Farm Dairy Effluent (FDE) Systems

Planning the right system for your farm

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Introduction

When making the decision to install a new farm dairy effluent system, there are a number of things to consider. This booklet does not include details on how to design and install your own system but rather helps you, the farmer, ask the right questions and get the right advice and service. This will result in the most appropriate farm dairy effluent (FDE) system being installed.

This book will walk you through the issues that need to be considered:

- Finding the right person for the job
- Before the system is designed
- Assessing the system specification report
- Reviewing the quote
- Once the FDE system is installed
- Where to go for help
- In the back section of this booklet are a number of examples of different effluent systems commonly used in New Zealand. A description of the main components of an effluent system is also provided.

Other resources that may be of interest to on this topic include:

- Farm Dairy Effluent (FDE) Design Code of Practice
- Farm Dairy Effluent (FDE) Design Standards
- Farm Dairy Effluent Systems: A Farmers guide to building a new effluent storage pond.

For a copy of any of these resources go to **dairynz.co.nz** or call **0800 4 DAIRYNZ (0800 4 324 7969)**

Finding the right person for the job

Getting the right person for the job is critical to getting the right system. Designing and installing farm dairy effluent systems is a technical job requiring specialist knowledge.

When looking at whose advice and service to use, the first thing to look for is an accredited FDE company. Accredited FDE companies are trained effluent system specialists. They understand and follow the Farm Dairy Effluent (FDE) Code of Practice and Design Standards when designing and installing FDE systems.

Using an accredited FDE company will provide assurance that:

- The investment in effluent infrastructure will be specific and relevant to you, your farming environment and your farm system
- The effluent system is capable of complying with regional council requirements when managed correctly
- The system is designed with an understanding of the current research and best technology options available at the time.

DairyNZ funded the establishment of the FDE Accreditation programme. Look for this logo when selecting a company. For a full list of accredited FDE companies visit **effluentaccreditation.co.nz**

When selecting a designer/engineer, consider the following;

- Do they have experience working with your type of farm system and farm size?
- Do they have experience in the type of FDE system you would prefer to operate?
- Do they have experience working with your specific regional council rules and dairy company requirements?
- Can they demonstrate competence through testimonials and references?

To help keep track of information and compare options you can use the table below.

	Person 1	Person 2	Person 3
Accredited FDE company			
Capability *Experience with farm size, type of system*			
Capacity *Size of the company*			
Track record			
Discussions with previous clients			
Current workload *Other work on their books?*			
Terms and Conditions *Concerns or queries*			
Ongoing support			

Before the system is designed

To ensure your selected designer/supplier has the right information to design the most appropriate system you will need to provide them with the following information. This is a critical stage – poor information now will compromise the whole project and your system may never meet your needs.

Your requirements

What do you want your new system to be able to do?

Future intentions

When designing effluent systems you are best to future proof your system by making sure your future intentions with your farm are taken into account. You do not want your new system to be inappropriate or unable to cope in five years time.

	Example	Your plans
Cow numbers	*Aiming to increase to 1000 cows*	
Feed	*Increasing amount of supplement feed, likely more maize silage and PKE*	
Feed pad	*Will build a feed pad*	
Wintering pads	*No*	
Farm expansion	*No*	

Restrictions

All farms have restrictions they are operating within; whether it is legislative, financial or labour it is important that these are clear and understood from the start. If you are unsure of your local or company regulations get in touch with your regional council or dairy company advisor.

	Example	Your restrictions
Resource consent/permitted activity	*Permitted activity*	
Maximum application depth	*15mm*	
Maximum application rate	*10mm per hour*	
Maximum nutrient loading	*200kg N ha/yr*	
Minimum storage requirements	*None*	
Financial: What is the budget?	*$180,000 plus contingency*	
Labour	*Language barriers so need simple effluent management plan*	

System design preferences

Whilst the design and installation of the effluent system is best carried out by a specialist, you may have ideas or preferences regarding your system. Make these preferences known to the designer/installer during the initial design discussion.

The back section of this booklet contains examples of different types of effluent systems commonly used in New Zealand. Go through the questions on page 16 to help identify what system may suit you.

In the table below summarise your design preferences.

I am interested in the following: (Circle the options that apply for each aspect below. Add detail as necessary)

System type	Land application		Other		Not sure
Example system	1 2 3	4 5	6 7	8 9 10	Not sure
Applicator type	Travelling Irrigator	Low rate	Contract Spreader	Centre pivot	Slurry tank
Increase storage	Yes	No			Not sure
Storage capacity that provides	High flexibility	Some flexibility	Sufficient		Not sure
Storage type	Liner	Tank	Clay	Other	Not sure
Solid separator system	Yes	No			Not sure
Solid separator type	Mechanical	Passive	Other		Not sure
Solids store area	Yes	No			Not sure
Land application area	Whole farm	Best nutrient usage	Meet minimum requirements		Not sure
Labour input	High	Low	Don't mind		Not sure
Automated checks and fail-safe controls	Very interested	Some interest	Not interested		Not sure

Other requirements or ideas ....

Core information to provide

The core information about your farming environment and the farm system you operate. You may need to get help to determine the core information a designer needs. As much information as possible should be checked and confirmed on farm.

Site Layout		**Provided**
Farm Map	*Show all current and planned infrastructure and land features*	
Sensitive areas, topography waterways	*Highlight on the farm map any features that affect the design of the FDE system including land slope, gullies, waterways, flood risks etc*	
Design area	*Identify potential area for sheds, storage and irrigation*	
Fencing		
Shelter	*Any present or required*	
Energy source	*Nearest supply and limitations*	
Water supply	*Closest available?*	
Vandalism	*Any problems?*	

FDE characteristics		**Provided**
Nutrient concentration	*Provide any information you have for previous FDE tests*	

Soil and Climate		**Provided**
Soil type	*Type and location and water properties of soils*	
Drainage	*Identify areas with poor or fast drainage – including natural or artificial drainage*	
Rainfall	*Provide any data you have*	
Wind	*Prevailing wind direction*	

Farm Management		**Provided**
Cows	*Average and peak cows*	
Milking	*Number of milkings per day, seasonal changes*	
Wash down	*Type of system*	
Labour	*Explain the skill level and time availability of the labour that will be operating the system*	

Construction		**Provided**
Completion date	*What date is the FDE system required to be operating*	
Health and Safety	*Any issues*	

Assessing the system specification report

A design report and plan summarising the final system specifications must be provided by the designer / installer. This should tell you the standards and specifications and what the system will be capable of achieving. You should also be able to get a quotation for the design and installation from this information or get it reviewed by another designer if desired.

Use the table below to compare different proposals from different designers. All the following information should be provided.

	Option 1	Option 2	Option 3
Designer information			
Name of supplier			
Contact details of supplier			
Name of designer			
Input information and assumptions			
Site layout			
Soils information			
Climate information			
Regulatory requirements			
Farm management needs			
FDE characteristics			
System specifications			
Size of application area(s)			
Land application method			
Range of application depths the system is capable of applying			
Range of nutrient loadings the system is capable of achieving			
Application intensity			
Expected application uniformity			
Solids separation method (if used)			
Solid separation efficiency and particle sizes removed (if used)			
Pumping rate			
Pump operating pressure			
Irrigator operating pressure			
Expected pumping frequency and duration			

Assessing the system specification report (cont)

	Option 1	Option 2	Option 3
Storage type			
Storage volume			
Plan, showing location of the proposed infrastructure and land application area			
Compliance information			
Description of how the system will comply with the relevant regulatory requirements, including resource consent conditions			
Expected operating costs ($/100 cows and $/yr)			
Expected labour costs			
Expected energy costs			
Routine maintenance costs (time and materials)			
Technical analysis evidence			
Nutrient budget			
Storage sizing calculations			

Reviewing the quote

A quotation based on the system specification must be provided to you to ensure all parties are clear about what is going to be provided. The following information must be provided and agreed to before work starts.

Bill of materials

	Provided	Queries
Description of the materials with rating or classification		
FDE collection infrastructure (e.g. grates, concrete)		
Materials for storage construction		
Solid separation equipment		
Stirring equipment		
Irrigation system components		
Pipes and fittings		
Pumping and related equipment		
Electrical equipment		
Supplied quantities		
Material costs for all components		
Installation costs for all components		
Exchange rate assumptions and variation to costs if they change		
Contingency costs		
GST		
Potential variations to the list and costs		
Payment structure		

Warranties

A written 12 month warranty should be provided that covers:

	Provided	Queries
Specified items that are covered		
How the warranty is going to be serviced		
The period of cover		
Who is responsible and what they are responsible for		
Expected reliability and life time of the system		

Delivery times

	Provided	Queries
List of estimated delivery times for all items		
Commencement date		
Installation completion date		
Final commissioning completion date		

Servicing

System servicing procedures and conditions must be provided and include:

	Provided	Queries
Charge-out rate		
Response time		

Once the FDE system is installed

Ensure you receive the following within one month of the installation being completed:

Commissioning report

The report will describe the system as it was installed, including the evaluation of its performance. The commissioning report should include:

Provided

- Date of commissioning
- Procedures followed during commissioning
- Results of performance testing

As-built plan

An accurate to-scale plan with all key items located and with dimensions of all key components provided.

Provided

Manuals and training

Appropriate manuals and training should be provided with your new FDE system and should include:

Provided

- Operations manual
- Maintenance manual
- Training for the system operator that covers the operation and maintenance of the new FDE system.

Effluent system examples

Effluent system examples

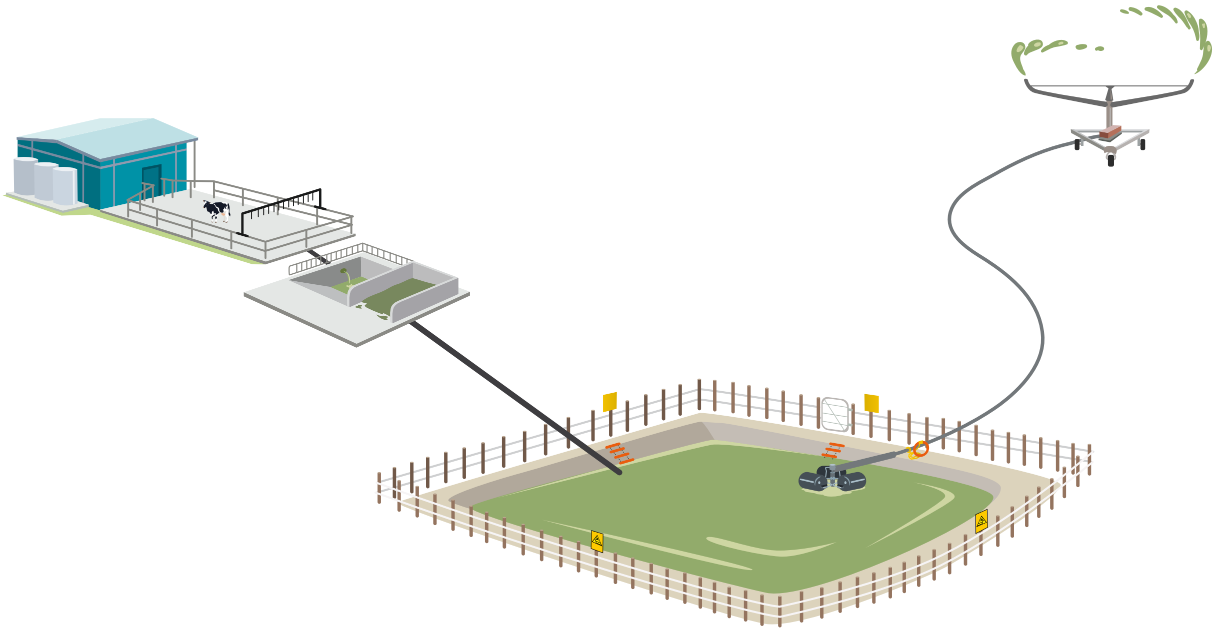
There are a large number of different effluent systems currently available. The following section shows ten examples of effluent systems that are commonly operated in New Zealand. Each system provides a description of the components involved and indicates in what situation the effluent system may be appropriate.

What type of system may suit you?

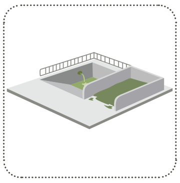
Do you have ...	Tick if yes	Consider...
Poorly drained or pugged soils or soils with artificial drainage		A low rate application system is best. A sprinkler type system is lower risk, however if you operate a travelling irrigator in these conditions it has to be run at high speed to deliver low depths. You will also need extra storage as you can't apply when soils are too wet
To irrigate on land with a slope greater than 7˚		
High rainfall area		
High water table		
A sensitive catchment		
A large herd (e.g. over 500 cows)		Include a solid separation component to your system to deal with the extra nutrients and solids before they get to storage. Also check you have a large enough area for applying effluent
An intensive feeding system		
A standoff or feed pad in regular use		
None of the above risk factors		You can use any type of applicator. Make sure you have adequate storage to manage through wet times and check your application rate

System 1: Travelling irrigator

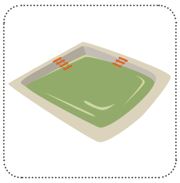
This system is the traditional design with a stormwater diversion in place at the yard. The effluent flows from the yard through a stone trap to a storage facility either via gravity feed or pump. It is then irrigated to land using a travelling irrigator.



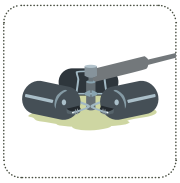
Stormwater



Stone trap



Storage



Pump station

Applicator travelling

Best suited for	
Farms	With no particular landscape /climate/soil risk factors
Soils	Freely drained soils
Slope	Flat ground to gently sloping
Labour	Moderate labour input
Capital investment	Low – mod (storage additional)
Other	Ideal for regular shaped paddocks

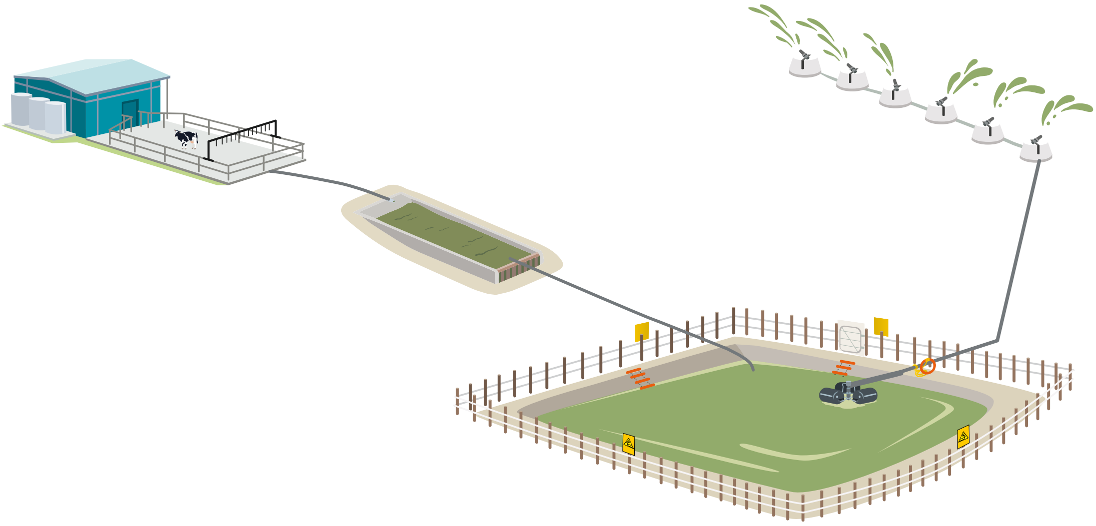
Caution

Travelling irrigators operated on heavy soils, or in sensitive or high risk environments **MUST** operate on fast speed to reduce over application.

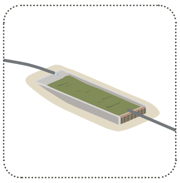
System 2: Low rate sprinkler

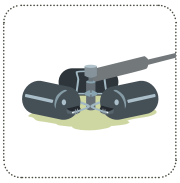
With passive separation

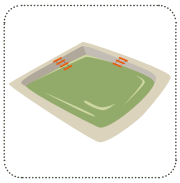
This system has a storm water diversion at the yard. The effluent is then gravity feed to a passive separator where the solids are removed. The liquid is then pumped to storage and irrigated to land via a small number of low rate applicators that are moved frequently.

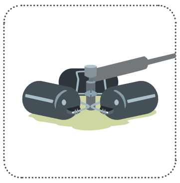


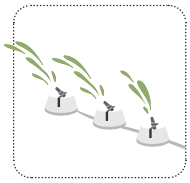

Stormwater


Passive separator


Pump station


Storage


Pump station


Applicator
low rate

Best suited for	
Farms	That require flexibility in application depth and rate, such as high risk soils, high rainfall areas or sensitive catchments
Soils	All soil types. Especially suited to poorly drained or artificially drained soils
Slope	All
Labour	Higher labour input
Capital investment	Moderate to higher (storage additional)
Other	Works well in small or irregular paddocks

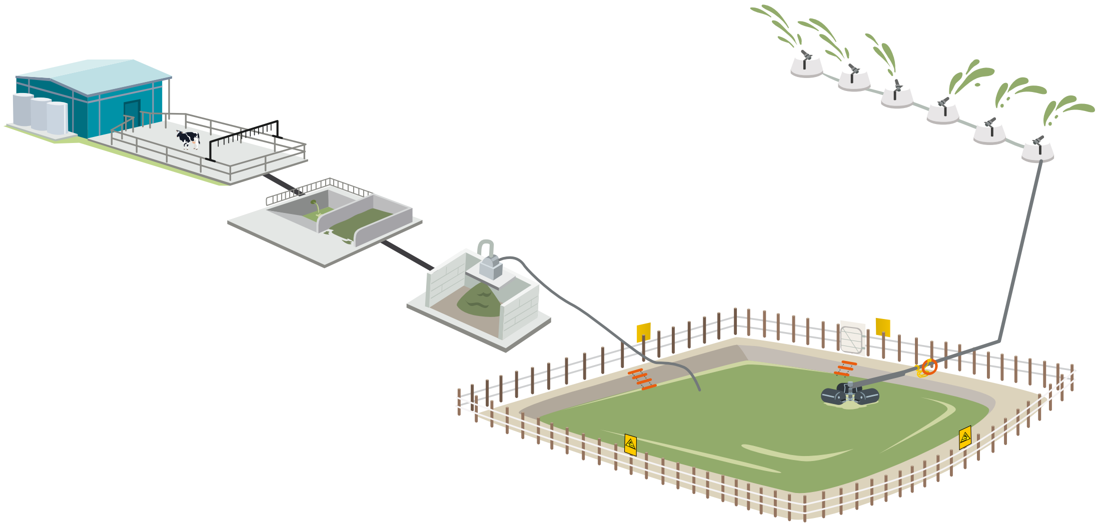
Note

Using a mechanical separator is an alternative option. This could increase the labour involvement slightly, due to the maintenance associated with running a mechanical device. – refer System 3

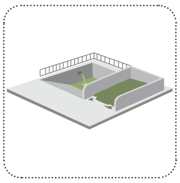
System 3: Low rate sprinkler

With mechanical separation

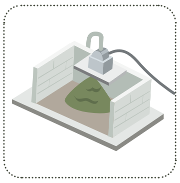
This system has a storm water diversion at the yard. The effluent then flows through a stone trap to a mechanical separator where the solids are removed. The liquid is then pumped to storage and irrigated to land via a small number of low rate applicators that are moved frequently.



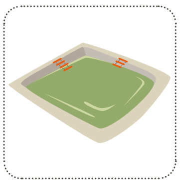
Stormwater



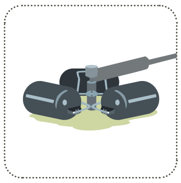
Stone trap



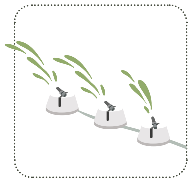
Solids separator



Storage



Pump station



Applicator low rate

Best suited for	
Farms	That require flexibility in application depth and rate, such as high risk soils, high rainfall areas or sensitive catchments
Soils	All soil types. Especially suited to poorly drained or artificially drained soils
Slope	All
Labour	Higher labour input
Capital investment	Moderate to higher (storage additional)
Other	Works well in small or irregular paddocks

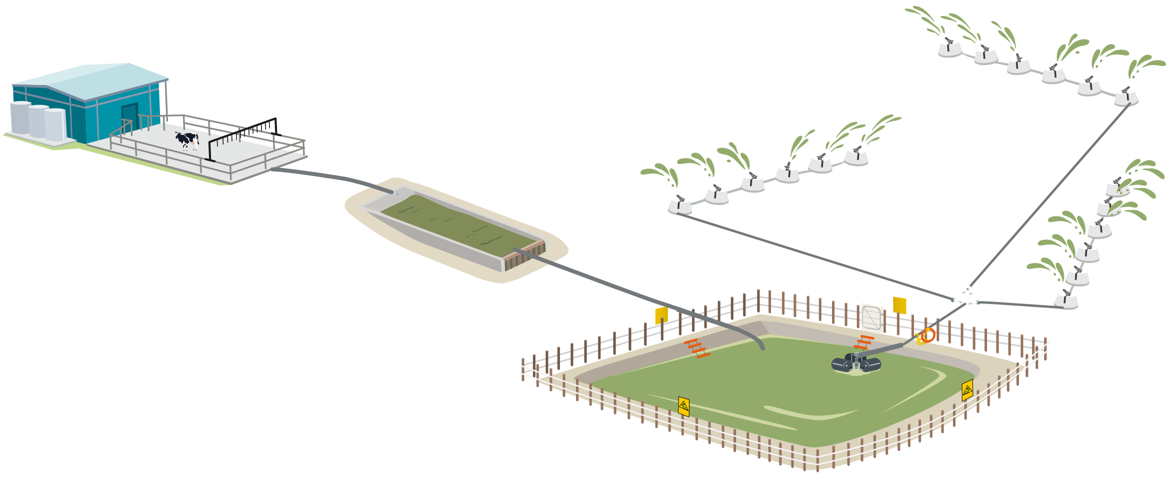
Note

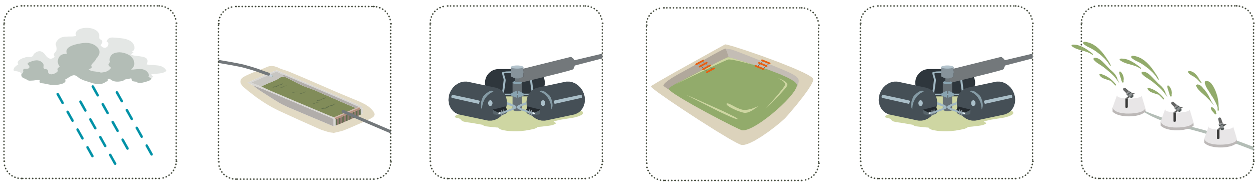
Using a passive separator is an alternative option. This will reduce the labour involvement and risk slightly, due to the issues associated with running a mechanical device – refer System 2.

System 4: Multiple line low rate sprinkler

With passive separation

This system has a storm water diversion at the yard. The effluent is then gravity feed to a passive separator where the solids are removed. The liquid is then pumped to storage at is irrigated to land via series of multiple irrigation lines simultaneously. Each line has a number of low rate applicators on it. Applicators distribute a large volume of effluent in a short period of time at a low application depth.





Stormwater | Passive separator | Pump station | Storage | Pump station | Applicator low rate

Best suited for	
Farms	All farms. Especially higher rainfall areas and farms that have limited opportunities to irrigate and empty ponds
Soils	All soil types. Especially suited to poorly /artificially drained high risk soils
Slope	All
Labour	Moderate labour input
Capital investment	Moderate to higher (storage additional)
Other	• Fast pond level reduction over large land area • Locations with few irrigation days available

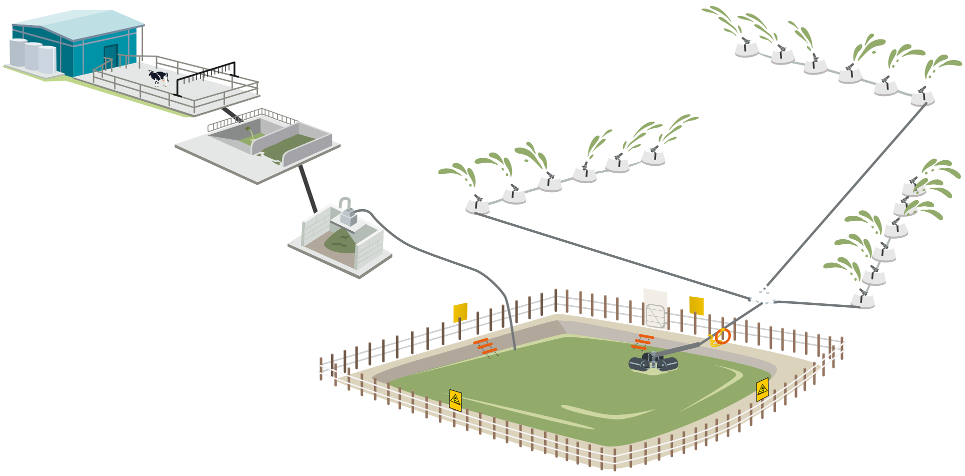
Note

Requires larger than normal pump size.

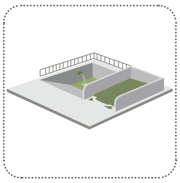
System 5: Multiple line low rate sprinkler

With mechanical separation

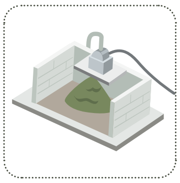
This system has a storm water diversion at the yard. The effluent then flows through a stone trap to a mechanical separator where the solids are removed. The liquid is then pumped to storage and is irrigated to land via series of multiple irrigation lines simultaneously. Each line has a number of low rate applicators on it. Applicators distribute a large volume of effluent in a short period of time at a low application depth.



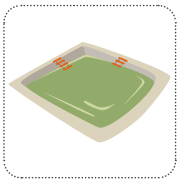
Stormwater



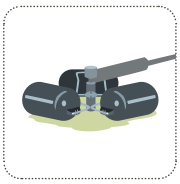
Stone trap



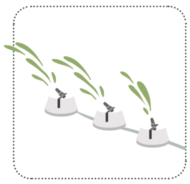
Solids separator



Storage



Pump station



Applicator low rate

Best suited for	
Farms	All farms. Especially higher rainfall areas and farms that have limited opportunities to irrigate and empty ponds
Soils	All soil types. Especially suited to poorly /artificially drained high risk soils
Slope	All
Labour	Moderate labour input
Capital investment	Higher (storage additional)
Other	• Fast pond level reduction over large land area • Locations with few irrigation days available

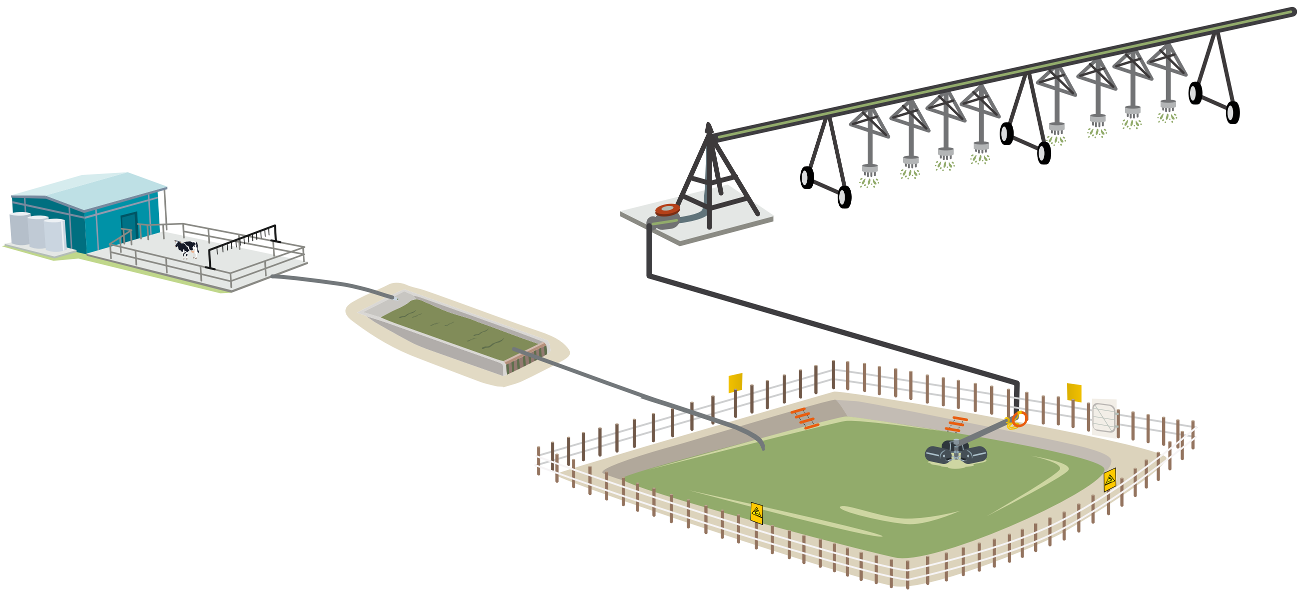
Note

Requires larger than normal pump size.

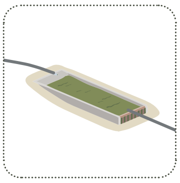
System 6: Pivot through mainline

With passive separation

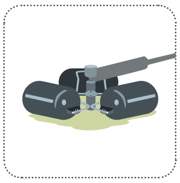
Using a pivot to irrigate is logically restricted to those already with pivots in place for water irrigation. The effluent is gravity feed from the dairy to the passive separator. The liquid is then pumped to the storage facility and applied to the paddocks through the pivot mainline.



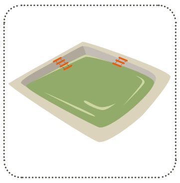
Stormwater



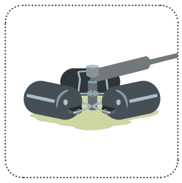
Passive separator



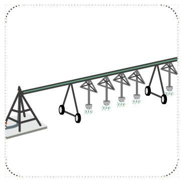
Pump station



Storage



Pump station



Applicator pivot

Best suited for	
Farms	Irrigation pivot already in place
Soils	All
Slope	Flat
Labour	Lower labour input
Capital investment	Moderate to higher (storage additional)

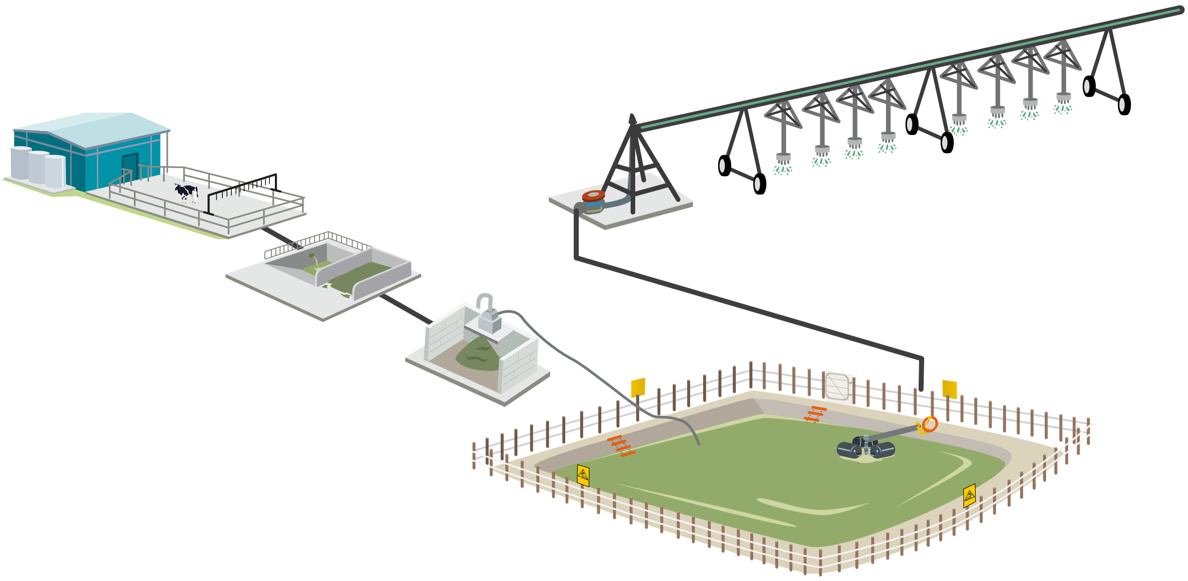
Note

Using a mechanical separator is an alternative option. This will increase the labour involvement slightly, due to the maintenance generally associated with running a mechanical device. – see System 7

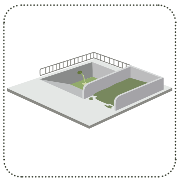
System 7: Pivot through mainline

With mechanical separation

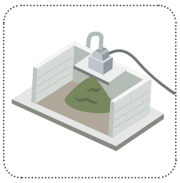
Using a pivot to irrigate is logically restricted to those already with pivots in place for water irrigation. The effluent flows through a stone trap to the mechanical separator. The liquid is then pumped to the storage facility and applied to the paddocks through the pivot mainline.



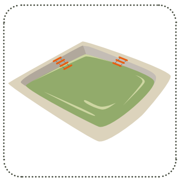
Stormwater



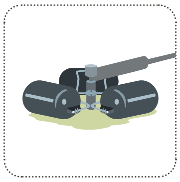
Stone trap



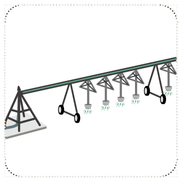
Solids separator



Storage



Pump station



Applicator pivot

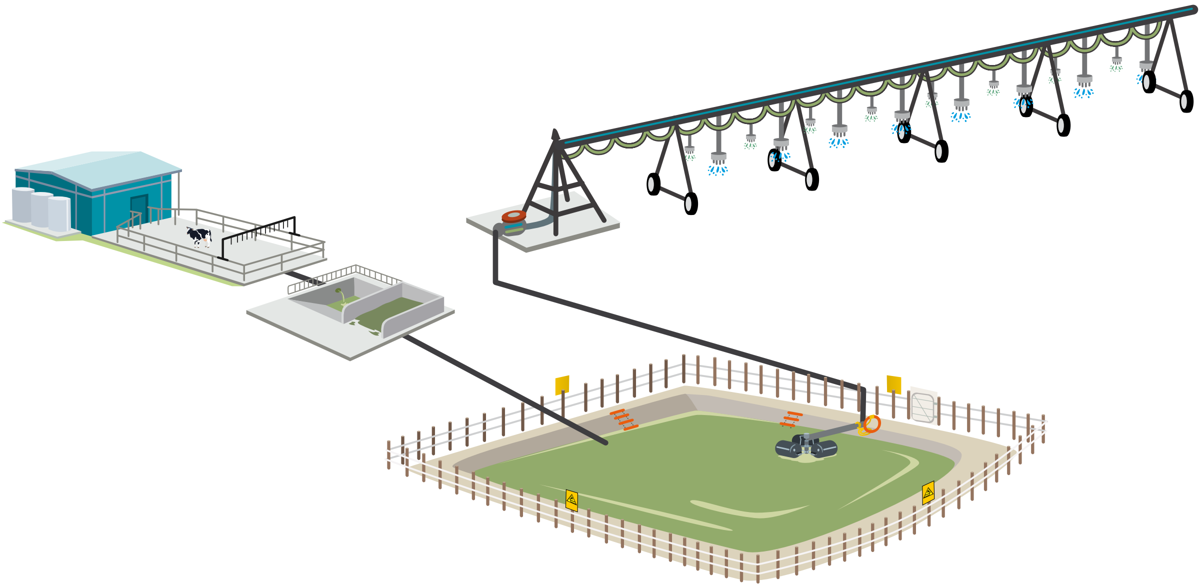
Best suited for	
Farms	Irrigation pivot already in place
Soils	All
Slope	Flat
Labour	Moderate labour input
Capital investment	Higher (storage additional)

Note

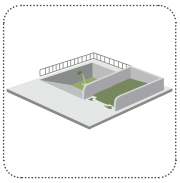
Using a passive separator is an alternative option. This will reduce the labour involvement slightly, due to the maintenance generally associated with running a mechanical device – see System 6.

System 8: Pivot with under slung sprinklers

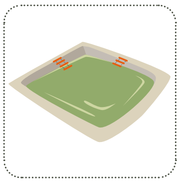
Using a pivot to irrigate is logically restricted to those already with pivots in place for water irrigation. If using under slung sprinklers the effluent is gravity fed from the dairy through a stone trap. The liquid is then pumped or gravity fed to the storage facility and applied to the paddocks through under slung sprinklers.



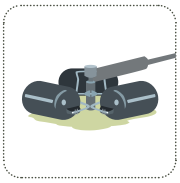
Stormwater



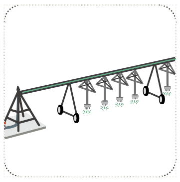
Stone trap



Storage



Pump station



Applicator pivot

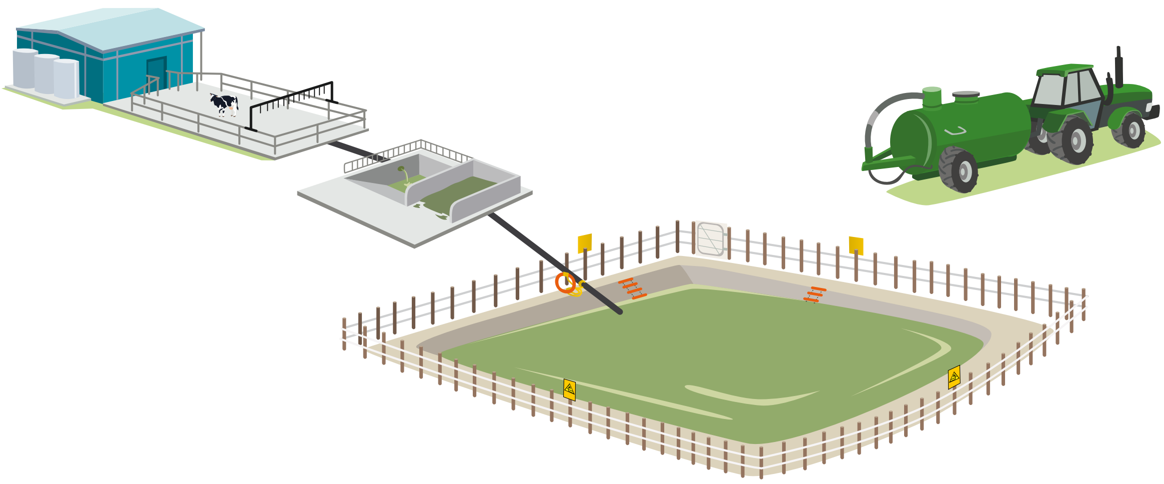
Best suited for	
Farms	Irrigation pivot already in place
Soils	All
Slope	Flat
Labour	Lower labour input
Capital investment	Lower (storage additional)

Caution

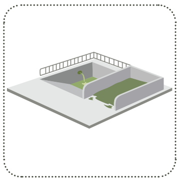
Effluent guns attached to the end of pivots typically provide poor nutrient spread and are at a high risk of over application, and as such are not recommended.

System 9: Muck spreader

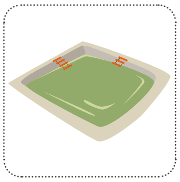
This system would typically include a storm water diversion then flow through a stone trap to a storage facility. A pump station is required if there is no gravity to storage. Effluent is stirred and sucked from storage into a muck spreader truck and sprayed to land.



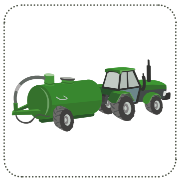
Stormwater



Stone trap



Storage



Applicator
muck spreader

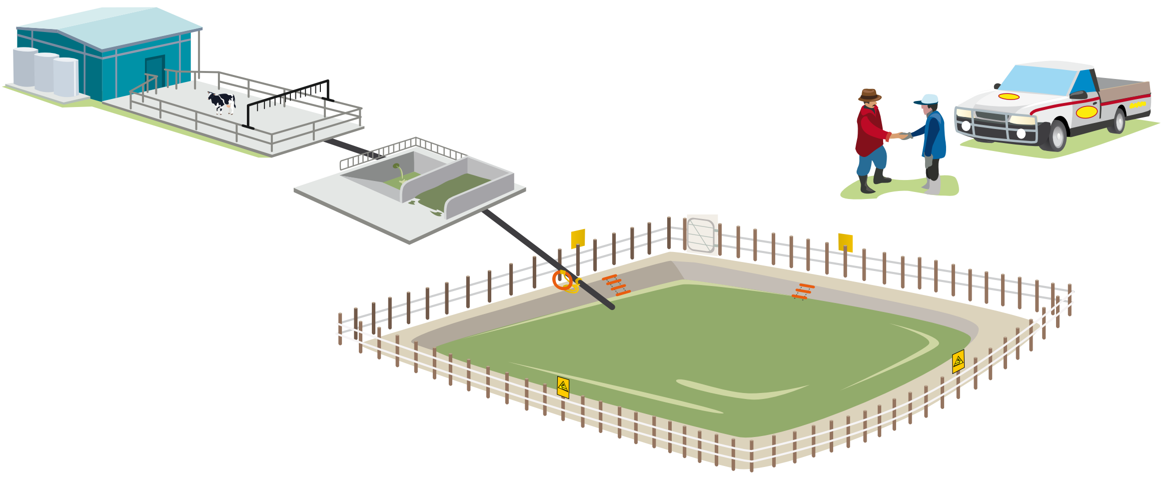
Best suited for	
Farms	Smaller farms and lower cow numbers, or when applying effluent to remote areas
Soils	All
Slope	Flat to sloping
Labour	Moderate to higher labour input
Capital investment	Lower (storage additional)

Note

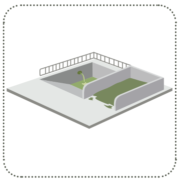
This system is not ideal on wet or heavy soils, as heavy machinery will cause damage to pasture and soils.

System 10: Contract spreader

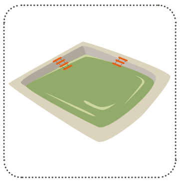
When using a contract spreader, effluent systems would include a stormwater diversion then flow through a stone trap to a storage facility. A pump station is required if there is no gravity to storage. Contract spreaders remove effluent from storage and apply by land using their own equipment.



Stormwater



Stone trap



Storage

Person (contract spreader)

Best suited for	
Farms	That do not want to deal with effluent management on a day-to-day basis
Soils	All
Slope	Flat to sloping
Labour	Very low labour input
Capital investment	Very low (storage additional)

Note

This system means the farm is reliant on the contractor in terms of timing.

Understanding the different components of an effluent system

The following provides a description of the individual components or building blocks of common effluent systems in New Zealand.

Stormwater diversion

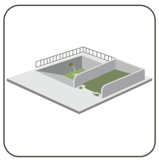
A stormwater diversion is a very effective way of reducing the amount of water entering the effluent system. This in turn reduces the effluent storage requirements and the amount of effluent having to be applied to land.

The stormwater diversion takes the rainfall that falls on the farm dairy and any surrounding yards and directs it away from the effluent system.

There are a huge number of stormwater diversion designs available, including manual and mechanical. Regardless of design care needs to be taken to manage the stormwater diversion correctly, installing an automatic facility or warning devices is advised.

Farms located in high rainfall areas would benefit from a stormwater diversion. Farmers may choose to only use stormwater diversion at times of the year when not milking. If using regularly during the milking season it is essential that robust systems are in place to ensure mistakes are not made.

Stone trap



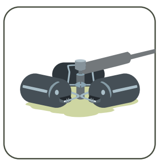
Stone traps are designed to slow down and redirect the flow of effluent so sand, stones and debris can drop out. This will prevent blockages in the effluent pipe work, pumps, storage facilities and applicators.

Stone traps are generally made of concrete and have a wide base which slopes down toward the pumping or draining end. The inlet is normally well above and on the opposite side/end of the stone trap to the outlet.

The solids that accumulate in the stone trap need to be regularly removed onto a sealed surface located directly beside the stone trap which drains any liquid back to the stone trap. The solids should be applied evenly to land.

All systems need a stone trap. Unless you have gravity fed flow to a weeping wall.

Pump station



The pump station’s purpose is to transfer effluent from one location to another. Where possible it is better and more cost effective to use gravity to move effluent. Pump stations may be required at to get effluent to storage and are definitely required to transfer effluent from storage to the applicator. There are a wide range of options available for transfer pumps including different types, sizes and capabilities. It is important that your pump has the correct specifications to ensure your effluent system works effectively.

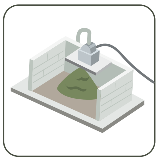
Solids separator

Solid separation involves the removal of coarse solids from the effluent resulting in a liquid effluent which will then go to storage and a store of solid material.

Using solid separation in the system will mean there is less liquid to be stored and storage facilities may require de-sludging less frequently. The removal of solids also allows the liquid effluent to be applied through any type of applicator. Low rate and mainline centre pivots systems ***must*** have a solids separator.

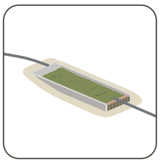
Solid separation should be considered when operating a feed pad or high feed input system as the amount of solids in the effluent is greatly increased in these systems.

There are two main methods of solid separation:



1. Mechanical separators: Mechanical separators achieve a high rate of separation and produce a dry solids component which is held on a pad or bunker for use at a later date. Once the solids are removed the liquid component is transferred to a storage facility. Mechanical separators are normally either slope screen, rotary screen or screw presses.

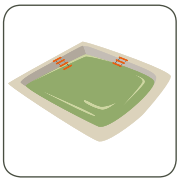
- Screw press systems force the effluent under pressure through a series of fine mesh layers. These are often elevated above the ground so solids can pile up beneath.



2. Passive separation: These are usually weeping walls. Weeping walls are lined storage areas which have a narrow slotted wall along the length of the store. There should be two storage areas which can be alternated. The liquid drains through the wall into a drainage channel and is transferred to a liquid storage facility. The solids remain in the storage area. Once the solids build up to a certain level they can be left to dry out and then applied to land. The sizing and design of the weeping wall is critical to its success.

	Pro's	Con's
Passive Separator (Weeping wall)	• Low risk of breakdown • Very low ongoing labour input • Low energy usage	• Farm specific – design different on every farm • Solid product has higher water content • Solids can become anaerobic causing odour • Takes up a large physical area • Emptying bunkers bigger job. May require a contractor
Mechanical	• Liquid effluent is better filtered • Require smaller physical area • Produces a drier solids product	• Ongoing mechanical maintenance • Increased risk of breakdown • Higher energy costs • Require stone and grit removal prior to separation • Works best when effluent properties are consistent

Storage



The storage component of an effluent system is critical for all farms. Having sufficient storage for your effluent provides you flexibility in terms of application. This means you can apply effluent when soil conditions are right and water and nutrient uptake can be maximised, and, allows you to irrigate at a time that suits you.

Storage facilities can be either in-ground or above-ground ponds and tanks. These need to contain the effluent without leaking, so are commonly lined with synthetic products or clay.

The amount of storage you need depends on your farm system and local environment. It is best calculated by using the "Dairy Effluent Storage Calculator".

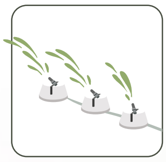
Include an agitator or stirrer to the storage facility. Continuously agitating and homogonising the effluent will keep solids in suspension hence reducing odour and the need to desludge.

For more detailed information on the design and construction of storage facilities refer to the *IPENZ Practise Note 21: Farm Dairy Effluent Pond design and Construction*, this can be downloaded from **dairynz.co.nz.**

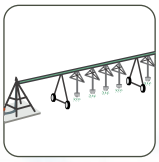
Applicator

The final component of an effluent system is the applicator. This distributes the effluent to the paddock. There are a large number of applicators including:

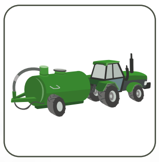
Travelling irrigators



Low rate application systems (small or large pods)



Pivots



Slurry tanker

	Pro's	Con's
Traveller	• Low capital outlay • Can distribute large quantities of effluent at one time period • Don't require fine solids removal • In case of breakdown, easy to interchange with alternate traveller • Easy to service and maintain	• Not well suited to steep topography • High application rates and depths • Risk of poor performance due to being poor daily set up • Poor performance due to poor design and lack of maintenance • Not well suited to small or irregular paddocks
Low rate systems	• Low application rates • Can be used more days of the year • Suited small or irregular shaped paddocks • Less moving parts – easy to maintain • Less chance of spray drift over boundaries etc • Can distribute large quantities of effluent at one time period at low depths • Easier to shift and run in rolling topography • Suits high rainfall/ high risk soils/ artificially drained land	• More difficult to get even application throughout the paddock particularly if different people shifting each time • More shifts involved to get same volume of effluent as traveller • Easily blocked (need solids separation or filtration) • Specific planning and design needed to get correct pressures and volumes to all sprinklers
Pivot	• Excellent low application depths • Many irrigation days available throughout the year • Can get rid of extremely large volumes of effluent quickly • Requires much less storage • Uses existing infrastructure • Little time spent setting up and moving	• Washing effluent out of lines afterwards • Pivots have been known to get stuck when operating during the winter • Requires computer operated valves if irrigating effluent over paddocks with water courses and drains. • Some 'add on' effluent sprinklers to pivots i.e. guns have very poor distribution uniformity • Need excellent solids removal or nozzles will block • Can have different application at each bay
Contract spreader	• Very low capital invested in system • Very low labour requirement • Empties pond fast • Proof of placement	• Reliant on contractors timeframes • Less benefit from regular water and nutrient application • Must make sure contractor applies with rules
Slurry tankers	• Can access any part of farm that is drivable • Excellent low application depths • Can move large volumes of effluent relatively quickly • No solids removal required • Easy to allow for wind drift • Excellent placement control • Has the ability to suck out sumps and other sources that don't have pumps • A relatively cheap option compared to pumps, pipes, irrigators etc	• Heavy gear causing damage to pastures and races • Not ideal on wet soils due to wheels causing pugging and compaction • Need good vehicle access to ponds • Health and Safety risks for driver on steep land

Where to go for help

Key industry contacts

DairyNZ

www.dairynz.co.nz
Phone 07 858 3750
email info@dairynz.co.nz

Fonterra

www.fonterra.com
Phone 09 374 9000

Tatua

www.tatua.com
Phone 07 889 3999

Westland Milk Products

www.westland.co.nz
Phone 3 756 9800

Synlait

www.synlait.com
Phone 03 373 3000

Open Country Dairy

www.opencountry.co.nz
Phone 9 589 1372

Miraka

www.miraka.co.nz
Phone 0800 647 252

For further information and resources on Farm Dairy Effluent go to **dairynz.co.nz** or call 0800 4 DairyNZ (0800 4 324 7969) dairynz.co.nz