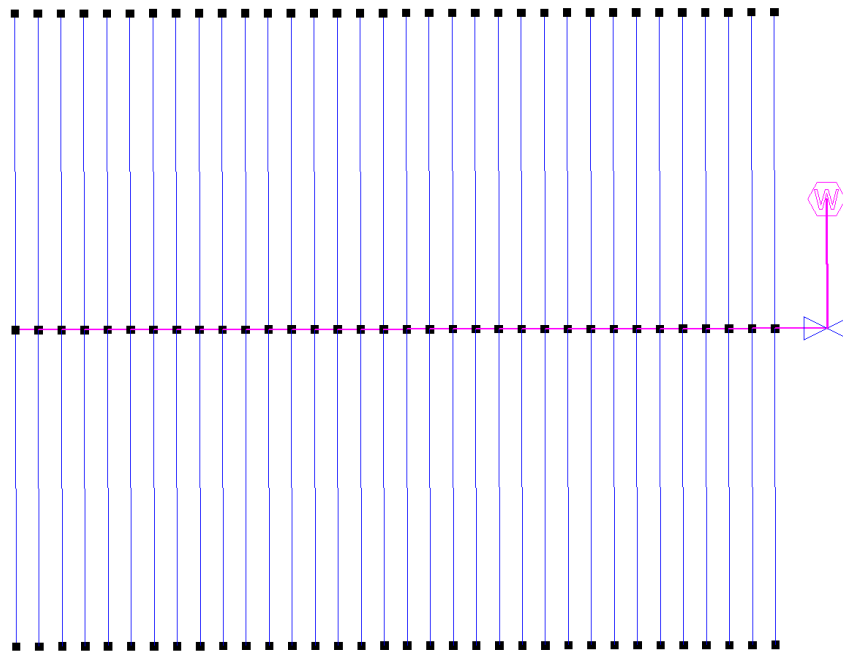


Figure 4-27

1.2.1.3 CHECKING CONNECTIONS

15. First, select *Design/Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design/Clear Connectivity Marks*.
16. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View/Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify/Select Object* and click on the item) and move the item to the center of the junction (*Modify/Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Settings/Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.2.1.4 ZONE DESIGN AND REPORTING

17. Select *Design|Design Parameters|Hydraulic Parameters* and enter the “Maximum Zone Pipe Velocity” as **5ft/s (1.5m/s)**. Click [OK].
18. The first step in Zone Design is to size the submain pipes. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design|Zone Design Configuration* and simply click [OK] on the dialog to clear this). Select *Design|Zone Design|LP Design*. It is always useful to view some reports before continuing. Look at the *Reports|Zone Design Reports|Zone Design Summary* this report gives a good indication of what is happening in the zone. It should look similar to [Figure 4-28](#). The present maximum dripper pressure is 13.22psi (9.3m) and the minimum is 12psi (8.5m). The actual pressure variation in the zone is calculated from the difference between the actual maximum and minimum outlet pressures relative to the actual maximum outlet pressure and is 9.28%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the [X].

Zone Name :		Zone no. 1		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		13.39 (psi)		Zone Head (U/S) :		13.39 (psi)			
Total Zone Flow :		18.32 US gpm		Valve Headloss :		0.00 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		0.32		0.32		12.00		12.00	
Maximum Outlet		0.32		0.32		13.80		13.22	
Outlet Variation (%)		0.00		0.00		13.04		9.28	
Outlet Locations (X,Y)		Minimum :		-17.3 8.2		Maximum :		43.0 33.5	

Figure 4-28

1.2.1.5 ENTERING MANAGEMENT REQUIREMENTS

The primary purpose of management is to allow you to specify an operating sequence for the zone control valves. This operating sequence is then used to set up a series of flow conditions so that the mainline can be correctly sized and/or analyzed.

19. Now we wish to assign the zones to system flows. Select *Design|Assign All Zones to One System Flow* as we only have one Zone (control valve or block). You will notice that “Zone no. 1” will operate on **System Flow 1** as in [Figure 4-29](#). Click [OK].

Assign System Flows to Zones

Number of System Flows:

Operating Times (day:hour:min)

	System Flow Name	On	Off
1	System flow - 1	1 : 0 : 0	1 : 1 : 0

System Flows Zone Operates On

	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Zone no. 001	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[OK] [Cancel]

1.2.1.6 MAINLINE DESIGN

20. Now we wish to size the mainline. Run *Design|Mainline Design|LP Design*.
21. Look at the *Reports|Mainline Design Reports|System Duty Reports* to see the water supply requirements for each system flow. Select *File|Save* to save the design. Type demo.des as the file name to save as.

1.2.1.7 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

22. When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
23. Now run *Design|Zone Design|Detailed Analysis* to finalise the zone design results. Check the Zone reports.
24. If the Zone reports show the pressures are within the required range and no changes are needed re-run Mainline Design. Because there is only a control valve in this design there is no point in running Mainline *Detailed Analysis*. Run *Design|Mainline Design|Analysis*. Check the Mainline reports.

1.2.2 SIMPLE DRIP TAPE DESIGN USING BLOCK ENTITIES

Tasks covered in this tutorial:

- Drawing an automatic block of tapes
- Setting a valve pressure
- Automatic Labeling
- Moving an item

This tutorial shows the steps required for drawing and designing a drip tape entity. Read the notes below and then proceed with the exercise.

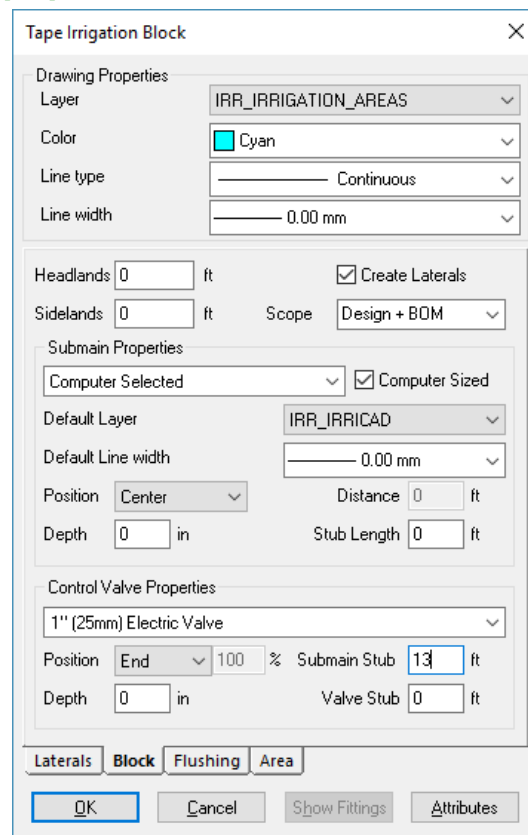
1.2.2.1 BLOCK ENTITIES

Using 'Block Entities' i.e. *Tape Irrigation Block*, is an alternative method to using *Tape Block*. The advantages of this method are ease and quickness of drawing the block complete with submain, control valve and flushing manifolds if required. When the block is drawn as a 'block entity' it is easy to change the parameters, for example row spacing or lateral direction. Extra labels are available for block entities, such as Area, Actual Flow, and Number of Rows. The only disadvantage of using 'Block Entities' is that the laterals cannot be modified individually and in the case of windmills for example, in the middle of the block, laterals cannot be cut out. However, the block can be exploded once drawn if required.

1.2.2.2 STARTING THE TUTORIAL

1. Double-click on the IRRICAD desktop icon or select *Start|All Programs|IRRICAD Pro* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.
2. In *Settings|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select [Open]. Change the "Zone Pipes Line Width" to 2 and the "Mainline Pipe Line Width" to 3.

3. Go to the **Units** tab and click the **[US] ([Metric])** button to restore the default units for this tutorial. Note Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the **[Save As Default]** button.
4. Select the **Misc** tab and click the **"Medium Design Size"**. Change the **"Base Database Symbol Size"** to **10ft (3m)**. This determines the size of the symbols according to the size of the design. When you are finished click **[OK]**.
5. Select **Draw|Rectangle|2 Point** and place the first point on the screen by left-clicking. Move the cursor and click again to place the opposite corner of the rectangle (the second point). Select **Modify|Change**, or if in **Select|Object** mode double-click, on the boundary of the rectangle. In the dialog change the **"Width"** to **60m** and **"Height"** to **50m** as in Figure AD1. Click **[OK]**. Select **View|Zoom All** then **View|Zoom Out**.
6. Using **Modify|Select|Object**, highlight the rectangle border by clicking on it and then select **Zone|Tape Irrigation Block** and click **[Yes]** on the message about converting the object.
7. Select **Zone|Tape Irrigation Block** and select the **Drip tape** from the dropdown list of tapes. Leave the **"Depth"** as **0**, as the tapes will be at ground level. Leave the default **"Inlet Pressure"** as **12psi (8.5m)** and ensure **"Regulated"** is unchecked. This Regulated option would mean you have PRVs at the start of each tape, which we do not have in this case. Type in **6ft (2m)** for the **"Lateral Spacing"** and leave the **"Number of Laterals"** as **0**. Ensure the **"Determine Automatically"** option for the **"Lateral Direction"** is selected.
8. Now click on the **Block** tab. Here we can choose to have our submain and valve drawn automatically if required. In the **"Submain"** area of the dialog box set **Center** as the **"Position"** but leave as **Computer Selected**. In the **"Valve"** area of the dialog box set the **"Position"** to **End**, the **"Submain Stub"** as **13ft (4m)** and specify the valve as the **1" (25mm) Electric Valve** (Figure 4-30). Click **[OK]**.



Tape Irrigation Block

Drawing Properties

Layer: IRR_IRRIGATION_AREAS

Color: Cyan

Line type: Continuous

Line width: 0.00 mm

Headlands: 0 ft

Sidelands: 0 ft

Scope: Design + BOM

Submain Properties

Computer Selected

Default Layer: IRR_IRRICAD

Default Line width: 0.00 mm

Position: Center

Distance: 0 ft

Depth: 0 in

Stub Length: 0 ft

Control Valve Properties

1" (25mm) Electric Valve

Position: End

100 % Submain Stub: 13 ft

Depth: 0 in

Valve Stub: 0 ft

Block | Laterals | Flushing | Area

OK Cancel Show Fittings Attributes

Figure 4-30

9. Now we need to select the lateral direction. Because **"Determine Automatically"** was selected, we can just click on the boundary we wish to align the laterals with. The block will automatically fill with tapes 2m apart. Select **View|Zoom All**. Once this is completed the laterals are automatically drawn, with a submain through the center of the block and with a central valve 13ft (4m) to the right as in Figure 4-31.

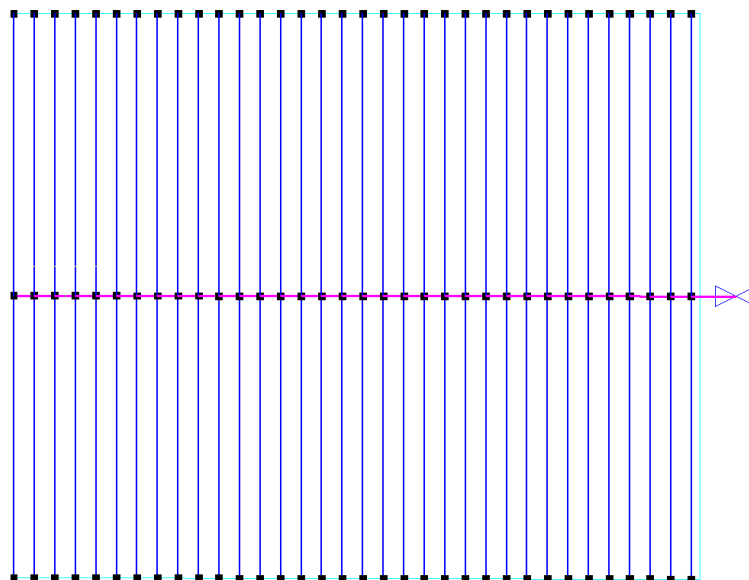


Figure 4-31

10. Now select *Mainline|Pipe*. Leave the pipe as **Computer Selected** and the “Depth” as **0**. Click **[OK]**. Connect the mainline pipe to the control valve with a left-click and draw upwards for approximately **33ft (10m)**. Left-click to place and then *Right-click|Restart*. Select *Mainline|Water Supply* and place on the end of the mainline pipe with a left-click as in [Figure 4-32](#). Leave the Water supply details as the defaults; simply click **[OK]**. Now select *View|Zoom All*.

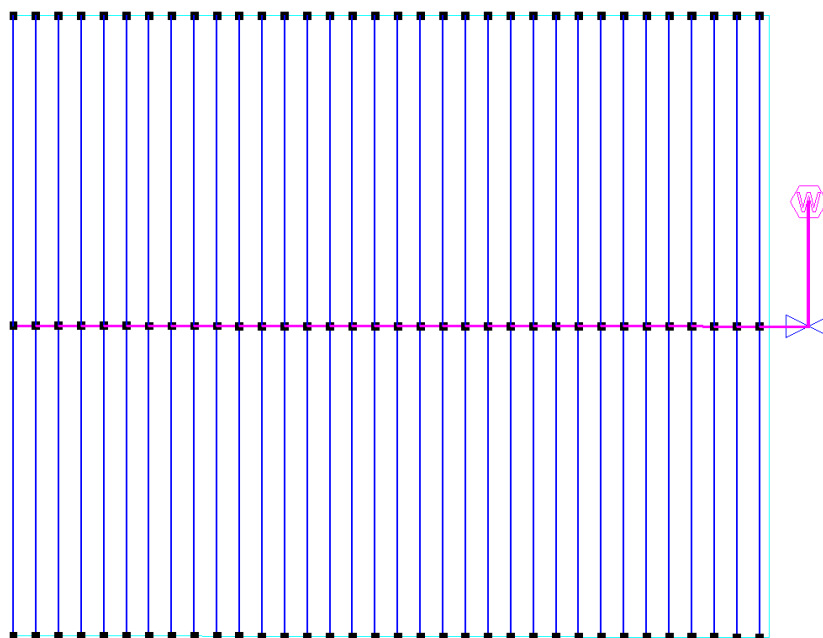


Figure 4-32

1.2.2.3 CHECKING CONNECTIONS

11. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any

unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design/Clear Connectivity Marks*.

12. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View/Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify/Select Object* and click on the item) and move the item to the center of the junction (*Modify/Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the “Default Snap Mode” in *Settings/Snap* is “Connect”. Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

1.2.2.4 ZONE DESIGN

13. Select *Design/Design Parameters/Hydraulic Parameters* and enter the “Maximum Zone Pipe Velocity” as **5ft/s (1.5m/s)**. Click [OK].
14. The first step is to size the submain pipes. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design/Zone Design Configuration* and simply click [OK] on the dialog to clear this). Select *Design/Zone Design/LP Design*. It is always useful to view some reports before continuing. Look at the *Reports/Zone Design Reports/Zone Design Summary*, this report gives a good indication of what is happening in the zones. It should look something similar to Figure 4-33. The present maximum dripper pressure is 12.43psi (8.74m) and the minimum is 10.79psi (7.59m). The actual pressure variation in the zone is calculated from the difference between the actual maximum and minimum outlet pressures relative to the actual maximum outlet pressure and is 13.08%. This pressure variation includes the submain friction loss as well as the loss in the tapes. Close the report window by clicking the [X].

Zone Name :		Area no. 1		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		12.80 (psi)		Zone Head (U/S) :		12.80 (psi)			
Total Zone Flow :		18.32 US gpm		Valve Headloss :		0.00 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		0.32		0.32		10.80		10.79 ***	
Maximum Outlet		0.32		0.32		13.20		12.43	
Outlet Variation (%)		0.00		0.00		18.18		13.17	
Outlet Locations (X,Y)		Minimum :		-13.0 , 3.6		Maximum :		47.4 , 28.6	

Figure 4-33

15. When this block is installed the control valve is going to be pressure-reducing and the downstream pressure will be set to **13psi (9m)**. To specify this go to *Design/Zone Design Configuration* and enter **13.00 (9.00)** in the “D/S Valve Pressure” column for Area no. 1. Click [OK] and run *Design/Zone/Detailed Analysis*. Open the *Reports/Zone Design Reports/Zone Design Summary* and notice that the valve pressure has been set to **15 (10.5)** and the resultant pressures throughout the zone have been recalculated from that. See Figure 4-34.

Zone Name :		Area no. 1		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		13.00 (psi)		Zone Head (U/S) :		13.00 (psi)			
Total Zone Flow :		18.32 US gpm		Valve Headloss :		0.00 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		0.32		0.32		10.80		11.20	
Maximum Outlet		0.32		0.32		13.20		12.84	
Outlet Variation (%)		0.00		0.00		18.18		12.76	
Outlet Locations (X,Y)		Minimum :		-13.0 , 3.6		Maximum :		47.4 , 28.6	

Figure 4-34

1.2.2.5 ENTERING MANAGEMENT REQUIREMENTS

The primary purpose of management is to allow you to specify an operating sequence for the zone control valves. This operating sequence is then used to set up a series of flow conditions so that the mainline can be correctly sized and/or analyzed.

16. Now we wish to assign the zones to system flows. Select *Design/Assign All Zones to One System Flow* as we only have one Zone (control valve or block). You will notice that “Area no. 1” will operate on **System Flow 1** as indicated [Figure 4-35](#). Click [OK].

Assign System Flows to Zones

Number of System Flows: 1

Operating Times (day:hour:min)

	System Flow Name	On	Off
1	System flow - 1	1:0:0	1:1:0

System Flows Zone Operates On

	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Area no. 001	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OK Cancel

Figure 4-35

1.2.2.6 MAINLINE DESIGN

17. Now we wish to size the mainline, select *Design/Mainline Design/LP Design*.
18. Look at the *Reports/Mainline Design Reports/System Duty Reports* to see the required demand on the water supply. This is the pressure and flow that is required downstream of the headworks to operate the system you have designed. Save the design as demo1.des by selecting *File/Save*.

1.2.2.7 AUTOMATIC LABELING

19. Now select *Settings/Labels*. In this dialog you specify which types of items you want labelled by checking the appropriate check boxes. Check “*Irri. Blocks*” and then click the [Text] button. Key words, that will create automatic labels that contain the text required, can now be added. By default the text box is loaded with the area name key word. We want the labels to include the area size, the name of the tape, the number of rows and the flow with the correct units. To do this, we need to specify the following keywords:

#NAME# The name of the Block/Area.
 #AREA# #AREAUNIT# The area of block including units.
 #DESC# The Tape description
 #NUMROW# Rows The number of rows (remember to add a space and then the word ‘Rows’ after the key word.
 #ACTFLOW# #FLOWUNIT# The actual flow, as calculated during the design process, including the units.

20. Click **[OK]** when you have finished entering the text, the dialog should look like [Figure 4-36](#) below.

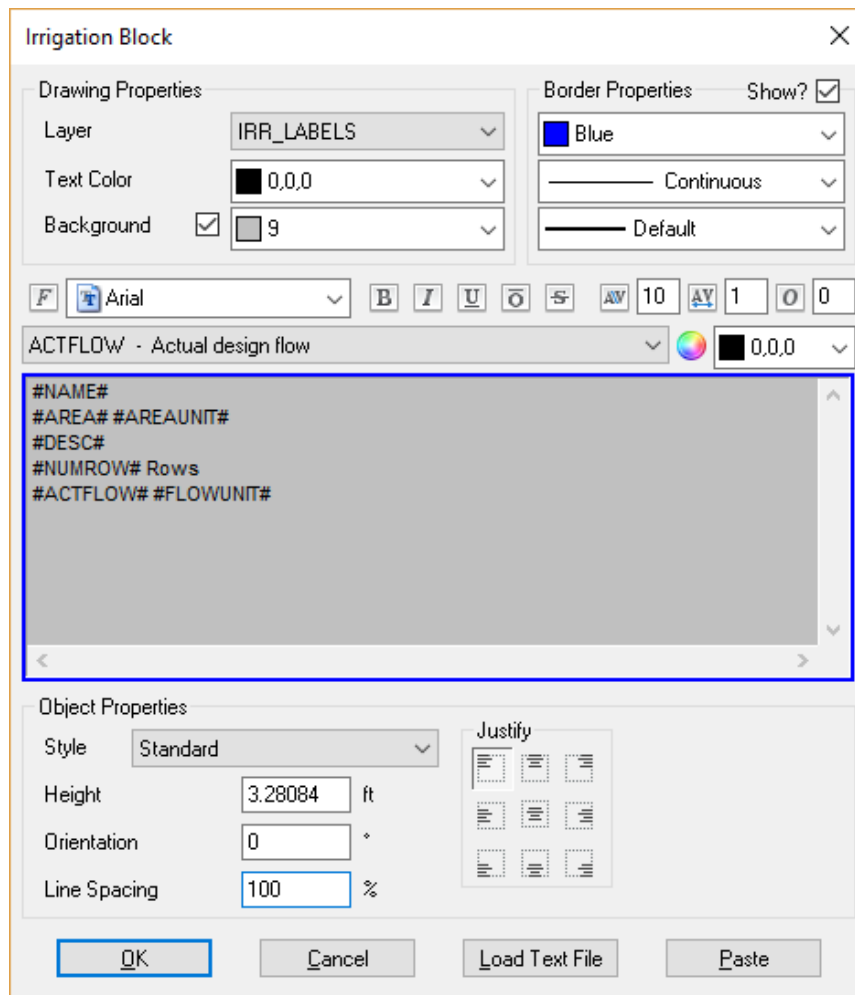


Figure 4-36

21. Now we can set the **[Background]** options. We can specify a background and a border of the label in a colour of our choice. Select a colour for the background and a colour and line thickness for the border. Click **[OK]**. Leave the “**Layer**” set to **[DEFAULT]** – this means that the labels will automatically be placed on the IRRICAD Layer. The next option determines the placement of the label. It can be BELOW the object (in this case below the Block), ABOVE, INLINE (centered within the block), to the LEFT or to the RIGHT. Select **INLINE**. Click **[OK]**.
22. Now select **Modify/Select All** and then **Tools/Create Labels**. The keywords will be resolved to appropriate values and a label will be placed in the center of the Block.
23. If you wish to change the style of existing labels, go to **Settings/Labels** and make the changes required. For example, select the **[Text]** button for “**Irri. Blocks**” and change “**Justify**” to “**Left**” instead of “**Center**”. Click **[OK]** on both dialogs and then select **Tools/Update Labels**. All existing labels on the design will be updated to reflect the changes made in the settings. Note: if the fill behind the label does not appear large enough for the label, zoom in and the select **Tools/Update Labels**.
24. Now select **Modify/Select Object** and click on the label. Select **Modify/Move** and move the label to below the valve. See [Figure 4-37](#).

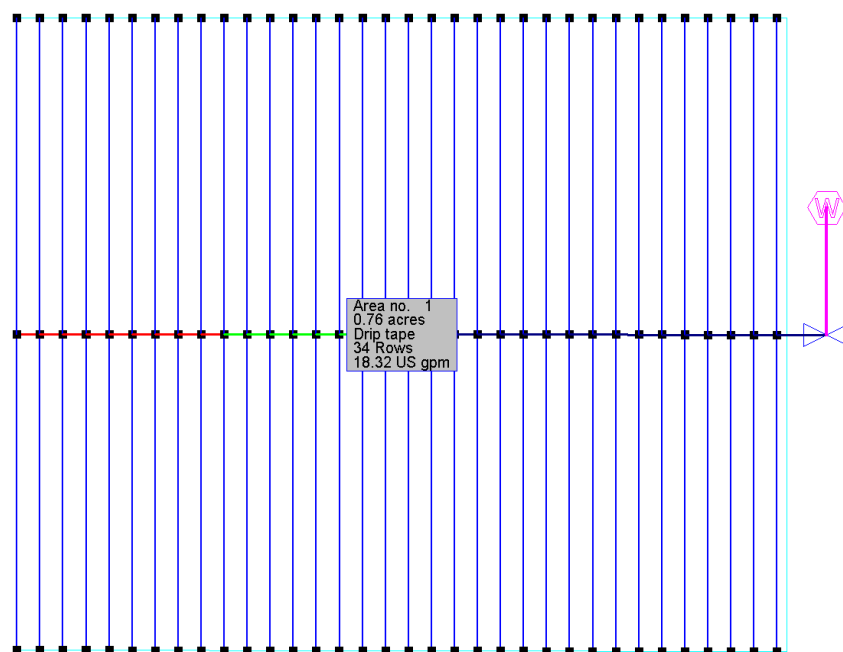


Figure 4-37

1.2.3 A SIMPLE ORCHARD DESIGN

Tasks covered in this tutorial:

- Drawing simple background information
- Creating sprayline outlets
- Drawing a block of connected spraylines (laterals)
- Specifying lateral and outlet spacing
- Connecting up multiple zone items
- Saving a design
- Specifying the maximum allowable velocity
- Limiting number of pipe sizes selected by computer sizing

1.2.3.1 BLOCK ENTITIES

Using 'Block Entities' i.e. *Spray Irrigation Block*, is an alternative method to using *Spray Block*. The advantages of this method are ease and quickness of drawing the block complete with submain, control valve and flushing manifolds if required. When the block is drawn as a 'block entity' it is easy to change the parameters, for example row spacing or lateral direction. Extra labels are available for block entities, such as Area, Actual Flow, and Number of Rows. The only disadvantage of using 'Block Entities' is that the laterals cannot be modified individually and in the case of windmills for example, in the middle of the block, laterals cannot be cut out. However, the block can be exploded once drawn if required.

1.2.3.2 STARTING THE TUTORIAL

1. Double-click on the IRRICAD desktop icon or select *Start|All Programs|IRRICAD Pro* to start IRRICAD. If IRRICAD is already running select *File|New* to start with a clean design.
2. In *Settings|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select *[Open]*. Change the "Zone Pipes Line Width" to **2** and the "Mainline Pipe Line Width" to
3. Go to the *Units* tab and click the *[US]* (*[Metric]*) button to restore the default units for this tutorial. Note Metric measurements are displayed in brackets. These settings can be retained for each design by clicking the *[Save As Default]* button.

4. Select the **Misc** tab and click the “**Medium Design Size**”. Change the “**Base Database Symbol Size**” to **10ft (3m)** as shown in [Figure 4-38](#). This determines the size of the symbols according to the size of the design. When you are finished click **[OK]**.

Figure 4-38

1.2.3.3 ENTER BACKGROUND INFORMATION

This is information required to position the irrigation system. Examples include boundaries, roads, buildings, text and symbols. For this tutorial we will put in a **390 x 150ft (120 x 45m)** rectangle for the block boundary.

5. Select **Draw/Rectangle/2 Point** and move the cursor to the bottom left of the screen and click the left mouse button to start the rectangle. You will notice that the status bar will ask you to enter the corner point of the rectangle prior to you clicking the mouse and for you to enter the opposite corner after you have placed the first. Draw the cursor away from the first point and left-click to place the second point. Now select **Modify/Change** and click on the border of the rectangle. Edit the “**Width**” to be **390 (120)** and the “**Height**” to be **150 (45)**. Click **[OK]**. Select **View/Zoom All**.

1.2.3.4 PLACING THE BLOCK

6. Before placing any laterals select **Settings/Irrigation – Design Specific**. Check the “**Create Wetted Radii**” and “**Create Sprayline Outlets**” check boxes (under normal circumstances “**Create Sprayline Outlets**” should be unchecked as the number of outlets may be high and will consequently slow down redrawing of the design). Now go to the **Layers** tab and scroll down until you see “**SPRAYLINE_OUTLETS**”. Check the box to turn this layer on (this layer can also be turned on in **View/Sprayline Outlets**). Click **[OK]**.
7. Drawing in each sprayline would be very tedious; we can however enter a block of connected spraylines (laterals) by selecting a polygon and ‘applying’ the required block properties to it. To do this use **Modify/Select Object** and click on the rectangle edge (it should change colour) and then select **Zone/Spray Irrigation Block**. Click **[OK]** on the message asking if you want to create block entities from the selected item. A dialog for setting the lateral and block properties will now be displayed. We want IRRICAD to size the laterals so leave the pipe as **Computer Selected**. The laterals are to be placed at ground level so the “**Depth**” field can remain at **0.0**.
8. In the same dialog, select the **Microsprinkler 360 degrees** and click on it to select it. Select the **WHITE 360** as the nozzle in the “**Nozzle**” field, highlighting the required nozzle and left-clicking the mouse. Enter a pressure of **18.5psi (14m)**.
9. Selecting a riser (outlet connector) is optional but in this example we will use a Microsprinkler stake and tube 3/8” (10mm). In the same dialog, select the **Microsprinkler stake and tube 3/8” (10mm)** from the “**Riser**” dropdown list.
10. Enter the “**Lateral Spacing**” as **13ft (4m)**. Enter the “**Outlet Spacing**” as **11.5ft (3.5m)**.
11. Select the **[Options]** button and check “**User Defined**” for the “**Lateral Direction**”, ensure that the option checked for “**Reference Outlet**” is “**Determine Automatically**”. Click **[OK]**.
12. Set the outlet spacing type to “**Rectangular**” with an “**Offset**” of **0%**. The dialog should look like [Figure 4-39](#).

Spray Irrigation Block

Drawing Properties

Layer: IRR_IRRIGATION_AREAS

Color: Cyan

Line type: Continuous

Line width: 0.00 mm

Pipe Properties

Pipe: Computer Selected

Depth: 0 in ☒ Computer Sized

Sprinkler

Microsprinkler 360 degrees

Nozzle Properties

Nozzle: WHITE 360.0

Pressure: 18.5 psi Radius: 10.9035 ft

Flow: 13.5841 US gph Arc: 360 °

Riser

Microsprinkler stake & tube 3/8" (10mm)

Block Properties

Lateral Spacing: 13 ft Scope: Design + BOM

Outlet Spacing: 11.5 ft ☒ Connected

☒ Rectangular Offset: 0 % ☐ Triangular

Options

Laterals **Block** **Flushing** **Area**

OK **Cancel** **Show Fittings** **Attributes**

Figure 4-39

13. Now click the **Block** tab, this tab contains options for automatically placing submain and control valves.
14. Leave the "Submain" as **Computer Selected** and select **Start** from the "Position" dropdown box. Select **Center** as the Control Valve "Position" and then select the **3" (80mm) Electric Valve** from the "Control Valve" dropdown list. Enter a "Valve Stub" of **5ft (1.5m)**. Click **[OK]**.
15. Because we selected "User Defined" for the "Lateral Direction" we now have to enter two points that define the lateral direction (this will be indicated in the bottom left of the status bar). *Right-click|Snaps|Endpoint* and click on the left top corner of the rectangle. Now you will notice that the status bar is asking for the 2nd point in the block lateral. *Right-click|Snaps|Endpoint* and click on the bottom left corner. Once this is completed the laterals are automatically drawn, with a submain at the top of the block and a central valve with a **5ft (1.5m)** stub, as in [Figure 4-40](#).

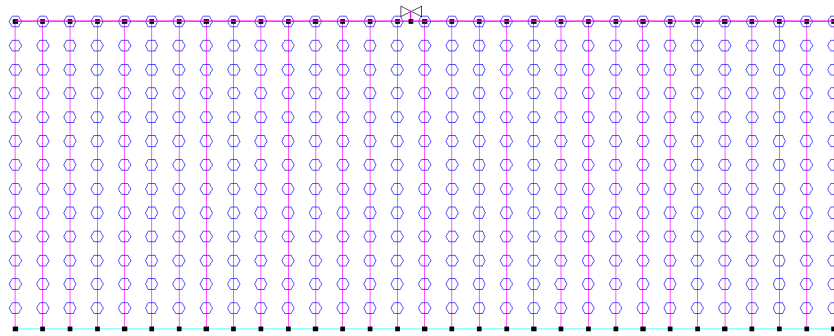


Figure 4-40

16. Now we are ready to enter the Mainline. Select *Mainline|Pipe*, set the pipe as **Computer Selected**, the “Depth” as **0** and the “Line Width” as **3**. Click **[OK]**. Connect the pipe to the control valve by clicking on it and then draw the mainline pipe out upwards for approximately **33ft (10m)**. Note that the status bar indicates the distance travelled since the last left-click via the ‘d=’ field. Left-click to place the end of the pipe and then *Right-click|Restart*.
17. Select *Mainline|Water Supply*. Connect to the junction on the left end of the mainline pipe. Accept the default name of Supply No. 1. Do not enter any flow or pressure requirements (IRRICAD will assume that the water supply is unrestricted and will determine these requirements during design and analysis). Click **[OK]**. Select *File|Save* and save the design as demo2.des. This completes the entry of the hydraulic components of the design. Your design should look like Figure 4-41.

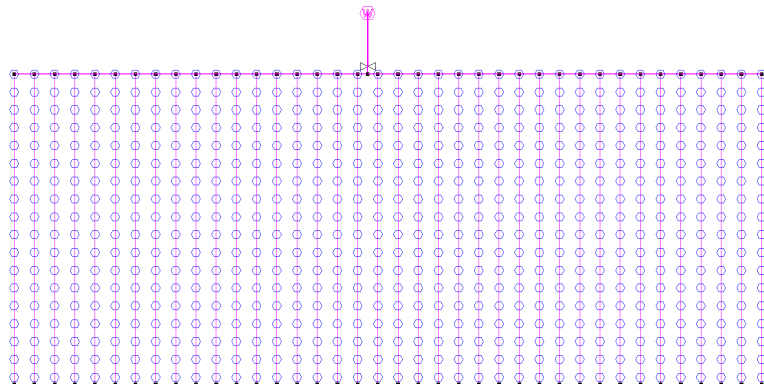


Figure 4-41

1.2.3.5 THE DESIGN PROCESS

Checking Connections

18. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks*.
19. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the center of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the “Default Snap Mode” in *Settings|Snap* is “Connect”. Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

Zone Design and Reporting

20. Select *Design/Design Parameters/Hydraulic Parameters* and set the “Maximum Zone Pipe Velocity” to **5ft/s (1.5m/s)**. Click [OK].
21. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design/Zone Design Configuration* and simply click [OK] on the dialog to clear this). Select *Design/Zone Design/LP Design*. This method of computer sizing takes into account the maximum allowable velocities (in *Design/Design Parameters/Hydraulic Parameters*) and the pressure requirements of the sprinklers. Select this option to have IRRICAD size the laterals and submain for the zone.
22. You will notice that 5 pipe sizes have been selected for the submain. In order to simplify installation we will limit the number of pipe sizes that can be selected for the submain. Select *Design/Zone Design Configuration* and enter **3** in the “Number of Submain Sizes” column. Click [OK] and re-run *Design/Zone Design/LP Design*.
23. It is advisable to check the data in the reports after zone design (*Reports/Zone Design Reports*). At this stage the *Zone Design Summary* report gives a good indication of the overall hydraulic performance of the zone, showing the allowable range and actual minimum and maximum outlet flows and pressures. Click on the [X] to close the report window.

Entering Management Requirements

The primary purpose of management is to allow you to specify an operating sequence for the zone control valves. This operating sequence is then used to set up a series of flow conditions so that the mainline can be correctly sized and/or analyzed.

24. Select *Design/Assign All Zones to One System Flow*. IRRICAD assigns Area no. 1 to operate on System Flow 1 as in Figure 4-42. The on and off times (one hour operating time), for the system flow, are automatically listed. Click [OK]. We are now ready to proceed with the design process.

Assign System Flows to Zones

Operating Times (day:hour:min)

	System Flow Name	On	Off
1	System flow - 1	1:0:0	1:1:0

Number of System Flows: 1

System Flows Zone Operates On

Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1 Area no. 001	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OK Cancel

Figure 4-42

Mainline Design

25. You can now size the mainline, to do this select *Design/Mainline Design/LP Design*. IRRICAD will then size the mainline and calculate the water supply pressure necessary to ensure that the zone control valve receives the required upstream pressure. You should have results similar to Figure 4-43.

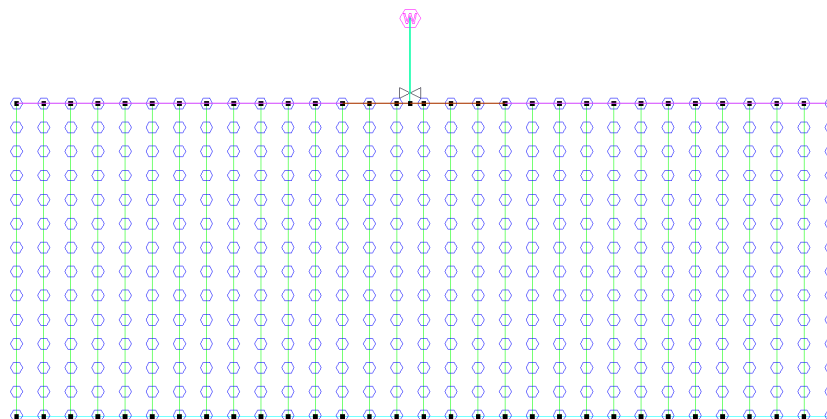


Figure 4-43

1.2.3.6 DISPLAY REPORTS

26. You may wish to view some of the design reports. As described previously the *Zone Design Summary* report (*Reports/Zone Design Reports*), detailed in Figure 4-44, shows a summary of the pressure variation in the block.

Zone Name :		Area no. 1		Valve Description :		3" (80mm) Electric Valve			
Zone Head (D/S) :		20.63 (psi)		Zone Head (U/S) :		20.95 (psi)			
Total Zone Flow :		98.26 US gpm		Valve Headloss :		0.32 (psi)			
		Allowable Flow		Actual Flow		Allowable Pressure		Actual Pressure	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		12.90		13.01		16.44		16.74	
Maximum Outlet		14.26		14.20		20.70		20.50	
Outlet Variation (%)		9.52		8.42		20.59		18.33	
Outlet Locations (X,Y)		Minimum :		5.3 , 24.1		Maximum :		37.0 , 69.8	

Figure 4-44

27. The *System Duty Report* (*Reports/Mainline Design Reports*) shows the duty required at the water supply. The *Mainline Summary Report* is a summary of actual and required pressures at the zone control valve.

Other tools that may be helpful, particularly in undulating blocks, are described below.

The hydraulic gradeline tool (*Reports/Hydraulic Gradeline*) allows you to click on a lateral or submain pipe and view a graphical display of the pressure along that section of pipe. For more information on this tool see the Help Topics (*Help/Help Topics*). Another useful tool, *Reports/Show Pressure Zone Limits*, visually shows the location of the emitters with the minimum and maximum pressure within a zone.

If you have had trouble completing this design, please check that the size of the original rectangle is correct.

Note this tutorial could be repeated using the *Zone/Tape Irrigation Block* tool for Drip tape blocks.

1.2.4 WORKING WITH MULTI-VALVE DESIGNS

Tasks covered in this tutorial:

- Subdividing blocks
- Automatically Connecting Valves
- Running more than one valve
- Managing multi-valves in Design
- Limiting the number of pipes selected
- Multiple valves running together

1.2.4.1 GETTING STARTED

1. Complete the above tutorial ([A Simple Orchard Design](#)) if you have not done so already.
2. We wish to split this block up into multiple zones because the flow of the entire block exceeds the capacity of the water supply. To automatically split the block into 4 even parts we can use the subdivide tool. Press <Alt> and click once on any part of the block entity (e.g., a lateral) when in *Select Object* mode and then select *Tools|Subdivide Block*.
3. In the “Slices” section, select “Number” and type in 4. In the “Cuts” section, select “None”. See [Figure 4-45](#).

Subdivision [X]

Area no. 001

Irrigated area:	14.54 acres	Total flow:	0.00 US gpm
Number of rows:	99	Longest lateral:	492.1 ft

Auto ☐

Max lateral length ft

☒ Equal Flow US gpm
☐ Equal Area acres
☐ Number of sub-blocks

Slices

☐ None
☐ Distance ft
☒ Number ☐ Use multiple values
☐ Rows

Cuts

☒ None
☐ Distance ft
☐ Number ☐ Use multiple values
 Cut Direction:

Figure 4-45

4. Click **[OK]**. A dialog will appear and a preview of the subdivision specified will be shown in the design view. Click the **[Accept/View Changes]** button to accept the subdivision. See [Figure 4-46](#).

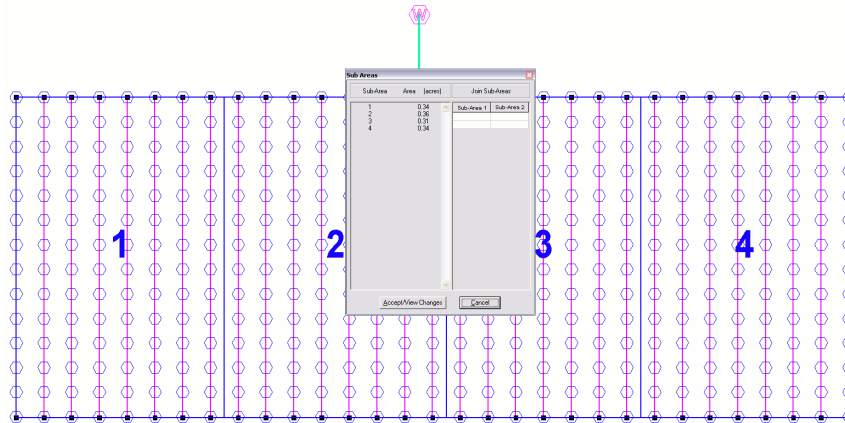


Figure 4-46

IRRICAD will automatically subdivide the block and connect submains and control valves for each new sub-block, thereby creating four new zones.

- Run a mainline pipe from the existing mainline to the left and to the right above the new valves. Now select **Tools|Connect Valves** for IRRICAD to automatically connect mainline pipe to the new valves. See Figure 4-47. Select and delete the center mainline pipe below the intersection of the new mainline pipes.

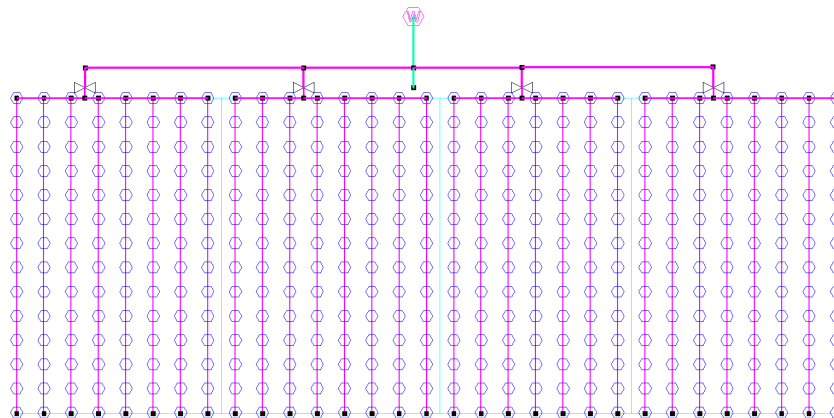


Figure 4-47

- Select and delete the center mainline pipe below the intersection of the new mainline pipes. Delete any segment of horizontal mainline that extends beyond the connection to the outermost valves. This is because iRRICAD cannot size pipe that has no flow.
- Now we will specify how the zones will be operated. As we want each zone to run by itself select **Design|Assign Each Zone to a Unique System Flow**. The dialog will automatically assign system flows to our zones. Note also that each zone has been given a new name based on the original block area name. See Figure 4-48. Click [OK].

Assign System Flows to Zones

Number of System Flows:

Operating Times (day:hour:min)

	System Flow Name	On	Off
1	System Flow - 1	1:0:0	1:1:0
2	System Flow - 2	1:1:0	1:2:0
3	System Flow - 3	1:2:0	1:3:0
4	System Flow - 4	1:3:0	1:4:0

System Flows Zone Operates On

	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Area no. 1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Area no. 2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Area no. 3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Area no. 4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OK Cancel

Figure 4-48

- Go to *Design/Zone Design Configuration* and change the "Number of Submain Sizes" to 3 for all zones.
- Select *Design/Zone Design/LP Design*. Once again you will notice that multiple submain sizes have been selected.
- Rerun *Design/Zone Design/LP Design*. Click [OK] on each of the warning messages.
- When you are happy with the zone design results and do not need to make any changes run Detailed Analysis. In order to run *Zone Detailed Analysis* first set the valve pressure in *Design/Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column.
- Now run *Design/Zone Design/Detailed Analysis* to finalise the zone design results. Check the Zone reports.
- Run *Design/Mainline Design/Mainline LP Design*.
- View the *Reports/Mainline Design Reports/System Duty Report*, your results should look similar to Figure 4-49.

Water Supply : Supply no. 1				
Duty Number	On time	Off time	Pressure (psi)	Flow US gpm
1	1: 0: 0	1: 1: 0	21.47	25.36
2	1: 1: 0	1: 2: 0	21.41	25.36
3	1: 2: 0	1: 3: 0	21.35	22.19
4	1: 3: 0	1: 4: 0	21.46	25.36

Figure 4-49

1.2.4.2 VALVES OPERATING TOGETHER

Throughout the above the tutorials we have usually specified that all valves operate independently regardless of the number of valves in the system. We will now look at different scenarios where more than one valve is operating at the same time.

- Select *Design/Assign Zones to System Flows*. Change the "Number of System Flows" to 2. Click [OK] to refresh the screen.
- Leave the "Operating Times" as the default (the actual running time is unimportant in this case), click [OK] again.

17. Now you can visually select which zones will operate on each system flow. Click on Area no. 1-1 and Area 1-2 (they will highlight when they are selected), then *Right-click|Assign to Sys Flow*. Click [OK].
18. Now click on Area no. 1-3 and Area 1-4, then *Right-click|Assign to Sys Flow*. Ensure the “System Flow Number” has changed to 2. Click [OK]. See Figure 4-50.

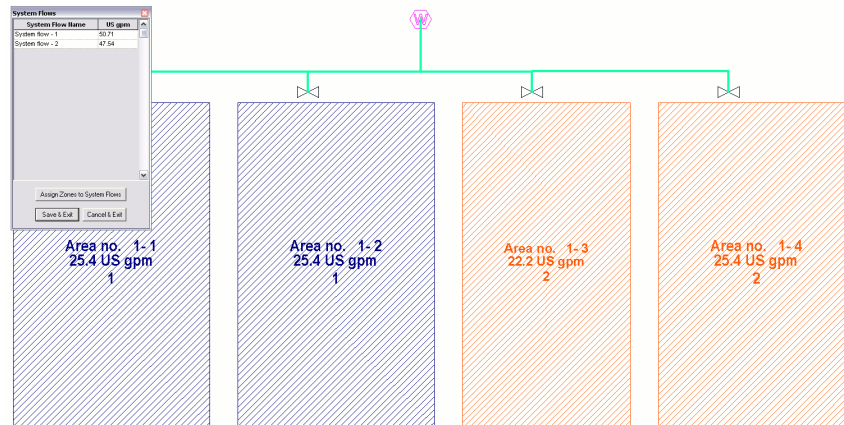


Figure 4-50

19. Re-run *Mainline Design*. Note that you do not need to re-run Zone design or analysis since nothing has changed in the zones. However, you will need to run *LP Design* for *Mainline Design* because the required pipe sizes may well change with the different flow regime.
20. Now open the *System Duty Report* (*Reports|Mainline Design Reports|System Duty*). Your results should look like Figure 4-51.

Water Supply : Supply no. 1				
Duty Number	On time	Off time	Pressure (psi)	Flow US gpm
1	1 : 0 : 0	1 : 1 : 0	21.60	50.71
2	1 : 1 : 0	1 : 2 : 0	21.57	47.54

Figure 4-51

1.2.4.3 FINALISE THE DESIGN

When the outlets are non-pressure compensating running *Detailed Analysis* provides the advantage of reporting the actual field flows based on the actual pressure at each outlet. This can be significant if the zone is large, mainline outlets have been used, or elevations have been included.

21. When you are happy with the zone design results and do not need to make any changes run *Detailed Analysis*. In order to run *Detailed Analysis* first set the valve pressure in *Design|Zone Design Configuration*. In the “D/S Valve Pressure” column enter the pressure stated in the “Actual Valve Pressure” column.
22. Now run *Design|Zone Design|Detailed Analysis* to finalise the zone design results. Check the Zone reports.
23. If the Zone reports are good re-run *Mainline Design*. Because there are only control valves in this design there is no point in running *Mainline Detailed Analysis*. Run *Design|Mainline Design|Mainline Analysis*. Check the Mainline reports.
24. Open the *Mainline Summary Report*. Note how one valve will have the same value for the “Valve Pressure” and the “Required Valve Pressure”. This is the zone that is driving the pressure requirement in that system flow. The other valve will have a higher “Valve Pressure” than its required pressure.
25. Now double-click on the Water Supply symbol and uncheck the “Calculate Pressure?” option. Enter the “Design Head” as **35psi (20m)**. The “Maximum Head” can be set to the maximum or static water pressure is known. If not, enter the same value as for the “Design Head”.

26. Run *Design/Mainline Design/Analyze* and open the *Mainline Summary Report*. Note the pressure now arriving at each valve based on the pressure at the water source (downstream of any headworks losses).

Note this tutorial could be repeated using the *Zone/Tape Irrigation Block* tool for Drip tape blocks.

1.2.5 USING COMPUTER SELECTION OF FITTINGS

Tasks covered in this tutorial:

- Changing more than one item at the same time
- Setting up Riser Selection Rules
- Running Computer Selection of Fittings
- Using the Bill of Materials Reports

Complete the above tutorial (A Simple Orchard Design with Multiple Valves) if you have not done so already.

1.2.5.1 SETTING UP

We will now have a quick look at IRRICAD completing the fitting selection for us. We have kept the above tutorials relatively simple, but to receive a bill of materials that is useable, we do need to put the pipes at their relative depths so the correct fittings are selected.

1. Select the whole drawing by using *Modify/Select All*. Now select the *Modify/Change Type* tool and click on one of the mainline pipes e.g. the pipe coming down from the water supply. In the dialog box enter a “Depth” of **600** and click [OK].

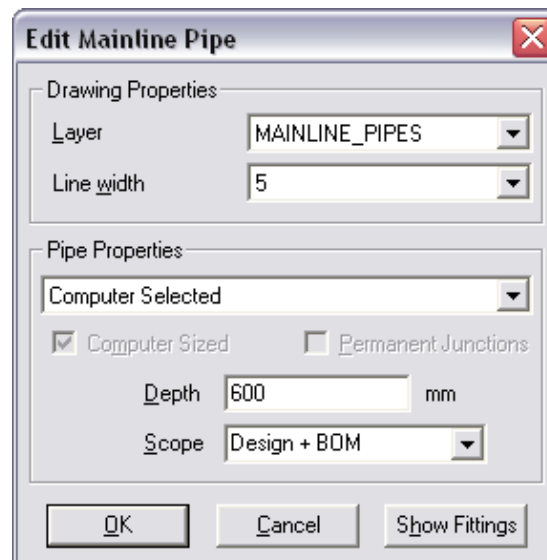


Figure 4-52

2. The next dialog box helps us to filter those items we want to change. Uncheck “Pipe” in the “Match” column.

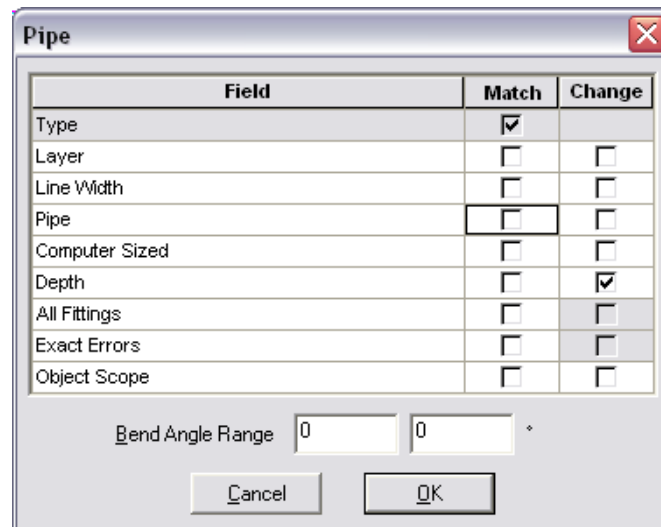


Figure 4-53

This means that all pipes will be changed, not only the same size ones as the one we clicked on. As we want both the Zone (excludes spraylines) and the Mainline pipes to change to the same depth, we will not specify that it has to match the same layer as the pipe we clicked on. See Figure 4-53. The only item checked is “Depth” in the “Change” column.

3. Click [OK]. The Status Bar will tell you how many items matched the criteria and therefore how many were changed. It should be 37. Now our mainline and submains are all at this depth.

Next we want to change the height of the control valves. You may or may not do this out in the field however, a height difference between the valves and the spraylines means you can have specific rules for each group.

4. Once again *Select All* and then click on one of the valves. In the dialog box enter **-100** as the “Depth” of the valve will be just above ground level. Click [OK].

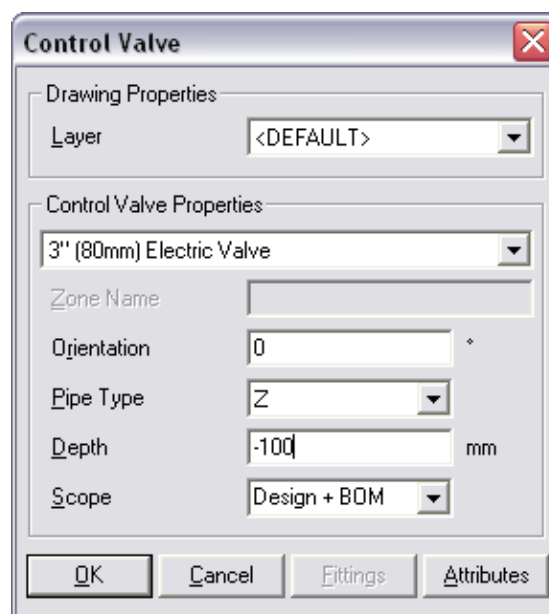


Figure 4-54

- In this case it doesn't matter if you match the valves or not as all three are the same. Ensure the "Change" "Depth" is checked before clicking [OK] as in [Figure 4-62](#). The Status bar should say 3 matched.

Field	Match	Change
Type	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Layer	<input type="checkbox"/>	<input type="checkbox"/>
Zone Name	<input type="checkbox"/>	<input type="checkbox"/>
Control Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Orientation	<input type="checkbox"/>	<input type="checkbox"/>
Depth	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Pipe Type	<input type="checkbox"/>	<input type="checkbox"/>
All Fittings	<input type="checkbox"/>	<input type="checkbox"/>
Exact Errors	<input type="checkbox"/>	<input type="checkbox"/>
Object Scope	<input type="checkbox"/>	<input type="checkbox"/>
User Attributes	<input type="checkbox"/>	<input type="checkbox"/>

Bend Angle Range: 0 0

Cancel OK

Figure 4-55

1.2.5.2 RISER SELECTION RULES

Riser selection rules enable us to change the rules to how we want risers selected or by specifying the riser ourselves.

If the **Rules** are not changed, IRRICAD will assume that the diameter of the vertical riser pipe is equal to the diameter of the largest pipe or valve at the higher of the two depths being connected. IRRICAD will also assume that the type of material for the riser pipe is the same as the largest item at the lower of the two depths. (Size of the Top and Type of the Bottom).

However, usually in Sprayline blocks or Tape blocks we have specific ideas of what the riser should be. This means we will need to change the rules or select a specific riser from the Pipe database.

	Depth 1 (mm)	Depth 2 (mm)	Riser	Size	Type	Riser Description
1	0.0	600	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	
2	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
3	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
4	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
5	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
6	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input type="radio"/> Bottom	

OK Cancel

Figure 4-56

1. Select *Design/Riser Selection Rules*. “Depth 1” is always the top depth, in this case **0** as this is the depth of the spraylines. “Depth 2” is the depth of the submain so type in **600**. To have the riser the same size and type as the Sprayline itself we will leave **Rule** checked for “Riser” and also check **Top** for “Size” and **Top** for “Type”. See Figure 4-63.

However we wish to specify a particular riser to be selected. Select **User** for “Riser” and then selected the **3/4" (20mm) Polyethylene Hose** as the riser we wish use in this sort of design. Then the size and type of what is in the block ignored when selecting a riser from the pipe database.

2. Now we can set the “Rule” for the control valves. Set “Depth 1” to **-100** and “Depth 2” as **600**. As our riser is going to be the same size and type as the submain itself so we will leave **Rule** checked for “Riser” and also check **Top** for “Size” and **Bottom** for “Type”. See Figure 4-64.

	Depth 1 (mm)	Depth 2 (mm)	Riser	Size	Type	Riser Description
1	0.0	600.00	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	3/4" (20mm) Polyethylene Hose
2	-100.00	600.00	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
3	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
4	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
5	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	
6	0.0	0.0	<input checked="" type="radio"/> Rule <input type="radio"/> User	<input checked="" type="radio"/> Top <input type="radio"/> Bottom	<input type="radio"/> Top <input checked="" type="radio"/> Bottom	

Save Load OK Cancel

Figure 4-57

If we had left the valves at ground level then the ¾" riser would have been selected to join the valves on the pipes. Having the valves at a different depth stops this.

3. Now you are ready to run *Design/Computer Selection of Fittings*. Once this is done have a look at the *Report/Costing/BOM Reports*. There are several to choose from and these can be printed as required.
4. You can zoom into a junction and double-click on the junction to access the *[Show Fittings]* button on the junction dialog. View the fittings IRRICAD has selected to solve that junction. Note if there is no suitable lateral take-off in the database enabled for selection a tee will be selected instead.

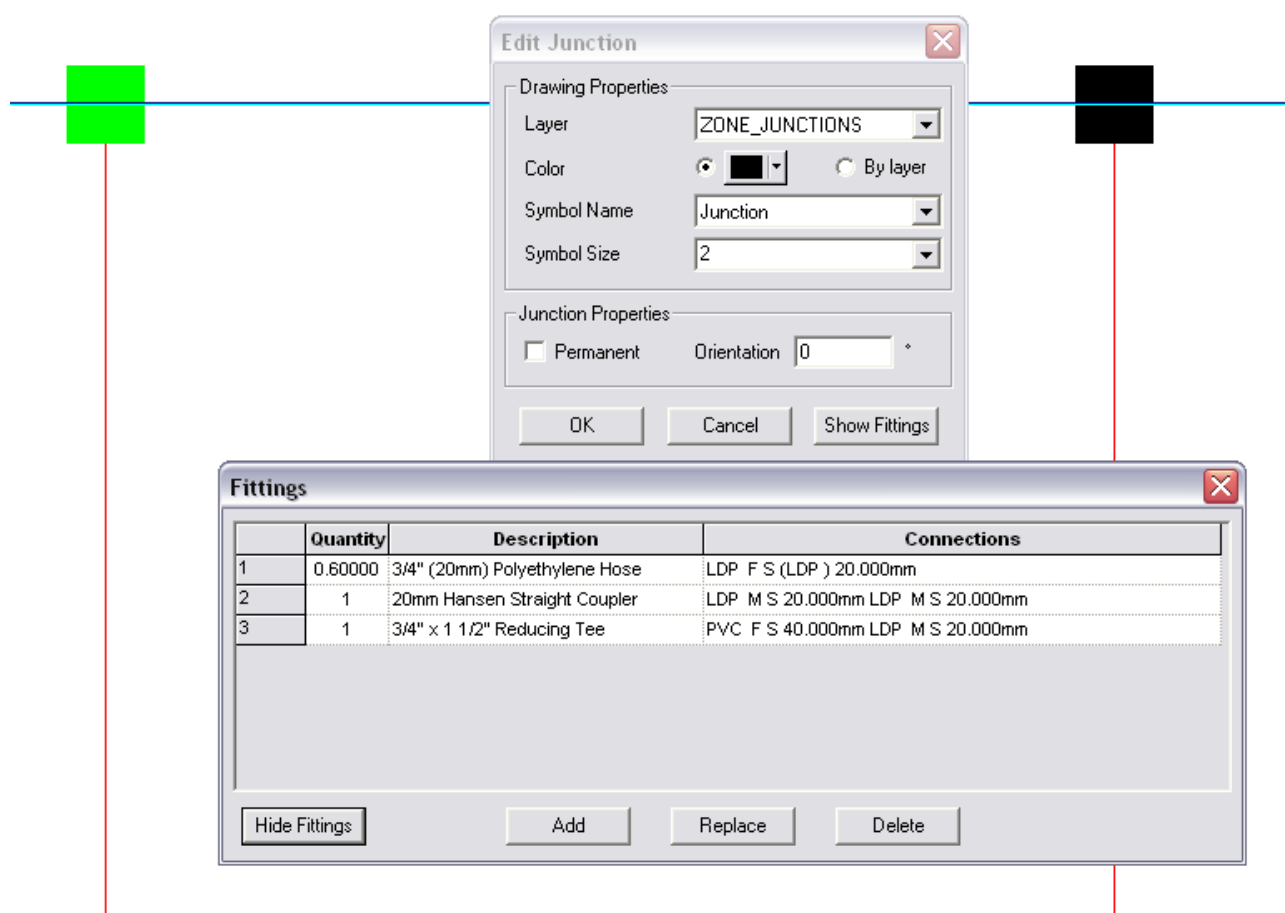


Figure 4-58

1.2.6 MICRO IRRIGATION DESIGN

This tutorial will take you through the steps required to design a Micro Irrigation scheme. The tutorial is intended to introduce you to the procedure required to design systems containing blocks of laterals as would normally be found in an orchard for example. Although the tutorial is based on a micro-sprinkler system the procedure applies equally well to drip and solid set systems. Although this tutorial shows a regular shaped system, irregularly shaped systems can be designed just as easily. There are many methods of completing such a design; this tutorial outlines only one of the possible ways.

1.2.6.1 STARTING THE TUTORIAL

1. Double-click on the IRRICAD desktop icon or select *Start/All Programs/IRRICAD Pro* to run IRRICAD. If already running IRRICAD select *File/New* to start with a clean screen. In *Settings/Irrigation - Design Specific*, browse for the tutorial database **Tutorial.mdb**. This should be found in the Irricad\database folder.
2. Go to the **Units** tab and click the **[US]** (**[Metric]**) button to restore the default units for this tutorial. These settings can be retained for each design by clicking the **[Save As Default]** button.
3. Go to the **Misc.** tab and select the Medium design size as in [Figure 4-59](#). Change the "**Base Database Symbol Size**" to **23 (7)**. This determines the size of the symbols according to the size of the design. Enter your name in the "**Designer**" field. When you are finished click **[OK]**.

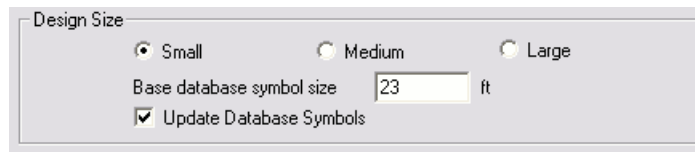


Figure 4-59

1.2.6.2 ENTERING BACKGROUND INFORMATION

This is information that will help to position the elements of the irrigation system. Examples include boundaries, roads, buildings, text and symbols. In this tutorial we will put in an 1155ft x 825ft (350m x 250m) rectangle for the block boundaries. We will use a grid to help with positioning although this is optional.

4. Select **Settings|Grid / Origin** and enter the “X” and “Y” spacing as **15ft (5m)**. Tab between the fields. Check the “**Display Grid Points**” checkbox. Now select **Settings|Snap** and check the “**Snap to Grid**” option. Click **[OK]**.
5. Select **Draw|Rectangle|2 Point** and click the left mouse button to start the rectangle. Draw the rectangle out to any size and then select it using **Select Object** and double-clicking on the boundary. Change the “**Width**” to **1155 (350)** and the “**Height**” to **825 (250)** and press <Enter>.

1.2.6.3 MORE BACKGROUND INFORMATION

6. Select **View|Zoom All** to get the whole area in view on the screen. Inside this area are four blocks that we are going to design an irrigation system for. We need to place four more rectangles inside the current boundary rectangle and then move them into position. To do this select **Draw|Rectangle|3 Point** and place the first point inside the existing boundary **45ft (15m)** - 3 grid points - from the top and left boundaries. Notice that only every 2nd grid point along the X-axis is shown at this zoom. Draw the cursor out towards the middle along the top. Now type **495,<0 (150,<0)** and press <Enter>. Move the cursor down at right angles and type in **330 (100)** and press <Enter>.
7. Select **Modify|Copy|Array** and click on the inner rectangle to select it then enter 1 for the number of copies and 2 for the number of rows. Click on the bottom right corner of the inner rectangle then move the ghosted rectangle to three grid points from the right boundary, in-line with the original. Click to place. Move the ghosted rows to 3 grid points from the bottom and left boundaries. Click to place.
8. You need to enter site data if elevation changes over the plan are likely to affect the hydraulics of the system. If the design area is essentially flat you do not need to enter any elevation data and all objects will be given a default height of 0.
9. In this example there is a 5ft (1.5m) fall from the top to the bottom of the screen. To allow for this, select **Draw|Contour** and enter one contour line at the top of the screen. Move to the top left of the screen just above and to the left of the boundary rectangle. Click the left mouse button then drag the rubberband horizontally to the right until it is above and to the right of the boundary rectangle and click the left mouse button. Select **Right-click|Done**. In the dialog, type **33 (10)** as the contour height. Click **[OK]**. Now draw a contour similarly along the bottom of the screen below the boundary rectangle. Select **Right-click|Done** and type **28 (8.5)** in the dialog as the contour height. Click **[OK]**.
10. If you can still see the green rubberband color, select **View|Redraw**. Your design should look something like [Figure 4-60](#).

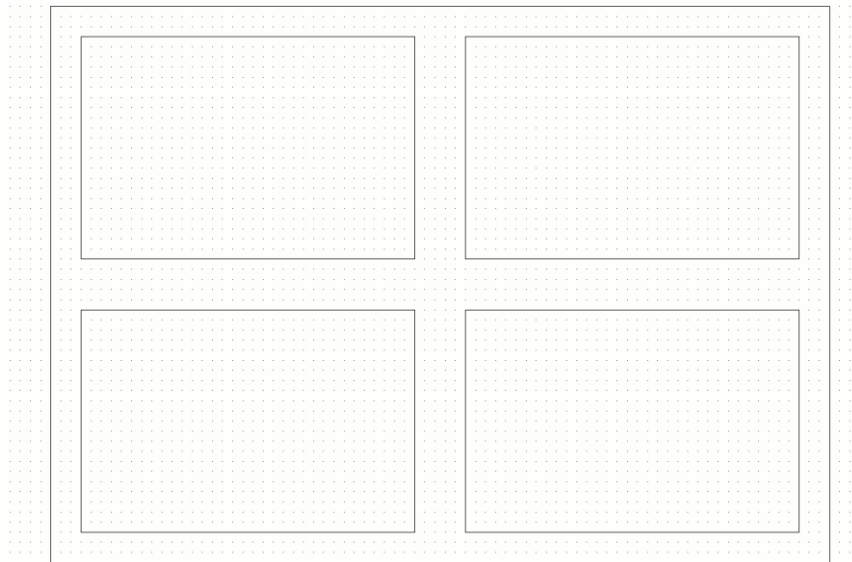


Figure 4-60

1.2.6.4 CREATING THE LATERALS

11. Before placing any laterals select *Settings/Irrigation - Design Specific* and uncheck the “Create Sprayline Outlets” checkbox. While you are in this dialog change the line widths of the pipes to “Laterals” 1, “Mainline Pipes” 3, “Zone Pipes” 2 and “Wires” 1.
12. Now select the *Settings/Irrigation Items* tab, and uncheck the “Flow Check Enabled” box if it is checked. Click [OK].
13. Select the top left small rectangle by using *Modify/Select Object* or clicking on the white arrow icon on the left-hand tool bar. Once the rectangle is highlighted, select *Zone/Spray Irrigation Block*. Click [Yes] on the ‘Create Block / Block Entities from Selected Items’ message.
14. The *Laterals* tab dialog for setting block and sprayline properties will be displayed. As you are completing a new design and may not know what pipe size to use you will get IRRICAD to size the laterals the pipe as **Computer Selected**. The laterals will be placed at ground level so the “Depth” field can remain at **0.0**. In the same dialog, select a sprinkler by clicking the down arrow. Highlight the **Micro-sprinkler 360 degrees** and left mouse click to select it. Select the **WHITE 360** as the nozzle by clicking on the down arrow of the “Nozzle” field, highlighting the required nozzle and left clicking the mouse. Enter a pressure of **18.5psi (13m)**. Selecting an outlet connector or riser is optional but for this example we will use a Micro-sprinkler stake and tube $\frac{3}{8}$ ” (10mm). If the micro-sprinkler is an assembly already containing a stake and tube you would not need to select another connector. In the same dialog, select the **Micro-sprinkler stake and tube $\frac{3}{8}$ ” (10mm)** from the dropdown list. Enter the “Lateral Spacing” as **13ft (4m)**. Enter the “Outlet Spacing” as **11.5ft (3.5m)**. Leave the “Outlet Spacing Properties” as **Rectangular** for a rectangular layout. Leave the “Offset” as **0%**, and ensure that the “Connected” checkbox is checked for connected spraylines. The dialog should look like [Figure 4-61](#).
15. Click the [Options] button and in the dialog that appears leave the “Number of Laterals” as **0** so that IRRICAD fills the blocks completely with laterals. Leave the “Lateral Direction” as **Determine Automatically**. Leave the “Extra Outlets” box unchecked so that IRRICAD does not put additional sprinklers on the ends of the lateral lines when the distance from the last sprinkler to the end of the line is greater than half the outlet spacing. Leave the “Outlet Orientation” at **0°** and the “Reference Outlet” as **Determine Automatically**. Leave the “Layer” as **<DEFAULT>** so the spraylines will be entered into the Spraylines layer. Leave the “Lateral Line Width” as **2**.

Figure 4-61

1.2.6.5 CREATING THE AUTOMATIC SUBMAIN AND VALVE

16. Click on the **Block** tab. The laterals are to run the full length of the smaller block rectangles but be about 15ft (5m) inside the side boundaries. Set the Headlands and sidelands as **15ft (5m)** each.
17. Ensure the **"Create Laterals"** check box is checked. The **"Scope"** determines if an item will be just for design purposes only or for design and costing. Ensure **Design + BOM** is selected.
18. As we want the submain through the center of the block in **"Submain Properties"** section select **Center** as the **"Position"**. This will now enable a pipe size to be selected, however, we require IRRICAD to size the pipe for us. Enter **20 inches (500mm)** as the **"Depth"** for the submain. Enter a **"Stub Length"** of **5ft (1.5m)** for the submain to extend beyond the last lateral.
19. In the **"Control Valve Properties"** section select **Start** as the **"Position"** and now you can select the 3" (80mm) Electric Valve from the dropdown list. Enter **15ft (5m)** as the **"Submain Stub"** from the valve to the first lateral. Enter the **"Depth"** as **-4 inches (-100mm)** as the height above ground. Leave the **"Valve Stub"** as **0** as there is no extra length after the submain stub.
20. Click **[OK]** and select the bottom boundary of the rectangle for IRRICAD to align the laterals with.
21. Repeat steps 12 to 19 on each of the remaining rectangles (IRRICAD will remember the selections from above) using the center boundary to align the laterals with so that all valves end up in the center. If the valve ends up on the wrong side of the area, do not worry, simply hold the <Alt> key down and double-click on any block entity and the dialog will appear (when in **Select Object** mode). Change the Valve **"Position"** to End and it will relocate the valve at the opposite end of the block.

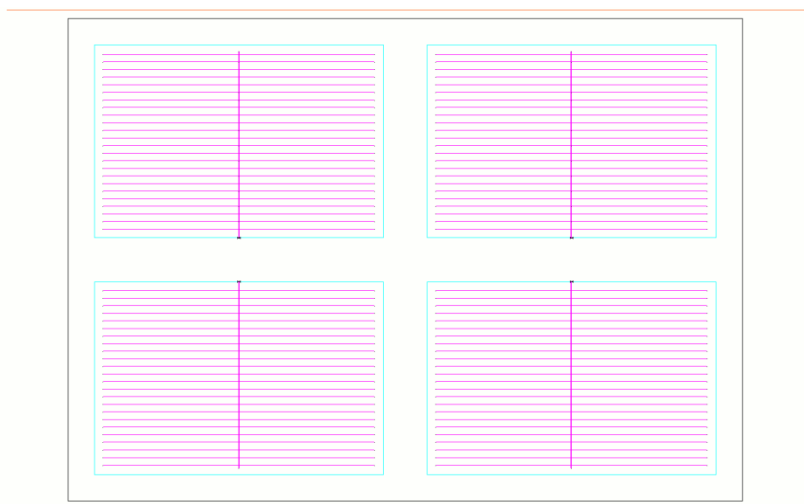


Figure 4-62

1.2.6.6 CONNECTING TO THE MAINLINE

22. Select *View/Zoom Window* and drag a window that will encompass all four control valves and by placing the top left corner and the bottom right corner of the zoom window by left clicking. Select *Mainline/Pipe*. Leave the pipe as **Computer Selected**. Enter the “Depth” as **20 (500)**, and leave the “Line Width” as **4**. Click **[OK]**. Connect the pipe to the top left block control valve by clicking on it then connect to the bottom left block control valve similarly. Select *Right-click/Restart*. Repeat to connect the two right block control valves.
23. Select *Settings/Snap* and click the **[Running Snaps]** button. Check the “Midpoint” option, the “RN Snaps On” and the “Show Preview” check box. Reselect *Mainline/Pipe* and move the cursor over the existing left-hand mainline until the preview of midpoint snaps appears (a diamond in the center of a line). Click on the mainline pipe at this position. Draw out the pipe to the right-hand existing mainline and once again move the cursor over the existing pipe until the midpoint is found. Left click to place then select *Right-click/Restart*. Now find the midpoint of the horizontal mainline pipe and click to attach a new pipe. Draw upwards approx. **10ft (3m)**.
24. Select *Mainline/Water Supply*. Connect to the junction on the end of the short piece of pipe by left clicking on it. Leave the name as the default **Supply No. 1**. Do not enter any flow or pressure requirements, as IRRICAD will determine these during design and analysis and assumes that the water supply is unrestricted. Click **[OK]**.
25. Select *Draw/Spot Height* and place a spot height on the water supply. Make the height **28.5 (8.75)**. This is to ensure that the position of the water supply will be allocated the correct elevation at that point. If spot heights are available for a client's property, these can be used in conjunction with contour lines. If you have the information it is a good idea to use it. Select *View/Zoom All*. Your design should look like [Figure 4-63](#). This completes the entry of the hydraulic components of the design.

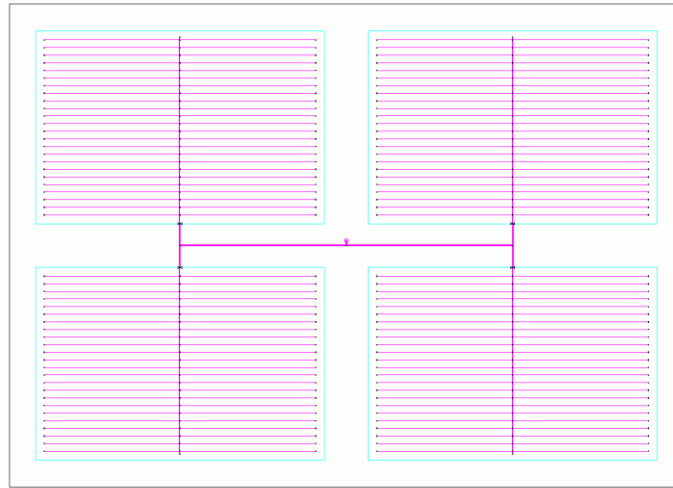


Figure 4-63

1.2.6.7 THE DESIGN PROCESS

We are now ready for the design process.

Checking Connectivity

26. Select *Design/Check Outlet Connectivity* to ensure that all the outlets are connected to the zone control valve and that the valve is connected to the water supply. If IRRICAD does not report any unconnected items you can continue. If items are reported as not connected, their location will be displayed.

Note: Outlets do not have to be connected. Zone Control Valves, however, must be connected to the water supply before designing the mainline.

Zone Design and Reporting

27. Select *Design/Zone Design Configuration*. In the dialog you will see all four blocks listed down one side. For each block you can decide if you wish to design / analyze that zone. Leave this box checked for all blocks. The next column allows you to turn on or off the ability to allow for minor losses - leave this checked for all blocks. "Change Diameter at Outlet" only applies to zones with telescoping laterals. A check will ensure that a change in lateral diameter will take place at an outlet location. It is not normally used for dripper or micro-sprinkler systems, so leave this option unchecked for all blocks. "Number of Lateral Sizes" allows you to specify the maximum number of pipe sizes used in each lateral (maximum 3). The default is 1. Change this to **2** for this design. "Number of Submain Sizes" allows you to specify the maximum number of pipe sizes to be used in the submain. Enter this as **2** for all blocks (if this number is left at 0 IRRICAD is unlimited in the amount of submains it can use to solve the design). "Valve Pressure" is used when you wish to specify a valve pressure for a zone. A **0** entry means that IRRICAD is required to calculate a suitable pressure, so leave this as **0.0** as in Figure 4-64. Click [OK].

Zone Name	Process	Allow For Minor Losses	Change Diameter At Outlet	Number Of Lateral Sizes	Number of Submain Sizes	D/S Valve Pressure (psi)	Actual Valve Pressure (psi)	Min/Max Emitter Pressures (psi)	Minimum Allowable Pressure (psi)	Maximum Allowable Pressure (psi)	Don't Use Database Envelope
Area no. 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	2	0.0	0.0	0.0 - 0.0	0.0	0.0	<input type="checkbox"/>
Area no. 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	2	0.0	0.0	0.0 - 0.0	0.0	0.0	<input type="checkbox"/>
Area no. 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	2	0.0	0.0	0.0 - 0.0	0.0	0.0	<input type="checkbox"/>
Area no. 4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	2	0.0	0.0	0.0 - 0.0	0.0	0.0	<input type="checkbox"/>

Set Selected Unset Selected Paste Selected OK Cancel

Figure 4-64

28. Select *Design/Design Parameters/Hydraulic Parameters* and enter the "Maximum Zone Pipe Velocity" as **5ft/s (1.5m/s)**. Click [OK].
29. Select *Design/Zone Design/LP Design*. This method of computer sizing takes into account the maximum allowable velocities (in *Design/Design Parameters/Hydraulic Parameters*) and the pressure requirements of the sprinklers. Select this option to have IRRICAD size the laterals and submains for the zones. You will get some warning messages during LP Design indicating that some of the blocks have nozzle pressures outside the specified operating range. You should have results similar to Figure 4-65.

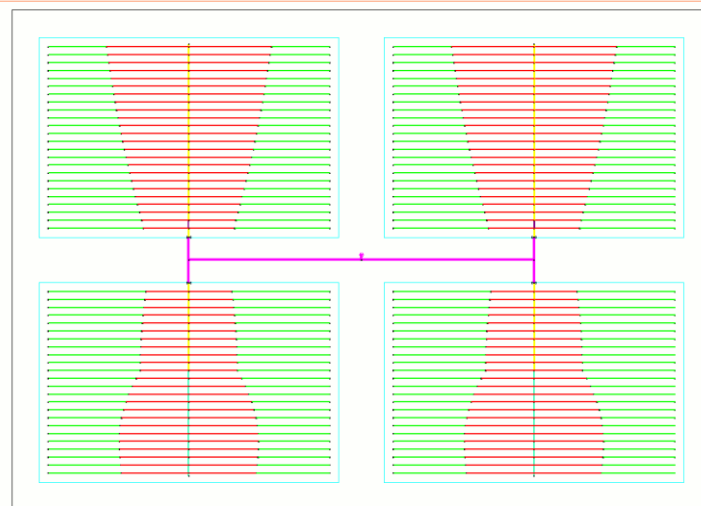


Figure 4-65

30. It is advisable to check the data in the zone reports after zone design (*Reports/Zone Design Reports*). At this stage the *Zone Design Summary* report gives a good indication of the overall design of the zones. As you will see, the minimum present outlet pressure is 0.2psi (0.2m) below the allowable minimum outlet pressure. We will not worry about this at this stage. Note down the present downstream pressure of the valve that IRRICAD has calculated for each zone as this will be used later for analysis. It should be between 17-21psi (12m and 15m). Click on the X to close the report window.

Entering Management Requirements

We now need to enter some management requirements. The primary purpose of management is to allow you to specify an operating sequence for the zone control valves, which set up a series of flow conditions in the mainline so that the mainline can be correctly sized and analyzed. You have the option of specifying a simple worst case scenario for valve operation or of specifying a full operational sequence for all valves.

31. Since we will be operating each zone separately, on different system flows, select *Design|Assign Each Zone to a Unique System Flow*. A system flow is a zone or group of zones operating at the same time. The resulting dialog will have automatically allocated the four system flows to different time slots and each zone to a different system flow. This table can be edited if required so check the data is correct. Note the number of system flows is 4. The sequential operating times (one hour) for each system flow are listed. If actual start and stop times are not important (and this is the case for this system) the default times should be accepted. System flow operating times cannot overlap. Now note that Block 1 will operate on system flow 1, Block 2 on system flow 2, and so on as in [Figure 4-66](#). Click [OK].

Assign System Flows to Zones

Operating Times (day:hour:min)

	System Flow Name	On	Off
1	System Flow - 1	1:0:0	1:1:0
2	System Flow - 2	1:1:0	1:2:0
3	System Flow - 3	1:2:0	1:3:0
4	System Flow - 4	1:3:0	1:4:0

Number of System Flows:

System Flows Zone Operates On

	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Area no. 1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Area no. 2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Area no. 3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Area no. 4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OK Cancel

Figure 4-66

Mainline Design

32. Now have IRRICAD size the mainline for the design. Select *Design|Mainline Design|LP Design*; IRRICAD will then size the mainline for the design and calculate the water supply pressure so that the zone control valves receive the required pressure.

1.2.6.8 MAKING CHANGES AFTER INITIAL DESIGNING

We now want to tidy up the design as the position where the laterals change size varies. In order to make the system easier to install it is desirable, in this example, though optional, to straighten up the size change positions. This will also fix the warning message about some nozzle pressures being outside the specified operating range.

33. Select *Tools|Move Sizes*. On the left side of the submain in the first block find the junction furthest from the submain where the laterals change size. Draw a line vertically through the laterals such that it passes through this junction by left clicking above the block and then left clicking at the bottom of the block, so that the line passes fully through all the laterals (holding the <Ctrl> key down will help with a straight line – if “Ortho Mode” is set to 0°) or use grid points as a guide to help you with this. When you select *Right-click|Done* a dialog will give you the choice of whether you want the lateral size change to take place at a sprinkler or not and which size you want to move. Uncheck the “Nearest Outlet” checkbox so that the lateral will change size on the line. Select the “Close” option, so that the junction closest to the line will be moved. Click [OK] and IRRICAD will move the junctions to the line.
34. Repeat for both sides of the submain in all blocks. Your design should now look like [Figure 4-67](#).

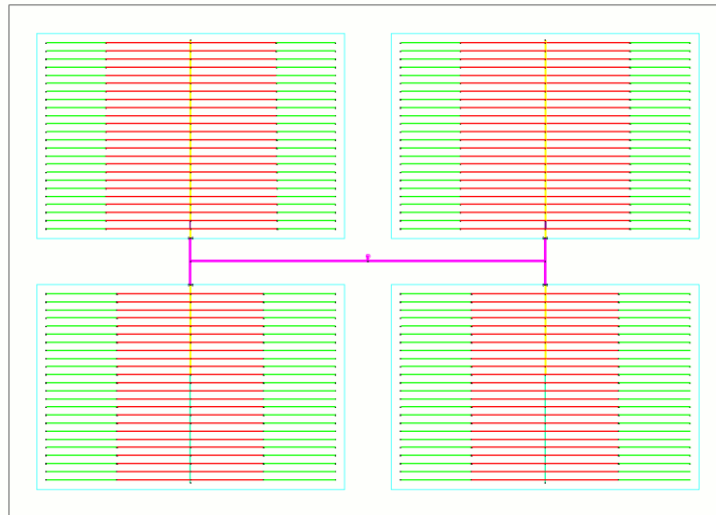


Figure 4-67

35. The system can now be analyzed to assess the effect of the modifications. Select *Design/Zone Design Configuration* and type in the valve pressures you noted previously as the "Valve Pressure" for the respective zone control valves. You can specify the same pressure at each valve - choose the highest pressure to enter for all. Click [OK].
36. Now select *Design/Zone Design/Detailed Analysis*. This will analyze each block without making any changes to the pipe sizes already selected. *Detailed Analysis* also shows you exactly what is happening at the outlets. When *Detailed Analysis* is completed, re-run *Design/Mainline Design/Analyze*.

1.2.6.9 DISPLAY REPORTS

You may wish to select and view some of the design reports.

As seen previously, the *Zone Design Summary* report (*Reports/Zone Design Reports*) gives you a summary of the pressure variation in the block. The *Mainline Design Reports/System Duty Report* gives you the duty required at the water supply for each system flow. The *Mainline Summary Report* gives a summary of actual and required pressures at the zone control valve.

37. Check that the outlet pressure variations (as seen in Figure 4-68 in the *Zone Design Summary* report) are within requirements. Note the changes since you have moved the lateral pipe sizes and run *Detailed Analysis*.

Zone Name : Area no. 1		Valve Description : 3" (80mm) Electric Valve	
Zone Head (D/S) : 20.89 (psi)		Zone Head (U/S) : 20.89 (psi)	
Total Zone Flow : 226.25 US gpm		Valve Headloss : 0.00 (psi)	
	Allowable Flow	Actual Flow	Allowable Pressure
	US gph	US gph	(psi)
Minimum Outlet	12.90	12.97	16.44
Maximum Outlet	14.26	14.26	20.70
Outlet Variation (%)	9.52	9.07	20.59
Outlet Locations (X,Y) Minimum : -726.9 , -146.6		Maximum : -656.1 , -237.7	

Zone Name : Area no. 2		Valve Description : 3" (80mm) Electric Valve	
Zone Head (D/S) : 20.89 (psi)		Zone Head (U/S) : 20.89 (psi)	
Total Zone Flow : 225.93 US gpm		Valve Headloss : 0.00 (psi)	
	Allowable Flow	Actual Flow	Allowable Pressure
	US gph	US gph	(psi)
Minimum Outlet	12.90	12.97	16.44
Maximum Outlet	14.26	14.26	20.70
Outlet Variation (%)	9.52	9.07	20.59
Outlet Locations (X,Y) Minimum : -412.2 , -146.6		Maximum : -482.3 , -237.7	

Figure 4-68

If you wish to narrow the pressure variation, there are several things you can do:-

- Move the change of pipe sizes of the laterals as described previously using *Move Sizes* so that there are longer lengths of the larger pipes.
- Manually change the submain pipe sizes using *Modify/Select Object* and *Modify/Change* or *Modify/Change Type*.
- Change the nominal pressure required at the outlets to a value closer to the actual pressure calculated by using *Modify/Select/All* and *Modify/Change Type* and selecting a representative sprayline.

For details on how to use these tools see the Tool & Command Reference, Section 5.

To have IRRICAD automatically select the pipe fittings required for the design you need to select *Design/Computer Selection of Fittings*. IRRICAD will look at each pipe or component junction in the design and from the database select the fittings needed to join these pipes or components together. The internal junction numbers will be displayed on the status bar as it does this.

After running *Computer Selection of Fittings* it is a good idea to look at one of the Bill of Materials reports, e.g., *Reports/Costing BOM Reports/BOM* to find out if IRRICAD was able to select all the fittings required for the job. If fittings could not be found to solve particular junctions details of those junctions will be listed at the end of the report.

1.2.6.10 TRAVEL TIMES

Travel Times can be calculated for the zone and mainline by enabling this option in *Design/Design Parameters/Hydraulic Parameters* - "Calculate travel times".

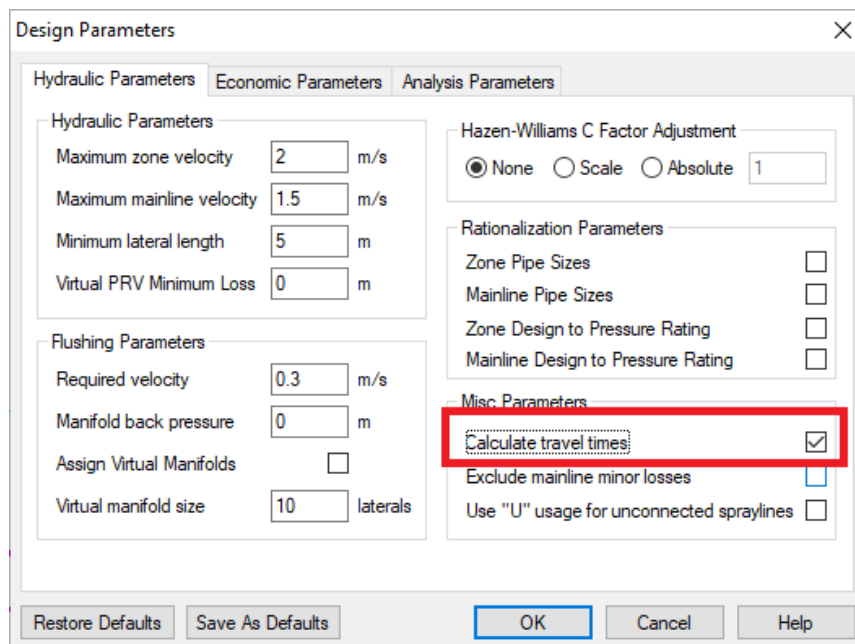


Figure 4-69

Now re-run *Design/Zone Design/Detailed Analysis* and *Design/Mainline Design/Analyze*. There are specific 'Travel Time' reports to view or the zone travel time will also be present in Zone Summary report.

1.2.7 SOLID SET SPRINKLER DESIGN

1.2.7.1 INTRODUCTION

This tutorial will take you through the steps of a setting up a solid set sprinkler design. To achieve the purpose of this tutorial we will proceed to set up a sprinkler system for frost protecting a stone fruit orchard. Although it is a regular shaped system irregular shapes can be just as easily. There are many ways of doing such a design, this tutorial outlining only one of the ways.

1.2.7.2 OVERVIEW

A solid set system is one that is non-movable, tends to be unconnected spraylines (though pipes and sprinklers are placed in one action, they remain separately pipes and sprinklers) and has a low number of sprinklers. Because we wish to place water on trees to protect from frost, we require a riser to place the sprinkler 16.5ft (5m) above the pipe in the ground.

1.2.7.3 STARTING THE TUTORIAL

1. Double-click on the IRRICAD Icon, or select *Start|All Programs|IRRICAD Pro*. If already running IRRICAD select *File|New* to start with a clean screen.
2. In *Settings|Irrigation – Design Specific* and browse [...] for the **Tutorial.mdb** database. Highlight and select *[Open]*. Change the “Zone Pipes Line Width” to **2** and the “Mainline Pipe Line Width” to **3**.
3. Note that at the top of the dialog is a series of tabs. Select the *Design Details* tab. Edit the design details for this design. For the site type **Stone Fruit Orchard** and for the notes type **Solid Set Sprinkler Tutorial**. Go to the *Units* tab and click the *[US] ([Metric])* button to restore the default units for this tutorial. These settings can be retained for each design by clicking the *[Save As Default]* button. Note Metric measurements are displayed in brackets. Select the *Misc.* tab and select the “Design Size” as “Medium”. Change the “Base Database Symbol Size” to **26 (8)**. This determines the size of the symbols according to the size of the design. When you are finished, click *[OK]*. Select *File|Save* and save the design.

1.2.7.4 ENTERING BACKGROUND INFORMATION

First we will enter the background or base information which is required in order to position the irrigation system. Examples include property boundaries, roads, buildings, perhaps text and symbols. This client has an area of 37 acres (15ha) in nectarine trees. For the tutorial we will put in an orchard boundary 1640ft (500m) x 980ft (300m) to cover the blocks of trees, water supply, house and some sheds. The rest of the client's property does not concern us for this project.

4. We will use a grid to help position things, though this is optional. Select *Settings|Grid / Origin* and set up a grid **20x20ft (6x6m)**. Check the “Display Grid Points” checkbox.
5. Select the *Snap* tab and select the “Snap to Grid” option. Click *[OK]*. Select *Draw|Rectangle|3 Point*. Place the cursor at the bottom left and left mouse click. Draw a horizontal line to the right, and then without clicking, type **1640<0 (500,<0)** on the keyboard and press <Enter>. Move the mouse upwards and, without clicking the mouse, type **980 (300)** on the keyboard and press <Enter>. Select *View|Zoom All*. You now have a rectangle 1640x980 (500x300) on the screen.
6. This small orchard is divided into blocks 330ft (100m) x 700ft (210m). Draw a *3-point Rectangle* in the same manner as above, so the smaller rectangle is inside the larger one. Start the top right corner of this rectangle 120ft (36m) (6 grid points) from the right boundary and 60ft (18m) (3 grid points) from the top boundary. Notice that only every 2nd grid point along the X-axis is shown at this zoom. Type **330,<180 (100,<180)** for the width and **700 (210)** for the length of the rectangle. Select the rectangle, then select *Modify|Copy|Linear* and enter **3**. Click *[OK]*. Select the top right corner as the reference point then drag the 3 copies to the left until the left most copy is about 120ft (36m) (6 grid points) from the orchard left boundary, i.e. the 4 rectangles are evenly spaced across as in [Figure 4-70](#), and left click. The

block rectangles are only 20-40ft (6-12m) apart. This distance between blocks represents a shelterbelt; the grid represents tree spacing within the block.

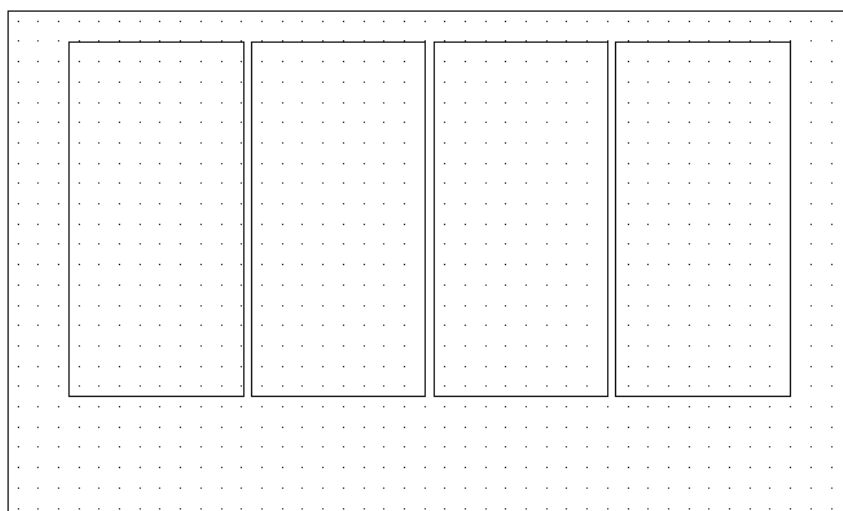


Figure 4-70

7. Using *Draw/Rectangle/2 Point*, draw a house and farm building towards the bottom left of the orchard boundary. Make the house **40x60ft (12mx18m)** and the buildings **20x20ft (6mx6m)**. Use grid points to size the rectangles.
8. Select *Settings/Snap* and select “**Connect**” to turn “**Snap to Grid**” off. Now place a road name at the top of the boundary by selecting *Draw/Text* and typing **Luke Road**. Change the “**Height**” to **32ft (10m)**. If you wish, change the font to another true type font. Click [OK], and place the label above the top property boundary line by left clicking. Select *Draw/Text* again and type **Tyre Road**, and change the “**Orientation**” to **90°**. Click [OK] and place at the left boundary. Label the house and buildings in the same way, changing the “**Orientation**” of the text back to **0°**.
9. Turn off the grid in *Settings/Grid/Origin/GIS* by unchecking the “**Display Grid**” check box.

1.2.7.5 LAYING OUT FIXED SPACED OUTLETS

10. Select the left most smaller rectangle by using *Modify/Select Object* and clicking on the rectangle edge.
11. Now select *Zone/Spray Irrigation Block*. On the *Laterals* tab, leave the pipe as **Computer Selected**. Select the **Big Impact Drive Sprinkler** and the **4.4mm “Nozzle”**. Change the “**Pressure**” for the nozzle to **64psi (45m)**. The “**Radius**” will change to 59.05ft (18m). Select the **3/4” x 16ft (20mm x 5m) Galvanized Pipe Riser** and change the “**Lateral**” and “**Outlet Spacing**” to 60ft (18m) each. Leave the “**Outlet Spacing Properties**” as “**Rectangular**” and **0%** “**Offset**”. Uncheck the “**Connected**” checkbox. Leave the “**Scope**” as **Design + BOM**. Click the [Options] button and check the “**Extra Outlets on Ends**” checkbox as in Figure 4-71. Click [OK] on both dialogs.

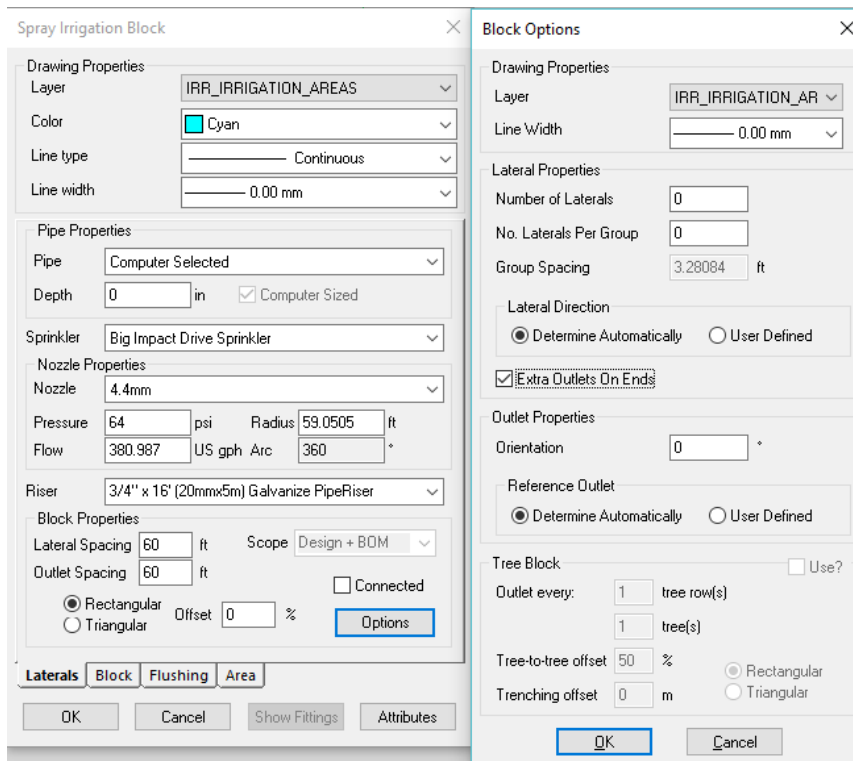


Figure 4-71

12. Click on the **Block** tab. The “Headlands” and “Sideways” will be left at **0** and ensure the “Create Laterals” box is checked. The “Scope” should be **Design + BOM**. Leave the “Submain Properties” as **Computer Selected** and select the **Start “Position”** for the submain with a **5ft (1.5m) “Stub Length”** and a **20in (500mm) “Depth”**.
13. In the “Control Valve Properties” select the **4” (100mm) Gate Valve (Flanged)** with **15ft (5m) “Submain Stub”** and a **-4in (500mm) “Depth”**. Click [OK].
14. Select the bottom edge of the left most rectangle for the laterals to be aligned with. The rectangle will automatically fill with spraylines at the correct row and outlet spacing.
15. Repeat steps 10 to 14 for each of the small rectangles. The plan should look like [Figure 4-72](#).

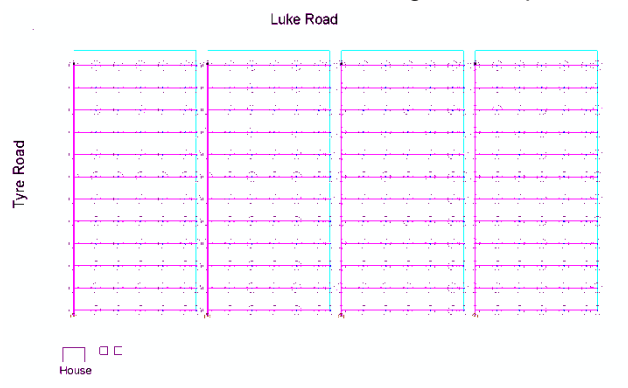


Figure 4-72

16. Select **Mainline|Pipe** and enter **20in (500mm)** as the “Depth” of the pipe. Click [OK] on the dialog.
17. Connect the four control valves by left clicking on each one then select **Right-click|Restart**. Because the water supply cannot be in-line on a mainline, tee-off a short piece of mainline on which to place the water supply by moving to the center of the pipe between the first 2 valves and left clicking, moving down about **65ft (20m)** and left click again. Move right about **16ft (5m)** and left click again then select **Right-click|Restart**.

18. The water supply can be positioned by selecting *Mainline|Water Supply*. Click on the end of the mainline pipe just created. Leave the *Water Supply* details at the default values. Click [OK].

We are assuming an unlimited water supply, so IRRICAD will work out the pressure and flow required from the water source. If the water supply is limited (e.g., resource restrictions), these would be entered here. See [Figure 4-73](#).

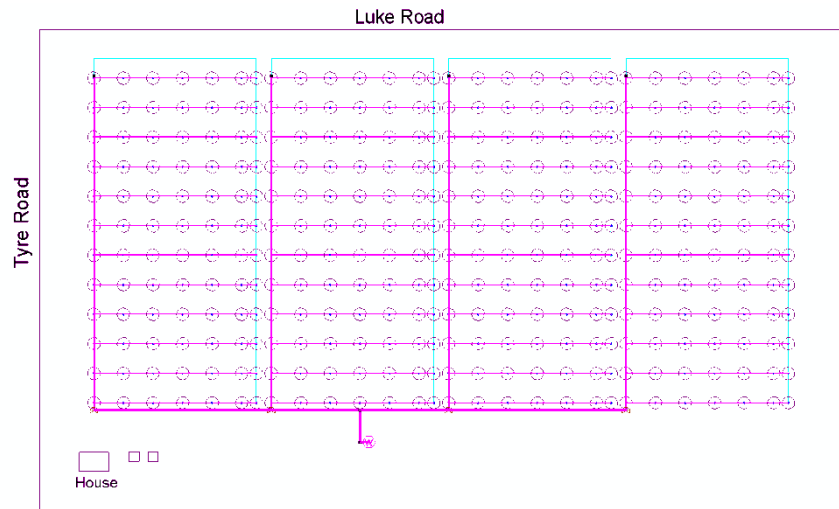


Figure 4-73

1.2.7.6 DESIGNING

Checking Connections

19. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks*.
20. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the center of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

Zone Design

21. Now select *Design|Design Parameters|Analysis Parameters*. At the bottom left of the dialog is a section headed Iterations. In the box titled "Max. for Velocity & LP" is a default of 200. Increase this value to **250** for this exercise. Under normal circumstances, if LP or Velocity Design is having problems solving the design, increase this value by 50 at a time. In *Hydraulic Parameters* check the "Max. Zone Pipe Velocity" is **6.5ft/s (2m/s)**. Click [OK].
22. Before selecting the design process run the Database Editor by clicking on the *Start|All Programs|IRRICAD Pro|Databases*. If the Tutorial database is not your default database, it will not automatically be opened (check the file name at the top of the Database Editor window). If the opened database is not **Tutorial.mdb**, click [Save Changes] and use *File|Open* to open the Tutorial database from in the \\Irricad\\database folder.

23. The first component tab is the **Pipe** tab. Find the **4" (100mm) Class C PVC Pipe** and type **ZM** in the usage column (or highlight the pipe and select **[Edit / View Pipe]**. Select **ZM** from the dropdown list in the "Usage" field). **[Save Changes]** and close the Database Editor.
24. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to **Design|Zone Design Configuration** and simply click **[OK]** on the dialog to clear this). Select **Design|Zone Design|LP Design**. As LP is running, you will see the pipes being selected for the design.

Entering Management Requirements

25. Management data must now be entered. Select **Design|Other Management Options|Zone Operating Times**. Enter the "On Time" for each zone as 5am and the "Off Time" for each zone as 7am (e.g., **1:5:0 - 1:7:0**). Click **[OK]**. This type of management is more commonly used for small irrigation systems that have blocks starting and stopping at different times.

Mainline Design and Finalising the Design

26. Now run **Design|Mainline Design|LP Design**.
27. Use **Select Object** to click on a pipe. Select **Right-click|Object Info**. Check the "Hydraulic Object Info" checkbox. This info gives you the layer the pipe is on, the pipe size and the hydraulic information for the pipe since design has been run. This is a quick summary for the hydraulic object selected. More than one item can be selected at a time; however, there is a limit to how many items **Object Info** can display.
28. Go to **Design|Zone Design Configuration** and enter the "Valve Pressure" as **78psi (55m)** for all zones.
29. Run **Design|Zone Design|Detailed Analysis**.

This will analyze each block without making any changes to the pipe sizes already selected. **Detailed Analysis** uses an iterative process to exactly match the flow of an emitter, sprayline or control valve to the pressure at that point and therefore allows a designer to more accurately gauge how a system would perform in practice. This is especially so when the resulting pressures are substantially different from those specified. In the standard analysis mode IRRICAD uses the selected nominal flows for emitters and spraylines to calculate the flow and resulting pressures in a system. In most circumstances this method is slightly conservative. **Detailed Analysis** gives us a better picture of what is happening at the outlets. Detailed analysis can be used for zone drippers, sprinklers, and spraylines, tapes and also VIH sprinklers in mainline. There is obviously no advantage in running a detailed analysis for systems that only contain pressure compensated emitters. For using **Zone Design|Detailed Analysis**, valve pressures must be specified. For running **Mainline Design|Detailed Analysis**, a water supply pressure must be specified.

30. Re-run **Design|Mainline Design|Analyze**.

1.2.7.7 REPORTING

31. Look at the reports. Useful reports which tell you the basics of what is happening in the system at a glance are the **Reports|Zone Design Reports|Zone Design Summary** and **Reports|Mainline Design Reports|System Duty Report**.

Your Summary Report should look something like Figure 4-66, where each zone flow is approximately 459gpm (104m³/h), the actual outlet pressure variation is 14% and the pressure loss through the valve is 0.

Zone Name : Area no. 1		Valve Description : 4" (100mm) Gate Valve (Flanged)	
Zone Head (D/S) :	74.88 (psi)	Zone Head (U/S) :	74.88 (psi)
Total Zone Flow :	533.38 US gpm	Valve Headloss :	0.00 (psi)
		Allowable Flow	Actual Flow
		US gph	US gph
			(psi)
			(psi)
Minimum Outlet	361.94	362.57	57.03
Maximum Outlet	399.29	387.67	71.12
Outlet Variation (%)	9.35	6.47	19.80
Outlet Locations (X,Y)		Minimum :	Maximum :
		109.7 , -6.1	9.1 , -61.0

Zone Name : Area no. 2		Valve Description : 4" (100mm) Gate Valve (Flanged)	
Zone Head (D/S) :	74.88 (psi)	Zone Head (U/S) :	74.88 (psi)
Total Zone Flow :	533.38 US gpm	Valve Headloss :	0.00 (psi)
		Allowable Flow	Actual Flow
		US gph	US gph
			(psi)
			(psi)
Minimum Outlet	361.94	362.57	57.03
Maximum Outlet	399.29	387.67	71.12
Outlet Variation (%)	9.35	6.47	19.80
Outlet Locations (X,Y)		Minimum :	Maximum :
		219.5 , -6.1	118.9 , -61.0

Figure 4-74

Look at some of the other reports for more results on the system.

To acquire a full costing report, we will want to price all the fittings as well as the design we have just laid out. Select *Design|Computer Selection of Fittings*. IRRICAD will automatically find fittings for the junctions. When this is complete, look at any of the *Costing / BOM Reports* in the *Reports* menu to find any fittings selection errors. Any junctions that could not be solved with the items currently in the database or flagged for usage will be listed at the end of the report.

See the *Correcting Fittings Errors*, Section 1.5.3 to find out how to fix these by updating the database.

1.2.8 RESIDENTIAL DESIGN

This tutorial design involves siting sprinklers in a garden, and connecting them up to a zone control valve and water supply.

1.2.8.1 STARTING THE TUTORIAL

1. The first step is to start a new design. Run IRRICAD or select *File|New*.
2. Now select *Settings|Irrigation - Design Specific* and browse for the database **Tutorial.mdb**. You should find this database in the Irricad\database folder.
3. While in this dialog ensure that the "Create Wetted Radii" checkbox is checked and change the line widths to the following:
 - Laterals: 2
 - Mainline: 4
 - Zone: 3
 - Wire: 1
4. Go to the **Units** tab and click the **[US] ([Metric])** button to restore the default units for this tutorial. These settings can be retained for each design by clicking the **[Save As Default]** button. Select the **Misc.** tab and select the **Small "Design Size"**. Enter the symbol size as **1.7ft (0.5m)**. Click **[OK]**.

1.2.8.2 BACKGROUND INFORMATION

We need to enter some details about the house and garden we are designing the irrigation system for. The L-shaped house is created with rectangles, and has a 5-sided conservatory on one end. We will use a grid to help us position things, though this is optional.

5. Select *Settings|Grid|Origin* and enter the “X” spacing as **16ft (5m)** and the “Y” spacing as **10ft (3m)**. Check the “Display Grid Points” checkbox. In the *Snap* tab select the “Snap to Grid” option. Click [OK]. Select *View|Zoom In* twice.
6. Select *Draw|Polygon|Center* and enter **10** in the “Number of Sides” field. Select “Inscribe” and click [OK]. Click on a grid point in the top left quadrant of the screen and then move the cursor up a grid point and left click. The polygon boundary should cover 3 grid points vertically, one point at the center and one each at the top and bottom of the boundary. Select *Draw|Rectangle|2 Point*. Click on the bottom of the polygon then draw the rectangle up and to the right until it covers 4x3 grid points and is therefore **48x20ft (15x6m)**. Left click.
7. Click on the 2nd to last box on the far right of the Status Bar which currently says “Grid”. This will now change to “Connect” and turn off the Grid at the same time and is the same as changing the “Snap” option in *Settings|Snap* and turning off “Display Grid” in *Settings|Grid|Origin/GIS*.
8. Select *Draw|Rectangle|3 Point*. Select *Right-click|Snaps|Endpoint* then click on the bottom right corner of the rectangle. Now hold the <Ctrl> key down and move the mouse to the left. Let go of the mouse (be careful not to bump it so that the straight line is maintained) and type **23 (7)** and press <Enter>. Move the cursor down and type **23 (7)** and press <Enter>.
9. Because we wish the house and conservatory to be one object, we wish to delete the line where the two rectangles join and the polygon sides inside the rectangle. If we were to select this line or a polygon side, the whole rectangle or polygon would be selected. If we explode the objects we can delete a line at a time as required. Select *Modify|Select|All*. Both rectangles and the polygon should be green in color - meaning they are selected. Now select *Modify|Explode*.
10. Select *Modify|Select Object*. Select the five polygon sides inside the rectangle and the rectangle side inside the polygon by holding down the <Shift> key clicking on them and select *Modify|Delete*. Click [Yes] to confirm deletion of the selected objects.
11. Click on the rectangle line where the rectangles meet (ensure only the short side is selected) and select *Modify|Delete*. Click [Yes] to confirm deletion of the selected objects. One line will be deleted.
12. The second line is the complete side of the horizontal rectangle. Select *Modify|Break*. Click on the line. Select *Right-click|Snaps|Endpoint* and click where the line meets the right-hand side vertical line of the two rectangles. Select *Right-click|Snaps|Intersection* and place the cursor on the inner corner where the second rectangle starts and left click. The line between has been erased. The house should look like [Figure 4-75](#).

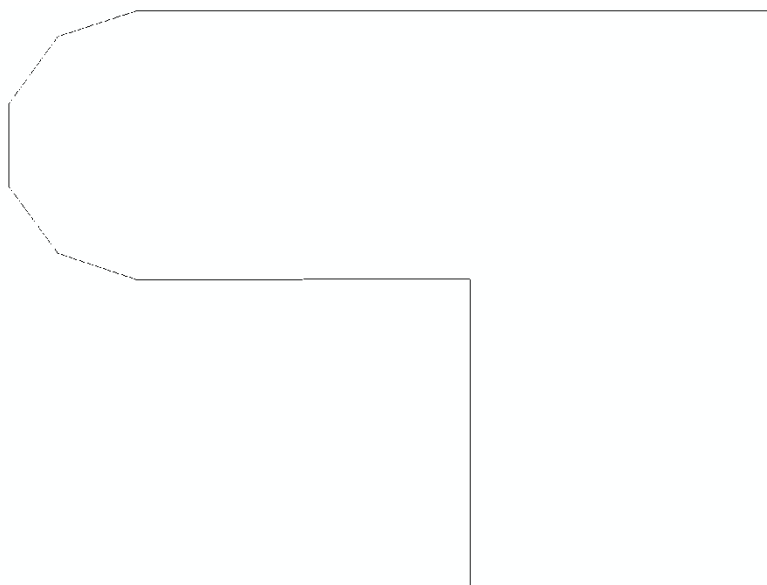


Figure 4-75

The bottom right hand side of the house is a garage. The driveway runs from here straight down to the road. A path continues from the drive up the side of the house to the front door. To draw these items in, we will use a double line for the driveway, and a single line to continue the path.

13. The width of the house at this point is approximately 23ft (7m). The path will be 3ft (1m) wide. Select **Draw|Line|Double**. The “Left Offset” will be **0**; the “Right Offset” will be **26ft (8m)**. Click [OK].
14. Select **Right-click|Snaps|Endpoint**. Place the cursor at the bottom right hand corner of the house, left click and draw the double lines downward. Type **11.5,<270 (3.5,<270)** and press <Enter>. Select **Right-click|Done**.
15. Select **Draw|Line|Single** then select **Right-click|Snaps|Endpoint**. Place the cursor on the top of the left-hand double line you have just drawn and left click. Type **23,<90 (7,<90)** and press <Enter>.
16. A sidewalk runs along the road at the bottom of the drive. Using double lines again, draw a sidewalk 3ft (1m) wide. Select **Draw|Line|Double**, leave the “Left Offset” as **0**, but change the “Right Offset” to **3ft (1m)**, select **Right-click|Snaps|Endpoint**. Place the cursor at the bottom right-hand side of the drive left click and type **6,<0 (2,<0)** and press <Enter>. Select **Right-click|Done**.
17. Now select **Draw|Line|Double** again, and reverse the left and right offsets, making the “Left Offset” **3ft (1m)** and the “Right Offset” **0**. Click [OK]. Select **Right-click|Snaps|Endpoint** and place the cursor at the bottom left-hand side of the drive, left click, type **66,<180 (20,<180)** and press <Enter>. If you cannot move this far to the left without going off the edge of the screen use your mouse wheel to zoom out. Select **Right-click|Done**. Select **View|Zoom All**.
18. Using **Draw|Line|Continuous** specify the property boundary so that it looks like [Figure 4-76](#). Select **Right-click|Snaps|Endpoint**. Place the cursor at the left top of the sidewalk left click and type **69,<90 (21,<90)** and press <Enter>. Now type **98,<0 (30,<0)** and press <Enter>. Select **Right-click|Snaps|Endpoint** then left click near the sidewalk to place the line the sidewalk on the right hand side of the house. Select **Right-click|Restart**. Select **File|Save** and save the design.

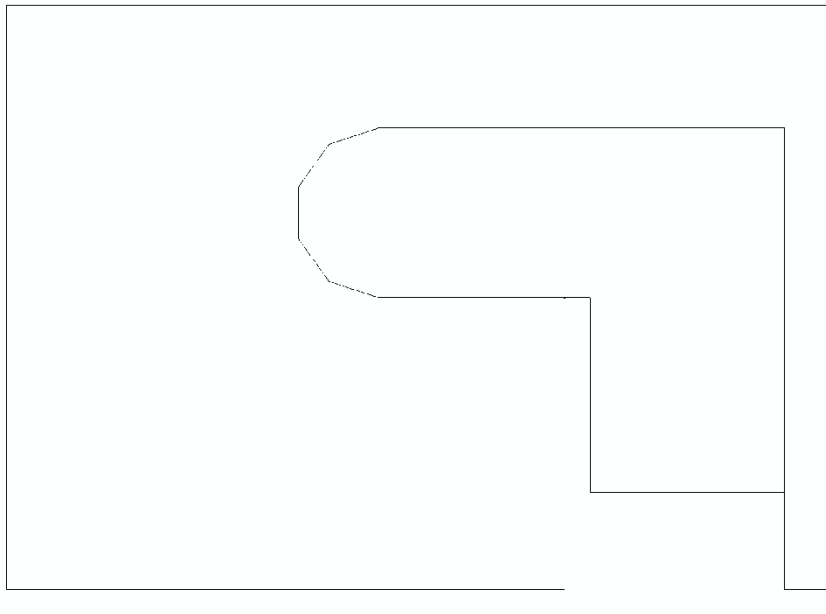


Figure 4-76

19. Along the right-hand side of the house and drive is a row of shrubs. Select **Draw|Symbol**. In the dialog you will see a [Load] button. Click this button and select **BROWN SHRUB** and **BROWN TREE** from the list of symbols (hold the <Ctrl> key down to enable multiple selections). Click [Open]. Ensure that **BROWN SHRUB** is selected. Leave the “Maintain Shape” checked but uncheck the “Dynamically Size” box and enter the “Width” as **5ft (1.5m)**. Click [OK].
20. Move to the bottom right of the property and left click to place a shrub between the house and the boundary. Select **Modify|Copy|Linear** and click on the shrub symbol. Enter **7** as the number of copies and click [OK]. Click the center of the symbol and drag the copies vertically upwards to evenly space them along the boundary next to the house. (You can hold the <Ctrl> key down to achieve a straight line.) Left click to place.

21. Select **Draw/Symbol** and select **BROWN TREE** from the drop down list. Check the "Dynamically Size" box. Click [OK]. Place a tree in the top right corner of the property by clicking on the corner of the boundary, and dragging the symbol size out until it is a suitable size. Left click to place.
22. By using **Draw/Curve/Continuous Bezier** draw a garden area around the bottom and left sides of the property boundary. Make the garden approximately **10ft (3m)** wide. By clicking the cursor on the screen, you can place the curve as required. When finished, select **Right-click/Done**. In the same way, draw a garden area around the conservatory about **7ft (2m)** wide. You will probably find it useful to set the Circular Cursor (**Settings/Cursor** and check the "Display Circle" box) to **10ft (3m)** or **7ft (2m)** respectively as required.
23. Place some **BROWN SHRUB** symbols **3ft (1m)** in size (**Draw/Symbol**), as described above, along the garden boundary parallel with the sidewalk. See [Figure 4-77](#).

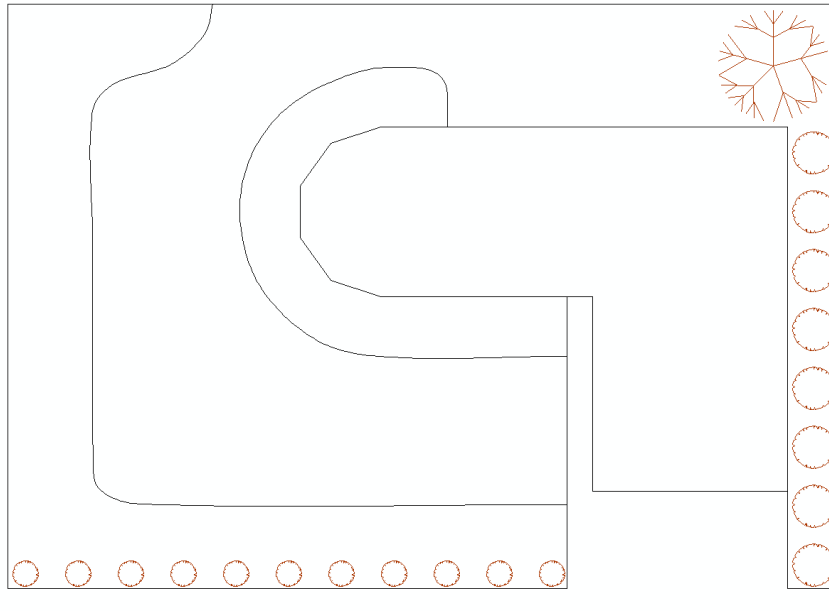


Figure 4-77

1.2.8.3 PLACING SPRINKLERS AND DIVIDING INTO ZONES WITHIN THE AVAILABLE WATER RANGE

The requirements for irrigating the garden involve irrigating the lawn and the garden.

24. To help orientate the sprinklers, select **Zone/Area** and draw two area boundaries, one around each piece of garden. To draw an area place the cursor at a boundary point, left click, then trace over the lines and curves, left clicking where required. Close the area by selecting **Right-click/Close**. Ignore the "Max. Intensity" and "Depth / Volume" values as we are using areas only for orientating arcs. Ensure the "Set Arc Orientation Using Area" checkbox is checked. Click [OK].
25. Select **Zone/Sprayline**. In the Sprinkler edit box, leave the pipe as **Computer Selected** and enter a "Depth" of **12in (300mm)**. Leave the "Scope" and **Design + BOM**. Select the **Garden Spray Sprinkler** from the dropdown list. The default nozzle (**10 garden**) is the only "Nozzle" available with this outlet. Change the "Pressure" to **20psi (14m)**. Note that the "Radius" **10.8ft (3.3m)** will adequately water the garden. Change the "Arc" to **180°**. Do not select a "Riser" for the outlet, as this is optional and not required in this case. Enter the "Outlet Spacing" as **10ft (3m)**. Uncheck the "Connected" box. Click the [Options] button and uncheck the "Fixed Spacing" box so IRRICAD will adjust the sprinklers to fit the required area. Click [OK] on both dialogs.
26. Move to the bottom right corner of garden area, just within the area boundary on the driveway side. Click to place the start of the sprayline. Move just inside the bottom left corner and click again. Go to the top left corner, click and then extend the sprayline along the top boundary about **10ft (4m)**. Click to place, and then select **Right-click/Restart**. If the sprayline is snapping

to the area boundary and the arc is not being orientated to inside the area, select **Right-click|Snaps|Place** before left clicking to place each point inside the area.

27. Place a sprayline around the conservatory garden starting next to the path along the garage, placing the sprayline next to the house, again, just inside the area. Several of the wetted radius arcs of the sprinklers in the conservatory garden do not touch the area. Although this is physically correct since the sprinklers cannot spray water around corners we will change the arcs to make the drawing look better. This is purely cosmetic. Using **Modify|Change** click on an arc that needs changing. Arcs are measured anti-clockwise from the horizontal (0°) so if the start of the arc needs adjusting edit the “**Start Angle**” field. If the end of the arc needs adjusting edit the “**Included Angle**” field. Click **[OK]**. You may need to do this several times to get the arc positioned correctly. Repeat for any other arcs that need adjusting. Your design should look something like **Figure 4-78**.

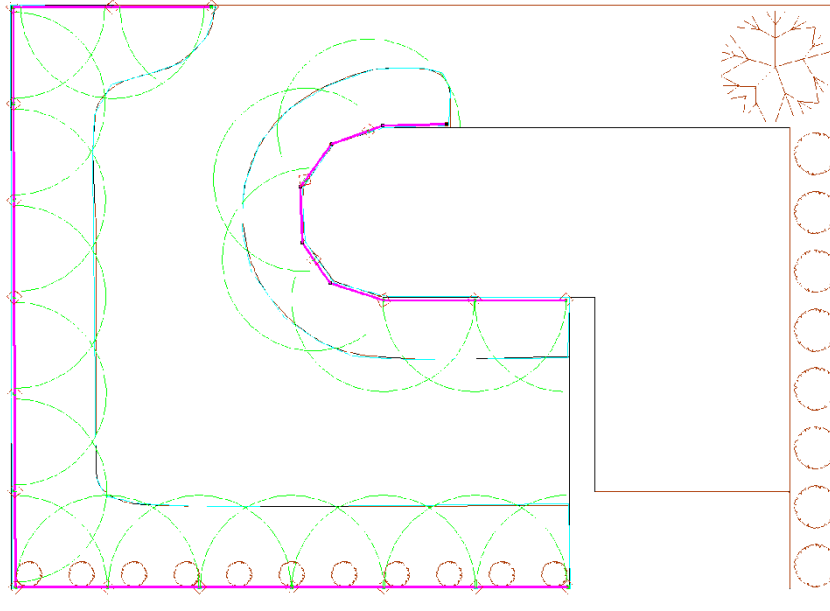


Figure 4-78

28. We are now ready to place the lawn sprinklers. Delete the Areas around the gardens. You can use **Modify|Selection Filter** to do this. Select **Area** as the “**Type**” and check the “**Filter**” checkbox. Select **Modify|Select|All** and press the <Delete> key. Go back to **Modify|Selection Filter** and uncheck the “**Filter**” checkbox.

Note: A shortcut to **Modify|Selection Filter** is to right-click on the last box of the Status Bar (far right). Here you can turn the filter On, Off or adjust the Filter Settings. You can turn the filter off simply by left-clicking on this box and the red fill will disappear – instantly showing you that the filter is no longer on.

29. Select **Zone|Area** and draw an area that will encompass all the lawn area. Check the “**Set Arc Orientation Using Area**” checkbox. Click **[OK]**.
30. Select **Zone|Sprayline**. Leave the pipe as **Computer Selected** and enter a “**Depth**” of **12in (300mm)**. Leave the “**Scope**” and **Design + BOM**. Choose the **Lawn Pop-Up Sprinkler**. Select the **13 “Nozzle”** from the dropdown list and change the “**Pressure**” to **35psi (25m)**. Type in **180°** for the “**Arc**”. Do not select a “**Riser**”. Enter the “**Outlet Spacing**” as **13ft (4m)**. Ensure the “**Connected**” checkbox is unchecked and also the “**Fixed Spacing**” box in the **[Options]** dialog. Click **[OK]**.
31. Draw the spraylines just inside the lawn boundary. Start at the right of the end of the top conservatory garden. Follow the edge of the house, then the right boundary, top boundary and the garden edges (within the Area you have drawn), clicking at each change of direction to place the sprayline. Select **Right-click|Restart** at the top end of the conservatory garden. Delete the pipe back to the last sprinkler (do not do this elsewhere, only back to the last lawn

sprinkler placed). Use **Zone/Outlet** to place a full circle **Lawn Pop-Up Sprinkler** in the center of the larger lawn to ensure good coverage.

32. Adjust any arcs as required. Note, depending on the actual dimension of your design and the placement of the house etc, select outlets with the required radius as needed. If you have a larger area of lawn, select a different nozzle that gives you a larger radius of throw. Note that any outlet can be deleted, placed (select **Zone/Outlet**) or moved to achieve better coverage. See [Figure 4-79](#).

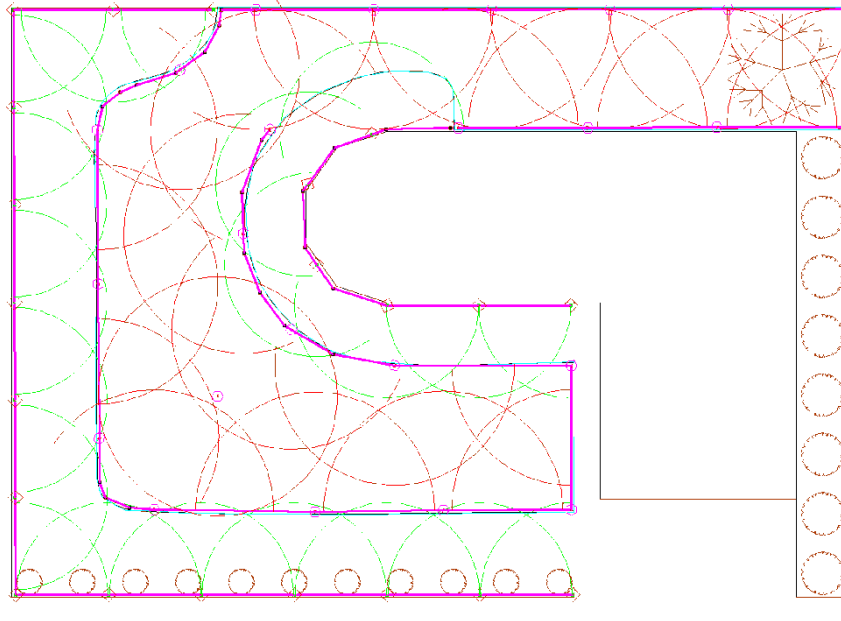


Figure 4-79

33. We wish to place a tape to water the shrubs at the side of the house. The first step is to set up the database to enable the drip tape to be used. Run the IRRICAD Database Editor either from your desktop or from the *Start/All Programs/IRRICAD/IRRICAD Pro Databases*. When the Database Editor has finished loading the current default database, click the **[Save Changes]** button. In the screen that remains, select **File/Open**. Browse for the **Tutorial.mdb** database in the *Irricad/database* folder. Click the **[Open]** button.
34. Now select the **Tapes** tab at the top of the screen. Highlight the **Drip Tape 0.17/100' (1.65lph)** and select the **[Edit / View]** button. Change the "Usage" to **L** and the spacing at the bottom of the dialog from 4.1ft (1.25m) to **1.6ft (0.5m)**. Click the **[Save]** button on this dialog, and then the **[Save Changes]** button on the main dialog. Exit the Database Editor.
35. Select **Zone/Tape** and from the dropdown list select the **Drip Tape 0.17/100' (1.65lph)**. Set the inlet pressure to **14psi (10m)**. Do not check the "Regulated" checkbox as this tape is not pressure regulated at the inlet. Click **[OK]** and draw a tape through the line of shrubs at the right-hand side of the house, from about the middle of the bottom shrub up to the middle of the top shrub. Select **Right-click/Restart**. See [Figure 4-80](#).

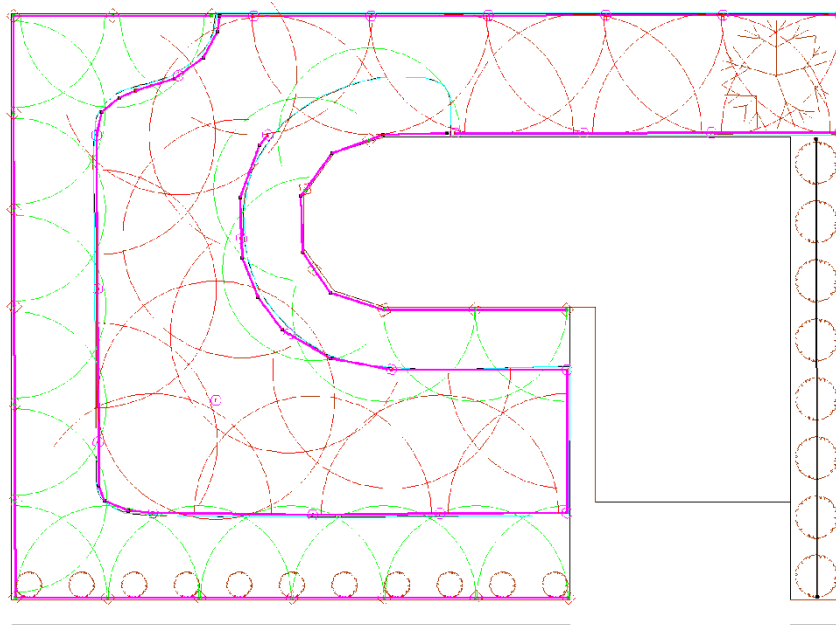


Figure 4-80

36. Select *Zone/Pipe*, and leaving the pipe as **Computer Selected**, enter a “Depth” of **12in (300mm)**. Connect this pipe to the start of the tape and draw it upward to just below the sprayline. Do not connect to the sprayline. You may wish to use *Right-click/Snaps/Place* to avoid connecting to the sprayline.

Because we have a maximum flow rate of 6gpm (1.4m³/h), this limits how many sprinklers we can have running at any one time. Because the garden and lawn sprinkler zones have a water requirement greater than the maximum available flow, we are required to create more zones.

To do this we will be cutting out sections of existing zone pipe, adding control valves and mainline pipes to join to the water source. When we have completed the changes, there will be six zones on this property: The lawn to the right of the water supply, the shrubs with drip tape, the conservatory garden, the front garden piece, the left side garden, and the main lawn piece.

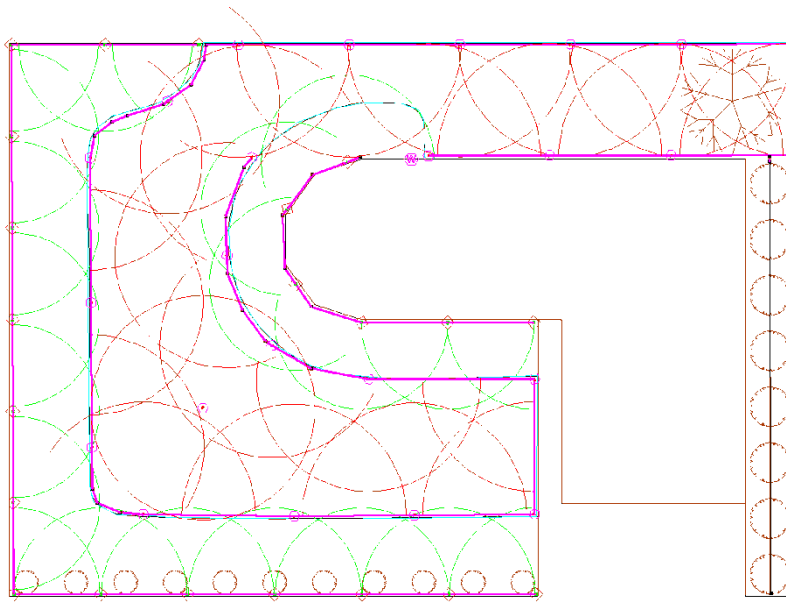


Figure 4-81

37. First we will enter a water supply to signify the tap that will supply the sprinklers. Select *Mainline|Water Supply* and place the water supply on the house wall boundary close to the end of the conservatory garden (see Figure 4-73). In the *Water Supply* dialog enter the "Name" as **Mains Supply 1**, the "Design Head" of **50psi (35m)** and "Maximum Head" as **60psi (42m)**, the "Design Flow" and "Maximum Flow" as **7gpm (1.6m3h)**. Though the tap will be above ground level we have not worried about that in this example.
38. Select *Zone|Control Valve*. Select a **1" (25mm) Electric Valve** from the dropdown list and enter a "Depth" of **12in (300mm)** and click [OK]. Click on the zone pipe end after the top conservatory garden sprinkler to connect the valve.
39. Use *Modify|Select Object* and click on the pipe between the second and third garden sprinkler from the left on the bottom boundary. Press the <Delete> key. Select *Zone|Pipe* and connect a **Computer Selected** pipe at **12in (300mm) "Depth"** to the third sprinkler mentioned above. Extend this pipe approx. **3ft (1.0m)**. Click to place then select *Right-click|Restart*. Select *Zone|Control Valve*. The **1" (25mm) Electric Valve** should still be selected. Place a valve on the end of the pipe you have just drawn as in Figure 4-82.
40. Place another valve at the top of the design on the garden sprayline directly above the valve you have just placed.
41. Now connect two valves to the pipe above the water supply. Place them opposite the water supply, one a little to the left and one a little to the right. Select the piece of pipe between them and delete.
42. Lastly, connect a valve to the top of the pipe connecting to the tape. See Figure 4-82.

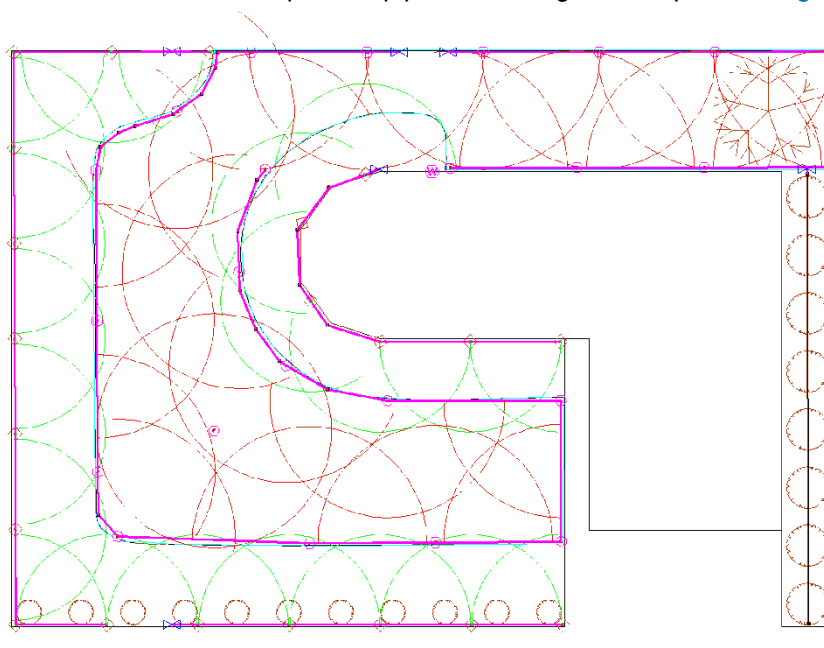


Figure 4-82

1.2.8.4 CONNECTING THE SYSTEM

43. We will now connect the valves with mainline pipes. Select *Mainline|Pipe* and select the **1" Class 125 PVC Pipe** and enter a "Depth" of **12in (300mm)**. Because we know what pipe size we want to use, we have selected it. Click [OK].
44. We need to zoom in near the water supply. Select *View|Zoom Window* and draw a window around the valves near the water supply and the water supply itself. Connect a mainline pipe between the two valves at the top of the design above the water supply by left clicking on them then select *Right-click|Restart*.
45. Left click on the water supply and draw the pipe vertically up to connect to the pipe you have just drawn between the valves. Left click on the pipe then select *Right-click|Restart*. Left click on the valve in the conservatory garden near the water supply and draw the pipe horizontally to connect to the mainline pipe from the water supply. Ensure the pipe does not snap to the center of the water supply itself, as only one pipe can connect to the water supply. If this

happens, select the pipe and delete it. Start again, but this time before connecting to the mainline pipe coming from the water supply use your mouse wheel to zoom in on the water supply. Now connect to the existing mainline pipe. Left click on this pipe then select *Right-click|Restart*. Select *View|Zoom All*.

46. Connect a pipe between the two garden valves at the top and bottom by left clicking on them then select *Right-click|Restart*.
47. Select *View|Zoom Window* and draw a window around the three valves along the top boundary. Tee off the left-hand side vertical mainline pipe by left clicking on it about **1.5ft (0.5m)** below the valve and draw the pipe horizontally to connect to the right-hand side vertical mainline pipe, left click then select *Right-click|Restart*. Select *View|Zoom All*.
48. Select *View|Zoom Window* and drag a window to encompass the water supply and the tape valve. Select *Mainline|Pipe* again and connect to the valve by left clicking on it. Left click again to connect the valve to the mainline pipe above the water supply.
49. There is still an unconnected sprinkler in the middle of the lawn. Due to the water limitation it cannot be attached to any of the other zones. Place a valve on the mainline pipe across from the sprinkler and draw a zone pipe from the valve to connect to the sprinkler. Your garden design should look like [Figure 4-83](#).

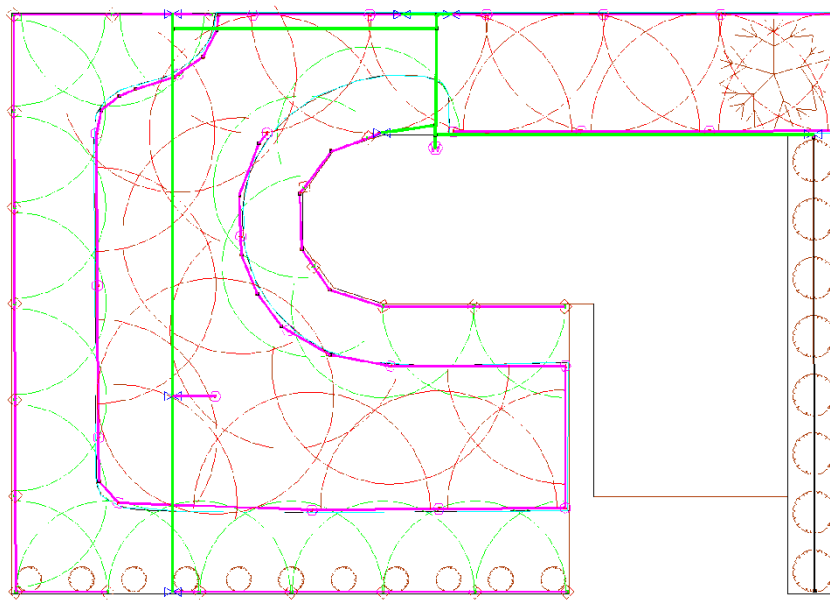


Figure 4-83

1.2.8.5 THE DESIGN PROCESS

Checking Connections

50. First, select *Design|Check Outlet Connectivity*. If everything is connected, proceed with Design. This tool is optional but is recommended for new users and for complex designs. Any unconnected items will be marked with a red cross in a circle. These can be removed by selecting *Design|Clear Connectivity Marks*.
51. If any outlets or control valves are marked as unconnected, check that you cannot see a black junction where the outlet, control valve or water supply connects to the pipes (use *View|Zoom Window* and draw a window where you want to zoom in). If you see a black junction at either of these points, it is because the valve, water supply or outlet is not connected to the pipe. Select the valve, water supply or outlet (*Modify|Select Object* and click on the item) and move the item to the center of the junction (*Modify|Move* and click on the item). The junction will disappear when the item is connected to a pipe. If you are still having trouble with the connection, check that the "Default Snap Mode" in *Settings|Snap* is "Connect". Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.

Zone Design

52. (Due to a minor issue in IRRICAD where, when doing designs back to back in the same session, the valve pressure setting from the previous design will be remembered in the next design first go to *Design|Zone Design Configuration* and simply click [OK] on the dialog to clear this). We wish to size the zone pipes, so select *Design|Zone Design|LP Design*. Look at the *Reports|Zone Design Reports|Zone Design Summary* report to see what is happening in the zones. The results should be similar to Figure 4-84. You will notice that the zone flow for the tape zone is 0m³/hr. This is due to the low flow and the rounding of the numbers in the report. Click the X to close the report window.

Zone Name :		Zone no. 1		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		20.19 (psi)		Zone Head (U/S) :		20.19 (psi)			
Total Zone Flow :		4.20 US gpm		Valve Headloss :		0.00 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		44.92		20.61		***		19.91 20.05	
Maximum Outlet		47.33		50.72		***		21.28 20.30	
Outlet Variation (%)		5.09		59.36		***		6.44 1.23	
Outlet Locations (X,Y)		Minimum :		-12.9 , 91.3		Maximum :		-20.0 , 97.4	

Zone Name :		Zone no. 2		Valve Description :		1" (25mm) Electric Valve			
Zone Head (D/S) :		20.03 (psi)		Zone Head (U/S) :		20.03 (psi)			
Total Zone Flow :		3.12 US gpm		Valve Headloss :		0.00 (psi)			
		<u>Allowable Flow</u>		<u>Actual Flow</u>		<u>Allowable Pressure</u>		<u>Actual Pressure</u>	
		US gph		US gph		(psi)		(psi)	
Minimum Outlet		41.53		20.65		***		19.91 20.05	
Maximum Outlet		43.75		41.90				21.28 20.14	
Outlet Variation (%)		5.09		50.71		***		6.44 0.46	
Outlet Locations (X,Y)		Minimum :		-12.9 , 81.0		Maximum :		-26.1 , 81.0	

Figure 4-84

53. When you are happy with the zone design results and do not need to make any changes run *Detailed Analysis*. In order to run *Zone Detailed Analysis* first set the valve pressure via *Design|Zone Design Configuration*. In the "D/S Valve Pressure" column enter the pressure stated in the "Actual Valve Pressure" column. Now run *Design|Zone Design|Zone Detailed Analysis* to finalise the zone design results. Check the Zone reports.

Entering Management Requirements

54. Now select *Design|Assign Each Zone to a Unique System Flow* and check that there are 7 system flows and each zone is operating on a separate system flow, like Figure 4-85 shows. Click [OK].

Assign System Flows to Zones

Operating Times (day:hour:min)

Number of System Flows:

	System Flow Name	On	Off
1	System flow - 1	1:0:0	1:1:0
2	System flow - 2	1:1:0	1:2:0
3	System flow - 3	1:2:0	1:3:0
4	System flow - 4	1:3:0	1:4:0
5	System flow - 5	1:4:0	1:5:0
6	System flow - 6	1:5:0	1:6:0
7	System flow - 7	1:6:0	1:7:0

System Flows Zone Operates On

	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Zone no. 001	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Zone no. 002	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Zone no. 003	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Zone no. 004	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Zone no. 005	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Zone no. 006	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Zone no. 007	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OK Cancel

Figure 4-85

Mainline Design

55. Now select *Design/Mainline Design/Analyze* to analyze the mainline pipes.
56. To have IRRICAD select fittings for the design, select *Design/Computer Selection of Fittings*. Select a *Costing / BOM Report* to view any fitting selection errors. For information on how to fix fittings selection errors, see [Correcting Fittings Errors, Section 1.5.3](#).

1.2.9 WHEEL LINE DESIGN

This tutorial explains how to configure IRRICAD to design a Wheel Line irrigation system with a complete bill of materials.

The IRRICAD functions in this type of design include:

- Spraylines
- Database assemblies
- Demand points
- Assign system flows in management

An understanding of these functions is necessary for this exercise. If you are not familiar with these functions, please read the relevant sections of the on-line help (*Help/Help Topics*).

This example will go over the design of a typical quarter mile (400m) wheel line.

1.2.9.1 OVERVIEW

An example wheel line system is shown in Figure WL1. In IRRICAD the wheel line is entered in the Zone layer as a control valve and the idle hydrants are entered as demand points in the Mainline layer. Each hydrant becomes a zone. If a system has two wheel lines, they would both be entered as spraylines and there would be two active hydrants. See [Figure 4-86](#).

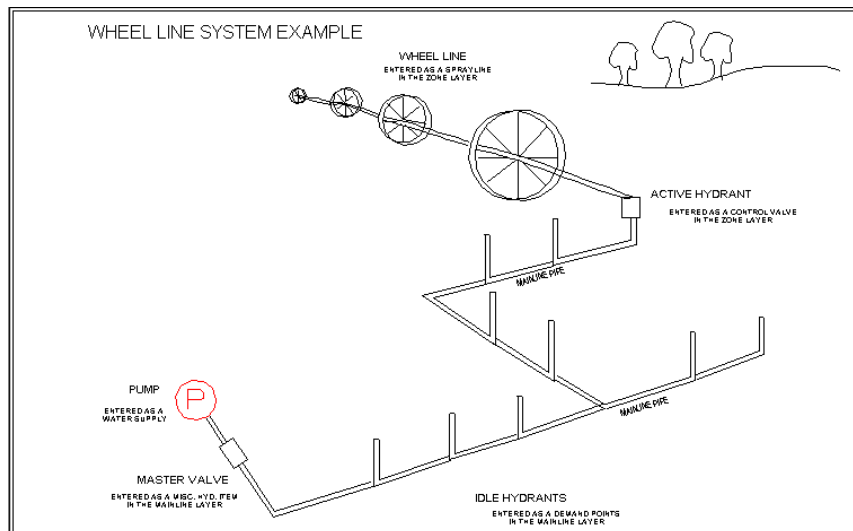


Figure 4-86

The *Assign Zones ...* option in the *Design* menu is used to tell IRRICAD which zones will operate together. Any combination of hydrants can be analyzed.

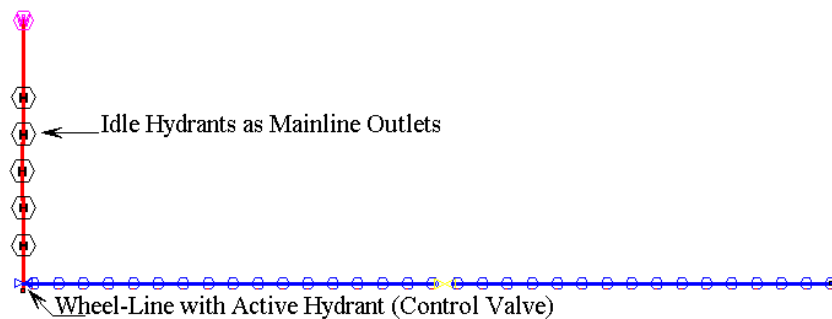


Figure 4-87

The layout of the typical quarter mile (400m) wheel line that will be used for this exercise is shown in [Figure 4-88](#).

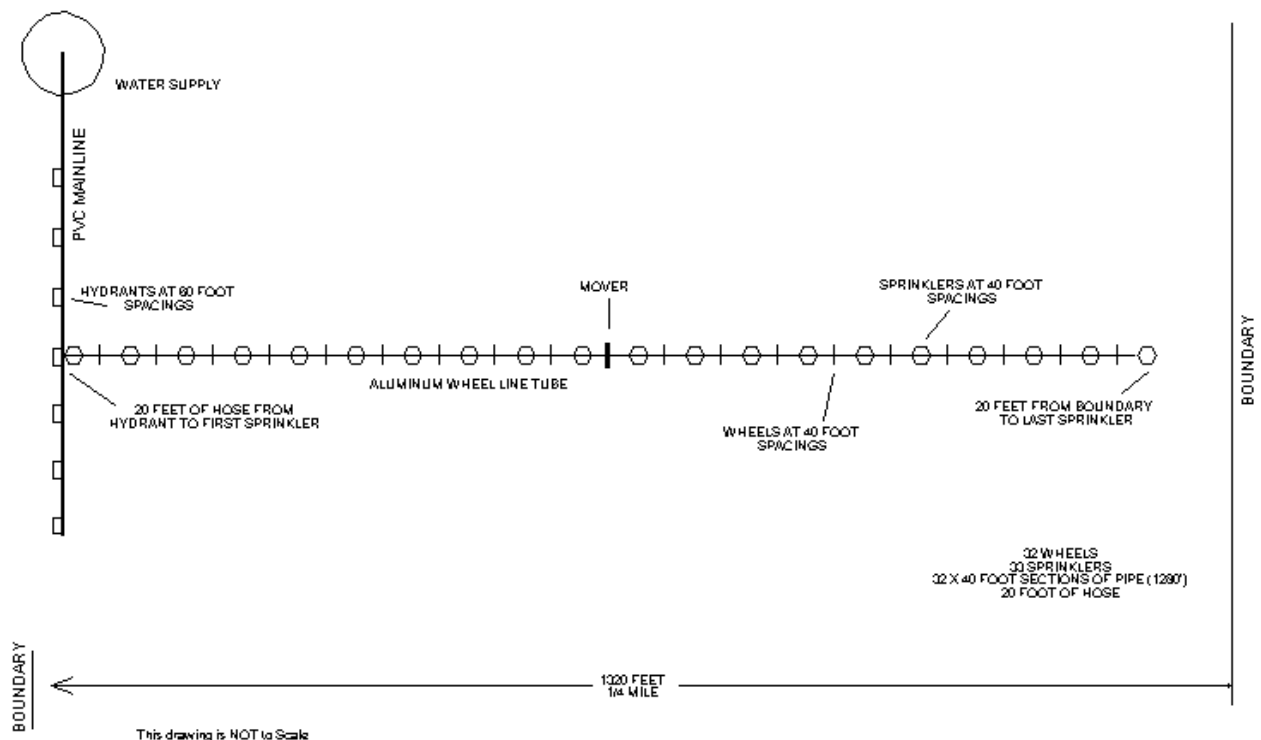


Figure 4-88

1.2.9.2 STARTING THE TUTORIAL

1. Run IRRICAD or start a new design by selecting *File/New*.
2. Go to the **Units** tab and click the **[US]** (**[Metric]**) button to restore the default units for this tutorial. These settings can be retained for each design by clicking the **[Save As Default]** button. Select *Settings/Miscellaneous*. Select the **Medium "Design Size"**, which will change the "Base Database Symbol Size" to **16.4ft (5m)**. Click **[OK]**.
3. Select *View/Zoom Out* twice to ensure that the sprayline can be entered in one action.

1.2.9.3 PLACING THE WHEEL LINE

4. Select *Settings/Irrigation Items - Design Specific*. Ensure the "Create Wetted Radii" and "Create Sprayline Outlets" check boxes are checked. Click **[OK]**.
5. Select *Zone/Sprayline*. Select the **4" (100mm) Aluminum Wheel Line Tube** from the list of pipes by pressing the down arrow, moving the cursor down the list and clicking the left mouse button when the required item is highlighted. Uncheck the "Computer Sized" check box and leave the "Depth" at **0**.
6. For the "Sprinkler", select the **Impact Drive Sprinkler** from the dropdown list. Now select the **5/32 IMPACT 360 "Nozzle"** from the nozzles that are associated with this sprinkler. Enter the "Pressure" as **50psi (35m)** as in Figure 4-89.
7. Select the **Wheel Line Sprinkler Riser Assembly** as the "Riser". Now type in **40ft (12m)** for the "Outlet Spacing" and leave the "Offset" as **0**. Leave the "Connected" check box as checked.
8. Now click the **[Options]** button at the bottom of the dialog. In the next dialog, leave the "Layer" as <DEFAULT> and change the "Line Width" to **2**. Leave the "Orientation" as **0** and ensure that the "Fixed Spacing" check box is checked. Click **[OK]** on both dialogs.

Zone Sprayline

Pipe Properties

Pipe: 4" (100mm) Aluminum Wheel Line Tube

Depth: 0 in

Scope: Design + BOM

☐ Computer Sized

☐ Permanent Junctions

Sprinkler: Impact Drive Sprinkler

Nozzle Properties

Nozzle: 5/32 IMPACT 360

Pressure: 50 psi

Radius: 49.3803 ft

Flow: 301.13 US gph

Intensity: 0.0630593 in/h

Arc: 360 *

Riser: Wheel line sprinkler riser assembly *

Sprayline Properties

Outlet Spacing: 49.3803 ft

Offset: 0 ft

☒ Connected

OK Cancel Options Show Fittings

Figure 4-89

9. Move your mouse to the far right of the screen about half way up. Place the start of the wheel line by clicking the left mouse button. Move the mouse horizontally across the screen and watch the distance at the bottom of the screen. When d= **1298ft (396m)** position the other end of the wheel line by clicking the left mouse button, and then selecting **Restart** from the **Right-click** menu.

The distance of 1298ft (396m) is significant. It can be anywhere between 1290ft (393m) and 1300ft (397m) but must not be greater than 1300ft (397m) or less than 1280ft (390m). The reason for this is that aluminum pipe is in 40ft (12m) lengths and there will be 1280ft (390m) in this design. There is normally 20ft (7m) of hose from the hydrant to the wheel line so the total length is about 1300ft (397m). This hose is not drawn on the plan, but is included in an assembly. If you draw the wheel line in at 1298ft (396m), the plan will show pipe from the sprinkler to the hydrant. IRRICAD will round this distance up to 1300ft (397m) in the bill of materials and we will use **Show Fittings** to add in -20ft (-7m) to trim it back to the required 1280ft (390m). This makes the plan look right and the bill of materials right.

10. The wheel line with sprinklers is now drawn on the screen. Use **Reports>Show Flow** to confirm the flow rate. Select **Reports>Show Flow** then draw a lasso around the wheel line by left clicking near one end then moving near the other end and left clicking again then moving down / up and left clicking then to near the first point and left clicking then selecting **Right-click/Close**. There should be 33 outlets and a flow of about 165gpm (37.5m³/h). Click the **Close** button to close the dialog.

1.2.9.4 PLACING THE HYDRANTS

11. To place the hydrant on the end of the wheel line select **Zone/Control Valve** and select the **Wheel line 4" (100mm) active hydrant assembly**. Leave the "Orientation" and "Depth" as 0. Click [OK]. Place the control valve on the left hand end of the wheel line by left clicking the mouse and give the zone a "Name" such as **Active Hydrant 1**.
12. The other idle hydrants will be spaced 60ft (18m) apart on a mainline. These hydrants are entered in the mainline layer as demand flows. To make it easier to place them 60ft (18m) apart a grid can be set up. We need to align the grid with the hydrant valve. Place the cursor exactly on the valve and note down the coordinates (x,y =) displayed on the status bar. Select **Settings/Grid / Origin** and enter the "X" and "Y" spacings as **60ft (18m)**. Check the "Display Grid Points" check box. Enter the "X" and "Y" "User Origin" as the coordinates of the hydrant valve. In the **Snap** tab select the "Snap to Grid" option. Click [OK].
13. Select **Mainline/Outlet** and find the **Demand Flow "Sprinkler"** in the drop down list. Select it and change the "Pressure" to **58psi (40.8m)** and the "Flow" to **165gpm (37.5m³/h)**. Select a **Capital H** for the hydrant "Symbol". These are the pressures and flows that you want available in the mainline at the hydrants. The pressure is an upstream pressure not a downstream pressure. A pressure of 58psi (40.8m) will allow for any losses through the hydrant and still give adequate pressure at the start of the wheel line. The pressure that you set here is really up to you, but on flat ground it should be higher than the sprinkler pressure that you have set in the sprayline.
14. Select the **Wheel line 4" (100mm) idle hydrant riser assembly** in the "Riser" field. Leave the "Orientation" as 0, and click [OK].
15. Now position your mouse on one grid point above the wheel line hydrant by left clicking. Because mainline outlets are valve-in-head sprinklers, you will be asked to enter a zone name. Enter a zone name such as Idle Hydrant 1. Move one grid point above that one and place another hydrant (Idle Hydrant 2).

1.2.9.5 PLACING THE MAINLINE AND WATER SUPPLY

16. Select **Mainline/Water Supply** place on the screen two grid points above your top hydrant with a left click. Leave the water supply data as the default. Click [OK].
17. Select **Settings/Snap** and turn off the "Snap to Grid" option by selecting "Connect". Click [OK].
18. Select **View/Zoom Window** and draw a window around the water supply and the hydrants. Select **Mainline/Pipe**. Leave the selected pipe as **Computer Selected** and the "Depth" as 0. Click [OK] and go to the water supply on the screen.
19. Connect the pipe to the water supply and to all the hydrants by left clicking the mouse each time the pipe passes over a hydrant, and draw a straight line through all the hydrants ending with the active hydrant. Connect about 10ft (3m) of mainline pipe past the last hydrant. This will allow IRRICAD to tee the mainline into the last hydrant rather than elbow into it. Select **Right-click/Restart**. See [Figure 4-90](#).



Figure 4-90

1.2.9.6 THE DESIGN PROCESS

20. Select *Design/Check Outlet Connectivity*. IRRICAD checks to ensure that outlets are connected to a water supply.
21. Now select *Design/Zone Design Configuration*. In the far column set all the “Valve Pressures” to **58psi (40.8m)**. This means you are fixing the valve pressures rather than letting them find their own levels. Click [OK].
22. Select *Design/Zone Design/Analyze*. You set the sprayline to **4" (100mm) Aluminum pipe** so you just have analyzed it rather than computer size the pipe.
23. Select *Design/Assign Each Zone to a Unique System Flow*. You have placed 6 hydrants in total so there will be 6 system flows. Each hydrant will operate on its own. IRRICAD automatically gives each system flow one hour and assigns each hydrant to its own system flow as in [Figure 4-91](#). Leave the times at one hour. Click [OK].

Operating Times (day:hour:min)			
	System Flow Name	On	Off
1	System flow - 1	1 : 0 : 0	1 : 1 : 0
2	System flow - 2	1 : 1 : 0	1 : 2 : 0
3	System flow - 3	1 : 2 : 0	1 : 3 : 0
4	System flow - 4	1 : 3 : 0	1 : 4 : 0
5	System flow - 5	1 : 4 : 0	1 : 5 : 0
6	System flow - 6	1 : 5 : 0	1 : 6 : 0

System Flows Zone Operates On														
	Zone Name	B	C	D	E	F	G	H	I	J	K	L	M	
1	Zone no. 1	1	0	0	0	0	0	0	0	0	0	0	0	0
2	Zone no. 2	2	0	0	0	0	0	0	0	0	0	0	0	0
3	Zone no. 3	3	0	0	0	0	0	0	0	0	0	0	0	0
4	Zone no. 4	4	0	0	0	0	0	0	0	0	0	0	0	0
5	Zone no. 5	5	0	0	0	0	0	0	0	0	0	0	0	0
6	Zone no. 6	6	0	0	0	0	0	0	0	0	0	0	0	0

Figure 4-91

24. Lastly select *Design/Mainline Design/LP Design*. The pipes are now sized and analyzed.
25. Zoom into the end of the mainline by selecting *View/Zoom Window* and dragging a window around the area including the end of the mainline. Notice that the piece of pipe past the last hydrant has not been sized. IRRICAD will not size pipes with zero flow. Select *Modify/Select Object*. Now click on the piece of pipe that has not been sized. Select *Modify/Change* and change the pipe to the same as the sized mainline (**4" Class 125 PVC Pipe**). Click [OK].
26. Select *View/Zoom All*. Now select *Zone/Misc. Hydraulic* and find the **Wheel Line Mover assembly** in the dropdown list. Click [OK]. Select *View/Sprayline Outlets*. Place the misc. hydraulic item on the wheel line between two sprinklers half way along the sprayline.
27. Since some changes have been made, the hydraulics need to be recalculated. Select *Design/Zone Design/Analyze*. Now run *Mainline Design/Analyze*.
28. To look at the pressures and flows in the system, look at the Design reports. Select *Reports/Mainline Design Reports/System Duty*, which will show you the pressure and flow required from the water supply to met each system flows needs. The *Reports/Zone Design Reports/Zone Summary* report will show you the minimum and maximum pressures in the wheel line and also the pressure loss through the hydrant. Close the reports by clicking on the X.
29. The *Reports/Zone Design Reports/Zone Design Full* report gives a more detailed list of pressures and flows in the wheel line. Scroll down in this report until you find the section titled Spraylines and Tapes. Notice on the far right the O/Loss is listed. This is the pressure that is caused by the factors set up in the Wheel line sprinkler riser. Remember the sprinkler is 3½ft

(1m) off the ground and the riser loss was equivalent to 5ft (1.5m) of ½" (12mm) pipe. Close this report and look into as many other reports as you like.

1.2.9.7 COMPUTER SELECTION OF FITTINGS

30. Select *Design|Computer Selection of Fittings*. When that is complete, select *Modify|Change* and by clicking on junctions and clicking on the **[Show Fittings]** button check to see what fittings are used. Close dialogs by clicking on **[Hide Fittings]** and **[Cancel]**. To correct the length of aluminum tube listed click on one of the two spraylines, click **[Show Fittings]** and **[Add]**. Select the **4" (100mm) Aluminum Wheel Line Tube** from the list of pipes by clicking on the left most (number) column or by clicking on the description column then clicking **[Select]**. Click **[Close]**. The fitting will be added to the list of fittings for the sprayline with a quantity of 3.28ft (1m). Click on the "Quantity" and change it to **-20ft (-7m)** and click **[Hide Fittings]**. You will get a warning message that the quantity is less than the recommended minimum because quantities are usually greater than 0. Click **[Yes]** to continue and **[OK]** to close the junction dialog. See the notes under [Placing the Wheel Line, Section 1.2.9.3](#) for an explanation. Look at a BOM report.

1.2.9.8 DATABASE ITEMS

Database assemblies play a key role in this type of design. There are five assemblies in this example. They are listed below.

Wheel line sprinkler riser assembly

Outlet Connector component database:

Item	Database	Part Number	Qty
Sprinkler leveler	Miscellaneous	L-75	1
Leveler elbow	Miscellaneous	SLE 1-12S	1
4" (100mm) Band-lock set	Couplers	58-4FWTD	1
76" (1930mm) wheel 4" hub	Miscellaneous	27-4-76	1

Inlet connection details	NONE, 1.00" (25mm)
Outlet Connection details	F T, 0.75" (18.75mm)
Height Above Ground	3.5' (1.05m)
Equivalent length diameter	0.50" (12.5mm)
HL equivalent length	5.00' (1.5m)
Leave the plotting symbol blank	
Usage Code	Y

The sprinklers on a wheel line are approximately 3.5ft (1.05m) above the ground. IRRICAD will take this into account when it determines pressures. To allow for the friction loss in the leveler and leveler elbow, an equivalent length and equivalent pipe diameter are used. If a 5gpm (19lph) nozzle is used, the friction loss that IRRICAD will calculate using the equivalent of 5ft (1.5m) of ½" (12mm) pipe is approximately 2psi (1.4m).

Wheel line 4" idle hydrant assembly

Outlet Connector component database:

Item	Database	Part Number	Qty
4" (100mm) Al hydrant valve	Valves	7-4 PT	1
4" (100mm) Class 160 PVC pipe	Pipe	4 160 SW	0.91m
4" (100mm) PVC male adapter	Coupler	436-040	2

Note: Though can enter a length of pipe in an assembly in feet if you have selected US units, the assembly itself will display the length in meters, e.g., if you had entered 3' of PVC pipe, 0.9144m will be displayed as present in the assembly.

Inlet connection details	NPT M T, 4.0" (100mm)
Outlet Connection details	NONE, 4.0" (100mm)
Height Above Ground	0.00
Equivalent length diameter	0.00
HL equivalent length	0.00
Leave the plotting symbol blank	
Usage Code	Y

Wheel line 4" active hydrant assembly

Valves component database:

Item	Database	Part Number	Qty
4" (100mm) AI hydrant valve	Valves	7-4 PT	1
4" (100mm) AI valve opener	Valves	3-6-4 EH	1
4" (100mm) Class 160 PVC pipe	Pipe	4 160 SW	0.91m
4" (100mm) PVC male adapter	Coupler	436-040	2
4"x20' (100mm x 6.1m) hose	Miscellaneous	49-20-4 CD	1
4" (100mm) female end adapter	Coupler	58-5-4 PRF	1

Inlet connection details	NPT M T, 4.0" (100mm)
Outlet connection details	ALUM F S, 4.0" (100mm)
Headloss constant	0.002579
Headloss index	1.17682

The headloss constant and index were calculated using IRRICAD's curve fitting utility. The flows and pressure losses used are listed below. The pressure losses include the losses in the hydrant, valve and hose.

PSI Loss	Flow gpm
2.2	164
4.0	230
6.4	300

Wheel line Mover assembly

Other Hydraulics component database:

Item	Database	Part Number	Qty
Mover 70-76	Miscellaneous	70-76	1
Plastic engine cover	Miscellaneous	70-404	1
4" (100mm) hub adapter set	Coupler	70-11-4	1
1" ZAMAC plug	Coupler	11503	1
76" (1930mm) wheel 4" hub	Miscellaneous	27-4-76	3

Inlet connection details	ALU F S, 4.0" (100mm)
Outlet connection details	ALU F S, 4.0" (100mm)

Wheel line 4" plug assembly

Couplers component database:

Item	Database	Part Number	Qty
4" (100mm) end plug	Coupler	59-5PRM	1
Wheel line Band-lock	Miscellaneous	58-2-2S	1

The reason for the assemblies are as follows:

The wheel line is set up using *Zone/Sprayline*. A sprinkler is selected from the Outlet component database, e.g., the **Impact Drive Sprinkler**. The **Wheel line sprinkler riser assembly** is then selected from the Outlet Connections component database. This means that for every sprinkler, a leveler, elbow, band-lock coupler and wheel are included.

The idle hydrants are laid out in the mainline layer by selecting a demand flow from the Outlets component database. The riser to that demand flow is then selected from the Outlet Connections component database. Selecting the **Wheel line 4" idle hydrant assembly** will ensure that for every idle hydrant a 4" (100mm) hydrant valve, 3ft (0.91m) of 4" (100mm) PVC pipe and 2 PVC male adapters are included.

At the upstream end of the wheel line a zone valve is positioned. The **Wheel line 4" (100mm) active hydrant assembly** should be selected for this valve. This ensures the valve opener, hose and fittings listed above are included.

The **Wheel line Mover assembly** is selected and positioned mid way along the wheel line. Note the assembly has only three wheels when the mover actually requires four wheels. This is because the mover displaces one wheel on the wheel line so the total in the bill of materials will be four.

IRRICAD will look for an end cap for the aluminum pipe during Computer Selection of Fittings. The **Wheel line 4" (100mm) plug assembly** will be selected and it will include the 4" (100mm) end plug and the band-lock.

1.3 PRINTING USING PLOT LAYOUTS

This is a simple tutorial to explain how to prepare your design ready for printing.

For this example we will use the [Micro Irrigation Design, Section 1.2.6](#)

1. Complete the tutorial if you have not done so already. Open the completed tutorial by using [File/Open](#) and browsing for a design file.
2. Select [Settings/Design Details](#). Enter the appropriate details in the edit boxes e.g., your Company Name, Site, Date, Designer Name, and Client Name, etc. Then go to the Client and Company tabs as required. Click [\[OK\]](#).
3. Select [Draw Plot Layout](#). The printer and paper size is set to the defaults. Click the [\[Printer\]](#) button on the bottom left of the dialog and select the printer you wish to print to from the dropdown list. Click [\[OK\]](#).

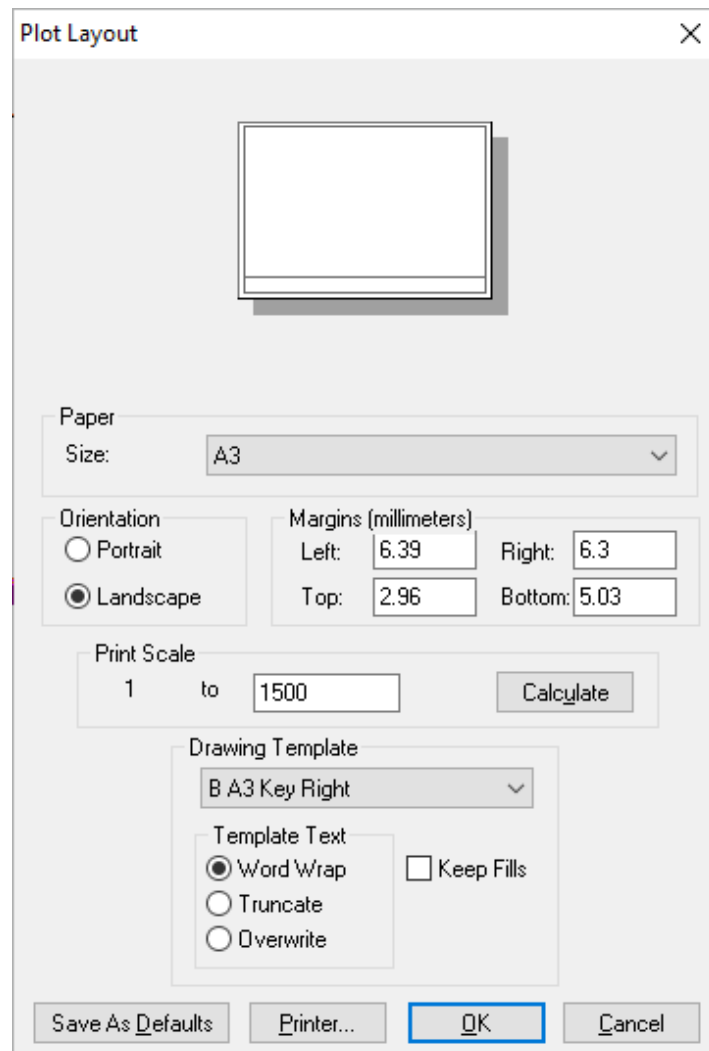


Figure 4-92

4. Select B (A3) as the paper size from the dropdown list if your printer will allow. Otherwise select A (A4) or C (A2) size paper. Select the paper source, e.g., Upper Tray. Select **Landscape** as the required "[Orientation](#)".
5. The default margins indicate the smallest margin physically possible for the printer to print on to. Leave the margins as the defaults.
6. Enter a print scale or click the [\[Calculate\]](#) button (scale is calculated on the current zoom).

7. Select a **"Drawing Template"** from the dropdown list. Selected the **"B A3"** templates for the B (A3) paper size. For A (A4) size paper select the **"A A4"** templates and for C (A2) size paper select the **"C A2"** templates. In general, you should always select a template to match the selected paper size. For this tutorial select the **B A3 Key Bottom** template. Your dialog should look like [Figure 4-92](#).
8. Click the **[OK]** button. The plot layout will be created at the specified scale.
9. Look at the plan with the layout. You will notice that details such as Company Name, Site, Client Name, Designer Name, Date, Scale and Design No (or Name) are present in the title block of the plot layout.
10. If you wish to center the layout on the design, select the border of the layout using **Modify/Select Object** and then select **Modify/Move** and position the layout correctly.
11. You are now ready to print. Select **File/Print**. The **Print** dialog will remember the settings from the **Plot Layout** dialog so you should not have to edit anything.

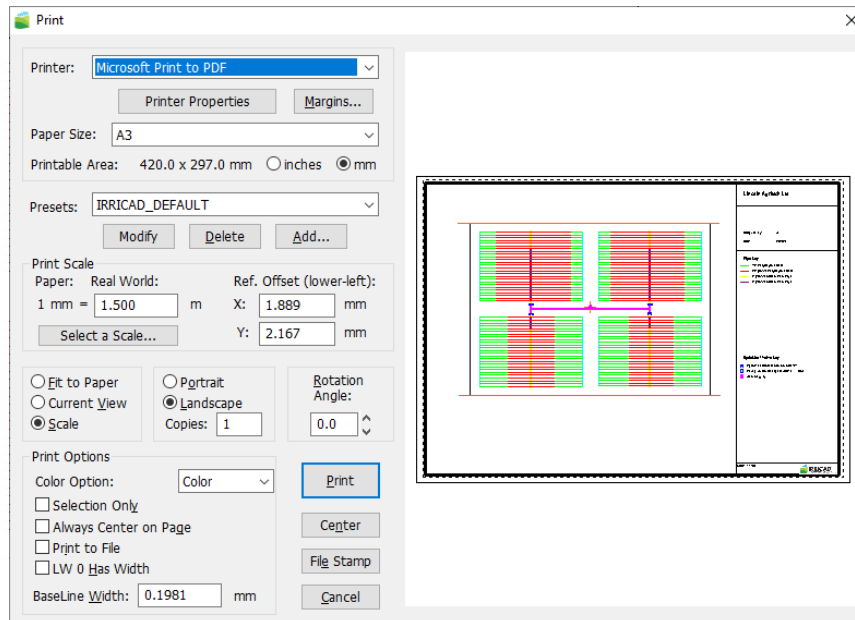
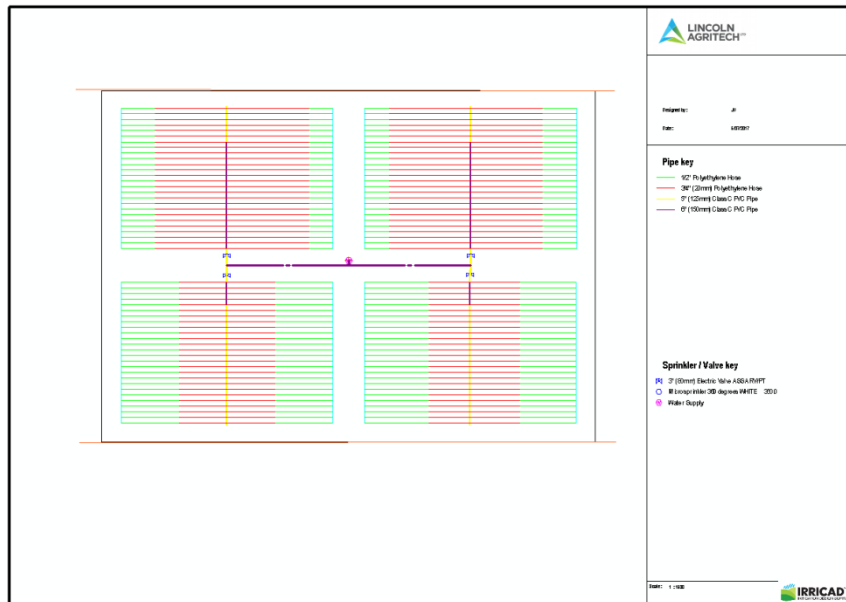





Figure 4-93

12. You may need to center the layout on the printable page. You can click the **[Center]** button or drag the print preview until positioned properly. Click the **[Print]** button.

The legend will itemize and display every unique item:



Sprinkler / Valve key

-  **3" (80mm) Electric Valve**
-  **Microsprinkler 360 degrees WHITE 360.0**
-  **Water Supply**

Pipe key







-  **1/2" Polyethylene Hose**
-  **3/4" (20mm) Polyethylene Hose**
-  **3" (80mm) Class C PVC Pipe**
-  **4" (100mm) Class C PVC Pipe**
-  **5" (125mm) Class C PVC Pipe**
-  **6" (150mm) Class C PVC Pipe**

Figure 4-94

1.4 MAINLINE DESIGNS

A mainline design can be any pipe delivery system from a rural water supply, stock water reticulation, etc. The difference between a mainline design and the designs we have looked at previously is that a mainline design has the valve and outlet in one. Normally a system is laid out with a water supply, some mainline pipe, control valves, some zone pipe and then zone outlets, where the control valves are the connection between zone and mainline items and the on / off control for each zone. In a mainline design we have a water supply, mainline pipe and mainline outlets. Each mainline outlet is seen by IRRICAD as a valve-in-head outlet – i.e. has its own on / off control. Therefore each mainline outlet is the zone and control valve all in one. The principles behind IRRICAD design have not changed; it is simply that the zone items and control valve are condensed into one object.

In terms of the designs and analysis of a mainline design, zone design is still required before running mainline design options.

These tutorials assume you have completed at least the Basic Start chapters and the Simple Design Tutorials. These tutorials assume you know how to select items, connect items, and select the working database and the units of preference.

In a mainline design the best report to view for the valve-in-head outlet/valve is the [Mainline Summary Report](#).

1.4.1 USING DEMAND POINTS

Demand points are used most often in mainline designs. The common use of demand points may be in large golf designs where it is known how much pressure and flow is required at certain points, or large agricultural designs where a hydrant is required to have a specific pressure and flow.

The screenshot shows the 'Zone Outlet' dialog box with the following settings:

- Drawing Properties:** Layer is set to '<DEFAULT>'.
- VIH Name:** An empty text field.
- Sprinkler:** Set to 'Demand Flow'.
- Nozzle Properties:**
 - ☒ Flow (selected), ☐ App Rate
 - Pressure: 35 m
 - Flow: 5 m³/h
 - Symbol: Blank
- Riser:** Set to 'No Component Selected'.
- Orientation:** 0 °
- Scope:** Set to 'Design + BOM'.
- Buttons:** OK, Cancel, Fittings, a lock icon, and Attributes.

Figure 4-95

Demand points are only useful if you know the pressure and flow required at a particular point. Demand points can be used to make a quick mainline analysis. A hydraulic analysis is only as correct as the information you put in.

Demand Points have no Pressure/Flow relationship and are simply going to supply the pressure and flow you put in, with the limits set in the database for that particular demand point.

Therefore there is no advantage in running *Detailed Analysis* to ascertain the actual flow based on the incoming pressure. This can be quite critical for some designs particularly if the water supply pressure (either specified or calculated where more than one zone is operating at a time) exceeds the minimum required pressure for non-pressure compensating emitters.

1.4.2 A QUICK RURAL WATER SUPPLY

1. Double click on the IRRICAD desktop icon or select *Start|All Programs|IRRICAD Pro* to start IRRICAD. If already running IRRICAD select *File|New* to start with a clean screen.
2. In *Settings|Irrigation – Design Specific* browse for the tutorial database **Tutorial.mdb**. This should be found in the \Irricad\database folder.
3. If you prefer to work in US units, go to the *Units* tab and click the **[US]** button. If you prefer to work in Metric units, click the **[Metric]** button to restore the default units for this tutorial. For this tutorial select **lph** as the “**Outlet Flow**” and **m** as the “**Pressure**”.

1.4.2.1 DRAWING THE LAYOUT OF THE SYSTEM

4. Select *Mainline|Water Supply* and place the water supply on the screen, near the right-hand side. Leave the “**Calculate pressure?**” option enabled, so that IRRICAD will calculate the system duty for the system you draw. Click **[OK]** to accept and close the dialog.
5. Select *Mainline|Pipe*. Leave the pipe as **Computer Selected** so that IRRICAD will select the pipe size for you. Click **[OK]** and click in the center of the water supply to place the start point of the pipe (left click on the screen). The pipe will rubberband with the cursor until you place the end point or next point of a pipe (if the pipe is bent). The pipe tool is like a continuous line tool and will rubberband between points until you end the pipe by selecting *Right-click|Restart*.
6. Select *Mainline|Outlet* and select **Demand Flow**. This type of outlet is called a Demand Point. It does not have a pressure / flow relationship but simply allows us to specify the flow and pressure required at a particular point. Enter **30m** and **5m³/h**. Click **[OK]**.

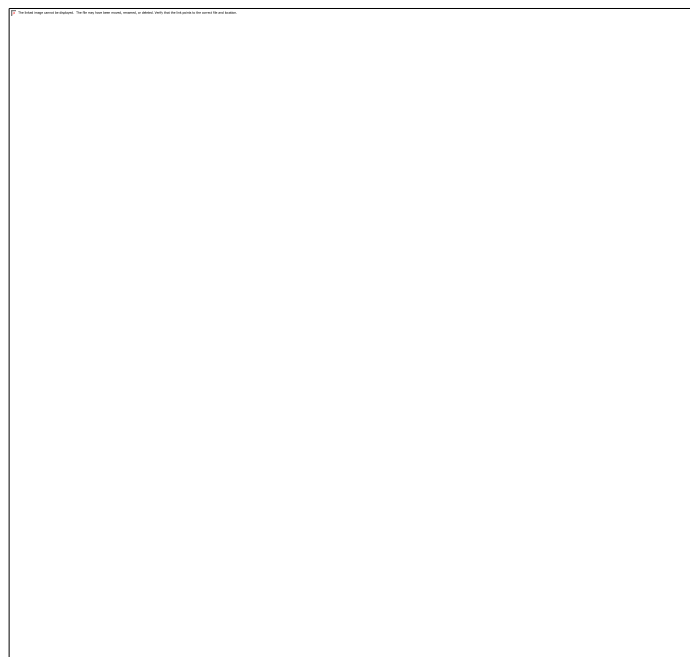


Figure 4-96

7. Left click on the mainline pipe where you wish to place a demand point or node. The outlet will automatically connect to the pipe. You will need to assign each outlet a zone name. Accept the default names for each node placed. Place 3 -4 outlets as in [Figure 4-97](#).

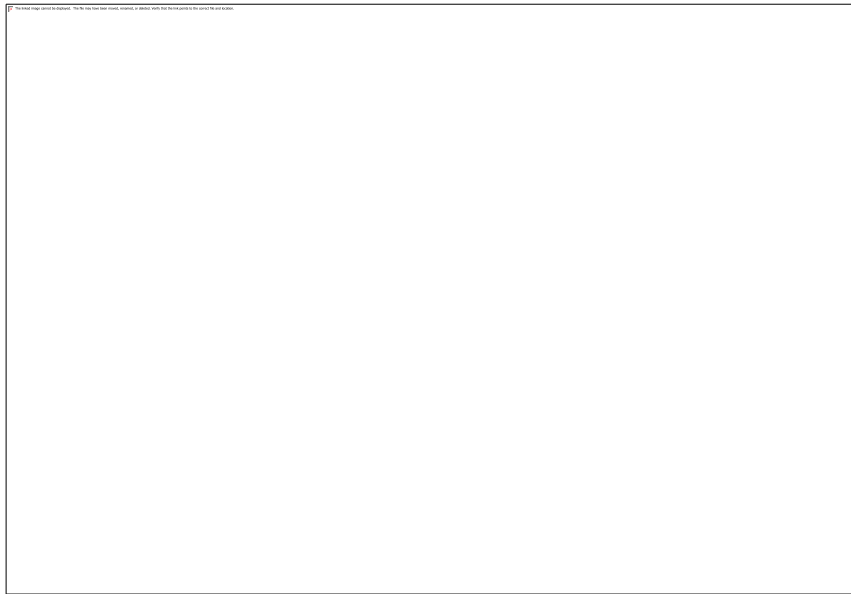


Figure 4-97

8. In *Settings/Miscellaneous* and select or enter the “*Base Database Symbol Size*” most suitable for your design size. Click [OK].

1.4.2.2 DESIGN

9. First, select *Design/Check Outlet Connectivity* to ensure that all outlets are connected to the water supply via mainline pipes. If you receive no messages, continue with design. If you do receive messages, check you cannot see a black pipe junction where the water supply or outlets connect to pipes. Pipes require pipe junctions, but where point objects connect, the junction should disappear. If an outlet is not connected, highlight the outlet by selecting *Modify/Select Object* and clicking on the outlet. Then select *Modify/Move* and move the outlet until the center of the outlet is central to the black junction and left-click. The black junction will disappear when the outlet is connected. If you are still having problems, ensure the default snap mode in *Settings/Snap* is set to **Connect**. Another reason items might not connect is that you are trying to connect zone items on to mainline items or vice versa. Remember a control valve is required between zone and mainline items.
10. Even though we only have mainline items present in the design, we will still need to analyze the zones i.e. the mainline outlets. Select *Design/Zone Design/Analyze*. This should be quite quick.
11. Once all outlets are placed we must tell IRRICAD how the system is to run. We call this Management. If all nodes are to run at one time (as is assumed the usual or the worst case scenario for rural water supply systems) select *Design/Assign All Zones to One System Flow*. IRRICAD will automatically fill out the table with 1 system flow running for a default time of 1 hour (the running time is not important, we just want to know what happens when it is running) and all zones assigned to run on system flow 1. Click [OK].
12. Now select *Design/Mainline Design/LP Design*. LP design a computer design option that will select pipes based on the pressure required at the outlet.
13. Now view the reports. Because this is a mainline design select *Reports/Mainline Design Reports*. Select *Reports/Mainline Design Reports/System Duty*. IRRICAD reports the pressure and flow required at the water supply to run the system you have designed. A pump can be sized from this data. The *Mainline Design Full* report is useful if you wish to know the velocity in the pipes, length of pipes and head difference. The *Mainline Summary Report* gives a summary of actual and required pressures at the zone control valve. The *Mainline*

Design Pipe Report lists the pressures in the pipes, and also lists the elevations of start and end point so the pipes.

1.4.2.3 VARIATIONS

14. Draw some contours or spot heights on the design. Elevation information can also be imported using *File|Import Contours*. Keep in mind that the elevation information needs to span all hydraulic input. Now redesign the system and view the reports.
15. Size the pipes using *Design|Mainline Design|Velocity Design*. You can set the maximum mainline velocity in *Design|Design Parameters|Hydraulic Parameters*. Keep in mind that *Velocity Design* does not know about the pressure that you are trying to achieve at the outlet. It is simply choosing a pipe size which will achieve a velocity as close as possible to the maximum allowable velocity set.
16. Run *Design|Computer Selection of Fittings*. IRRICAD will find fittings for each junction.

Note: You do not have to lay out a design in a specific order. You can place the nodes first, then pipe, then water supply if you wish. IRRICAD is very flexible until the *Design* section where management is required, then *Zone Design* then *Mainline Design* in that order. Remember the items available in the tutorial database are only a small set of items available in full IRRICAD databases. Databases are also easily changed or added to via the Database Editor.

1.4.3 STOCK WATER RETICULATION NOTES

Water troughs can be entered as demand points on the design for a quick analysis however, it is best to mirror the water trough valve as an outlet with nozzles for use in this type of mainline design. Then, because the water trough now has a pressure/ flow relationship, *Detailed Analysis* can be used to show actual field conditions where the flow is based on actual pressure at the trough valve. This is particularly important when:-

- more than one trough is filling at a time
- the property has undulating topography
- the troughs that are filling are at very different locations or elevations.

1.4.3.1 ENTERING THE TROUGH VALVE INTO THE DATABASE

Locate the manufacturer's technical specification sheet for the trough valve.

Enter the trough valve as an outlet and nozzle(s) (see [Entering a New Outlet Into the Database, Section 1.5.1.2](#)).

In the design place the trough valve where required via *Mainline|Mainline Outlet*. Connect the mainline outlets with *Mainline|Mainline Pipe*.

1.4.3.2 THE DESIGN PROCESS

Set up a "Partial Management", which means that a finite number of system flows (which troughs are running together), is decided based on possible worse case scenarios. This may include troughs close to the water source, at different ends of the farm, or close together at the far end of the farm.

If pipe sizing is required remember that if there are loops in the system or multiple water supplies that *Mainline|Mainline Design|Velocity Design* will have to be used.

Finalise pipe sizes by manual changes if required and analyse those changes. If partial management has been used ensure all pipes have a size (these can be extrapolated from sized pipes that have the same number of troughs downstream).

Set the water supply pressure and action that *Mainline|Mainline Design|Detailed Analysis*. This will provide field pressures and flows at each of the running troughs.

1.5 DATABASE AND FITTING SELECTION

Design|Computer Selection of Fittings is a great tool to save time, producing a complete Bill of Materials. IRRICAD uses rules to solve junctions with fittings so if it can't find the fittings it needs it will list the unsolved junctions at the end of any Bill of Materials report or Costings report.

1.5.1 CUSTOMIZING YOUR DATABASE

Using the Irricad Database Editor, new items can be added to the database, deleted from the database, turned on or off for selection or edited. The on-line help or the hard copy manual explain the fields in database item dialogs so you can easily enter your own items or customize the existing items.

Probably the most future time saving task will be to create separate databases for the different types of designs you do. This is particularly true if you do quite different design work which all use different materials. One database may be Residential.mdb, another Vineyard.mdb, and another Stockwater.mdb. Now instead of turning items on and off in the database depending on the type of design you are doing today, you will only have the items you use for that particular system. This means your databases are smaller and you have more of them, and that you do not have multitudes of extraneous items you will never use present.

After you have either split up your databases to be design specific, or have deleted all the extraneous items out of them, you will either have the exact fittings you use or a range of fittings for IRRICAD to choose from. If you only use saddles instead of tees (both available in the Tees component group) then you will only have saddles available. If you decide to use saddles in a particular design, instead of tees, you can turn the cheaper tees off in the database (select **N**) before running *Computer Selection of Fittings*.

1.5.1.1 ENTERING NEW PIPES IN TO THE DATABASE

1. Run the Database Editor (*Start|All Programs|IRRICAD|IRRICAD Pro Databases*). Note the database the editor opens with is your default database – set in IRRICAD in *Settings|Irrigation – Design Specific* and clicking the **[Save As Default]** button. If the database does not automatically open then go to *Tools|Options* and enable the “Open database on Startup” option. Then select **Default Database** or **Last Database** as per your preference.
2. Enter a new pipe by selecting *Component|Add Item*. IRRICAD will copy the pipe the cursor is currently on so if there is an existing pipe similar to the pipe you are adding to the database, click on this before selecting *Component|Add Item*.
3. A usage code is required for all items in the database if you want to be able to select this item in IRRICAD, either manually or during design or fitting selection. Most items have a Yes, No usage code, but pipes are designated to be used for either Laterals, Zone pipes, Flushing pipes or Mainline pipes. Laterals are connected spraylines, zone pipes are any pipes (other than laterals) used downstream from a control valve, flushing pipes will be eligible for manual selection and mainline pipes are all pipes used upstream from a control valve. Pipes can have more than one usage code; any combination of L, Z, F, S, U, or M you wish. If the usage code is blank then this item cannot be used or selected.
4. Enter a name for your pipe, describing its basic qualities e.g., 2” (50mm) PVC Class 6.
5. Now enter a unique warehouse code for the pipe. This can be your ordering code or an inventory code.
6. Enter a supplier code (you can make your own in IRRICAD – *Reports|Supplier Code Multipliers*).
7. Enter a pipe type for your pipe, e.g., PVC, LDP etc. You can make your own in IRRICAD – *Design|Pipe Fitting Matching Table* but note IRRICAD uses this pipe type to select fittings so it should match the appropriate fittings.
8. The nominal diameter is the size the pipe is usually referred to by, e.g., 2” (50mm).
9. The actual diameter is very important to be entered precisely as this is the diameter IRRICAD uses in its pipe friction loss calculations.

10. The pipe roughness is the Hazen-Williams C factor, which can be found in Appendix B for all smooth pipes.
11. Enter the maximum allowable pressure as per manufacturers' specifications for that pipe.
12. Enter a wholesale cost and retail price and select a plotting colour and line type for this pipe. Click the **[Save]** button .

You now have a new pipe to use in a design.

The other item dialogs do not differ too much from this format. However, you can find information on this in the IRRICAD Database Editor section of the manual.

1.5.1.2 ENTERING A NEW OUTLET INTO THE DATABASE

All water outputting devices exist in IRRICAD as an Outlet body and a nozzle or collection of nozzles, regardless whether the device physically has nozzles or not.

To enter a new outlet into the database:

1. Enter the nozzle data first. To do this you require the manufacturer's technical data sheet for the nozzles.
2. Open the Database Editor and if the database that automatically opens is not the database you wish to add the new product to, then select **Exit** (save changes if required) and then **File/Open** and browse the working database you wish to edit.
3. Use the arrows at the top of the right-hand-side of the open database to scroll along until you see the **Nozzles** tab.
4. Select **Component/Add Item**. IRRICAD will copy the nozzle the cursor is currently on so if there is an existing nozzle similar to the nozzle you are adding to the database, click on this before selecting **Component/Add Item** and start entering the relevant information into each field.
5. When you get to the "Radius Equation Constant (K)" and "Radius Equation Index (n)" fields, we will use the manufacturer's data in the **Curve Fit** to calculate the Constant (K) and Index (n). If the **Curve Fit** is not currently displayed on the right-hand side of the window, select **View/Curve Fit** and select **Outlet wetted radii from pressure** from the dropdown list.
6. The table you see requires at least three sets of data. Firstly ensure that the units above each column are set to match the units you are reading off the manufacturer's data. Enter the Pressure and the resultant Radius from the data sheet into the table.
7. Click the **[Fit Curve]** button. The Constant and Index will be calculated for you. Ensure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Radius Equation Constant (K)" field and the Index into the "Radius Equation Index (n)" field by clicking the green arrow button.
8. When you get down to the "Flow Equation Constant (K)" and "Flow Equation Index (n)" fields below, select **Outlet flow from pressure** from the dropdown list in the **Curve Fit**. Once again read the data off the manufacturer's data sheet for this nozzle. Firstly ensure that the units above each column are set to match the units you are reading off the manufacturer's data. Enter the Pressure and the resultant Flow from the data sheet into the table.
9. Click the **[Fit Curve]** button. The Constant and Index will be calculated for you. Ensure that R^2 is above 90% or re-check your data. Copy the Constant in to the "Flow Equation Constant (K)" field and the Index into the "Flow Equation Index (n)" field by clicking the green arrow button.
10. Finish by selected a plotting symbol, size and colour. Click the **[Save]** button.
11. Repeat this process for as many nozzles as you wish to add into the nozzle component group.
12. Now use the arrows at the top of the right-hand-side of the open database to scroll along until you see the **Outlets** tab.
13. Select **Component/Add Item**. IRRICAD will copy the outlet the cursor is currently on so if there is an existing outlet similar to the outlet you are adding to the database, click on this before selecting **Component/Add Item** and start entering the relevant information into each field.

14. For Outlets the inlet connect type (how the outlet connects to a riser or on to the pipe) can be NONE but still requires a gender and connect type e.g., NONE F S (or T for threaded, or B for barbed)
15. Leave the “Default Nozzle” field at this stage. The inlet diameter is the size of the outlet body e.g., 20mm for a popup body or 4mm for a dripper.
16. The “Arc Type” determines how the outlet operates – is it a **Fixed** outlet e.g., the arc cannot be adjusted? Is it a **Variable** outlet – the arc can be adjusted? Is it a **Matched** outlet – as the arc is adjusted the amount of flow is also adjusted accordingly
17. The “Flow Tolerance” is usually 5% above and 5% below as a rule of thumb unless the nozzle is pressure compensating.
18. Finish filling in the fields and [Save] the new outlet.
19. Now with your new outlet highlighted, select *Component|Edit Nozzles*. This will take you to the **Nozzles** component group. In the bottom field you will see any nozzles which were copied for the existing outlet when you create the new one. Select the grey box to the left of the nozzle name. If there are more than one nozzle here (and if they do not belong with your new outlet), you can drag the cursor down to highlight all of the nozzles. Now select *Component|Remove Nozzles*.
20. Now click on the little grey box to the left of the required nozzle name to automatically be added to your outlet. Select all of the new nozzles you have just created for this outlet. You can see the added nozzles in the list below the main grid. Once you have added all the required nozzles, select *Component|Edit Nozzles*.
21. Select *File|Exit* and then the [Yes] button to save the additions to your database and to close the database.

1.5.2 HOW IRRICAD SELECTS FITTINGS AND UNDERSTANDING THE FITTING SELECTION RULES

Read Appendix G: Fitting Selection Details in the online Help Topics (*Help|Help Topics*). This chapter covers the rules that IRRICAD uses to solve the different types of junctions.

1.5.2.1 QUICK NOTES ON MAKING IRRICAD SELECT THE FITTINGS YOU WANT

IRRICAD will select the items you want if you keep in mind the rules that are used during Fitting selection.

In summary IRRICAD will always search the Lateral Take-Off component group first, then move search the cross, tee, bend and coupler groups as needed. IRRICAD always looks for the single cheapest item which has the correct connection codes required. An assembly is seen as a single item. Hence an assembly containing all the fittings required will be chosen if it is the only item that has the correct inlet and outlet connections. If a single item can not be selected, IRRICAD will choose the cheapest option of multiple components to solve the junction.

If there are many options for IRRICAD to choose from but you wish a particular item or set of items to be selected change the connection codes to be unique to those items so there is no other choice for the selection. Instead of BSP F T try BSPS F T making sure the item it is connecting to also has been given the unique connection code for this design. You can also make the item cheaper than its competitors.

1.5.2.2 USING RISER RULES

IRRICAD uses internal riser selection rules, but you can override these with creating your own.

The internal rules are: select the riser pipe that is the same size as the top item and the same type as the bottom item. This means that if the submain (100mm PVC MS) is buried at 500mm and the valve (80mm BSP FT) is at -300mm (above ground) the riser pipe selected will be an 80mm PVC MS pipe.

You can override the internal rule by either specifying your own rule or selecting the pipe you want used in a particular situation. Select *Design|Riser Selection Rules*. Enter the depths to which this rule applies. The first depth entered must be the higher depth. Now select either **Rule** or **User**. If you

select **Rule**, you have the options of specifying how the size and type of the riser is determined. If you select **User**, select the pipe you wish to be used from the drop down list on the far right.

Select *Design/Riser Selection Rules*. The rules you set can only be applied to a particular change in depth. Therefore you can set a riser rule for the riser selection between a submain and the laterals. This will not effect the riser selection between the mainline and valve providing the valve is at a different depth than the laterals or the mainline is at a different depth than the submain.

When creating a rule, remember that “Depth 1” needs to be higher than “Depth 2”. Remember that 0 is at ground level and a negative number is above ground. If you select **User**, you can select the pipe you wish to be used as the riser in that particular case. If you select **Rule**, you can select the “Size” and “Type” of pipe to be used based on the existing items in the design. For example if the valve is 80mm BSP valve and the mainline is 100mm PVC, do you wish the riser to be 80mm PVC, 100mm BSP, 80mm BSP or 100mm PVC? Select **Top** and **Bottom** appropriately for “Size” and “Type”.

1. Using the Tutorial.mdb draw a block of tapes using *Zone/Tape Irrigation Block* any size you wish. Select a **Center** submain through the middle of the block, setting the “Depth” to **20in (500mm)**. Select a valve (at **0 “Depth”**) and then draw in a mainline pipe (at **20in (500mm) “Depth”**) to connect to the water supply. Select your own pipe sizes as you place the pipes or use *Design* to size them for you.
2. Now run *Design/Computer Selection of Fittings*. Using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral. Select *Modify/Change*, and then click the *[Show Fittings]* button. See what IRRICAD selected as the riser. IRRICAD has selected tape as the riser but it cannot find the correct tee to complete the junction.
3. Go in to *Design/Riser Selection Rules* and set the depths as required (**0** for “Depth 1” and **20” (500mm)** for “Depth 2”) and set the rule to be **Top** for “Size” and **Bottom** for “Type” and re-run *Design/Computer Selection of Fittings*.
4. Using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral. Select *Modify/Change*, and then click the *[Show Fittings]* button. Because IRRICAD is now looking for a ½” (16mm) PVC pipe and there is none available or turned on in the database, it cannot solve the junction.
5. Now change the “Riser” to **User** in *Design/Riser Selection Rules*. Select the pipe you wish to use for the riser, such as the ¾” (20mm) **Polyethylene hose**. Now re-run *Design/Computer Selection of Fittings* and using *Select Object* or *Select Window*, select one junction where the submain connects to a lateral. Select *Modify/Change*, and then click the *[Show Fittings]* button to view the changes.

Note: If there are more than 40 fittings for IRRICAD to choose from, when solving a particular junction, a warning message will be issued just to let you know.

1.5.2.3 USING PIPE FITTING MATCHING SETTINGS

The *Pipe Fitting Matching Table* in the *Design* menu allows you to insert new pipe types and designate their connection codes and to what fitting types they can connect.

More than one type of pipe can connect to a fitting type, but each pipe type can only connect to one fitting type, e.g., PVC, PV1, PV2 and PV3 pipe types can all connect to PVC fitting type, but PV1 pipe type can only connect to PVC fitting type.

The Bill of Materials reports will round up the lengths of pipes, whereas the costing reports will display the exact length. The rounded lengths in the BOM reports can be altered by the extra allowance, the rounding, and the rolls / lengths.

Remember that for an item to connect to another item it must have the same nominal diameter, the same connection type and be the opposite gender.

1.5.2.4 EXPLAINING SUPPLIER CODES AND MULTIPLIERS

Supplier codes can be used to view or print a bill of materials for the different sources of product for a job.

Supplier codes can also be used to increase across the board prices for a particular manufacturer.

Open the *Reports/Supplier Code Multipliers* table. Each supplier code can have a multiplier that can be used to calculate the final prices displayed in the costing reports. These multipliers will increase or decrease the final job cost using a base price, either the retail price or wholesale cost as entered into the database for that item. If the multiplier is a number other than 1 and the above check boxes for B, C, and / or D have been checked, and if the default pricing type in *Design/Design Parameters/Economic Parameters* is set to **Multiplier**, the costing of the job will be calculated accordingly.

If **Retail** or **Wholesale** is the default pricing type in *Design/Design Parameters/Economic Parameters*, then the costing reports will show the relevant prices or costs.

Remember the Bill of Materials will round up the lengths of pipes, whereas the Costing Reports will display the exact length. The rounded lengths in the BOM reports can be altered by the extra allowance, the rounding, and the rolls / lengths in the *Pipe Fitting Matching Table*.

1.5.3 CORRECTING FITTINGS ERRORS

After rerunning *Design/Computer Selection of Fittings*, there may be a few junctions that IRRICAD can't solve. This is due to that fact that the items it looks for are not in the database.

The first error may be similar to:

US Units:

Problem selecting suitable Tee

X: 102.20 Y: 263.82

PVC M S 2.00 PVC M S .00 1.50

Metric Units:

Problem selecting suitable Tee

X: 102.20 Y: 263.82

PVC M S 50.00 PVC M S .00 40.00

1. Use *View/Zoom Window* and zoom in on a piece of your design. Select *View/Go To Coords* and type in the X and Y co-ordinates displayed on your report, using the tab key to tab between the two fields. Let go of the mouse and use the <Enter> key as [OK]. The cursor will now be at the co-ordinate you entered, and this co-ordinate will be at the center of the page. Select *Modify/Change* and click on the item at this co-ordinate. Click the [Show Fittings] button. Here will you see all the fittings selected to solve this junction.

IRRICAD reports the connection types of the existing items in the design in the fittings errors, not the items it requires. In some instances it is straightforward where we could enter an item in to the database based on the information above, just reversing the gender so the items connect. In more complicated situations, it a good idea to go and look at the junction to see which junction IRRICAD is trying to solve. Reading up on the Fitting Selection Rules (in Appendix G) will help you understand the items IRRICAD needs to solve the junction.

2. Run IRRICAD Databases by clicking on the *Start/All Programs/IRRICAD/IRRICAD Pro Databases* or double-click on the icon if one is present on your desktop. (Note the database the editor opens with is your default database – set in IRRICAD in *Settings/Irrigation – Design Specific* and clicking the [Save As Default] button). Select *File/Open* and browse for the required database in the \Irricad\database folder if your working database has not opened.

Open this database and select the required component tab, entering the item or items required to solve the junction.

3. Return to IRRICAD and rerun *Design|Computer Selection of Fittings*. If any other fitting errors are still present in the *Reports|BOM / Costing Reports|BOM* report, solve the next junction in the list using the above method to help you.
4. Use the tape irrigation block you drew above. Solve the missing End Cap.

Try an example of your own.

1.5.4 CREATING AND MODIFYING ASSEMBLIES

To create an assembly, it is important to note the following rules:

- If creating an assembly based on a particular valve, for example a 2" (50mm) Electric Valve Assembly, you still need to add a 2" (50mm) Electric Valve to the assembly.
- It is not necessary to have all items in the assembly with the correct connections for fitting together as the only connection types used are those entered for the Assembly as the one item. However, for practical reasons, it is beneficial to have the connections required between the assembly items.
- Outlet assemblies must contain an outlet.

1.5.4.1 USING ASSEMBLIES

You may wish IRRICAD to select different fittings than it has chosen.

You can create an assembly of the items you require, as long as those items are in the database.

1. For example, if you wish to make an assembly in the Tees group, go to the Tees component group and select the Tee you would like to use in your assembly (this is only so that most of the description is available for you to make changes to). Now select *Component|New Assembly*. Change the "Usage" code to **X**. Change the "Description" so you know this item is an assembly, and possibly what use it has e.g., **2½" (63mm) tee with expanding coupler to 3½" (90mm)**. Change the "Warehouse Code". Change the "Major Connection Code" and "Minor Connection Code" to reflect the ends you wish to connect to e.g., **2½" (63mm) MDP FS** and **3½" (90mm) MDP FS**. Now click the *[Continue]* button.
2. Most importantly select the tee required in this assembly by clicking on the grey box to the left of the description of the tee e.g., **2½" (63mm) Female Tee** and enter the **1** as the required number of this item. Now select **1** of the **Reducing Coupling 3½" x 2½" (90 x 63mm)**. When you have completed adding items into your assembly, select *Component|Finish Assembly*. It is your job to ensure the items you are selecting will connect together. Save your database upon closing.
3. Now run *Design|Computer Selection of Fittings* for your assembly to be selected. View the *BOM / Costing Reports*. You will notice that an X usage code will list the assembly name in the main part of the list, and then afterwards list all the items that make up that assembly.

1.5.4.2 CREATING AN ASSEMBLY

We wish to create a swing joint assembly for use in small turf irrigation.

This assembly will contain:

- Three 90° street elbows
- ¾" PVC pipe

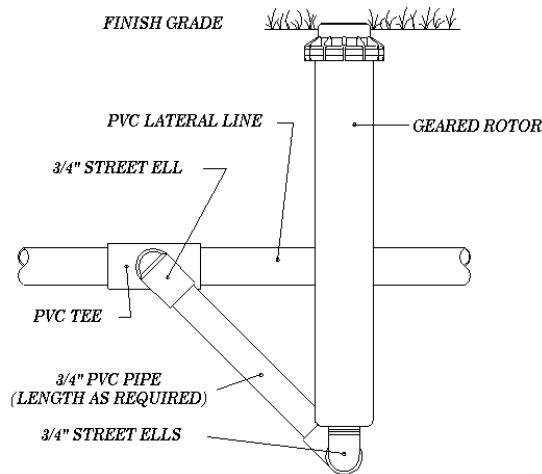


Figure 4-98

1. Run the IRRICAD Database Editor (*Start|All Programs|IRRICAD|IRRICAD Pro Databases*). The Database Editor opens your default database automatically. If the Tutorial database is not the default database (the name of the database is displayed on the title bar), use *File|Open* browse for the **Tutorial.mdb**. This should be in the Irricad\database folder.
2. Click on the Outlet Connections tab (you may need to scroll along the top to see this tab). Find the **Microsprinkler Stake and Tube $\frac{3}{8}$ " (10mm)**. Click on the gray box to the left of the description to select the item. Select *Component|New Assembly*. Note that the characteristics for the existing riser have been copied. Edit the name for the outlet assembly to be: **Pop-Up Swing Joint Assembly**. Change the "Warehouse Code" to **SwingJAssembly** and select a "Supplier Code".
3. The "Inlet Connection" and "Outlet Connection" should correspond with the actual items that will be at either end. In this case a $\frac{3}{4}$ " PVC elbow will be at the inlet end with a connection type of BSP MT to connect into the PVC faucet tee IRRICAD selects. The item that will be at the outlet end of the assembly will be a reducing street elbow, found in the Elbows / Bends tab, with a connection type of PVC MT with a minor diameter of $\frac{1}{2}$ " (15mm) to connect directly to the lawn pop-up sprinkler. Check that the "Inlet Connection" and "Outlet Connection" types for the assembly are **BSP MT** and change this if required. The "Inlet Diameter" is $\frac{3}{4}$ " (20mm) and the "Outlet Diameter" is $\frac{1}{2}$ " (15mm).
4. The "Height Above Ground" is **0** (zero) because it is below ground. The "Equivalent Length Diameter" is $\frac{3}{4}$ " (20mm); this is the diameter to be used in the headloss calculations and represents the average diameter.
5. The "Headloss Equivalent Length" is equal to the complete length water will traverse through. We will use **6.6ft (2m)** in this case to represent the length of pipe and elbows: 0.66ft (0.2m) of PVC pipe, 2ft (0.6m) x 3 for equivalent lengths of $\frac{3}{4}$ " elbows. The costs will equal those of the included items added together. Click the *[Continue]* button.
6. Using the tabs at the top of the screen, click on the Elbows / Bends tab and click on the grey box to the left of the **$\frac{3}{4}$ " (20mm) Female PVC 90 Street Elbow**. Type in **2** for the number to be selected. Click *[OK]*. Select **$\frac{3}{4}$ " x $\frac{1}{2}$ " Male Street Elbow** and type in **1** for the number required. Click *[OK]*.
7. Go to the Pipe tab and select the **$\frac{3}{4}$ " (20mm) Class 125 PVC Pipe**. Type **0.66ft (0.2m)** for the length required.
8. As the Assembly is now complete, select *Component|Finish Assembly*.

1.5.4.3 MODIFYING AN ASSEMBLY

We wish to add to an existing assembly - go to the Outlet Connections component group and select the **Lawn Pop-Up Assembly**.

1. Select *Component|Add to Assembly*.

Because the tee branch connecting to the street elbow is PVC FS, and the elbow end of the $\frac{3}{4}$ " (20mm) female PVC 90 Street Elbow is PVC FS, these items will require a coupler in order to be joined together in the field. A $\frac{3}{4}$ " (20mm) PVC male coupler that has an inlet and outlet connection type PVC MS is required.

2. Return to the Coupler tab and click on the f=grey box to left of the $\frac{3}{4}$ " **PVC Male Coupler** to add to the assembly. Type in **1** for the number to be selected. Click **[OK]**. Select *Component/Finish Assembly*. Exit the database and click the **[Yes]** button to save changes.

1.6 CREATING AND MODIFYING SYMBOLS

This exercise will cover the process of making a new symbol, modifying an existing symbol and setting up a block of trees.

1.6.1 CREATING NEW SYMBOLS

Firstly we will create a simple pine tree symbol. The process is to use the drawing options to draw the symbol on screen, then to use *Create Symbol* to save it for later use. The symbol will consist of a small horizontal line with four curved branches protruding from it.

1. Select *Settings|Grid / Origin / GIS* and enter “X” and “Y” spacing of **20 (6)** and check the “Display Grid Points” checkbox.
2. Now select the *Snap* tab and select the “Snap to Grid” option. Click [OK].
3. Select *Draw|Line|Single* and draw a vertical line of **160ft (48m)** for the trunk. Left click to place the start and drag the line vertically until the status bar d=160 (48) and the line cover 8 grid points then click to place the end.
4. Select *Draw|Arc|Center Start End*. Move to the top of the trunk and one grid point to the left and click. Click on the top of the trunk then move to the grid point vertically below the first (center) arc point and click. Move one grid point to the left of the last end point and click then two grid points to the right (onto the trunk) and click then two grid points vertically below the first (center) arc point and click. Move one grid point to the left of the last end point and click then three grid points to the right (onto the trunk) and click three points vertically below the first (center) arc point and click.
5. Repeat for the three branches on the right hand side of the tree in mirror image. Your symbol should look like [Figure 4-99](#).

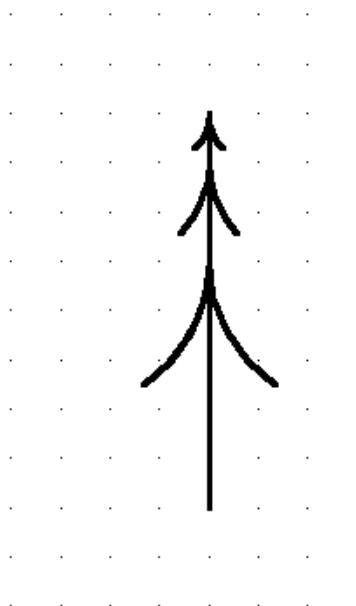


Figure 4-99

6. If you wish this symbol to be a green tree, select by using *Modify|Select|All* or *Modify|Select|Window*. Now select *Modify|Change*. In the dialog, select the color you wish to change it to (e.g., dark green) by clicking on the color field and selecting the color you require.
7. Click [OK] on the color dialog and click [OK] on the Drawing Properties dialog. Because there is more than one type of object selected (e.g., line and arc), the Change / Match dialog appears with the color in the “Change” column checked. Click [OK].
8. Now select the object by using *Modify|Select|Window* and invoke the *Tools|Create Symbol* command. Type in **Pine Tree** for the name and click [OK].

9. Select **Draw/Symbol**. You will notice that the newly created symbol is automatically loaded for use in your current design. The initial width and height in the dialog are the extents of the symbol definition. The **"Maintain Shape"** checkbox controls whether an instance of the symbol maintains the ratio of the width and height at which it was created (box checked) or whether it can be stretched or squashed in one dimension / direction (box unchecked). The **"Dynamically Size"** checkbox controls whether an instance of the symbol can be sized interactively on the screen by rubberbanding an enclosing rectangle (box checked) or placed at the (fixed) size entered in the dialog (box unchecked).
10. Experiment with placing grass symbols with and without the boxes checked to see the effects of these options.

1.6.2 MODIFYING AN EXISTING SYMBOL

In this part of the exercise, you will modify the existing CLOTHESLINE symbol.

1. Select **File/New** to start with a clean screen. Select **Settings/Grid / Origin / GIS**. Set the grid size as **33x33ft (10x10m)** and check the **"Display Grid Points"** checkbox. Now select **Settings/Snap**. Select the **"Snap to Grid"** option. We will use the grid to help us align the clothesline wires correctly. Click **[OK]**. Select **Draw/Symbol**. You will notice that CLOTHESLINE is not available from the drop down list of symbols. Click the **[Load]** button and select CLOTHESLINE from the master list of symbols. Click **[Open]**.
2. Uncheck the **"Dynamically Size"** checkbox. Type in 198ft (**60m**) for the width. Click **[OK]**. Place the symbol on the screen with a left click. Note that the symbol can only be placed on the grid points.
3. Before adding to the symbol, you need to explode it into its individual components. Select **Modify/Explode** and click on the symbol. Alternatively, select the symbol prior to invoking the **Explode** tool.
4. Now select **Draw/Polyline**. Move to the grid point on the top left diagonal nearest the center of the clothesline. Left click and move horizontally to the equivalent grid point on the top right diagonal and left click again. Repeat for the bottom right then bottom left diagonal then back to the starting point, or select **Right-click/Close**.
5. Repeat the whole process for a second polyline one-grid point further out from the center.
6. Select **Settings/Snap** and turn off **"Snap to Grid"** by selecting **"Connect"**.
7. Finally select **Draw/Circle/Center Radius**. Select **Right-click/Snaps/Midpoint** then place the cursor in the center left click the mouse button and move the cursor slightly away from the center. Notice the circle follows the cursor. The radius of the circle is given on the status bar (d). Make d about 3ft (1m). Left click to place. The symbol should look like [Figure 4-100](#).

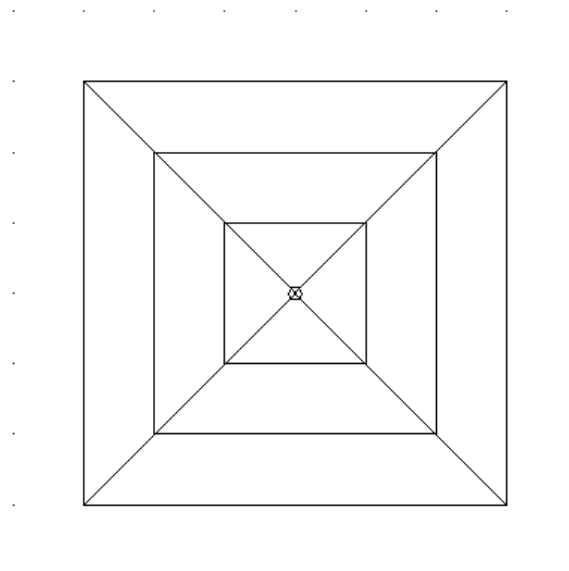


Figure 4-100

8. All that remains now is to save the symbol for later use. As before, select the symbol with *Modify/Select Window* and draw the window around the symbol. Save the symbol with *Tools/Create Symbol* and enter a new name e.g., CLOTHESLINE2. Click [OK].
9. If you want to replace the old symbol definition with the new so that you have only one CLOTHESLINE symbol you must first unload the old definition before saving the new. Select *Draw/Symbol*, click the [Unload] button, select CLOTHESLINE and click [OK] on the [Unload] dialog then click [Cancel] on the Symbol dialog. Now you can use the *Create Symbol* tool to create the new CLOTHESLINE symbol. These symbols can now be used in subsequent designs.

Note: Symbols are only loaded if they have previously been used in the design. If a new design is started, all required symbols will need to be loaded.

1.6.3 SETTING UP A BLOCK OF SYMBOLS

This exercise will cover the process of using the symbol created in Section 4.6.1 to set out a block of trees. Note setting out a block of trees can also be achieved using the *Draw/Tree Block* tool

1. Select *Draw/Symbol* and [Load] the newly created **Pine Tree** symbol. Uncheck the "Dynamically Size" checkbox. Enter the "Width" as **12ft (3.5m)**. Click [OK].
2. Place a symbol on a grid point at the top left of the screen. Select *Modify/Copy/Array* and, moving the cursor over the symbol just placed, click the mouse. In the dialog enter **14** as the "Number of Copies" and **14** as the "Number of Rows" and click [OK]. Click on the grid point where the tree is placed as the reference point. Drag the ghosted symbols to the right of the original symbol and left click. Then drag the cursor down at right angles to the previous ghosted row of trees and left click. You now have a block of trees 14 x 15. See [Figure 4-101](#).

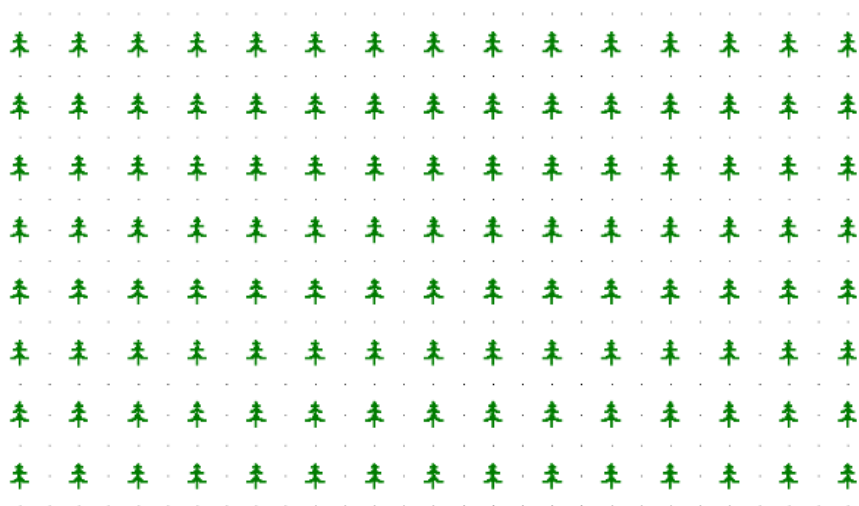


Figure 4-101

1.7 DIGITIZING PLANS

A digitizer tablet can be used in conjunction with IRRICAD to enter scale plans on the IRRICAD screen.

There are two ways to do this: entering a scale or entering known reference points on the drawing from which a scale is calculated.

First we need to create a scaled plan from which to digitize – see [Figure 4-102](#) (metric units) or [Figure 4-103](#) (US units).

1. Draw a rectangle measuring 8" x 6" (200mm x 140mm) on an A (A4) size piece of paper. This represents a property boundary of 120' x 90' (40m x 28m) at a scale of 1":15' (1:200). Draw another rectangle 4" x 2.5" (100mm x 60mm) for the house. The bottom left corner of the house should be 2" x 2" (45mm x 50mm) from the bottom left corner of the property. Draw a third rectangle 1.5" x 1.5" (40mm x 40mm) for the garage to the right of the house touching the right property boundary. Draw a curved drive along the left and top of the property. The drive should be 1" (20mm) wide and positioned 0.5" (10mm) from the left and top boundaries. Label the bottom left corner of the property A (0,0), the bottom left corner of the house B (30',30') or (9m,10m), the top right corner of the house C (90',67.5') or (29m,22m) and the top right corner of the property D (120',90') or (40m,28m). Your drawing should look like [Figure 4-102](#) (metric units) or [Figure 4-103](#) (US units) without the measurements.

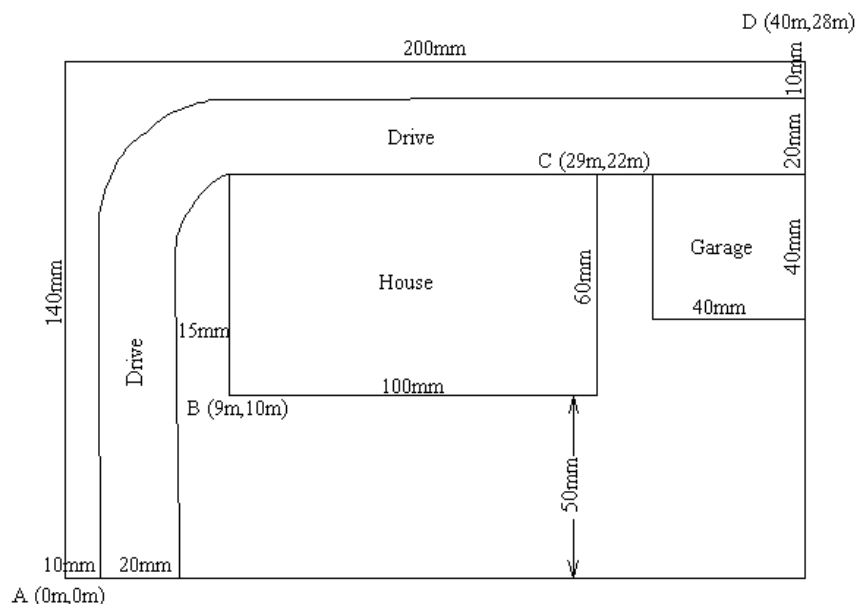


Figure 4-102

2. Attach this scaled plan securely to the tablet so it cannot move during the digitizing process. While digitizing IRRICAD must be in tablet or absolute mode. This mode is turned on automatically when you enter a scale or reference points. You can tell if tablet mode is on or off by looking for a check mark in selecting [Settings|Digitizer|Tablet Mode](#). At any time during digitizing you can turn off tablet mode and resume later. You will not need to re-enter a scale or reference points, just turn tablet mode on again. Tablet mode is switched on or off by selecting [Settings|Digitizer|Tablet Mode](#). When tablet mode is on, the distance the digitizer puck is moved is relative to the scale. When tablet mode is off, the digitizer puck can be used like a mouse.

When tablet mode is on, the puck cannot be used to select menu items or tools - use the mouse or the keyboard. To use the keyboard, hold down the <Alt> key and click the underlined key (usually a

letter) in the menu description (e.g., <Alt>+D for the Draw menu), then use the arrow and enter keys or the underlined key to select a particular menu item.

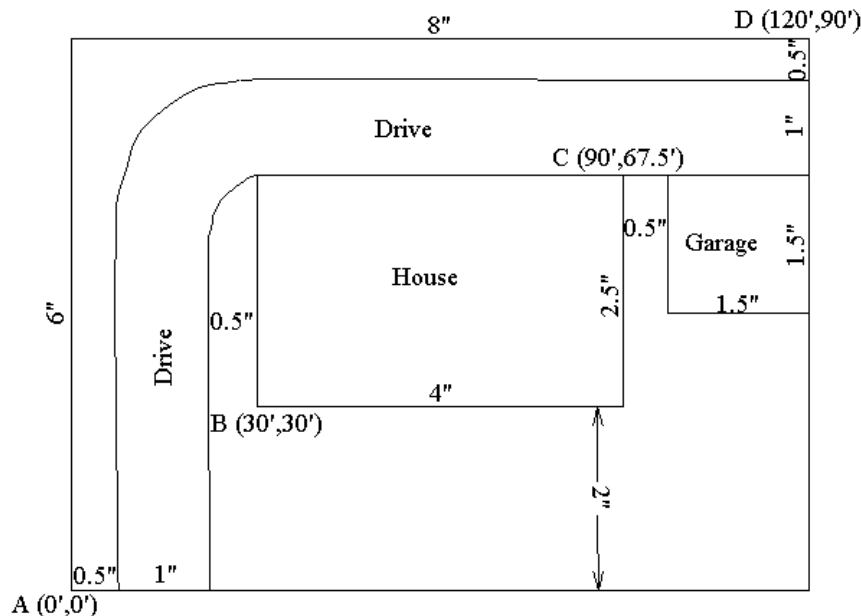


Figure 4-103

The digitizer puck buttons are set up to emulate the mouse buttons. Typically, button 1 is the left mouse button, button 2 the right mouse button, button 3 the middle mouse button (for 3 button mice) and button 4 is Esc. These defaults can be changed in the Windows Control Panel.

Tablet mode may also be toggled using the puck button assigned to the middle mouse button.

1.7.1 USING THE SCALE METHOD

This method can only be used for one-sheet digitizing. The complete area that will be digitized must fit within the tablet's active area. If the drawing is larger than the tablet, and therefore has to be moved around the tablet for the whole plan to be digitized, the reference method must be used.

1. Select **Settings|Digitizer|Scale**. In the dialog box enter the plan scale **15 (200)**. Click the **[OK]** button. **Tablet Mode** is automatically turned on.
2. Select **Draw|Rectangle|2 Point** or <Alt>+D,R,2. Place the puck on point A and left click. Move to point D and left click again. This will create the property boundary. Move to point B and left click then to point C and left click again. This will create the house. Select **Right-click|Snaps|Object**. Place the puck on the top right corner of the garage and left click. Move to the bottom left corner of the garage and left click again.
3. Select **Draw|Curve|Spline** or press <Alt> + <D> then <V> then <S> on the keyboard. Select **Right-click|Snaps|Object** then place the puck on the bottom left of the drive and left click. Move up to where the drive starts to curve around the corner and left click again. Move around the curve left clicking about 6-8 times to create small segments, then move to the top right of the drive. Select **Right-click|Snaps|Object** then left click on the boundary. Select **Right-click|Done** or press <Esc> to finish the curve. Repeat the process for the right hand side of the drive snapping to the bottom boundary, the top left corner of the house and the right boundary.
4. Turn Tablet Mode off by selecting **Settings|Digitizer|Tablet Mode** (or clicking the middle button). Check the size of the property is 120 x 90ft (40m x 28m). To do this you can select **Draw|Line|Single** and place the first point on the bottom left boundary corner and draw out the rubberband line until the puck is or crosshairs are over the top left property corner. Do not place the second point of the line; note the distance as shown on the status bar (d = ?), Now move the puck to the bottom right boundary corner. Once again, do not place the second

point of the line; note the distance as shown on the status bar ($d = ?$). Select *Right-click/Restart* or press the Esc key.

1.7.2 THE REFERENCE METHOD

This method is used if at least two points on the plan are known in world co-ordinates. It is also used when the plan to be digitized is larger than the tablet or when the plan will not be completely digitized in one session.

To digitize a large plan it must be divided into sections small enough to fit on the tablet. Sections should have overlapping reference points e.g., if the first section has points A and B then the second section should have points B and C and so on. The first section should be referenced then digitized. When completed, the plan should be placed so that the next section is on the tablet with two other points available for referencing. The plan can be sideways or upside down if necessary. The referencing procedure is now repeated and the new section digitized. This is repeated until the whole plan has been digitized.

Reference points can be measured on the plan prior to starting. The co-ordinates of these points must be calculated in world units. For example, point B is measured as (2",2") or (45mm,50mm) which, when multiplied by the scale 1":15ft (200), gives world co-ordinates of (30ft,30ft) or (9m,10m).

1. Select *Settings/Digitizer/Reference*. IRRICAD will prompt you to enter the first reference point. Place the puck crosshairs over point A and left click. For the second reference point move to D and left click. Note that we could also use B or C in this example. In the dialog enter **0** for X1, **0** for Y1, **120 (40)** for X2, **90 (28)** for Y2 and **15 (200)** for the scale and click **[OK]**.
2. IRRICAD will calculate a scale from the reference points and compare it to the value entered. If the two scales differ by more than 5% a warning message with the calculated scale is displayed. If you click **[Yes]** to continue IRRICAD will use the entered scale. If you click No to terminate the process, re-select *Settings/Digitizer/Reference* and repeat the process, entering the correct scale. Note that if you do not know the scale of a plan you can use this method to get IRRICAD to calculate the scale for you. Normally round the calculated scale to a sensible value e.g., if the calculated scale is 1:198.86 then enter 1:200.
3. *Tablet Mode* is automatically turned on at the end of referencing. Digitize the plan and check the size as for the scale method. Also check that the co-ordinates of points A, B, C and D are as shown on the scaled plan.

1.8 PLOT TEMPLATES

1.8.1 EDIT AN EXISTING PLOT TEMPLATE

Often it is easier to customize an existing template rather than to create a completely new template. The steps involved are:

1. Change the background color. In order to see the white fills and black lines, it is best to change the background color so it is neither black nor white. To do this go *Settings|Drawing Items* and in the lower middle section of the dialog box you will see "Background Color". Click on the color to bring up the selection palate and select a light shade of a color you prefer. Avoid green as this is the default highlight color. Click [OK].
2. Select *Plot Template|Edit Template*. By default, IRRICAD lists templates found in the folder specified in the path `\\IRRICAD\\symbols\\template`. If necessary, change the path and drive to locate the template to open.
3. Select a template by double-clicking the file name or by selecting the file name and clicking [Open]. Ensure the template is for the paper size that you want to use. The template will be drawn on the screen.
4. Go to *Settings|Drawing Items* and uncheck the "Fills" check box under "Display". This will turn the fills off to make editing easier.
5. Edit the template by using any drawing tools such as lines, arcs, rectangles, text and symbols or other IRRICAD tools such as *Change*, *Move* and *Delete* to add and change objects as required.
6. To select objects for editing, use *Modify|Select|Window*, or use the selection filters (*Modify|Selection Filter* setting the type to e.g., text and checking the "Filter" check box). If *Select Object* is used fills will often be selected when text or lines are targeted.
7. To edit a legend object it must first be exploded (*Modify|Select Object* then *Modify|Explode*). Legends must be (re-)created using *Plot Template|Make Legend* before the template is saved. See the section on *Creating Legends* (Section 1.8.2.1) for a complete explanation.
8. Keywords created as text objects may form part of the template. When IRRICAD generates the plot layout in *Draw|Plot Layout* it recognizes these keywords and replaces them with the required information. Keywords start and end with #.
9. Go to *Settings|Drawing Items* and check the "Fills" check box under "Display" to turn the fills back on.
10. Use *Modify|Select|Window* to select the whole image on the screen. Go to *Plot Template|Save Template* and specify the name for this particular template.

1.8.2 CREATING A NEW PLOT TEMPLATE

The steps involved in creating a new plot template are:

1. Change the background color. In order to see the white fills and black lines, it is best to change the background color so it is neither black nor white. To do this go to *Settings|Drawing Items* and in the lower middle section of the dialog box you will see "Background Color". Click on the color to bring up the selection palate and select a light shade of a color you prefer. Avoid green as this is the default highlight color. Click [OK].
2. Change the distance units to feet (meters) by selecting *Settings|Units* and clicking the down arrow on the distance edit field.
3. Decide the paper size that you wish to create a plot template for. e.g., Size B (A3) paper. Determine the maximum printable area on the paper and multiply by 1000 e.g., a printable area of 17 x 11" becomes 1416.67 x 916.67ft (420mm x 297mm becomes 420 x 297m). B (A3) size paper with an assumed margin perimeter around the paper of 0.3" (8mm) then becomes 25ft (8m). If the lower left corner of the paper is assumed have coordinates of 0, 0 then the printable area is from 25, 25 to 1391.67, 891.67 (8, 8 to 412, 289). To see a table of paper sizes and their dimensions see Paper Sizes, Section 2.9.8.7.

4. Start with a new design. The following process will define the extent of the active area, create two rectangles (one inside the other) and create a white fill in the area between the two rectangles. To work through the example using metric A3 paper, use the numbers in brackets.
5. Change the units to **ft (m)** in *Settings|Units*. Select *Draw|Line|Single*. Type **25,25 (8,8)** and click <Enter>. As you type the coordinates they will appear on the status bar at the lower left of the screen. Ensure that the coordinates are typed correctly. The comma between the two numbers is necessary. Type **1391.67,891.67 (412,289)** and click <Enter>.
6. Select *View|Zoom All* to display the diagonal line representing the extents of the printable area. This will be used later and then deleted.
7. Select *Draw|Rectangle|2 Point*. Type **-41.67,-41.76 (-12,-12)** and click <Enter>. Type **1458.33,958.33 (432,309)** and click <Enter>.
8. Select *View|Zoom All* to display the rectangle representing the outer boundary of the fill. This is intentionally outside the paper size.
9. Select *Draw|Rectangle|2 Point*. Type **33.33,33.33 (10,10)** and click <Enter>.
10. Type **1383.33,883.33 (410,287)** and click <Enter>. Select *View|Redraw* to refresh the image. The smaller rectangle represents the inner boundary of the fill and it will be the border line for the template. See [Figure 4-104](#).

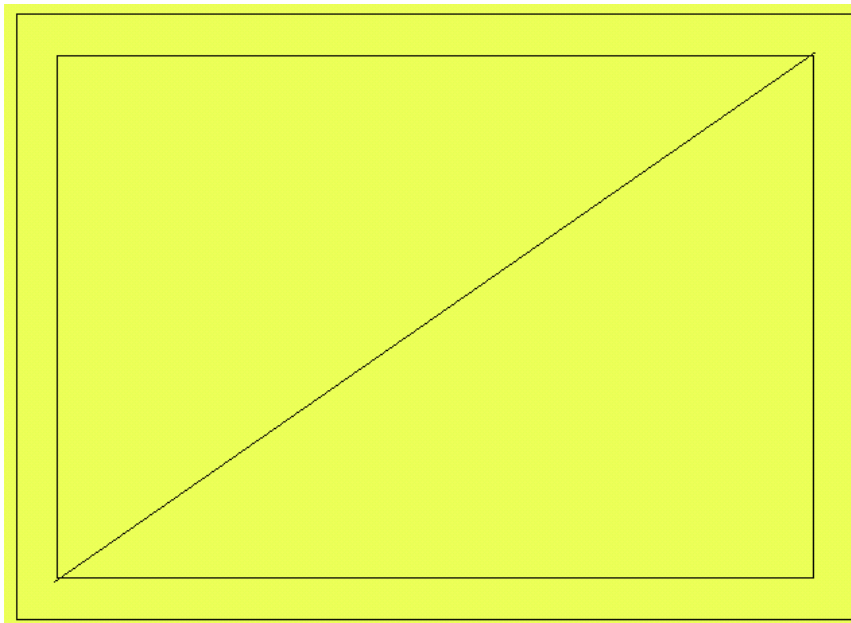


Figure 4-104

11. Go to *Settings|Drawing Items* – “Current Color”. Click on the color box to bring up the color palate and select white. Click [OK], [OK] to return to the main screen.
12. Select *Draw|Fill|Seed* and click on a space between the two rectangles. The space between the two rectangles will turn white. See [Fills](#), [Section 2.9.8.4](#).
13. Go to *Settings|Drawing Items* - “Current Color”. Click on the color box to bring up the color palate and select black. Click [OK], then [OK] to return to the main screen.
14. Select *Modify|Select Object*. Place the cursor just at the top of the outer rectangle and click on the edge. Only the outer rectangle should be highlighted. Click the <Delete> key to delete the rectangle.
15. While still in *Select Object* mode, place the cursor just at the inside edge of the inner rectangle and click on the edge. Only the inner rectangle should be highlighted. Select *Modify|Change* and change the “Line Width” to 4. While still in *Select Object* mode, click on the diagonal line.
16. Go to *Plot Template* and click on *Make Active Area*. Select *View|Redraw* and a faint dashed rectangle will appear just outside of the border rectangle.
17. Select *Modify|Clear Selection* and then *Modify|Select Object*, click on the diagonal line and click the <Delete> key. See [Figure 4-105](#).

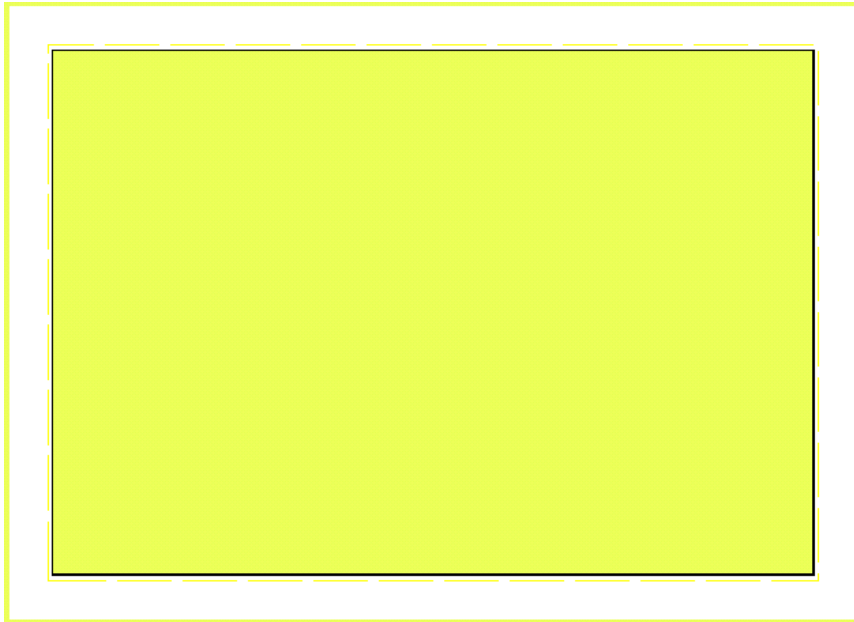


Figure 4-105

18. It is a good idea to save the work done so far. Select *Modify/Select/Window* and place a window to encompass everything on the screen including the fill. Select *Plot Template/Save Template*. Type in a name of your choice then click [OK].

The next part of the process is to place dividing lines and text.

19. Select *Draw/Line/Single*, type **33.33,76 (10,48)** and click <Enter>. Move the mouse across the screen towards the right side of the border. Click the right mouse button, select *Snaps/Perpendicular* and then click on the right border.
20. Select *Modify/Change*, select the line you just placed and change the “Line Width” to **4**. Don't worry if it appears thicker than the border rectangle. Go to *Draw/Text* and type in **#CONA#**. Select a font, set the size to **13.33ft (4m)** and click on “Left” justification. Place the text in right side area of the bottom section. See Figure 4-106. #CONA# is the key word that causes IRRICAD to insert the company name into the design. Many more dividing lines and text can be added to the template.

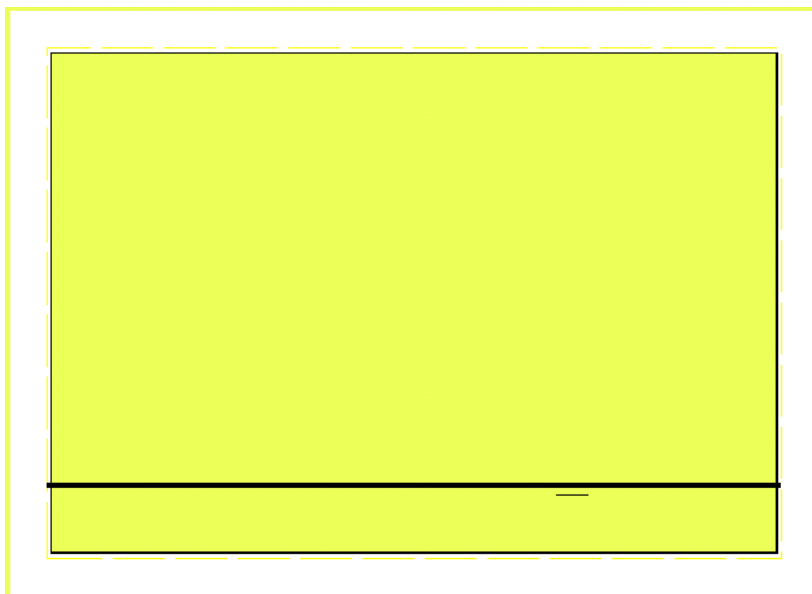


Figure 4-106

21. Save the template. Select *Modify/Select/Window* and place a window to encompass everything on the screen including the fill. Select *Plot Template/Save Template*. Type in the same name that you used before.

1.8.2.1 CREATING LEGENDS

The following steps demonstrate how to create a pipe legend and a valve legend in the plot template being used in this exercise:

22. Select *View/Zoom Window* to zoom in on the lower left corner of the template.
23. Select *Draw/Rectangle/2 Point* and draw a rectangle about **4" (100mm)** long and just under **150ft (45m)** high.
24. Make a copy of this rectangle to the right of the original. Select *Modify/Copy/Linear*, click on the rectangle and then click **[OK]** for 1 copy. Click on the top left of the rectangle and while holding the <Ctrl> key down, move the copy to the right of the original. Click to place the copy. (Holding the <Ctrl> key down while drawing an object activates the "Ortho Mode"). See [Figure 4-107](#).

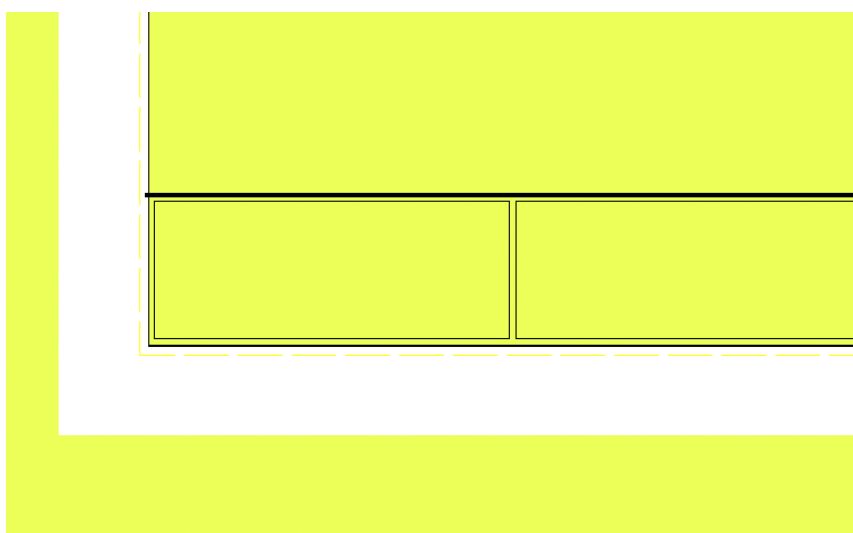


Figure 4-107

25. Go to *Settings/Drawing Items* – "Current Color". Click on the color box to bring up the color palate and select white. Click **[OK]**, **[OK]** to return to the main screen.
26. Select *Modify/Select Object*. Place the cursor on an edge of the left rectangle and click to highlight the rectangle. Select *Draw/Fill/Selection*. A white fill will appear. Repeat this step completely for the right rectangle. For a more detailed explanation of fills in plot templates see [Fills, Section 1.8.2.2](#).
27. Go to *Settings/Drawing Items* – "Current Color". Click on the color box to bring up the color palate and select black. Click **[OK]**, **[OK]** to return to the main screen.
28. Select *Modify/Select Object*. Place the cursor just at the top of the left rectangle and click on the edge. Only the rectangle outline should be highlighted. Click the <Delete> key to delete the rectangle outline. Repeat for the right rectangle. See [Figure 4-108](#).

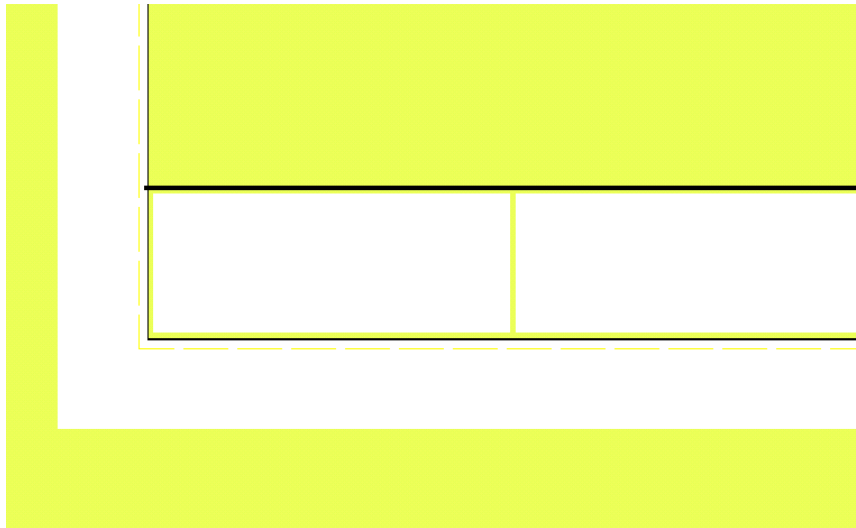


Figure 4-108

29. Select *Draw/Line/Single* and draw a short line in the top left of the small rectangle. Select *Modify/Select Object*, then *Modify/Change* and then click on the line. Change the "Line Width" to **3**.
30. Select *Draw/Text* and type the word **Pipe**. Set the font to your choice and set the size to **10ft (3m)**. Place the text to the right of the short line.
31. If at any time the line and text disappear behind the fill, select *View/Redraw*. It is easier to use *Modify/Select/Window* to select an item located within a fill.
32. In the second rectangle insert a symbol placeholder. Go to *Draw/Symbol* and click the [Load] button. Go to the \IRRICAD\symbols\database folder. You may need to go up one level to get to this folder. Browse for a symbol called **Placeholder.vcs**. Highlight this symbol file, click [Open], ensure the boxes of "Dynamically Size" and "Maintain Shape" are checked and then click [OK]. This symbol is now be loaded for placement. Move the cursor to the top left of the second rectangle. The symbol needs to be about **20 x 20ft (4 x 4m)** in size so click once to define the bottom left of the symbol, move the mouse up and out and click again to define the top right of the symbol.
33. Select *Draw/Text* and type in the word **Symbol**. Set the font and size the same as for the pipe legend. Place the text to the right of the symbol. See [Figure 4-109](#).

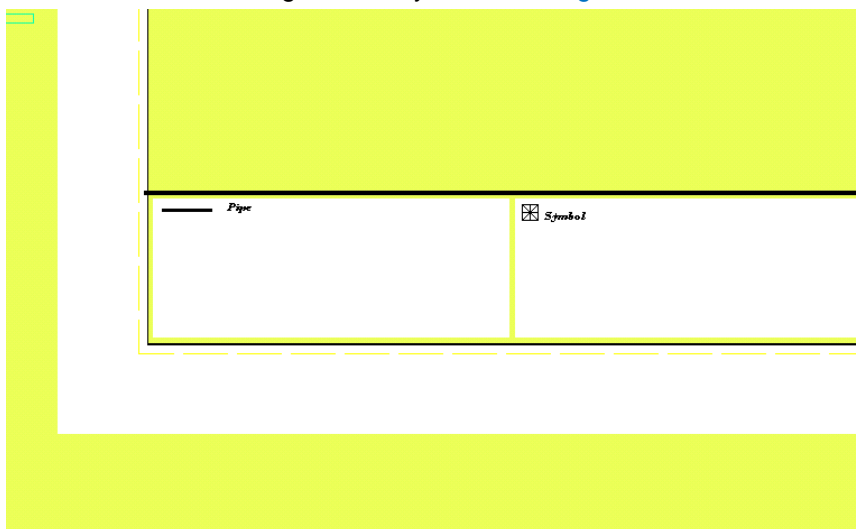


Figure 4-109

Now that the components of the legends are in place it is necessary to group them together and save them as legends.

34. Select *Modify|Select|Window* and place a window to completely encompass the pipe legend, including the fill. Select *Plot Template|Make Legend*. Leave the fields as **Pipe, 1**, and **50%**. Click **[OK]**.
35. Using *Modify|Select|Window* place a window to completely encompass the symbol legend, including the fill. Select *Plot Template|Make Legend*. Change the legend type to **Symbol** by clicking on the dropdown arrow and selecting **Symbol**. Click **[OK]**.

1.8.2.2 FILLS

To complete the plot template in this working example it is necessary to place a fill over the bottom section of the template so parts of the design will not be plotted in the area containing the company name, scale, legends etc. To do this:

36. Select *View|Zoom All*.
37. Go to *Settings|Drawing Items – “Current Color”*. Click on the color box to bring up the color palate and select white. Click **[OK]**, **[OK]** to return to the main screen.
38. Select *Draw|Fill|Boundary*. Move the cursor to the bottom left of the template.
39. Select *Right-click|Snaps|Endpoint*. Click on the bottom left corner of the black border line.
40. Click the right mouse button and select *Snaps|Endpoint*. Click on the end of the left end of the dividing line above the legends.
41. Select *Right-click|Snaps|Endpoint*. Click on the end of the right end of the dividing line above the legends.
42. Select *Right-click|Snaps|Endpoint*. Click on the bottom right corner of the black border line.
43. Select *Right-click|Done*. The whole area under the dividing line should now be white. Any text and lines will have disappeared behind this fill.

1.8.2.3 MOVING FILLS TO BACK

In the example it is necessary to bring the text and lines to the forefront.

44. Select *Modify|Select|Window* and place a window that completely encompasses the whole bottom divided section of the template. This should include the legends. See [Figure 4-110](#).

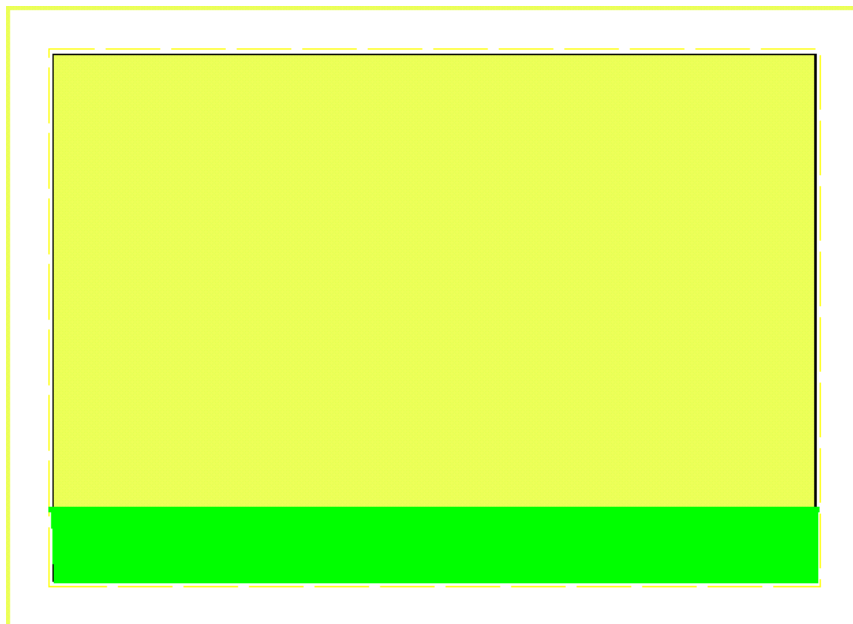


Figure 4-110

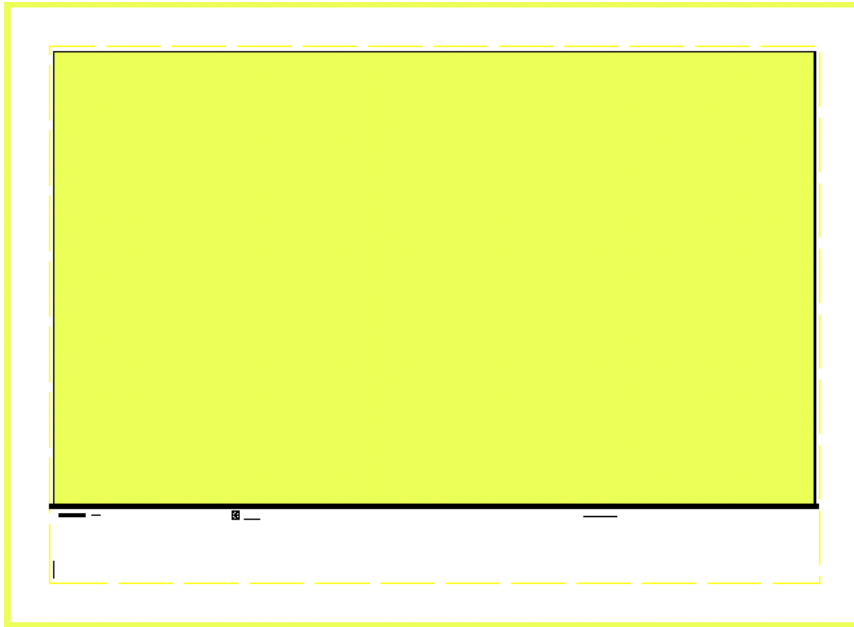


Figure 4-111

45. Go to *Plot Template* and click on *Move Fills to Back*. The legend symbols, text and #CONA# should now be visible. See [Figure 4-111](#).
46. Save the template for the last time in this exercise. Select *Modify/Select/Window* and place a window to encompass everything on the screen including the fills. Select *Plot Template/Save Template*. Type in the same name that you used before.
47. Reset the drawing color to black by going to *Settings/Drawing Items – “Current Color”*. Click on the color box to bring up the color palate and select black. Click [OK], [OK] to return to the main screen.

The process is complete. Naturally it is possible to customize the plot templates in much more detail. This can be done using the drawing tools.

1.9 TIPS FOR ADVANCED USERS

1.9.1 USING A PUMP IN A DESIGN

The pump must be placed downstream from the water supply and must not be placed in loops. Remember a water supply can only have one connection. Enter the water supply details to reflect true conditions of the supply – the height of water relative to ground level, or the existing pressure of the water source.

If the water supply is a river or open water source, and therefore the pressure may be zero, uncheck the “**Calculate Pressure**” option and set the water supply design and maximum pressures to **0m**.

If the water supply is a tank enter the height of the water level above ground level as the design and maximum pressures e.g., 1 ft (m). Base this on the worse-case scenario, such as the tank is almost empty, so that you know the system will still work under those conditions.

If the water supply is a well, enter the pressure as a negative pressure, indicating the level of the water below ground level e.g. -2m pressure if the water level is 2 meters below the ground (i.e. the static water level). If the well is artesian i.e. positive static water level, enter a positive number (e.g. 2m).

If the water supply is a well, enter the pressure as a negative pressure, indicating the level of the water below ground level e.g., -2ft (m) pressure if the water level is 2 feet (meters) below the ground (i.e. the static water level). If the well is artesian i.e. positive static water level, enter a positive number e.g., 2ft (m).

When a pump is used in a system, there are often more items that result in a headloss. These items such as rising column losses (submersible pump only), suction pipe loss (surface pump), drawdown losses (well only), headworks losses, etc. can be entered in to the design and therefore analyzed as close to field results as possible.

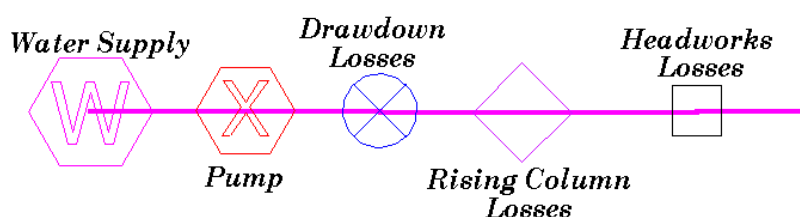


Figure 4-112

If the water supply is a well with a static water level below ground level, there will be a negative pressure in the pipe between the water supply and the pump, which will be reported during analysis. It does not matter in which order the above items are placed on the mainline pipe, only that they are placed so that any losses are accounted for. The items above can be entered at the depth they are at, or left at zero for convenience.

1.9.1.1 ENTERING PUMPS IN TO THE DATABASE

Use the manufacturer's data in [Figure 4-113](#) for the pump. From the pump curve supplied read off the pressure and resulting flow for several points along the 6 stage curve. In IRRICAD databases, select the Utilities menu, the **Curve Fit** option and the Pumps option. Enter at least three sets of data into the curve fitting utility for pumps (ensure the units above each column match the units you are using from the graph). Click the **Fit Curve** button. The curve fitting generates three numbers to use in the database (coefficients of a quadratic). This produces numbers A, B and C that IRRICAD uses in the pump formula to calculate the pressure the pump will produce based on the flow. The pressure

provided by the pump can be seen in the Mainline Full report – seen as a large head difference – (-ve or +ve) or using Hydraulic Object Info.

Enter a new pump into the Tutorial database from a pump curve.

1. Run IRRICAD Databases from the desktop icon. To open the **Tutorial.mdb** select *File/Open* and browse for the database.
2. Click on the Pumps component group tab and click the **[Add Pump]** icon or select *Component/Add Item*. Enter the “Usage” (Y), “Description”, “Warehouse Code”, “Connection Types” (use **PUMP F S** so it easy to identify in the reports) and “Diameters”.
3. If you cannot see the Curve Fit bar on the right-hand side select *View/Curve Fit*. Ensure the units match the units you are reading off the graph in [Figure 4-113](#). Enter at least 3 sets of points from the curve, particularly around the area you wish to operate the pump in the design.

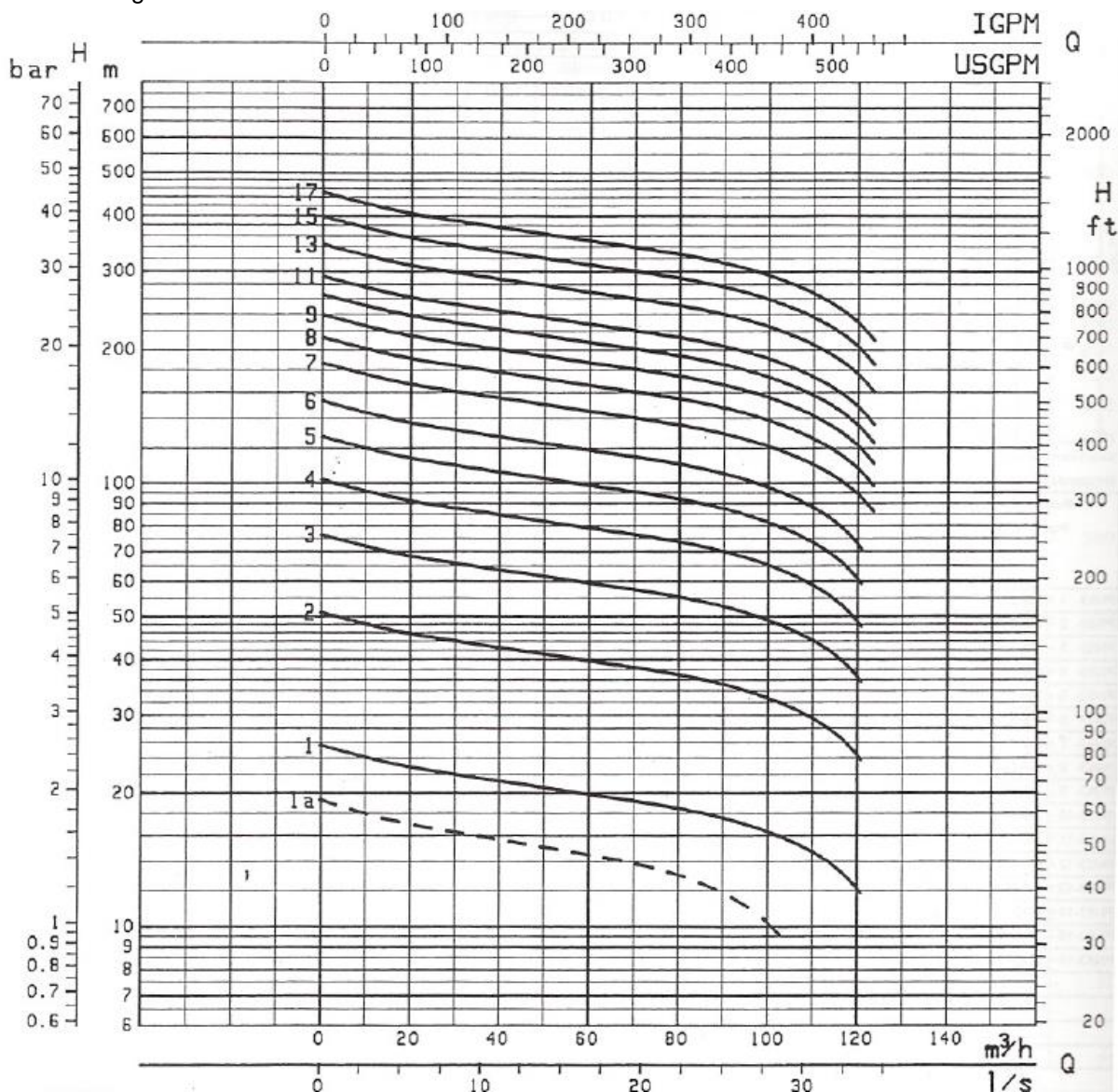


Figure 4-113

4. Click the **[Fit Curve]** button. Ensure the R^2 is greater than 90%. If it is not, re-enter the points. The curve fitting generates three numbers to use in the database (coefficients of a quadratic). This produces numbers A, B and C that IRRICAD uses in the pump formula to calculate the pressure the pump will produce based on the flow. The pressure provided by the pump can be seen in Hydraulic Object Info.

- Click the green arrow to automatically populate the H/Q Curve factors A, B and C in the Pump Details dialog.
- Enter the “Minimum Flow” and “Maximum Flow” for that pump and select a “Plotting Symbol”, “Symbol Size” and “Plotting Colour” for the new item. [Save] the new pump.

Notes:

If a surface pump model is 100 x 65: 100 is the suction diameter, 65 is the diameter of the discharge (outlet). If an extra number is present in the description this is the size of the impeller.

For a submersible pump, enter the inlet and outlet diameter the same.

1.9.1.2 MISCELLANEOUS HYDRAULIC ITEMS IN YOUR SYSTEM.

These are items that have a pressure loss in the system. These losses can be based on flow or can be a fixed loss.

If fitting selection is not important, it is convenient to enter the connection type for Misc. Hydraulic items to reflect the description e.g., DD for drawdown. This makes it easier to find them in the Mainline Full Report. Also you can change the connection codes after design but prior to fitting selection easily if required.

Drawdown Losses

Drawdown losses are based on well tests. Determine the drawdown for the well (pumping level - static water level).

Solve the formula used for Misc. Hydraulic items: $H = K \times Q^n$ where H is in meters and Q is in m³/hr.

The drawdown is equal to the headloss in m (e.g., if the dd = 9.6m, then the headloss = 9.6m).

Q is the flow at the well, e.g., 49m³/h. I is the exponent.

For alluvial aquifers: If there is only one well test (Q-dd pair) available estimate the index is around 1.5. For a large flow use 1.7 (> 50 l/s). Find the value of the constant e.g., $K = H/Q^n$.

If there are two points supplied (2 well tests) on the same well can calculate the index (exponent). $N = \log(D1/D2)/\log(Q1/Q2)$. $K = D1/Q1^N$.

For wells that are uncased in rock or limestone use an index (n) close to 1.0

- Enter the constant (K) and index or exponent (n) in to the correct edit fields in the Other Hydraulic component group in the database. The intercept (C) is 0.

Enter a new Drawdown loss item in to your database. The data you have is a flow of 49m³/h and with 9.6m drawdown. Calculate the Constant K and the Index (exponent) n.

- Go to the Other Hydraulics component group tab in the Tutorial database. Click on [New Item]. Enter the “Usage” (Y), “Description”, “Warehouse Code”, “Connection Types” and “Diameters”. Enter the “Constant” and “Index” as you have calculated in the correct fields. Leave the “Fitting Type” blank (only used for PRVs). Enter the “Minimum Flow” and “Maximum Flow” for the item and select a “Plotting Symbol”, “Symbol Size” and “Plotting Colour” for the new item. [Save] the new item.

Rising Column (Rising Main) Losses in a Submersible Pump

This item can also be the suction pipe loss in a surface pump.

Use a friction loss chart for the type of rising column used.

Enter at least three sets of numbers read from the chart for the correct flow and rising column size into the curve fitting utility for valves (same as Misc. Hydraulic but no intercept), making sure the units

above each column match the units you are using from the chart. Click the Fit Curve button. The curve fitting generates two numbers to use in the database. This produces constants and intercepts that IRRICAD uses in the Misc. Hydraulic formula to calculate the headloss through the rising column. It is easier to calculate for 100m and then adjust for the actual length.

For galvanized rising columns use the following: These have been calculated for a column 328ft (100m) long

Pipe Size	Constant	Index
8"	0.0001479	1.834
6"	0.00049076	1.84
5"	0.001254	1.810
4"	0.003307	1.852
3"	0.01174	1.855
2 1/2"	0.02448	1.874

Alter the constant relative to the length of the rising column (using the metric)

E.g., $\frac{\text{constant} \times \text{length (m)}}{100\text{m}}$

for an 8" rising column which is 85m long $0.0001479 \times 85 / 100 = 0.000126$ which is the "Constant".

The rising column of the pump we will be using is 6" (150mm) and is 213ft (65m) long. Calculate the constant relative the length (as above).

1. Go to the Other Hydraulics component group tab in the Tutorial database.
2. Click on [New Item]. Enter the "Usage" (Y), "Description" (ensure the description specifies the length), "Warehouse Code", "Connection Types" and "Diameters". Enter the "Constant" and "Index" as you have calculated in the correct fields. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [Save] the new item.

Headworks Losses

This Misc. Hydraulic item can be used to account for other losses relative to the flow.

$n = 2$

H = for example, if you estimate the pressure loss in the headworks to be 5psi @ 26385gph (3.5m @ 100m³/h) you can assume $n=2$ (in most cases) and solve for K .

Solve for K $H = KQ^n$

There is no intercept so leave the intercept field (C) as 0.

You can calculate the headloss through each of the items in the headworks or expected to be in the headworks at a particular flow and therefore calculate the constant and the index. The headloss will change as the flow increases or decreases. Note that existing systems tend to have high headloss at the headworks.

Enter a new Miscellaneous loss item in to your database – where the pressure loss is 5psi @ 26385gph (3.5m @ 100m³/h).

1. Go to the Other Hydraulics component group tab in the Tutorial database. Click on [New Item]. Enter the "Usage" (Y), "Description", "Warehouse Code", "Connection Types" and "Diameters". Enter the "Constant" and "Index" as you have calculated in the correct fields. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and

"Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [Save] the new item.

Miscellaneous Fixed Losses

Misc. losses can be added to account for any other possible losses. These can be added into the Other Hydraulics component group by entering an intercept and leaving the constant and index as zero. Use only if you want to include a fixed loss regardless of flow.

1. Go to the Other Hydraulics component group tab in the Tutorial database. Click on [New Item]. Enter the "Usage" (Y), "Description", "Warehouse Code", "Connection Types" and "Diameters". Enter the "Intercept" as **6.5ft (2m)**, leaving the "Constant" and "Index" as **0**. Leave the "Fitting Type" blank (only used for PRVs). Enter the "Minimum Flow" and "Maximum Flow" for the item and select a "Plotting Symbol", "Symbol Size" and "Plotting Colour" for the new item. [Save] the new item.

1.9.1.3 DRAW A DESIGN WITH A PUMP AND ALL COMPONENTS

1. Now draw a design with the new pump in it, place the drawdown losses, rising column losses, headworks losses and miscellaneous losses you have just entered in the database.
2. Enter the *Water Supply* "Head" as **-33ft (-10m)** for both.
3. Place a **Demand Flow (Mainline/Outlet)** with a "Pressure" of **100psi (70m)** and a "Flow" of **26385gph (100m³/hr)** on the end of the mainline to represent a hydrant.
4. *Design* the system and view the reports to see the effect on the system the above items have. The best report to see this in is the *Mainline Design Full* report.
5. Now change the demand point to a **P of 70m and Q of 50m³/hr**. Re-run *Zone Analysis*, *Valve Analysis* and *Mainline Design/Analyse* and re-look at the *Mainline Full Report*.

1.9.2 MULTIPLE WATER SUPPLIES

If only one water supply exists in a design or there are completely separate systems on the same design you can leave the "Calculate pressure?" option enabled in each water supply for IRRICAD to calculate based on each system duty.

However, if there are 2 or more water supplies present for the same system and you are not concerned about pumps, you must enter at least the pressure in to all water supplies. You can increase or decrease the pressure to achieve the flow you require from each. If the water supplies are supplying the same system then *LP Design* cannot be used. You must use *Velocity Design* to size the pipes.

Note: If the multiple Water Supplies are unconnected in your design then they must supply different system flows as set in Management.

1. Draw a design with 2 water supplies, one on each end of an **8-inch (200mm)** mainline pipe. **164ft (50m)** long. Enter the pressures for the water supplies to be **90psi (65m)**.
2. Select the *Mainline/Outlet Demand Flow* and set the demand point "Pressure" to be **70psi (50m)** and the "Flow" to be **13192gph (50m³/hr)**.
3. Use *Right-click/Snaps/Midpoint* to connect the demand point halfway along the pipe.
4. After completing Zone analysis and Management run *Mainline Design/Analyse*. View the *System Duty Report*.



Figure 4-114

5. Now select the demand point and move it closer to the left-hand water supply. Re-analyze the mainline and view the System Duty Report.



Figure 4-115

6. Now select the demand point again and move it closer to the other right-hand water supply. Re-analyze the mainline and look at the *System Duty Report*.

This exercise highlights the effects on the water supplies under changing conditions.

1.9.2.1 PRVs WITH MULTIPLE WATER SUPPLIES ON A SYSTEM

If a PRV on the water supply is required, in a design containing multiple water supplies, do the following:

Make the water supply the PRV – enter the water supply pressure equal to the PRV pressure setting e.g., if the PRV is to be set at 70psi (50m), enter the water supply pressure as 70psi (50m). Never put PRVs in loops. Manually check the PRV is able to regulate at that set pressure and at that flow.

1.9.2.2 MEETING THE FLOW REQUIREMENT FROM THE WATER SUPPLIES

As the flow from the water supplies is determined by the demand of the zones running on a system flow typically in a real design there is a balancing act between the pressure at the water supply and the flow it produces. Change the pressure until you achieve the required flow from each water supply.

There is also the option to 'fix' the flow, rather than the pressure, on one or more water supplies, in the water supply dialog. Typically, at least one water supply will not have a fixed flow and therefore be able to determine the flow not provided by the other water supplies – this is required if each system flow has different demands. The fixed flow water supplies will be able to calculate the required pressure not provided by the fixed pressure water supplies.

Figure 4-116

1.9.2.3 USING PUMPS IN PARALLEL

If two pumps are in parallel – they are effectively in a loop – NEVER put pumps in a loop. If this is the case, draw two water supplies with a pump each and connect the mainline after the pumps:

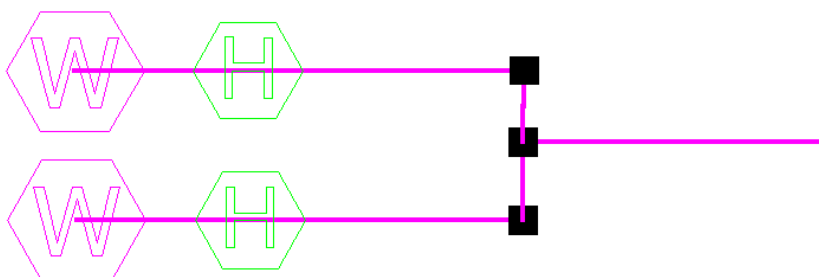


Figure 4-117

Remember using the same pump in parallel doubles the flow.

1. Draw a small design like the above picture using the **Tutorial.mdb**.
2. Enter 25in (**0.1m**) as the “Design Head” and “Max Head” for both water supplies.
3. Select an **8-inch (200mm)** pipe for the mainline pipe. Select the **Pump 350gpm @ 70psi (1320lpm @ 50m)** as the pump.
4. Use the **Demand Flow** outlet as the *Mainline Outlet* and enter a “Pressure” of **68psi (48m)** and a “Flow” of **39578gph (150m³/hr)**.
5. *Assign all Zones to One System Flow* and enter system flow 1 to be supplied by both water supplies.
6. Analyze the zone.
7. Run *Mainline Design/Analyze* and view the *Mainline Design Full* report. Click [OK] on both warning messages about not having pumps in loops.
8. Turn *Hydraulic Object Info* on in *Right-click/Object Info* and view the hydraulic results of each component.

Note that when there is more than one water supply on a system then some pipes and water supplies will report in the opposite direction. This will look like there are negative flows when in reality IRRICAD is simply reporting the pipe end ‘P1’ in the upstream position from the subsequent water supply.

1.9.2.4 PUMPS IN SERIES

Pumps can be placed in series. Once again, no pump should be placed within a loop.

1. Edit the above drawing so that there is only one water supply.
2. Add an extra pump on the same pipeline.
3. Change the demand point to require **128psi (90m)** pressure and **19789gph (75m³/hr)**.
4. Re-run zone analysis, management, and mainline analysis.
5. Check the *Mainline Design Full* report.
6. Turn *Hydraulic Object Info* on in *Right-click/Object Info* and view the hydraulic results of each component.

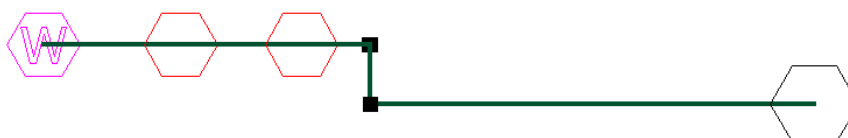


Figure 4-118

Remember using the same pump in series doubles the pressure output.

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