K-Line™ Effluent

For efficient effluent dispersal

TECHNICAL MANUAL

What is effluent?

Farm dairy effluent is the natural liquid waste flowing from the cows through to a storage pond for application to paddocks.

Effluent is not:

Penicillin tubes, gloves, stones, cow hide hairs, swedes, corn, supplementary feeds, pumice etc.

Contents

Overview

The growth in dairy production over the last 10-15 years has changed much of New Zealand's farming landscape, both from farming practices and land uses. With New Zealand's dairy herd approaching over 4.9 million, the challenge is on to dispose of the effluent generated, which at 40-50 million cubic metres (m^3) of farm dairy effluent, it is quite a challenge. Effluent, being largely composed of digested grass, contains faecal bacteria and a wide range of nutrients. These nutrients, when allowed to migrate into waterways or groundwater can result in significant issues with algal blooms, the killing of fish and problems with human and animal health caused by faecal bacteria. New Zealand's clean, green and unpolluted status is invaluable, to New Zealand's dairy and tourism industry as well as many other groups and people in New Zealand. The dairy industries world markets are also becoming increasingly interested in the method and cleanliness of the farming practices used to make their products. Careful management of effluent by dairy farmers is a key element in achieving this aim.

Many of the problems that occur as a result of dairy effluent dispersal occur because effluent is treated as a waste product rather than as a valuable nutrient source. K-Line™ for Dairy Effluent when used with storage can help to mitigate many environmental issues, it does this because -

- Low application rates of K-Line™ help to minimise the amount of nutrient that is transferred to the waterways
- Storing the effluent during the periods of the year when the soils are saturated also minimises the losses to waterways.

Land disposal has, for many years been the cornerstone of effluent disposal, preferred by farmers and Councils alike, however in many parts of New Zealand, due to both weather and soil conditions it presents some risks especially on soils that have low infiltration rates, artificial drainage systems or indeed free drainage.

Soils

- For land application of farm dairy effluent it is critical to have an understanding of the soil processes that affect the successful application of effluent. Soils being storehouses of nutrients, moisture and oxygen are at the backbone of any dairy farming venture. Soils provide the critical balance between water and air (oxygen) and also provide a physical structure in which a plant grows, not to mention the nutrients that the soil holds. This soil structure has some very important effects upon the way soils hold and carries water and oxygen
- It is this structure that determines how effluent will be transported when it is applied to the soil. The structure of the soil has a very large effect on the 'infiltration rate' of the soil. If liquid is applied at a faster rate than the soil can absorb then ponding or runoff is likely to occur. K-Line™ applies the liquid very slowly over an extended period therefore minimising the chance of runoff or ponding. It should also be noted that the 'infiltration rate' of the soil diminishes as that soil approaches 'field capacity'. Infiltration is the process by which water on the ground surface enters the soil. Infiltration is governed by two forces, gravity and capillary action
- Trials show the loss of phosphorus and bacteria to drainage water is only 5-7% of the loss of a travelling irrigator when soil is near field capacity. This also shows nitrogen levels in the drainage are minimised to almost nil (see Figure 1).

Drainage from a 'Mole and Tile' drained paddock after effluent application

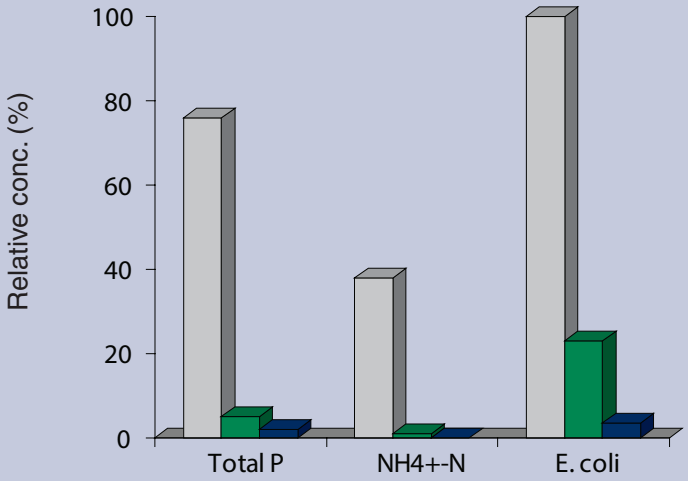


Figure 1.

Rotating twin gun
K-Line™
K-Line™, intermittent pumping

Fertiliser properties of effluent

Farm dairy effluent, when recycled back onto the land, offers a source of N, P, K and S and trace elements to enhance pasture or crop production and reduce fertiliser expenditure. The organic matter in the effluent will improve soil water holding capacity, soil aeration and drainage, and tillage characteristics. Application of effluent on to pastoral soils may also increase earthworm numbers.
Environmental quality is the major reason for applying effluent to land, but the value of nutrients, and a minor irrigation benefit, is a significant bonus. Effluent correctly applied can substitute for some solid fertiliser use, as well as assist in the maintenance of environmental water quality.
Successful use of effluent requires assessment of its value in fertiliser terms for both pasture and crop production.
A nutrient analysis of the effluent can be carried out to ensure that effluent application rates meet plant requirements. The fertiliser value of effluent applied to land direct from the farm dairy is typically $1,200 to $1,500 per 100 cows per annum under normal grazing conditions.

Fertiliser value of effluent

The table on the right gives the equivalent fertiliser value of effluent collected and applied to land (total liquid and solid).

The following fertilisers are used for the solid fertiliser comparison as they are popular and best reflect the proportion of the various elements in the effluent:

- Urea N-P-K-S-Mg: 46-0-0-0-0
- 50% Potash Super: 0-5-25-6-0
- Magnesium Oxide (i.e. Mg Oxide): 0-0-0-0-52.

Nutrient availability to the pasture

Research shows that 1kg N from effluent is equivalent to 1kg N from urea, in terms of pasture production, composition and nitrate leaching. Therefore farm dairy effluent can produce a good pasture response, up to 10 - 15kg DM per kg N applied in the effluent.
Most of the potassium (K) in effluent is also available for pasture uptake (up to 90%), however phosphorus (P) will require time to be broken down into plant available forms.

Approximately half the phosphorus value in effluent is available to plants in the first year.

Equivalent fertiliser value of effluent from 100 cows

Nutrient (kg/year)					Approximate solid fertiliser equivalent (tonnes/year)	Value ($/year)
N	P	K	S	Mg		
590					1.3 of Urea	700
	70	540	80		1.3 - 2.2 of 50% Potash Super	400 - 700
				100	0.2 of Mg Oxide	100
Total value per annum						**$1200 - $1500**

K-Line™ Effluent

What is K-Line™?

- K-Line™ is a flexible hose line sprinkler system originally designed for irrigation. However, the low application rate makes the K-Line™ system well suited to effluent distribution. At the heart of the system is a series of tough plastic pods protecting a sprinkler, firmly attached to special K-Line™ K-Pipe™
- K-Line™ provides an excellent method of liquid dispersal options from the many and varied sources
- K-Line™ systems are all designed to operate at low pressure
- K-Line™ provide a number of product choices which gives you maximum flexibility of a customised effluent dispersal system for your farm
- K-Line™ will suit any paddock shape, size or terrain
- K-Line™ is easily moved by any quad-bike or farm vehicle
- K-Line™ is a low application rate system.

Farmer benefits

- Low capital cost
- Ease of installation use and shifting
- Tailor application to staff availability
- Low application rate to remove the risk of ponding and run-off, keeping nutrients within the plant root zone, compliant to regional council requirements
- Better retention of nutrients lowers fertiliser requirements
- Control of application with automated timers
- During busy times (e.g. calving) effluent dispersal can be avoided
- Best possible use of the nutrients in farm dairy effluent.

Production benefits

- Farmers say that K-Line™ provides them with greater pasture growth rates
- K-Line™ provides a more uniform application compared to travelling irrigators
- More palatable pasture compared with effluent applied by a travelling irrigator.

	Requirements	Benefits			
	Minimum Filtration	Palatability	Distribution	Application Rate	Nutrient Management
K-Line™ Std Naan 5022  430mm (d) x 230mm (h) The K-Line™ standard has a Naan 5022 sprinkler with a 4mm nozzle and therefore requires the best liquid quality.	 or  Weeping Wall Solid Separator & Storage 	Optimum	Optimum	Optimum	Optimum
K-Line™ Mid Senninger 5023  560mm (d) x 290mm (h) The K-Line™ mid has a Senninger 5023 sprinkler and a nozzle up to 6.35mm, therefore it can handle a slightly less liquid quality.	  Two Pond Storage	Optimum	Optimum	Optimum	Excellent
K-Line™ Max^{70} Senninger 7025  860mm (d) x 590mm (h) The K-Line™ Max^{70} has a Senninger 7025 sprinkler and a nozzle up to 9.53mm. It can therefore handle a lower liquid quality.	 Single Pond Storage	Medium	Excellent	Optimum	Good
K-Line™ Max^{80} Senninger 8025  860mm (d) x 590mm (h) The K-Line™ Max^{80} has a Senninger 8025 sprinkler and a nozzle up to 15.88mm. It can therefore handle the lowest liquid quality.	 Pumping Sump with Stone Trap	Satisfactory	Excellent	Optimum	Okay

Selection criteria for your K-Line™ system

Selection of a suitable K-Line™ pod and a successful installation is very much dependent on the degree of separation of the solids from the liquids.

K-Line™ Std system

For the K-Line™ Std effluent pod the nozzle selection is 4mm therefore the separation of the solids would need to be better than 3mm. The minimum requirement for successful use would be a Weeping Wall system. This product will be most suitable if your effluent system has better separation than this.

K-Line™ Mid system

For the K-Line™ Mid effluent pod the nozzle selection is 6.35mm therefore the separation of the solids would need to be better than 5mm. The minimum requirement for successful use would be a Weeping Wall system. This product will be most suitable if your effluent system has better separation than this.

K-Line™ Max^{70} system

For the K-Line™ Max^{70} effluent pod the nozzle selection is from 5.56mm to 9.53mm, therefore the separation of the solids would need to be slight and the use of the Max^{70} pod system with large single ponds would be the minimum requirement for successful use. This product will be most suitable if your effluent system has better separation than this.

K-Line™ Max^{80} system

For the K-Line™ Max^{80} effluent pod the nozzle selection is from 9.53mm to 15.88mm, therefore the separation of the solids would need to be only slight and the use of the Max^{80} pod system with a good stone trap and a pumping sump would be the minimum requirement for successful use. This product will be most suitable if your effluent system has better separation than this.

K-Line™ Std Effluent

Why use K-Line™ Std Effluent?

- Low rate of application
- No leaching or run-off
- No ponding
- Cost effective
- Easily shifted
- Low maintenance
- Meets all regional council requirements
- Virtually no contamination of pasture.

Naan 5022 Sprinkler

- The Naan 5022 ½" full-circle sprinklers distribute effluent over a 20m diameter
- Naan 5022 sprinklers can achieve application rates down to as low as 2mm per hour. This reduces the risk of ponding and run-off and other forms of preferential flow. The soil has time to filter nutrients and bacteria
- Outlasts and costs less than brass or aluminium sprinklers
- Built for strength and durability using high-impact engineering-grade thermoplastics and top quality stainless steel components
- Pressure range between 1.5 bar and 3 bar
- Standard lower bearing pipe thread: ½" male thread
- Quick release bayonet nozzles for fast interchange
- Single nozzle design minimises clogging.

Pressure and flows of the Naan 5022

Nozzle (mm)	P bar	Q m3 / hr	Application Depth (m)
3.2 Green	2.0	0.570	1.43
	3.0	0.700	1.43
	4.0	0.810	1.43
3.5 Blue	2.0	0.660	1.65
	3.0	0.810	1.65
	4.0	0.930	1.65
4.0 Black	2.0	0.850	2.13
	3.0	1.030	2.13
	4.0	1.180	2.13

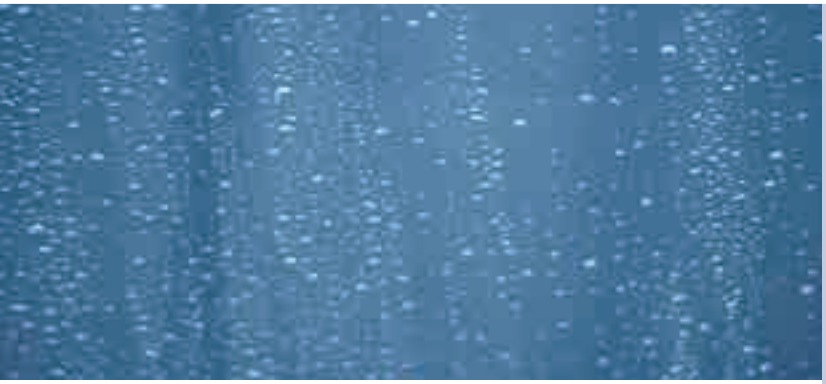
Sprinkler operation

- Naan 5022 sprinklers have a range of nozzles down to 3.2mm in size that are suitable for effluent. The recommendation is to use the 4mm black nozzle
- The table above shows the flow rate and depth of the recommended black K-Line™ Std sprinkler nozzles and also the next two smaller nozzles
- Complete flow rates: 0.57 - 1.03 m^3/hr.

Spacings : 20m
Recommended working pressure : 1.7 - 3 bar
Flow rate : 570 - 1,030 litres/hr
0.57 - 1.03m^3/hr

Spacing and pipe system

Special 40 and 45mm K-Pipe™ is available to complete your new K-Line™ Std effluent pods. The K-Pipe™ is simply threaded through the K-Line™ pod then with a 14mm drill and 13mm socket you are able to assemble your system. The special K-Pipe™ is designed to be flexible but highly resilient to the shifting process.



Sprinkler information

1. Naan 5022 impact sprinkler

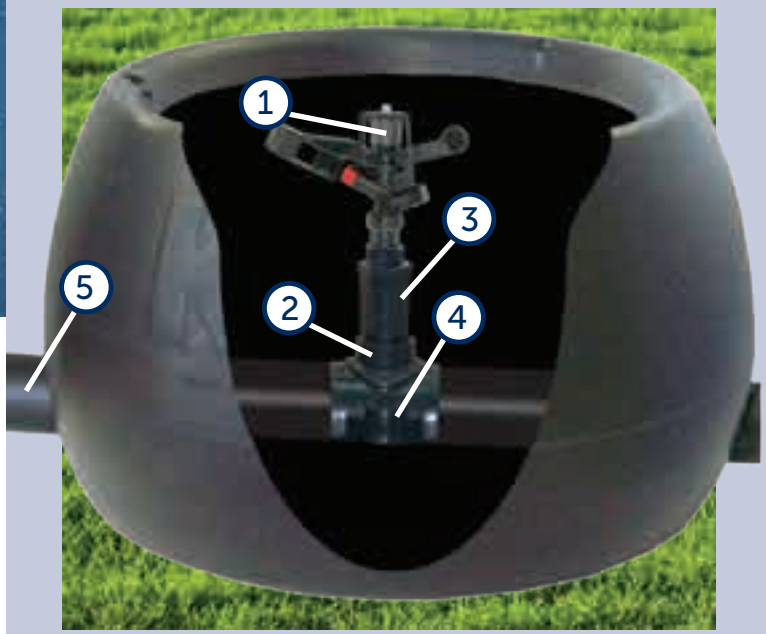
Order code: Naan-5022-xxx
Nozzle options code (xxx)
GRN = Green 3.2mm
BLUE = Blue 3.5mm
BLK = Black 4mm

2. K-Line™ Naan adaptor

Order code: Naan-adaptor
Connects Naan 5022 sprinkler to the K-Line™ saddle.
1/2"bsp(Bottom) x 1/2"bsp (Top)

3. K-Line™ Tapping saddle

Order code:
KLTPS40 40mm Tapping saddle
KLTPS45 45mm Tapping saddle
Includes brass nuts



Pod size: 430mm (d) x 230mm (h)

Naan 5022
3.2 - 4mm nozzles for effluent applications

K-Line™ Tapping saddle
40mm and 45mm. Made specially for K-Line™ systems

1 x Naan adaptor
- ½ male and female specifically for the Naan sprinkler

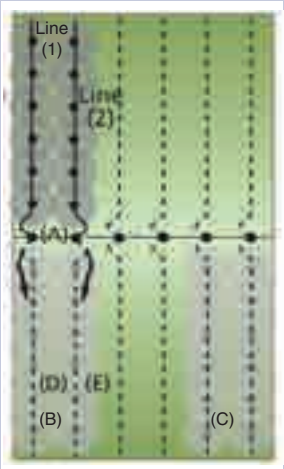
1 x U Bolts
2 x Brass nuts

K-Pipe™
40mm and 45mm. Made specially for K-Line™systems

System components

- The K-Line™ Std pod comes complete with the sprinkler, riser assembly and saddle to connect your K-Pipe™ to the pod
- K-Line™ provides a complete series of K-Pipe™ solutions
- To ease shifting K-Line™ also provides end tow units.

K-Line™ Std Effluent



Shifting rotation within a typical paddock (12 pods)

Line 1 moves to D

Line 2 moves to E

Layout of the system

The shift pattern is quite different compared to a K-Line™ irrigation system. With an irrigation system it is important to shift the system when it is running. This is not practical when the system is filled with effluent. The K-Line™ Std lines are therefore shifted when they are not running. The K-Line™ Std lines themselves are generally made with 40mm or 45mm K-Pipe™ and have the same fittings at each end, so the lines can be connected to the submain at either end of the line. The K-Lines need to be pulled directly from one end to the other. Because the lines are short and contain only a few pods this process is very easy. The process works for paddocks of all shapes and sizes.

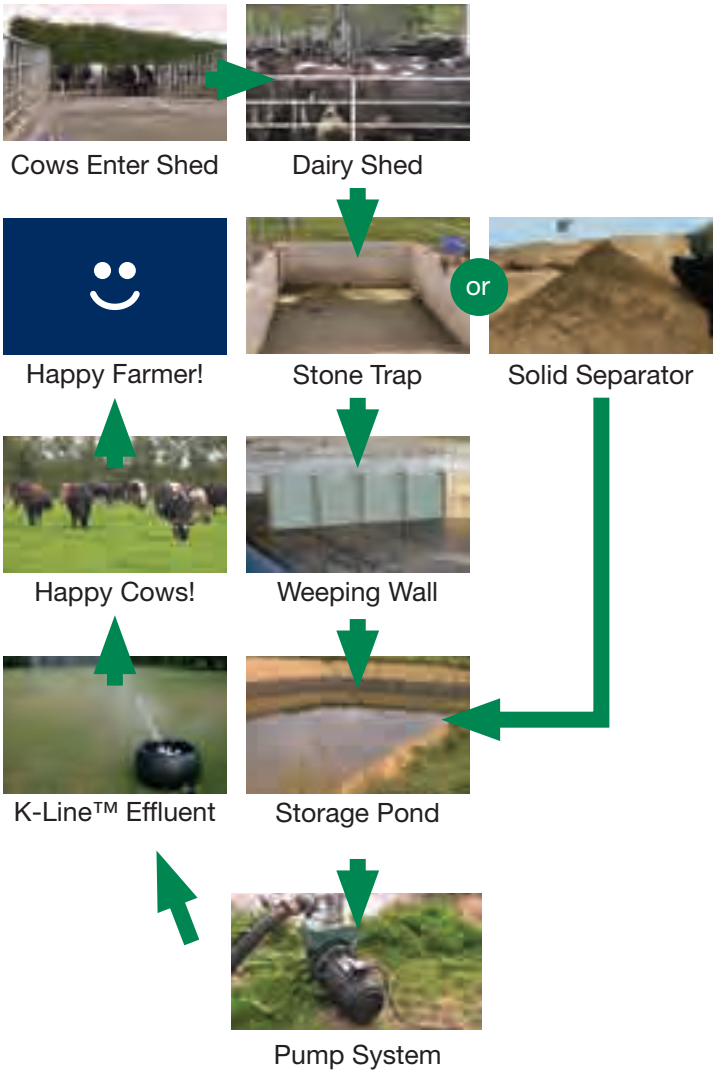
The simple process

Go to the submain (valve) end of the sprinkler line (1) (point (A) in Figure 3). Uncouple the line (1) from the submain, then connect the tow rope onto the K-Line™ then tow towards point (B) The K-Line™ will end up in position (D). Unhook, install a plug end then re-couple the K-Line™ back at the submain. Repeat this shifting process for line (2) uncouple at point (A) then tow the line toward point (B), Install the plug then re-couple at point (A).

When the field has been irrigated completely (point (C)), disconnect the sprinkler line from the feed line, tow the sprinkler line into a new paddock and you're ready to start the dispersal rotation again.

Best management practice

To apply a consent application of 15mm depth, run the system for 4-5 hours. For best management practice, it is recommended that the effluent dispersal area should be 8ha/100 cows.



What you need

The process starts with a visit from your consultant to plan the K-Line™ effluent system. The consultant will examine the shape and size of your property, land dispersal area, the quality and quantity of the effluent supply, effluent rotation, the soil types involved and historical weather patterns.

Your requirements together with hydraulic analysis, pressure requirements, pump sizes, power systems and budget, will determine the options. As K-Line™ Std only distributes the liquid portion of the effluent and has 4mm nozzles, it is important to eliminate solids. Solids can be removed by either a Weeping Wall (drying bed), multiple pond systems or solid separators.

The system typically consists of a pump, main line, submain and K-Lines. Assembly is so simple many people choose to install the submain, feed and sprinkler lines themselves.

Why use K-Line™ Mid Effluent?

- Low rate of application
- No leaching or run-off
- No ponding
- Cost effective
- Easily shifted
- Low maintenance
- Meets all regional council requirements
- Virtually no contamination of pasture.

Senninger 5023 Sprinkler

- The Senninger 5023 ¾" full-circle sprinklers distribute effluent over a 25m diameter
- Senninger 5023 sprinklers can achieve application rates down to as low as 2mm per hour. This reduces the risk of ponding and run-off and other forms of preferential flow. The soil has time to filter nutrients and bacteria
- Outlasts and costs less than brass or aluminium sprinklers
- Built for strength and durability using high-impact engineering-grade thermoplastics and top quality stainless steel components
- Pressure range between 1.5 bar and 3 bar
- Standard lower bearing pipe thread ¾" male thread
- 23° angle for maximum distance of throw
- Single nozzle design minimises clogging.

Pressure and flows of the Senninger 5023

Sprinkler Base Pressure (bar)	2.07	2.41	2.76	3.10	3.45	3.79	4.14	4.48
#13 Nozzle - White (5.16mm)								
Flow [L/hr]	1476	1594	1701	1806	1903	1999	2087	2169
Diam. at 0.46m ht. [m]	28.0	29.0	29.9	30.5	31.1	31.4	31.7	32.0
#14 Nozzle - Blue (5.56mm)								
Flow [L/hr]	1701	1837	1960	2083	2194	2294	2408	2498
Diam. at 0.46m ht. [m]	28.7	29.9	30.8	31.4	32.0	32.3	32.6	32.9
#15 Nozzle - Dark Brown (5.95mm)								
Flow [L/hr]	1933	2087	2228	2362	2498	2612	2725	2839
Diam. at 0.46m ht. [m]	29.3	30.5	31.4	32.3	32.6	32.9	33.2	33.5
#16 Nozzle - Orange (6.35mm)								
Flow [L/hr]	2187	2362	2521	2680	2816	2953	3089	3225
Diam. at 0.46m ht. [m]	29.9	31.1	32.0	32.9	33.2	33.5	33.8	34.1
#17 Nozzle - Dark Green (6.75mm)								
Flow [L/hr]	2430	2635	2794	2975	3134	3293	3430	3566
Diam. at 0.46m ht. [m]	30.2	31.7	32.6	33.5	33.8	34.1	34.4	34.7
#18 Nozzle - Purple (7.14mm)								
Flow [L/hr]	2703	2930	3112	3316	3498	3657	3816	3975
Diam. at 0.46m ht. [m]	30.5	32.0	33.2	34.1	34.4	34.7	35.1	35.4

K-Line™ Mid Effluent

Sprinkler operation

- Senninger 5023 sprinklers have a range of nozzles down to 5.16mm in size that are suitable for effluent. The recommendation is to use the 6.35 nozzle
- The table shows the flow rate and diameter of throw of the recommended #16 orange K-Line™ Mid sprinkler nozzles and includes the other options
- Complete flow rates: 1.4 - 3.5 m^3/hr.

Spacing and pipe system

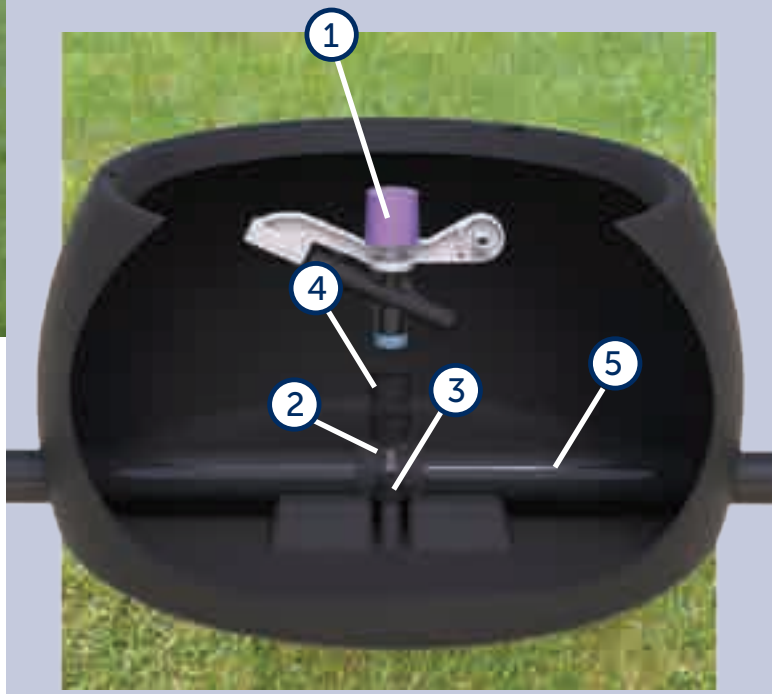
Special 40, 45mm K-Pipe™ is available to complete your new K-Line™ Mid effluent pods. The K-Pipe™ is simply threaded through the K-Line™ pod then with a 14mm drill and 13mm socket you are able to assemble your system. The special K-Pipe™ is designed to be flexible but highly resilient to the shifting process.

Sprinkler information

1. Senninger 5023 ¾" Full-Circle Sprinklers
Order code: SEN-5023-xxx
Nozzle options code (xxx)
#13 = White 5.16mm
#14 = Blue 5.56mm
#15 = Dark Brown 5.95mm
#16 = Orange 6.35mm
#17 = Dark Green 6.75mm
#18 = Purple 7.14mm

2. K-Line™ Senninger 5023 Mid Adaptor
Order code: MID.ADAPTOR
½ x ¾" male and female adaptor to specifically connect the Senninger sprinkler to the K-Line™ saddle

3. K-Line™ Tapping saddle
Order code:
KLTPS40 40mm Tapping saddle
KLTPS45 45mm Tapping saddle
Includes brass nuts



Pod size: 560mm (d) x 290mm (h)

1 **Senninger 5023**
5.95 - 6.75mm nozzles for effluent applications

2 **K-Line™ Tapping saddle**
40mm and 45mm. Made specifically for K-Line™ systems.

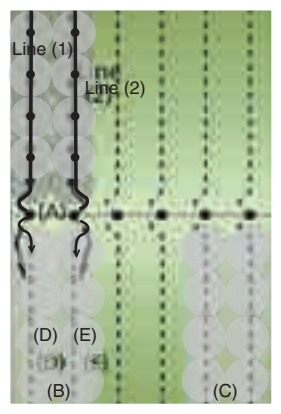
3 **1 x U Bolts**
2 x Brass nuts

4 **1 x Senninger adaptor**
- ½ x ¾" male and female specifically for the Senninger sprinkler

5 **K-Pipe™**
40mm and 45mm. Made specifically for K-Line™ systems

System components

- The K-Line™ Mid pod comes complete with the sprinkler, riser assembly and saddle to connect your K-Pipe™ to the pod
- K-Line™ provides a complete series of K-Pipe™ solutions
- To ease shifting K-Line™ also provides end tow units.



Shifting rotation within a typical paddock (8 pods at 25 metre spacings)
Line 1 moves to D
Line 2 moves to E

Layout of the system

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The simple process

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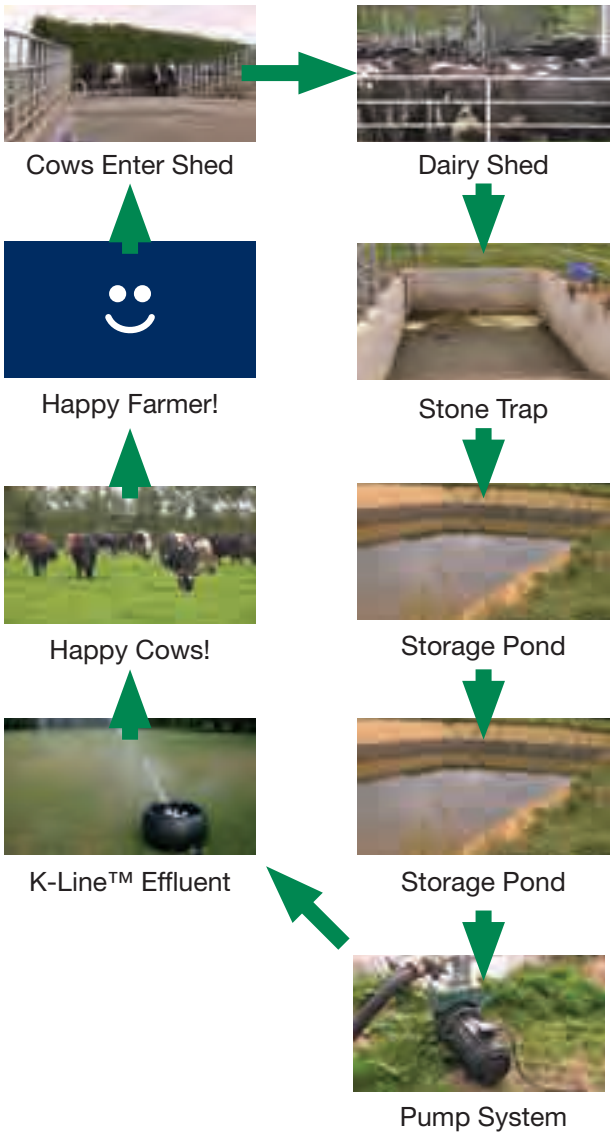
When the field has been irrigated completely (point (C)), disconnect the sprinkler line from the feed line, tow the sprinkler line into a new paddock and you're ready to start the dispersal rotation again.

Best management practice

To apply a consent application of 15mm depth, run the system for 3-4 hours. For best management practice, it is recommended that the effluent disposal area should be 8ha/100 cows as.



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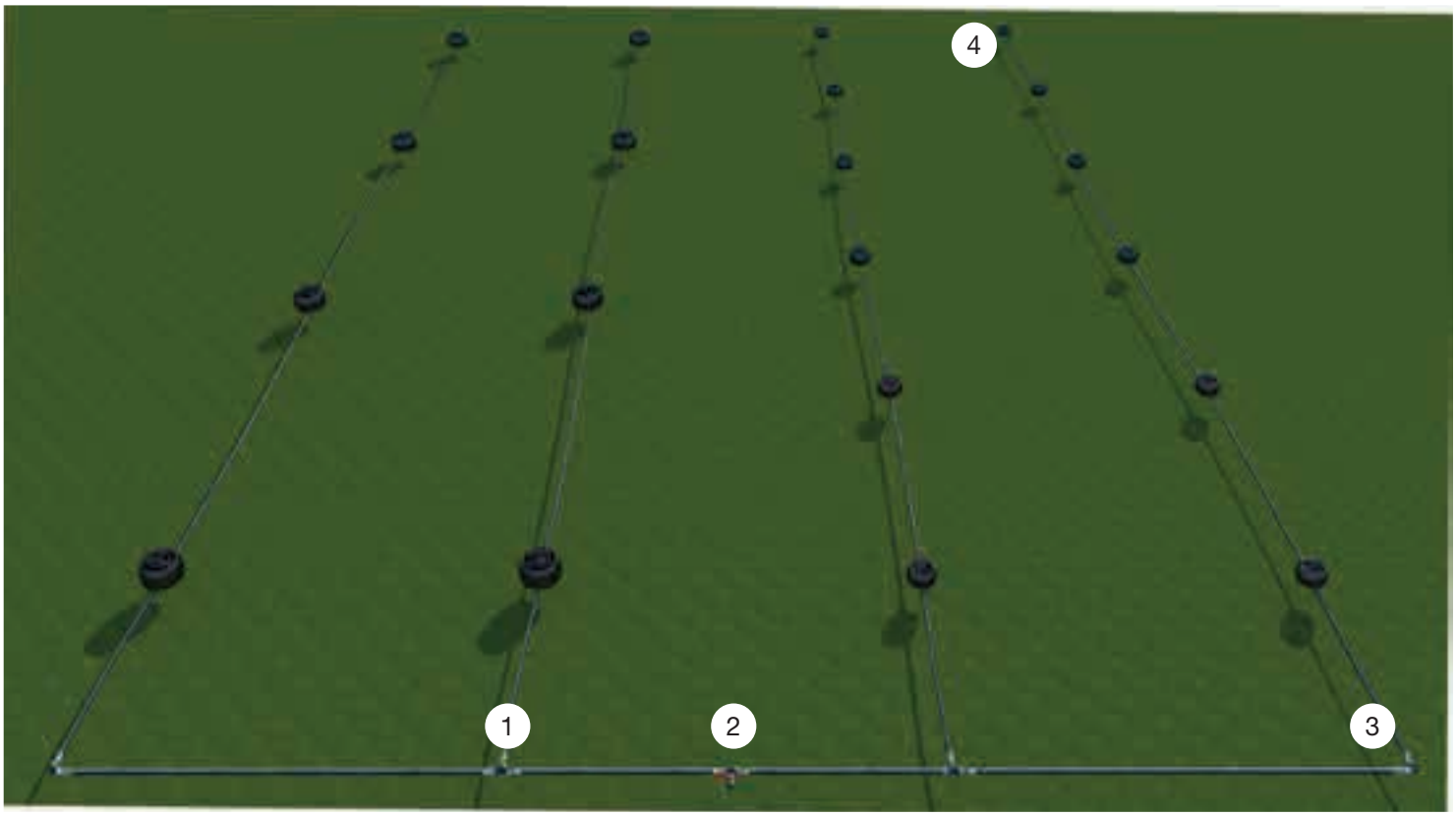
Your requirements together with hydraulic analysis, pressure requirements, pump sizes, power systems and budget, will determine the options. As K-Line™ Mid only distributes the liquid portion of the effluent and has 6.35mm nozzles, it is important to eliminate solids over 5mm. Solids can be removed by either a Weeping Wall (drying bed), multiple pond systems or solid separators.

The system typically consists of a pump, main line, submain and K-Lines. Assembly is so simple many people choose to install the submain, feed and sprinkler lines themselves.

Components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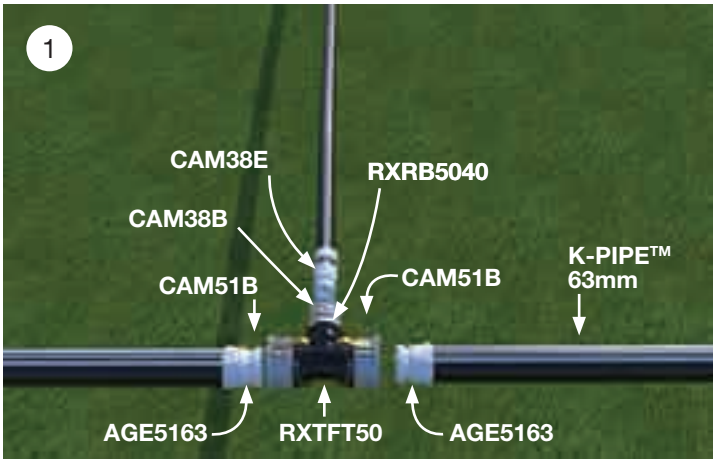
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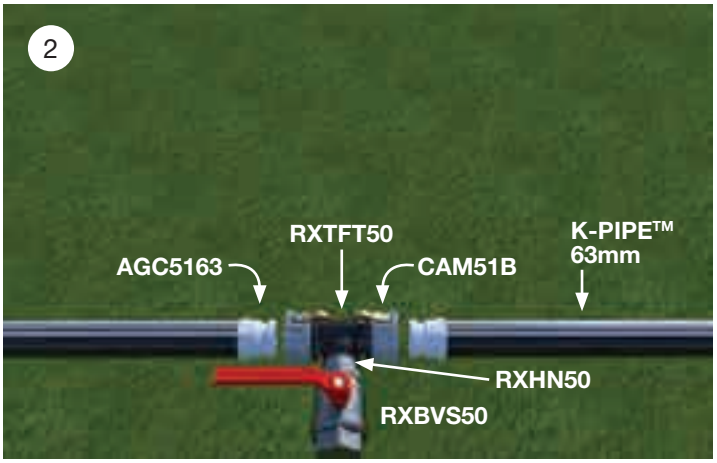
CAM51B
CAM51B
K-PIPE™
63mm
AGE5163
RXTFT50
AGE5163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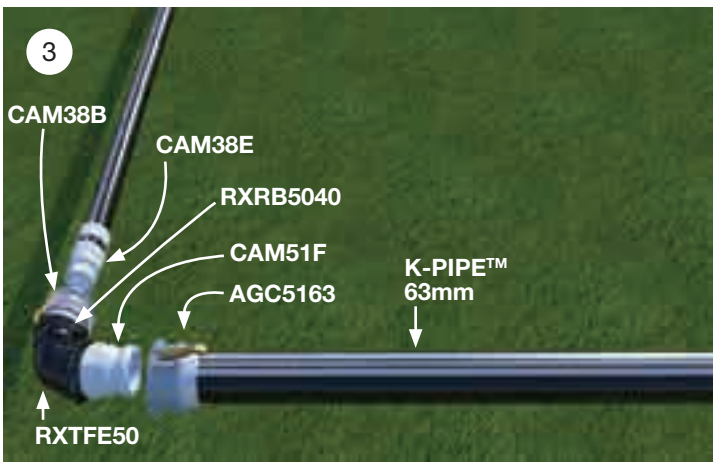
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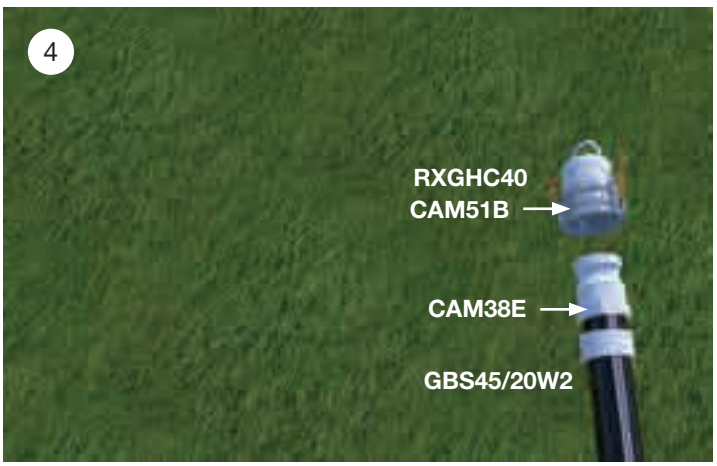
CAM38B
CAM38E
RXRB5040
CAM51F
AGC5163
K-PIPE™
63mm
RXTFE50


4
RXGHC40
CAM51B
CAM38E
GBS45/20W2

Why use K-Line™ Max70 Effluent?

- Low rate of application
- No leaching or run-off
- No ponding
- Cost effective
- 3 pods to replace a travelling irrigator
- Large nozzle to minimise blockages
- Easily separated by camlocks and shifted individually
- Low maintenance
- Meets all regional council requirements.

Senninger 7025 S Sprinkler

- The 70 series full-circle sprinklers distribute effluent over a large diameter, for higher volume systems
- Senninger sprinklers can achieve application rates down to as low as 2mm per hour. This reduces the risk of ponding and run-off and other forms of preferential flow. The soil has time to filter nutrients and bacteria
- Outlasts and costs less than brass or aluminium sprinklers
- Built for strength and durability using high-impact engineering-grade thermoplastics and top quality stainless steel components
- Built-in hex wrench for easy in-the-field maintenance standard lower bearing pipe thread: 1" male thread
- 25° angle for maximum distance of throw
- Single nozzle design minimises clogging.

Pressure and flows of the Senninger 7025

Sprinkler Base Pressure (bar)	2.41	2.76	3.10	3.45	3.79	4.14	4.48	4.83
#14 Nozzle (5.56mm)								
Flow [L/hr]	1842	1967	2090	2201	2317	2408	2498	2612
Diam. at 0.46m ht. [m]	32.3	33.8	34.4	35.1	35.7	36.3	36.9	37.5
#16 Nozzle (6.35mm)								
Flow [L/hr]	2430	2589	2748	2907	3043	3180	3316	3430
Diam. at 0.46m ht. [m]	33.8	35.7	36.6	37.5	38.4	39.3	39.9	40.5
#18 Nozzle (7.14mm)								
Flow [L/hr]	3021	3225	3407	3611	3770	3952	4111	4270
Diam. at 0.46m ht. [m]	36.0	37.8	38.7	39.3	40.8	42.4	43.3	43.9
#20 Nozzle (7.94mm)								
Flow [L/hr]	3634	3884	4134	4361	4565	4770	4951	5156
Diam. at 0.46m ht. [m]	37.8	39.6	40.8	41.8	43.3	44.5	45.7	46.6
#22 Nozzle (8.73mm)								
Flow [L/hr]	4384	4656	4951	5201	5474	5701	5928	6155
Diam. at 0.46m ht. [m]	38.4	40.5	43.0	45.1	46.6	47.9	48.8	49.4
#24 Nozzle (9.53mm)								
Flow [L/hr]	5088	5428	5746	6064	6359	6655	6905	7177
Diam. at 0.46m ht. [m]	39.6	42.1	44.2	46.0	47.5	48.8	50.6	51.5

Sprinkler operation

- Special Senninger 7025 S Sprinklers have a range of nozzles down to 5.56mm in size. However the selection of these are only required when the application rate required is very low, with 9.53mm the recommended nozzle size
- The table above shows the flow rate and diameter of throw of the recommended K-Line™ Max70 sprinkler nozzles
- Complete flow rates: 1.84 – 7.27 m^3/hr.

K-Line™ Max^{70} Effluent

Spacing and pipe system

Special 63mm K-Pipe™ tubing complete with M&F (male and female) camlocks come pre-fabricated so you can instantly connect your new K-Line™ Max^{70} effluent pods. The special K-Pipe™ is designed to be flexible but highly resilient to the shifting process.

System components

- The K-Line™ Max^{70} pod comes complete with 51mm female and male camlocks
- K-Line™ provides a 63mm K-Pipe™ x 40 metres that is M&F (male and female) camlocked (51mm connectors)
- With this combination it means that the lines can be connected in any order to the pods
- To ease shifting K-Line™ also provides male adaptors and end tow units, both 51mm camlocked.

Sprinkler information

1. Senninger 7025 Full-Circle Sprinklers

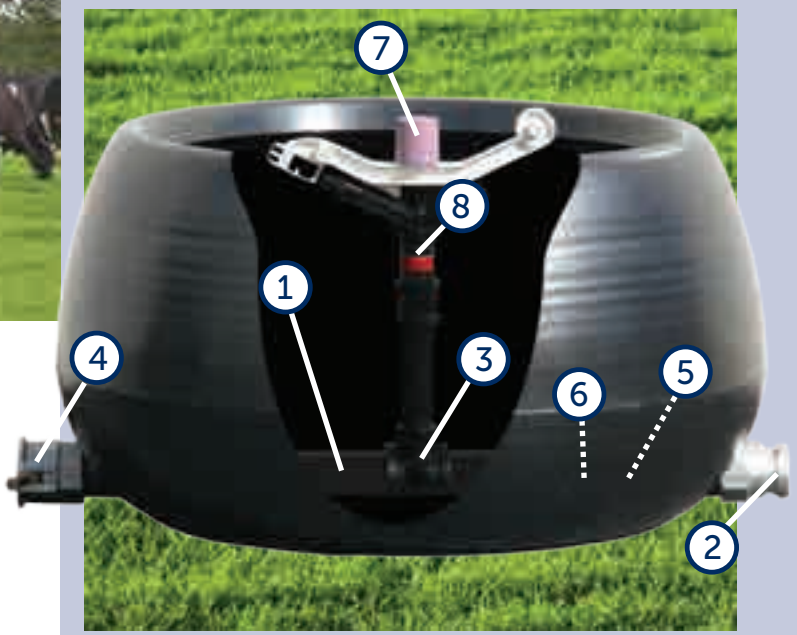
Order code: SEN-7025-xxx
Nozzle options code (xxx)
#14 = 5.56mm
#16 = 6.35mm
#18 = 7.14mm
#20 = 7.94mm
#22 = 8.73mm
#24 = 9.53mm

2. RX Hex Socket 25mm and RX Poly Riser 25mm

Order code: RXHS25 and RXPPR25
Connects Senninger 7025 Sprinkler to the Plassim Saddle

3. Plassim Tapping saddle

Order code: PTS6325SS
63x25mm Plassim saddle with spigot includes brass nuts



Pod size: 860mm (d) x 590mm (h)

1 **RX PP Riser**
for 800mm x 50mm thread, both ends

2 **CAM51A**
Female threaded adaptor

3 **KLTPS63**
63mm x 25mm Plassim 2 bolt saddle with insert top

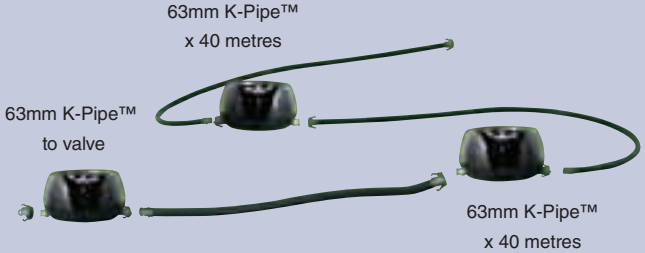
4 **CAM51D**
Female threaded coupling

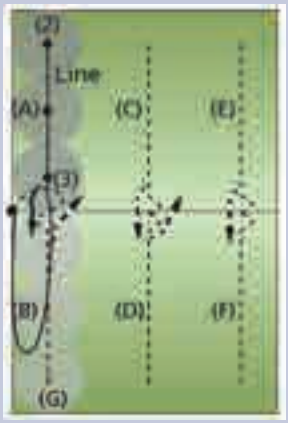
5 **3 x U Bolts**
6 x Brass nuts
4 x Spacers

6 **2 x PTSB63**
63mm Plassim saddle bare top

7 **7025 S Senninger**
5.56 - 9.53mm nozzles specifically for effluent applications

8 **1 x SEN70.Adapator**
Standard riser
1" x 1" suits Senninger 70 series sprinkler





Shifting rotation within a typical paddock (3 pods)

Line moves:
A to B
B to C
C to D
D to E
E to F

Layout of the system

The shift pattern is quite different compared to a K-Line™ irrigation system. With an irrigation system it is important to shift the system when it is running. This is not practical when the system is filled with effluent. The K-Line™ Max70 lines themselves should be made with 63mm K-Pipe™ tubing and should match the K-Line™ Max70 pod. This allows the same M&F fittings at each end, so the lines can be connected to the submain at either end of the line with the male adaptor. The K-Lines need to be pulled directly from one end to the other, because the lines are short and have only a few pods, this process is very easy. The process works for paddocks of all shapes and sizes.

The simple process

Go to the submain valve point (1) to isolate the system. Remove the tow hook from the line end (2). Uncouple the feedlines from the first K-Line™ Max70 pod (3), then connect the tow hook onto the K-Line™ Max70 then tow (dead pull) towards point (G). The K-Line™ will end up in position (B). Unhook, then re-couple the K-Line™ back at the feedline using M&M adaptor. Repeat this shifting process for the line until the field has been irrigated completely (position F). When the field has been irrigated completely, disconnect the sprinkler lines from each other and also from the feed line, tow the sprinkler into a new paddock and you're ready to start this dispersal rotation again.

Best management practice

To apply a consent application of 15mm depth, run the system for 3-4 hours.

General principles of effluent application would suggest that (depending on consent). For best management practice (BMP), an application of 15mm per shift would be a maximum, with an application area of 8ha/100 cows considered.

What you need

The process starts with a visit from your consultant to plan the K-Line™ effluent system. The consultant will examine the shape and size of your property, land dispersal area, the quality and quantity of the effluent supply, effluent rotation, the soil types involved and historical weather patterns.

Your requirements together with hydraulic analysis, pressure requirements, pump sizes, power systems and budget, will determine options. K-Line™ Max70 minimum requirements is a suitable storage pond to draw from. The system typically consists of a pump, main line, submain and 63mm K-Pipe™ feeder. An 8mm screen is recommended.

Assembly is so simple many people choose to install the submain, feed and sprinkler lines themselves.

K-Line™ Max80 Effluent

Why use K-Line™ Max80 Effluent?

- Low rate of application
- No leaching or run-off
- No ponding
- Cost effective
- 1 pod to replace a travelling irrigator
- Large nozzle to minimise blockages
- Easily separated by camlocks and shifted individually
- Low maintenance
- Meets all regional council requirements.

Senninger 8025 S Sprinkler

- The 80 series full-circle sprinklers distribute effluent over a large diameter, for higher volume systems
- Senninger sprinklers can achieve application rates down to as low as 2mm per hour. This reduces the risk of ponding and run-off and other forms of preferential flow. The soil has time to filter nutrients and bacteria
- Outlasts and costs less than brass or aluminium sprinklers
- 25° angle for maximum distance of throw
- Built-in hex wrench for easy in-the-field maintenance standard lower bearing pipe thread: 1¼" male thread
- Built for strength and durability using high-impact engineering-grade thermoplastics and top quality stainless steel components
- Single nozzle design minimises clogging.

Sprinkler operation

- Special Senninger 8025 S Sprinklers have a range of nozzles down to 9.53mm in size. However the selection of these are only required when the application rate required is very low, with 14.29mm the recommended nozzle size
- The figure shows the flow rate and diameter of throw of the recommended K-Line™ Max80 sprinkler nozzles
- Complete flow rates: 5.98 - 15.88 m^3/hr.

Pressure and flows of the Senninger 8025

Base Pressure (bar)	2.41	2.76	3.10	3.45	3.79	4.14	4.48	4.83	5.17
#24 Nozzle (9.53mm)									
Flow [L/hr]	5360	5724	6064	6405	6723	7018	7291	7563	7836
Diam. at 0.46m ht. [m]	39.0	40.8	42.4	43.9	45.4	46.9	47.9	48.5	48.8
#26 Nozzle (10.32mm)									
Flow [L/hr]	5542	6655	7041	7427	7790	8154	8472	8790	9108
Diam. at 0.46m ht. [m]	41.5	43.3	44.8	46.3	47.9	49.1	50.0	50.6	51.2
#28 Nozzle (11.11mm)									
Flow [L/hr]	7223	7700	8176	8631	9040	9448	9834	10981	10561
Diam. at 0.46m ht. [m]	43.3	45.1	46.6	47.9	49.1	50.6	51.5	52.1	52.7
#30 Nozzle (11.91mm)									
Flow [L/hr]	8199	8767	9289	9789	10266	10720	11175	11583	11992
Diam. at 0.46m ht. [m]	44.8	46.6	48.2	49.4	50.6	51.8	52.7	53.3	54.3
#32 Nozzle (12.7mm)									
Flow [L/hr]	9312	9971	10561	11129	11674	12197	12696	13173	13650
Diam. at 0.46m ht. [m]	45.7	47.5	49.1	50.3	51.5	52.7	53.6	54.6	55.8
#34 Nozzle (13.49mm)									
Flow [L/hr]	10516	11243	11924	12583	13196	13786	14332	14877	15399
Diam. at 0.46m ht. [m]	46.6	48.5	50.0	51.2	52.4	53.6	54.9	55.8	56.7
#36 Nozzle (14.29mm)									
Flow [L/hr]	11788	12605	13378	14104	14786	15444	16080	16694	17261
Diam. at 0.46m ht. [m]	47.2	49.1	50.6	51.8	53.0	54.3	55.8	57.0	57.9
#38 Nozzle (15.08mm)									
Flow [L/hr]	12719	13605	14422	15195	15944	16648	17330	17988	18624
Diam. at 0.46m ht. [m]	47.9	49.7	51.2	52.4	53.6	54.9	56.4	57.9	58.5
#40 Nozzle (15.88mm)									
Flow [L/hr]	-	15240	16149	17034	17875	18647	19419	20146	20850
Diam. at 0.46m ht. [m]	-	50.3	51.8	53.0	54.3	55.5	57.0	58.5	59.1

Spacing and pipe system

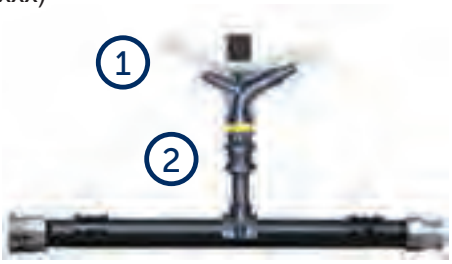
Special 63mm K-Pipe™ tubing complete with M&F (male and female) camlocks come pre-fabricated so you can instantly connect to your new K-Line™ Max80 effluent pods. The special K-Pipe™ is designed to be flexible but highly resilient to the shifting process.

System components

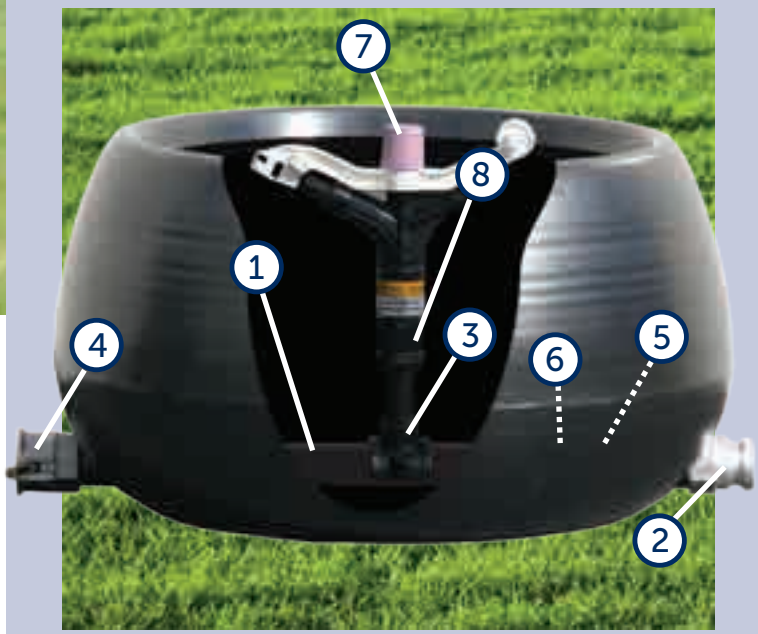
- The K-Line™ Max80 pod comes complete with 51mm female and male camlocks
- K-Line™ provides 63mm K-Pipe™ x 40 metres that is M&F (male & female) camlocked (51mm connectors)
- With this combination it means that the lines can be connected in any order to the pods
- To ease shifting K-Line™ also provides end tow units, 51mm camlocked.

Sprinkler information

1. Senninger 8025 Full Circle Sprinklers
Order code: SEN-8025-xxx
Nozzle options code (xxx)
#24 = 9.53mm
#26 = 10.32mm
#28 = 11.11mm
#30 = 11.91mm
#32 = 12.7mm
#34 = 13.49mm
#36 = 14.29mm
#38 = 15.08mm
#40 = 15.88mm



2. RX Hex Socket 32mm, reducing bush 32 x 25mm and RX Poly Riser 25mm
Order code: RXHS25, RXRB3225, and RXPPR25
Connects Senninger 7025 sprinkler to the Plassim saddle.



Pod size: 860mm (d) x 590mm (h)

1 **RX PP Riser**
for 800mm x 50mm thread, both ends

2 **CAM51A**
Female threaded adaptor

3 **KLTPS63**
63mm x 25mm Plassim 2 bolt saddle with insert top

4 **CAM51D**
female threaded coupling

5 **3 x U Bolts**
6 x Brass nuts
4 x Spacers

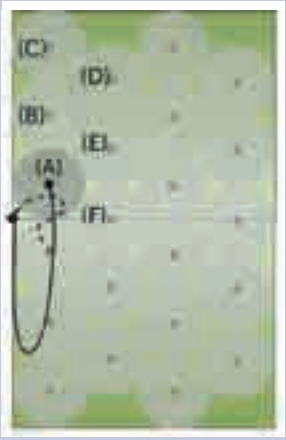
6 **2 x PTSB63**
63mm Plassim saddle bare top

7 **8025 S Senninger**
9.53 - 15.88mm nozzles specifically for effluent applications

8 **1 x SEN80.Adapator**
Standard riser
1 1/4" x 1" suits Senninger 80 series sprinkler

Pod comes completely assembled, all you need to do is connect camlocked pipe to camlocks.

K-Line™ Max80 Effluent



Shifting rotation within a typical paddock (single pod)

Line moves:
A to B
B to C
C to D
D to E
E to F

Layout of the system

The shift pattern is quite different compared to a K-Line™ irrigation system. With an irrigation system it is important to shift the system when it is running. This is not practical when the system is filled with effluent. The K-Line™ Max80 lines are therefore shifted when they are not running.

The K-Line™ Max80 lines themselves should be made with either 50mm low density pipe or 63mm K-Pipe™ tubing and should match the K-Line™ Max80 pod. This allows the same M&F fittings at the ends, so the lines can be connected to any of the lengths of K-Pipe™. As only a single pod or possibly 2 pods on a line you simply tow the pod to the next location.

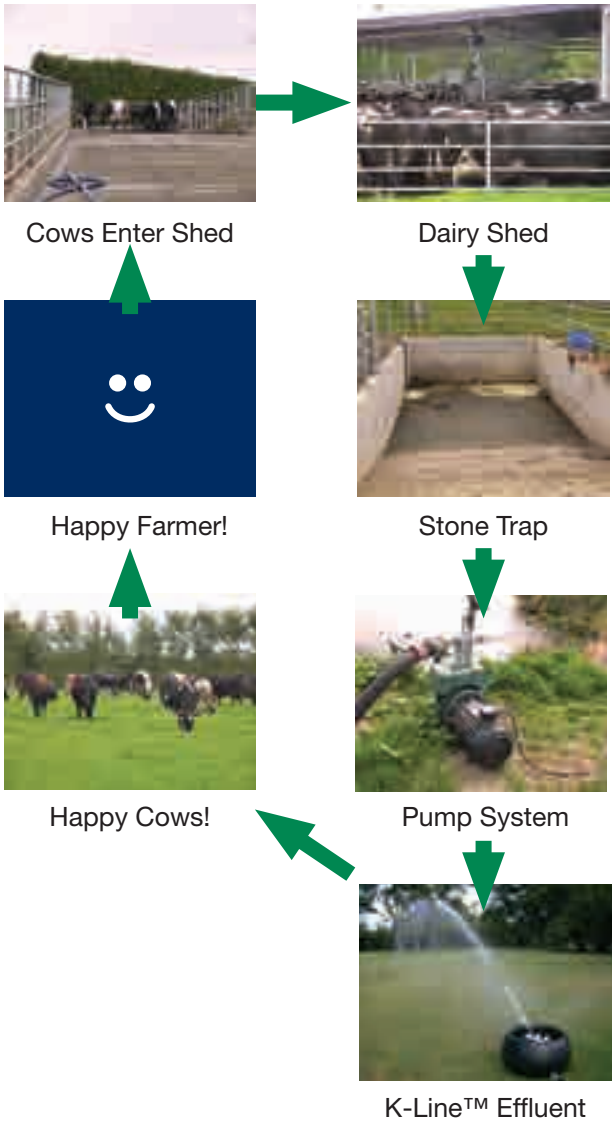
The simple process

Move the single skid up to 50 metres (ensure that no overlap occurs) Work in a 50 x 40 grid until the paddock is complete. When the field has been irrigated completely, disconnect the K-Line™ Max80 pod from the feed line, tow the sprinkler line into a new paddock and you're ready to start the dispersal rotation again.

Best management practice

To apply a consent application of 15mm depth, run the system for 2-3 hours. It is recommended that the effluent dispersal area should be 8ha/100 cows as best management practice.

General principles of effluent application would suggest that (depending on consent). For best management practice (BMP), an application of 15mm per application would be a maximum, with an application area of 8ha/100 cows considered.



What you need

The process starts with a visit from your consultant to plan the K-Line™ effluent system. The consultant will examine the shape and size of your property, land disposal area, the quality and quantity of the effluent supply, effluent rotation and the soil types involved. Also, historical weather patterns will need to be considered.

Your requirements together with hydraulic analysis, pressure requirements, pump sizes, power systems and budget, will determine the options. K-Line™ Max80 minimum requirements are a suitable stone trap and sump to draw from. The system typically consists of a pump, main line, submain and K-Pipe™ feeder.

Assembly is so simple, many people choose to install the submain, feed and sprinkler lines themselves.

Filtration – K-Line™ Effluent

The K-Line™ pond filter has been fabricated with the intent to assist with the final polishing of the effluent that is held in storage awaiting dispersal onto the paddocks. The unit consists of two 'clam' shells with a connecting piece in the middle of 1mm mesh. The upper 'clam' provides buoyancy to the filter although it is neutrally buoyant due to polyethylene being .95 of the density of water.

The outlet 50mm is in the bottom of the unit with a 50mm polyprop riser to the centre of the centre of the unit, this ensures that no 'hot spot' is created when suction is applied to the filter mesh. The suction pipeline travelling to the pump should minimise the friction losses and therefore for the flows that K-Line™ has, it is recommended that this is either 50mm Low Density pipe or 63mm Metric Medium density.

The selection of 3.5mm mesh is a compromise, the selection of a smaller mesh would cause it to blind off in more situations. 3.5mm has been found to be most satisfactory in many conditions.

K-Line™ Effluent Pump Systems

Two stage centrifugal pumps.

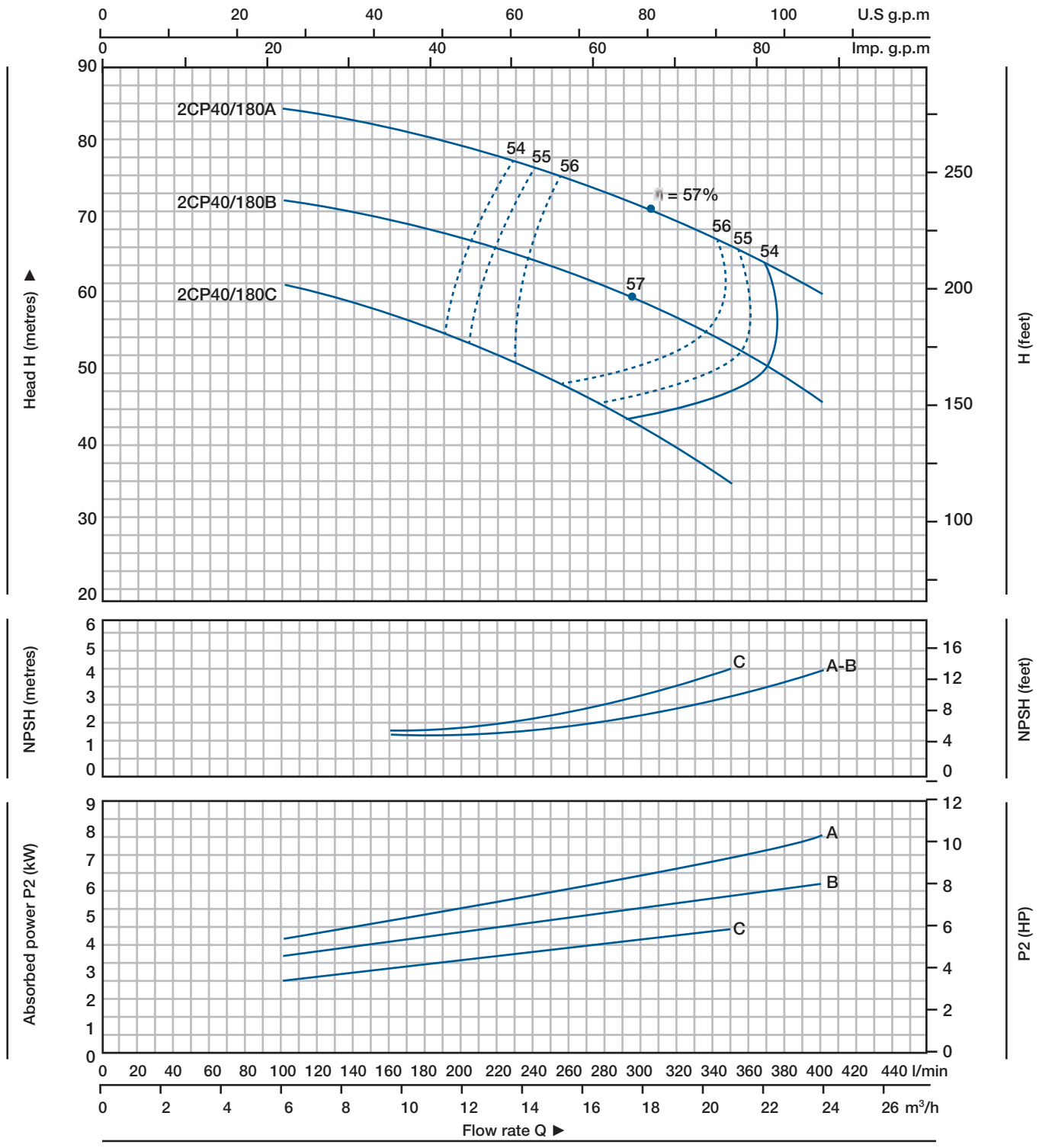
Two Stage Pumps recognised for their high efficiency, versatility and quiet running:

- Firstly that the effluent liquid is still biologically active, this means that it will still generate gas if conditions are right. This then requires that the pump must (even if it has light suction lift), be 'self-priming'
- Secondly pumps are more efficient if they are 'closed' impeller units compared to open impeller types. When it gets to the pump the K-Line™ effluent is usually relatively clean given that it has traversed a drying-bed and a 1mm screen prior to the pump system. The flow rate for 24 pods will be approximately 22m³/hr or 360l/min, therefore the head that this pump should generate would be about 50m
- Cast iron frame and stand, impeller in s/s 304, stainless steel shaft, seal. The protection to be carried out by the user with motor protector suitably adjusted. Other tension and frequencies on request. Non-stop operation. Forced ventilation enclosed type motor.

Technical information over the page.

Characteristic curves and performance data

50hz n=2900 1/min HS=0m



MODEL 3-Phase	POWER kW	POWER HP	Q	m³/h	0	6.0	6.6	7.5	8.4	9.6	10.8	12.0	15.0	18.0	21.0	24.0
				l/min	0	100	110	125	140	160	180	200	250	300	350	400
2CP 40/180C	4	5.5	H Metres		64	62	61	60	59	58	56	54.5	49	43	35	
2CP 40/180B	5.5	7.5			76	73	72.5	72	71	70	69	67.5	64	59.5	54	46
2CP 40/180A	7.5	10			88	85	84.5	84	83	82	81	79.5	76	72	67	60

Q= Flow rate H= Total manometric head HS= Suction height

Tolerance of characteristic curves in compliance with EN ISO 9906 App. A.

Solid separation

Solids separation is a key element for running the K-Line™ for dairy effluent system. There are a number of ways to achieve this result with K-Line™ Std and Mid, however we must ensure that solids are separated prior to effluent passing into the storage ponds. Filters placed on the outlet side of the storage pond will be ineffective if the solids are not processed beforehand. These solid separation methods will have the advantages of:

- Causing less blockages in the K-Line™ sprinklers that have much smaller nozzles (e.g. 4mm nozzles of the K-Line™ system) than traditional systems
- Providing more dilute effluent with low solids that can be pumped over a greater distance for irrigation
- Creating other useful products. Solids separation provides a solid fertiliser with high organic matter and nutrient value that can be incorporated into cropping land or paddocks at re-grassing.

Gravity systems

This is the simplest system for removing liquid from solids. Whilst there are a number of methods for removal of solids, all depending on the liquid content of the effluent, slurry or sludge, we believe that a single solution may well suit almost all situations. For the K-Line™ system we recommend a ‘Weeping Wall’ outlet system that allows liquid to escape, combined with a ‘drying bed’. The liquid that passes through the 'weeping-wall' is then fed or pumped into a storage pond for later irrigation. It is essential that any solids are stored on a properly sealed and contained site, and that liquid is not allowed to drain into the soil where it could pollute groundwater. Instead, liquids must be directed into a sealed treatment pond or stored before land application. Storage facilities should be sited at least 45m from the farm dairy. All storage facilities must be designed and constructed to stand up to the load of the stored material and safely contain it.

Solids that have been separated by gravity can have high nutrient concentrations and a nutrient analysis and nutrient budget should be used to assess land application rates. Where dehydration has occurred, K is likely to be particularly high in relation to N and so K may be the limiting factor in determining land application rates. K can also be high in post-separation liquids.

Solids settling beds

The system with the least capital cost to set up has been found to be the drying bed and Weeping Wall. Drying beds are solids settling pits which must be constructed at a minimum of 45m from the dairy shed. It is assumed they will be mechanically cleaned once a year. The Weeping Wall structure can be used for initial settling of solids before transferring liquids to a holding pond for irrigation. In this case, the settling bed may be dug into the ground and a Weeping Wall outlet created at one end. Slots in the Weeping Wall will vary from 4mm - 8mm gaps.
This spacing will depend on the liquid and fibre content of the effluent. There must be enough fibre within the scrapings or washdown so that manure slurry does not run out through the slots.

The drying beds have been constructed 1-2.5m deep, depending on the site. For ease of cleaning, the width of the pit should be no more than 8m at the top bank level unless it is practical and desirable to empty it from both sides. In pits constructed in soil which is stable enough not to require lining, 1:1 batters are suggested. A 2m deep pit therefore would have a bottom width of 4m if the width at ground level was 8m. There may be instances where the drying bed should be constructed above ground level so the liquid can drain by gravity to storage. The length of the pit can be calculated by dividing the volume required to contain one season's solids by the average effective width and depth. The current allowance is 2 litres sludge per cow per day, but this will vary from shed to shed. Therefore approximately 40m^3 storage is required for each 100 cows milked per season. Note: the effective width needs to take account of the entry height of the pipe bringing in the dairy shed effluent. The effective height is from this pipe to the base of the pit. Ideally the dairy shed effluent should enter at one end of the pit and the Weeping Wall to allow liquid to drain out be constructed at the other end. The narrow width is for ease of cleaning with a digger. K-Line™ have a prefabricated plastic Weeping Wall solution.

The structure must be sealed and designed to withstand the load of the liquid (consult an engineer for advice).

Depending on the situation the filtered liquid will either be able to flow to a storage area by gravity or will need to be pumped. If it is to be pumped sufficient room is required behind the Weeping Wall to site the pump and provide some buffer storage. The pump is likely to be controlled either by a float switch or probes. Insufficient buffer storage will result in the pump cycling on and off excessively. Submersible pumps rated to handle waste water are recommended. The flow rate requirement is not high since the pumping rate doesn't need to match the in flow rate. For example the rate of flow into the drying bed might be a maximum of 10,000 l/hr and the total daily liquid volume 40,000 litres. Assuming the drying bed was to be drained over 16 hours (to allow some extra pumping time for future expansion) the flow rate required is only 2,500 l/hr.

Weeping Wall settling bed for dairy effluent

Weeping Wall storage for feed pad slurry

Above photos supplied by John Scandrett.

Mechanical solids separation

Mechanical solids separation methods can achieve high rates of solids removal from both farm dairy and feed pad effluent. The effluent is typically pumped from the sump to the solids separator, which removes and stockpiles the solids product for later land application. The liquid is held in a storage facility for irrigation. Mechanical separation is ideal for feed pad effluent that contains high fibre content, which could otherwise lead to pond in-filling. It is generally suited to large operations, which can generate 30-40 m^3 of waste a day. Removing solids greatly reduces the volume of effluent for storage and makes it more manageable.

- Screw press separators – the effluent is forced under pressure through one or more layers of fine mesh screens to separate the solids and liquids. Screw press separators are normally built on raised platforms over concrete pads so that solids (15-25% DM) can pile up below for easy removal.

When planning for a mechanical solids separation system, consider the following:

- Sufficient storage facilities are still required for effluent prior to separation
- All handling equipment should be placed so that if any effluent is spilt it will flow back to the farm dairy sump
- There should be plenty of storage space for separated solids and liquids so that the farmer is not forced to immediately apply effluent to land when it is undesirable
- The separated solids should be covered to prevent rainwater infiltrating and creating liquid effluent again
- Land area and machinery are required for land application of solids in addition to liquid effluent. Solids should be applied to land in compliance with regional council rules
- Mechanical separators have to be regularly inspected and maintained.

Pressure separator on overhead stand

Fan screw press separator on overhead stand

K-Line™ Weeping Wall

Features:

- Non-corroding - won't rust!
- Made of PVC with
  - High UV stability
  - High physical strength
  - Triangular bar
  - Will not swell or warp
- PVC with high physical strength
- Triangular bar shape.

Benefits:

- Separates valuable effluent into components that are more easily managed and distributed
- Triangular bar gives maximum strength and no barrier to efficient liquid flow while holding back solids
- Made from an efficient bar extrusion that allows various gap spacing between bars (standard spacings; 4mm, 6mm and 8mm)
- We have a range of sizes available (standard sizes are 1200mm wide x 1200mm high, 1000mm wide x 1500mm high and 1000mm wide x 1000mm high), please refer to your consultant for advice on what size panels would best suit your requirements.

Reasons for selecting each gap type:

4mm gap

- Hosing straight off a yard
- Low fibrous material
- Relatively high water content.

6mm gap

- An intermediate solution between the 4mm and 8mm gap.

8mm gap

- For use in feed lots where the yards are scraped clean
- High fibrous material
- Relatively low water content.

How many panels do you need?
Indications would suggest that roughly 1 panel per 100 cows per drying bed would be needed.

CODE	GAP	WIDTH	HEIGHT
KLWEEP1000.1200.4mm	4mm gap	1000mm	1200mm
KLWEEP1000.1200.6mm	6mm gap	1000mm	1200mm
KLWEEP1000.1200.8mm	8mm gap	1000mm	1200mm
KLWEEP1000.1500.4mm	4mm gap	1000mm	1500mm
KLWEEP1000.1500.6mm	6mm gap	1000mm	1500mm
KLWEEP1000.1500.8mm	8mm gap	1000mm	1500mm
KLWEEP1200.1200.4mm	4mm gap	1200mm	1200mm
KLWEEP1200.1200.6mm	6mm gap	1200mm	1200mm
KLWEEP1200.1200.8mm	8mm gap	1200mm	1200mm
KLWEEP600.2000.4mm	4mm gap	600mm	2000mm
KLWEEP600.2000.6mm	6mm gap	600mm	2000mm
KLWEEP600.2000.8mm	8mm gap	600mm	2000mm

NB: All PVC Weeping Wall Panels are 70mm deep

Application area

The application area is that area of pastoral land set aside for the receiving of effluent as a nutrient and irrigation treatment. The area of pastoral land required is calculated on the basis of the nutrient (i.e. nitrogen or potassium) concentration and the hydraulic load (i.e. amount of water) of the effluent. Regional councils generally focus on N loading; however in many cases achieving an acceptable K loading to avoid animal health issues will be the determining factor for farmers requiring a larger area than that which would meet regional council requirements. Many land application systems have failed because they have received too much effluent, both on a nutrient loading basis and on a hydraulic loading basis.

Successful land application systems will:

- Have sufficient area to deal with the nutrient and hydraulic loading
- Utilise equipment that will apply effluent at low application rates
- Allow for rest periods between applications so that bacteria in the soil can break down effluent organic matter to prevent a decline in the soil infiltration.
  This also gives the pasture time to regain palatability for stock.
  The importance of allowing a large enough area of the property for land application of effluent cannot be over emphasised.

Adequate provision of land area:

- Reduces nitrate leaching and, therefore, wasted nutrients and groundwater contamination
- Minimises metabolic problems due to excessive potassium (K)
- Prevents ponding and surface runoff of effluent or sealing of the soil surface
- Avoids physical deterioration of soil
- Stops weed invasion of the treated area
- Makes best use of the nutrients for pasture growth. If there is not enough suitable land, arrangements must be made to apply the excess effluent on suitable land elsewhere or have an alternative back-up effluent treatment system.

Farmers should not apply effluent to land that is already saturated with water. This is why large storage facilities are essential in most regions. It is the financial outlay for basic labour and capital components that costs, rather than the outlay for an extended system to provide additional application area. In a typical grazing situation (i.e. not intensive feedpad or feedlot systems), to meet a regional council effluent N limit of 200 kg/ha/yr the minimum receiving land area would be a minimum of 4 ha per 100 cows. Best management practice suggests larger areas are desirable e.g. 8 ha per 100 cows. This will also help avoid metabolic problems from excessive potassium (K). While these figures are a guideline it is highly recommended that areas be calculated according to each farm's effluent volume and nutrient content.

Hydraulic loading

To avoid surface ponding from the application of effluent, apply several low volume applications rather than all the effluent at one time.

The recommendations for the daily application area to avoid excessive hydraulic loading are given for all pastoral soil types.

Maximum application rate (mm/h)

The maximum application rate (mm/h) is the amount of effluent applied within a certain time period. If effluent is applied at a greater rate than the infiltration rate of the soil, runoff can occur and water and nutrients will be lost to waterways. The maximum application rate given in Table 1 is for soils on pastoral land of up to 8° slope. K-Line™ will have an average application rate (mm per hour) of between 2-8mm/hr. K-Line™ unlike any system that travels across the land, applies its effluent at a low rate continuously over the hour. Travelling devices all have an instantaneous application rate that far exceeds their average over an hour.

Travelling irrigators in particular have an uneven rate of application such that an instantaneous application rate of up to 120mm/hr has been measured.

Minimum application interval (days)

The effluent can be applied to land repeatedly but a minimum interval between applications is suggested to allow for infiltration and for the nutrients to be taken up by the soil. The minimum application interval (days) given in the table below considers the water and solids component of the effluent only. The decision when to reapply effluent to land also revolves around other factors:

- Stock rotation
- Pasture length
- Prevailing weather and its influence on applicator access and soil saturation
- Fertiliser value of the effluent for the remaining land area
- Regional council regulations
- Disease risk.

Daily area

Effluent can be applied from the K-Line™ at anytime when the soil has a soil moisture deficit. Working from a nutrient level of the liquid we would need to apply a total in a season of possibly up to 30mm. The table below gives a suggestion as to the maximum that we should be applying in one time and also the maximum application rate. The maximum application rate suggested below is greater the rate that K-Line™ will apply, therefore application rate is never going to be a problem for K-Line™.

Table 1.

Effluent application recommendations for various soil types under pasture cover

Soil type	Maximum application at any one time (mm)	Maximum application rate (mm/h)	Maximum application interval (days)
Sand	15	32	5
Pumice	15	32	5
Loamy sand	18	32	5
Sandy loam	24	20	15
Fine sandy loam	24	17	15
Silt loam	24	10	20
Clay loam	18	13	20
Clay	18	10	20
Peat	20	17	15

Note 1: For soils at 50% Water Holding Capacity prior to effluent application.

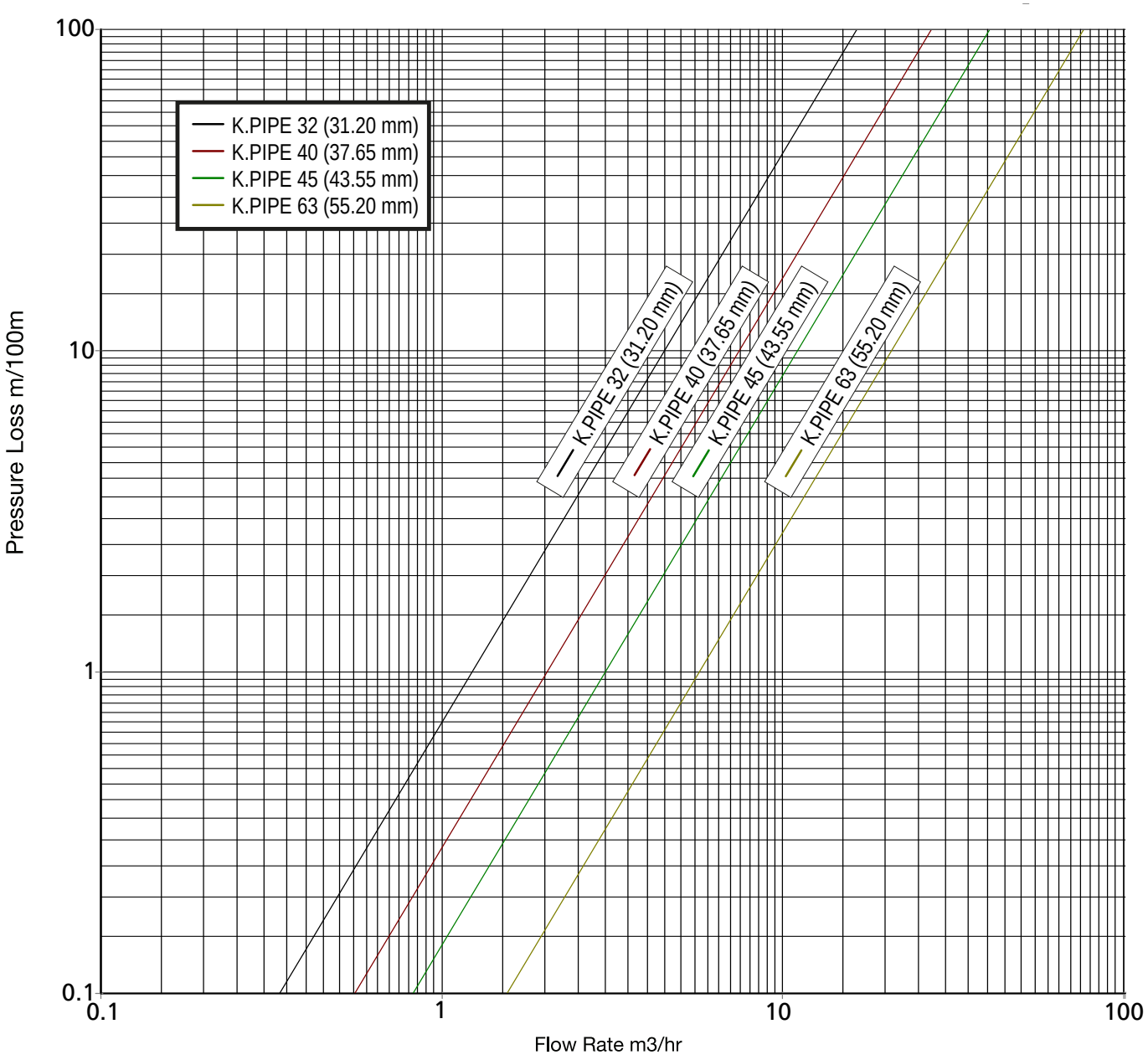
Note 2: For land slopes up to 8°. Application onto low to steep hills should be avoided.

Note 3: Rooting depth of pasture 0.31 to 0.76m. Effective rooting depth for nutrient uptake 0.2m.

New Zealand Pastoral Agriculture Research Institute Limited, pers. comm.; Standards Association of New Zealand, 1973; Livingstone, 1992; Wrigley, 1993.

Water holding capacities for various soil types from Standards Association of New Zealand, 1973.

RX Plastics flow chart for K-Line™ Pipe



Indicative weights (kg) for K-Line™s as specified in the charts at 15m spacings

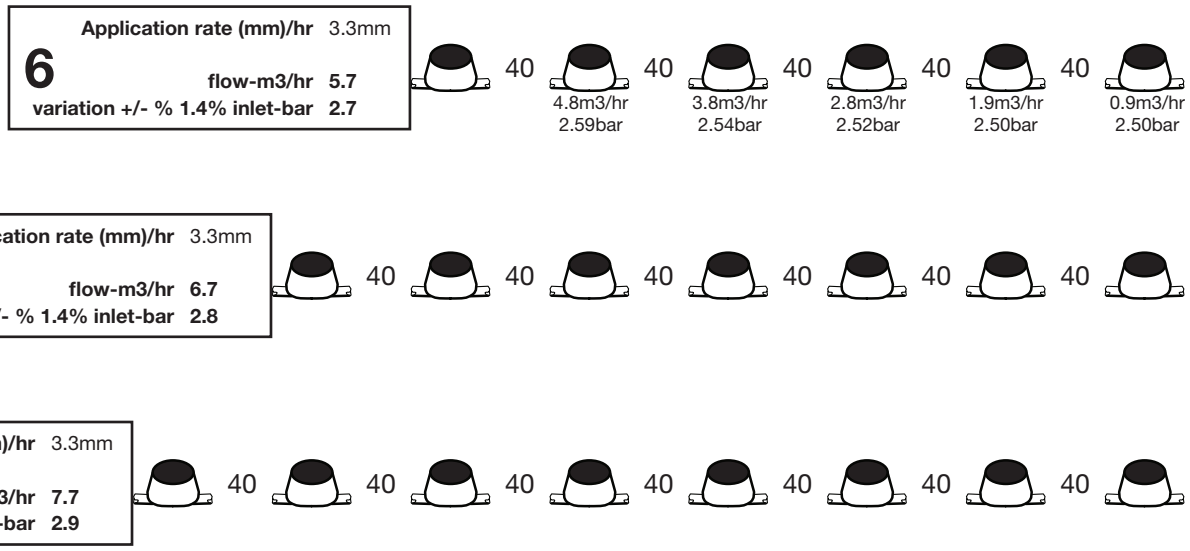
NB: For best traction the lighter the line the easier it will be to move, especially on damp or wet grass. Experience would suggest 6-8 skids maximum, without the necessary step of a four wheel drive or four wheeler to move it.

Nominal Size	Internal Dia mm	O D Dia mm
40	37.55mm	44.15mm
45	43.55mm	50.00mm
63	55.20mm	63.00mm

Skids	Black 40	Black (Weight in Kg)
6	5.0	133
7	6.0	159
8	7.0	185

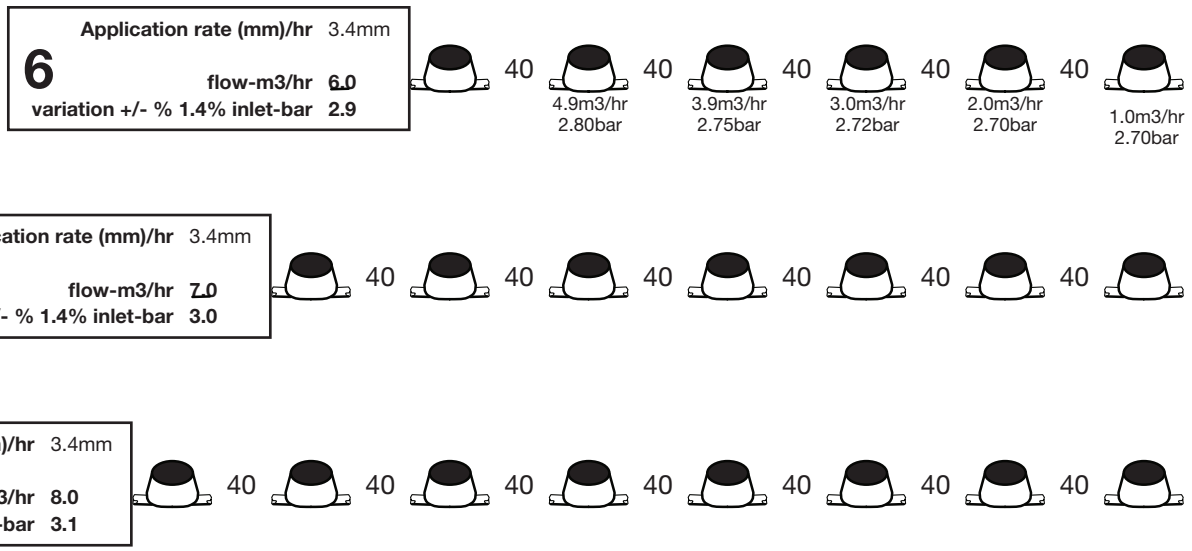
Naan 5022 (black nozzle), minimum pressure of 2.5bar at the last sprinkler and spacings of 15m x 20m

Minimum pressure (bar) = 2.50 bar. Distance between skids = 15m x 20m. Area = 300 m^2



Naan 5022 (black nozzle), minimum pressure of 2.7bar at the last sprinkler and spacings of 15m x 20m

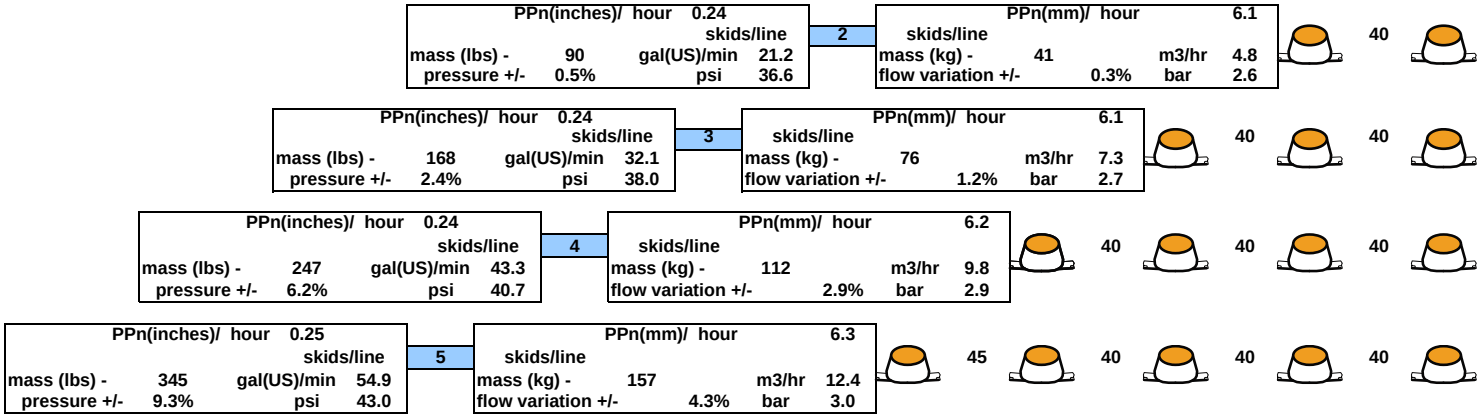
Minimum pressure (bar) = 2.70 bar. Distance between skids = 15m x 20m. Area = 300 m^2



***When considering your farm effluent dispersal requirements always refer to the Farm Dairy Effluent (FDE) Design Code of Practice**

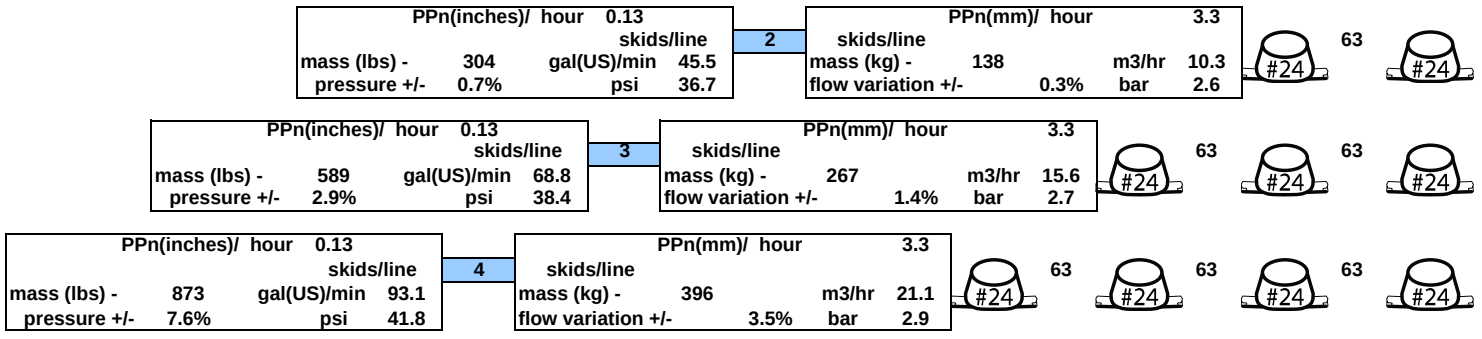
Senninger 5023 - #16 - orange - (6.35mm), minimum pressure of 2.5 bar at the last sprinkler and spacings of 20 metres x 20 metres

Minimum pressure (bar) = 2.50 bar. Distance between skids = 20m x 20m. Area = 400 m². Hours = 1



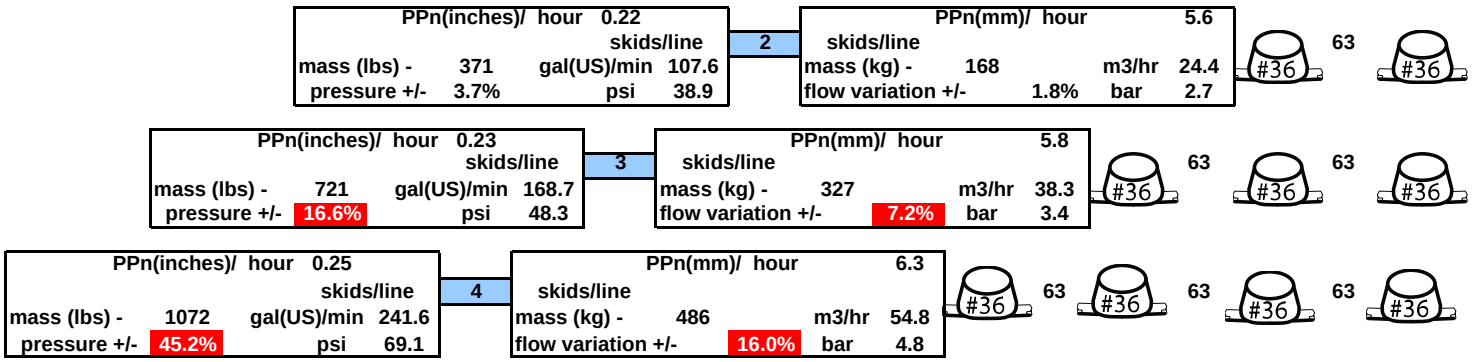
Senninger 7025 - #24 - (9.53mm), minimum pressure of 2.5 bar at the last sprinkler and spacings of 40 metres x 40 metres

Minimum pressure (bar) = 2.50 bar. Distance between skids = 40m x 40m. Area = 1600 m². Hours = 1

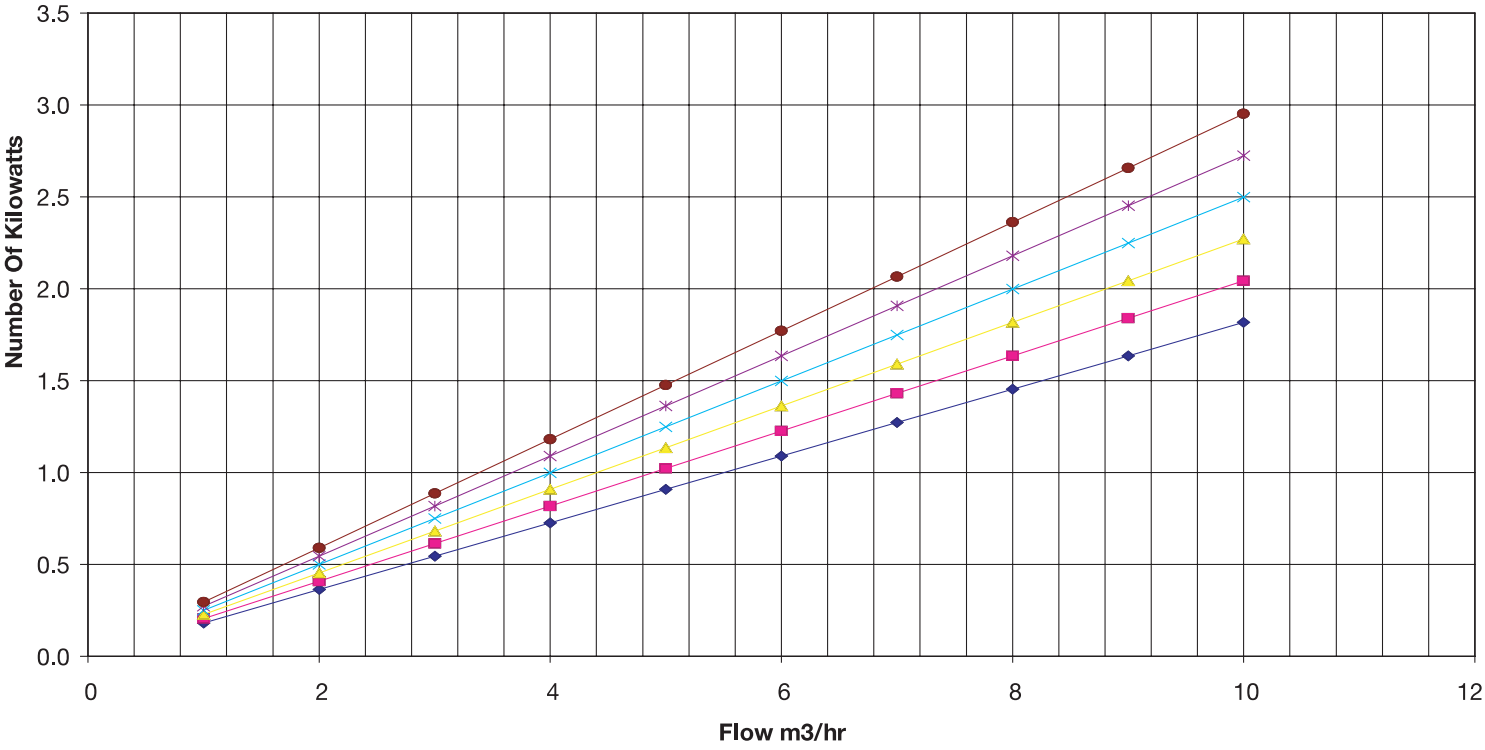


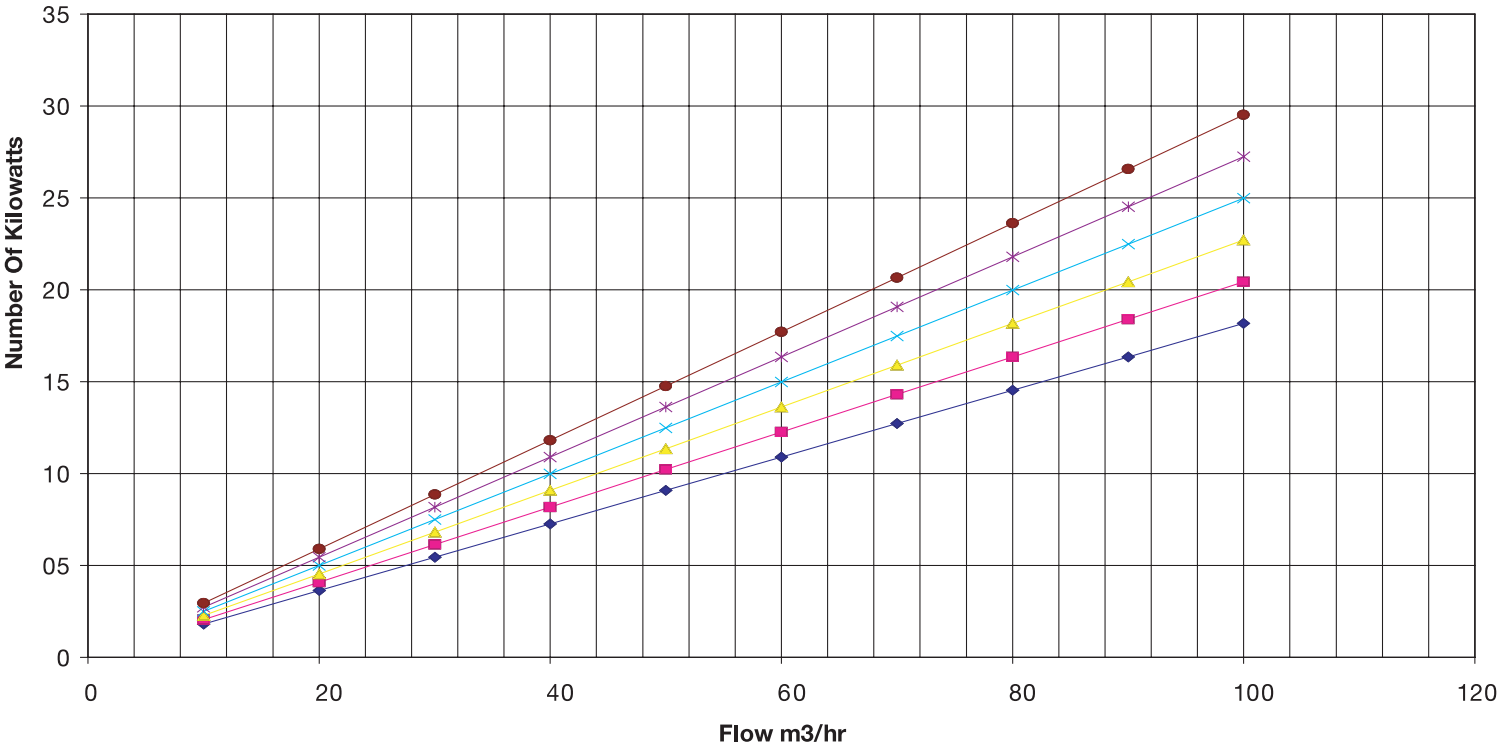
Senninger 8025 - #36 - (14.29mm), minimum pressure of 2.5 bar at the last s and spacings of 50 metres x 44 metres

Minimum pressure (bar) = 2.50 bar. Distance between skids = 50m x 44m. Area = 2200 m². Hours = 1



Pump kilowatts required (60% efficiency)





40m Head 45m Head 50m Head 55m Head 60m Head 65m Head

RXP

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