A guide to managing farm dairy effluent

Bay of Plenty

Bay of Plenty REGIONAL COUNCIL

DairyNZ

Profitability. Sustainability. Competitiveness.

This booklet has been put together by the Bay of Plenty Regional Council and DairyNZ.:

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Fonterra

Dairy Effluent Action Team

This booklet will cover

Introduction

Farm dairy effluent is a valuable resource and if managed well can increase pasture production and reduce fertiliser costs. However, effluent also poses an environmental risk due to the nutrients and disease-causing bugs it contains. Untreated effluent entering waterways or groundwater can have a detrimental effect on human health and water quality, and is a breach of best management practices.

This booklet will help you comply with the Bay of Plenty rules and your consent conditions so you can minimise the effects on surface and groundwater quality and get the most from the nutrient value of your effluent.

The dairy industry is committed to achieving effluent compliance 365 days of the year.

Farm benefits of good effluent management

- Nutrient benefits: for productive soil, pasture and crops – and savings on fertiliser inputs, reducing losses off farm
- Preventing animal health issues: metabolic disorders can be caused by build-up of potassium (K) levels, even when you manage effluent to stay within N-load limits. Nutrient budgets and larger effluent blocks can help you avoid this
- Better growth conditions: the water content of effluent can give your pasture a boost during dry weather. The organic matter in effluent will make your soil 'spongier', enhance soil life and worm activity, and improve soil properties (aeration and drainage, water holding capacity). This makes the soil more productive and less prone to compaction or erosion
- Complying with your resource consent.

"How we manage the impact that farming has on the environment has become more important as we strive to maintain good environmental standards in the areas where we live. Over time, streams, rivers, lakes and estuaries may come under increasing pressure. Good effluent management is part of the answer to keeping them in good health and is part of farmers' contribution to the community – that adds to the important economic role that farming plays. Good effluent management also makes good sense by using nutrients well and helping to minimise nutrient loss through leaching or runoff."

Stuart Morrison – Bay of Plenty farmer

Nutrient benefit

Farm dairy effluent offers a source of nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg) and sulphur (S), as well as trace elements to increase pasture or crop production.

A good effluent system is one of the few capital costs on a farm where you can get a return on your investment by savings made through cost reductions (i.e. applying less fertiliser). As fertiliser becomes more expensive, the return on the investment is greater.

How solids content affects nutrient value

The nutrient concentration of effluent varies depending on how much water you use in wash-down and the dry matter content of the effluent, slurry or sludge.

How storage affects nutrient value

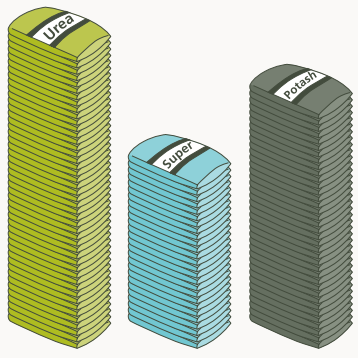
Another factor determining nutrient concentration is how long the effluent remains in storage before being applied. Nutrient content in stored effluent may decline due to losses to the atmosphere (N) or settling out in the solid fraction of the effluent (P). Nutrients attached to solids will be recaptured when the ponds are desludged or stirred. Other nutrients (K) are more soluble, and levels remain high in liquid effluent over time.

While storing effluent may see some loss of nutrient content, best use can be made of nutrients if effluent irrigation occurs when plants are actively growing. Applying effluent to saturated soils will waste the nutrient value and risk environmental pollution.

Nutrient content of effluent is affected by the solids content and the length of time effluent is stored before application.

Solid fertiliser equivalent of effluent from 100 cows under different scenarios

System One – All-grass system

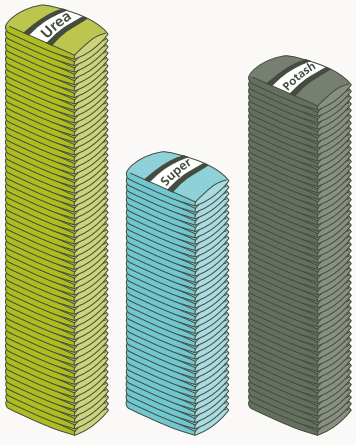


1.7 t (43 bags) of urea

1.0 t (26 bags) of superphosphate

1.5 t (37 bags) of muriate of potash

System Two – Maize 0.6 t/cow/yr on feed pad

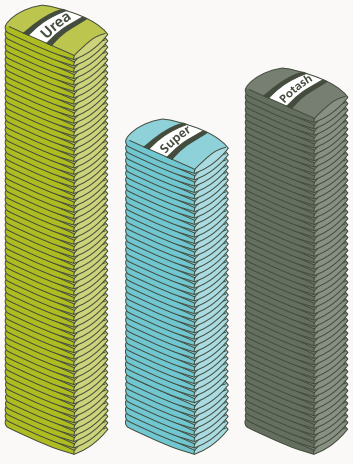


2.3 t (59 bags) of urea

1.5 t (37 bags) of superphosphate

2.1 t (52 bags) of muriate of potash

System Three – 0.6 t Maize + 0.4 t PKE/cow/yr on feed pad



2.5 t (62 bags) of urea

1.8 t (45 bags) of superphosphate

2.1 t (53 bags) of muriate of potash

Nutrient content of effluent depends on the type and amount of feed.

If you have a feed pad, you will collect more effluent, and therefore more nutrients, than if you are only collecting from your farm dairy.

The amount of nutrient benefit you gain in collecting effluent off a feed pad will depend on:

- How many cows are on the pad
- How much, and what type of feed they get
- How long the stock spend on the pad.

	Nutrients in effluent from 100 cows (kg/yr)			**Effluent area needed to apply 150 kgN/ha** (recommended annual loading)	
Effect of time spent on a feed pad *(farm dairy effluent plus feed pad effluent – feeding 2tDM/ha of maize silage)*					
Time on the pad	**N**	**P**	**K**	**% of farm***	**ha /100 cows***
½ hour per day on pad	838	100	868	14	5.6
1 hour per day on pad	1008	120	1044	17	6.8
2 hours per day on pad	1348	160	1396	22	8.8

* Effective effluent application area excludes waterways/drains/buffer zones and other exclusion areas.

The longer the period of time that cows spend on a feed pad, the greater the volume of effluent and its value as fertiliser.

Higher stock numbers or more intensive feeding or more time on pad = more nutrients.
More nutrients = a larger effluent block needed / a greater percentage of farm area required.

How much effluent does your farm system generate?

Less effluent and nutrients generated if:	More effluent and nutrients generated if:
Cow numbers low	Cow numbers high
Low N fertiliser applied	High N fertiliser applied
No supplementary feeding	High supplementary feeding
Water-efficient washdown system and technique used	High water use in dairy/yards/pads
Once-a-day milking	Twice-a-day milking
Effluent only collected from yards/dairy	Effluent collected from feed pad or stand-off area
Herd not under stress in yards/dairy	Herd under stress in yards/dairy
No rainwater enters system	No stormwater diversion in place

As your farm system changes, update nutrient budgets regularly to see if you still have enough area in your effluent block to avoid applying too much N and K (see pg 19). Use the pond storage calculator to see if you still have adequate storage (contact the Bay of Plenty Regional Council consents team to discuss).

Code of Practice and Standards for Farm Dairy Effluent System Design

A code of practice and standards have been written to provide guidance to the effluent services sector on the design of effluent systems. The code and standards will ensure that systems are designed so that they deliver the right amount of effluent to the right place at the right time. Good system design will help to maximise financial benefits from nutrients and help farmers achieve compliance. An accreditation system will be linked to the code and standards so that farmers will have some assurance that effluent system designers provide high quality advice. The code and standards are available on the DairyNZ website, **dairynz.co.nz.**

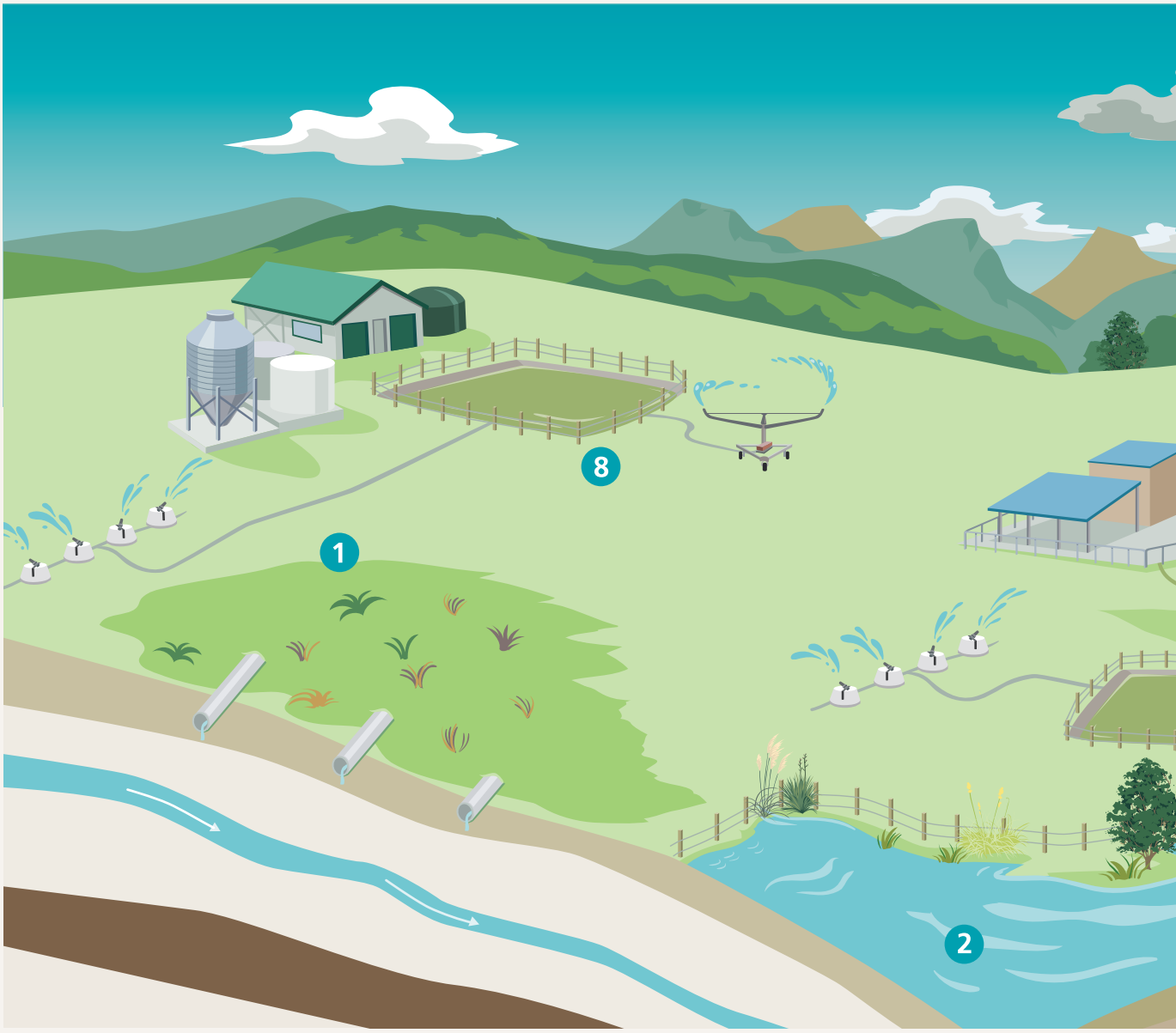
"There is a lot of information out there so farmers should seek that information and not necessarily wait for someone to bring them the information."

Mac Pacey – Bay of Plenty farmer

Use an accredited effluent professional to design your system and supervise the installation.

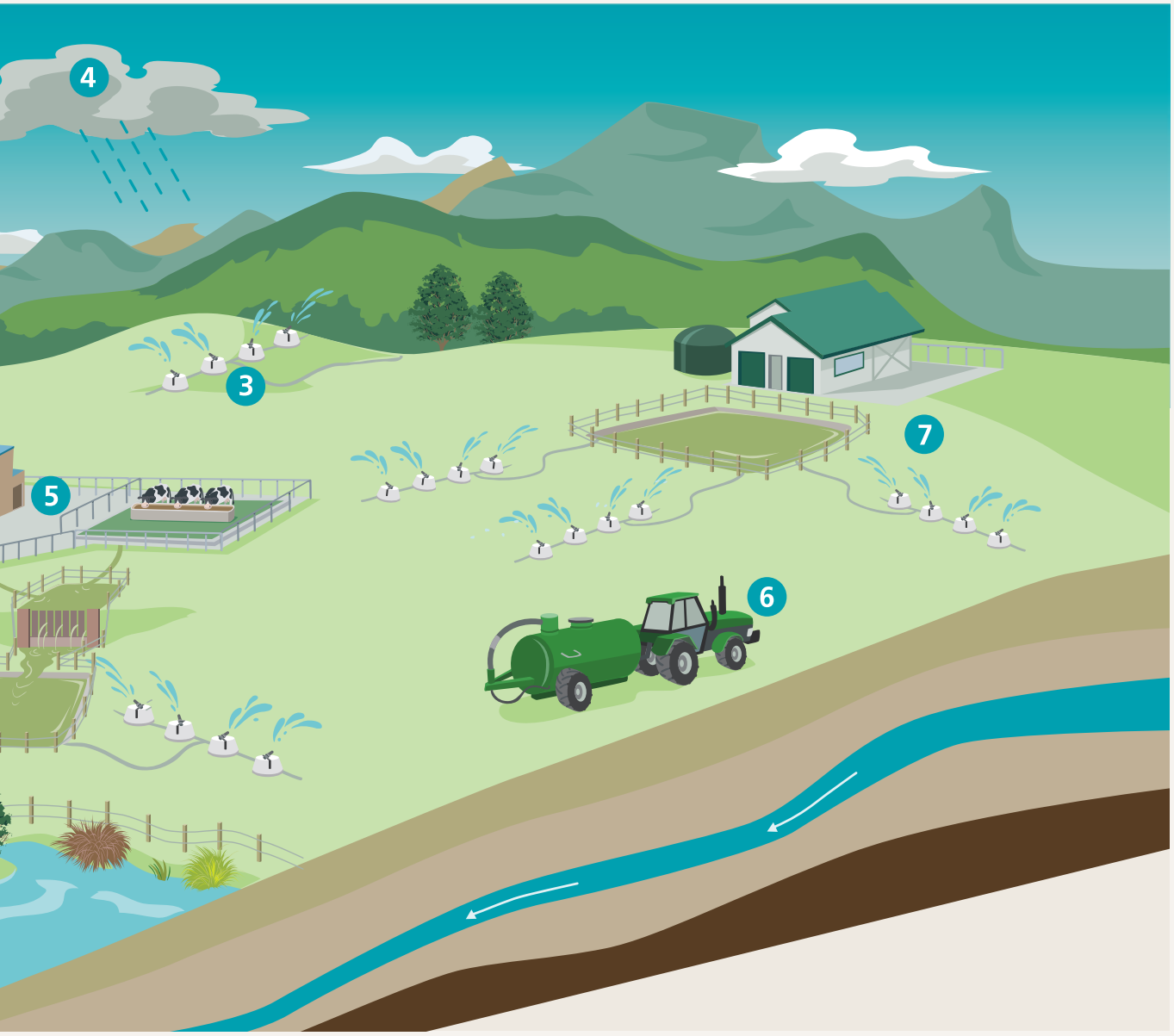
Matching your effluent system to your situation

Whether you are starting from scratch or upgrading, the effluent system you choose should be suited to the conditions of your farm, your farming system and your staffing situation.



1	**Are your soils poorly drained or underlain with artificial drainage?**	A system that can deliver effluent at low depths is best. A sprinkler-type system is lower risk – 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 operate your traveller when soils are too wet.
2	**Do you have free draining soils above a sensitive receiving water body like a shallow aquifer or a lake fed by groundwater springs?**	Depth is important and so is nutrient loading – keep within the 150kg N/ha/yr Nitrogen loading. (Other factors are also important to prevent N loss in these areas, such as wintering practices).
3	**Is your land undulating or sloping (more than 8°)?**	Rate is critical – so there is no runoff. If your land also has poor soakage properties, use a low application system. If it is free-draining and sloping, travelling irrigators should be set to a fast speed.
4	**Are you in a high rainfall area?**	Check you have enough pond storage to see you through the wet periods – contact the Bay of Plenty Regional Council consents team to use the pond storage calculator.

Low application systems decrease the likelihood of surface ponding and runoff and provide more flexibility when the soil is wet. These systems allow precision in how much water and N is applied. Some low application options may require other changes to your storage and solids removal systems.



5	**Do you have a large herd, intensive feeding system, or a stand-off or feed pad in regular use?**	Consider a solids separation system to deal with the extra nutrients and solids in your effluent. Check you have a large enough area for spreading effluent.
6	**Do you need a low capital input system, even though ongoing labour input may be higher?**	Consider travelling irrigators with adequate storage, or you can compare the cost of hiring a contract spreader.
7	**Are you willing to spend a little more up front to reduce ongoing labour because you have limited labour available?**	A sprinkler system capable of covering a large area all at once can allow you to get your pond levels down without daily shifting of equipment.
8	**If you have no special risk factors associated with your property...**	You still need to ensure you have adequate storage to manage through wet periods (you can use the Bay of Plenty Regional Council pond storage calculator), and check your irrigator's application rate (see pg 21).

Future-proof your system

When you are installing a new system or upgrading an existing one, it pays to consider possible future scenarios.

Think about whether you are likely to:

- Bring more land into operation
- Increase stock numbers or supplementary feed significantly
- Install or increase use of a feed pad or stand-off area
- Have stock spend more time in the dairy or on stand-off areas.

When you intensify your farm operation, or when you build additional structures and collect effluent from them, your effluent system needs to change to keep up. Build in flexibility when you upgrade your system to cope with future growth.

In more intensive systems, using vehicles to transport the effluent to more distant parts of the farm or even off the property (e.g. to a cropping block or runoff) may be useful.

Where effluent is very fibrous (e.g. from feed pads), extra steps in effluent treatment may be needed to remove solids prior to effluent irrigation.

Changing an existing system – look at the big picture

If you are retrofitting an existing set-up, look at the whole system and consider the implications of any change. Talk with other farmers who have tried systems and consult professionals.

If you are thinking of switching application methods (e.g. sprinklers instead of a travelling irrigator), find out what else will need to change in the system (e.g. storage, solids separation, different pressure or pumping requirements, labour inputs or maintenance).

Building in contingencies

What will you do if your primary system fails? It is essential to have a contingency plan.

Consider the following options:

- Access to a spare pump or similar back-up equipment, and
- Extra storage in case you cannot pump or irrigate due to equipment failure or power cuts.

Extra storage can come in handy during busy periods on the farm.

Effluent must never enter waterways. Have a sound contingency plan to cut down on stress, avoid pollution and ensure you comply with your consent at all times.

Working with soil and water features on your farm

Within your farm you will most likely have high-risk and low-risk areas for effluent irrigation. Prepare an effluent irrigation plan that shows these different areas. You will need to register a plan with the Bay of Plenty Regional Council as part of your resource consent, similar to the one below.

Some high-risk areas are obvious because water can be seen ponding or running off from these soils during rainfall. Other risks are less visible. The ideal soil for irrigation absorbs and filters the effluent through many small pores – this is called 'matrix flow'. Typical examples include ash, fine pumice, or loamy soils. Soils with high clay content or artificial drainage often have larger cracks and channels. While the effluent might 'disappear' when applied, it can travel through these cracks and channels to reach subsurface drains or groundwater, and then flow underground to contaminate ground water. This is called 'bypass flow'. Soils with bypass flow are higher risk zones.

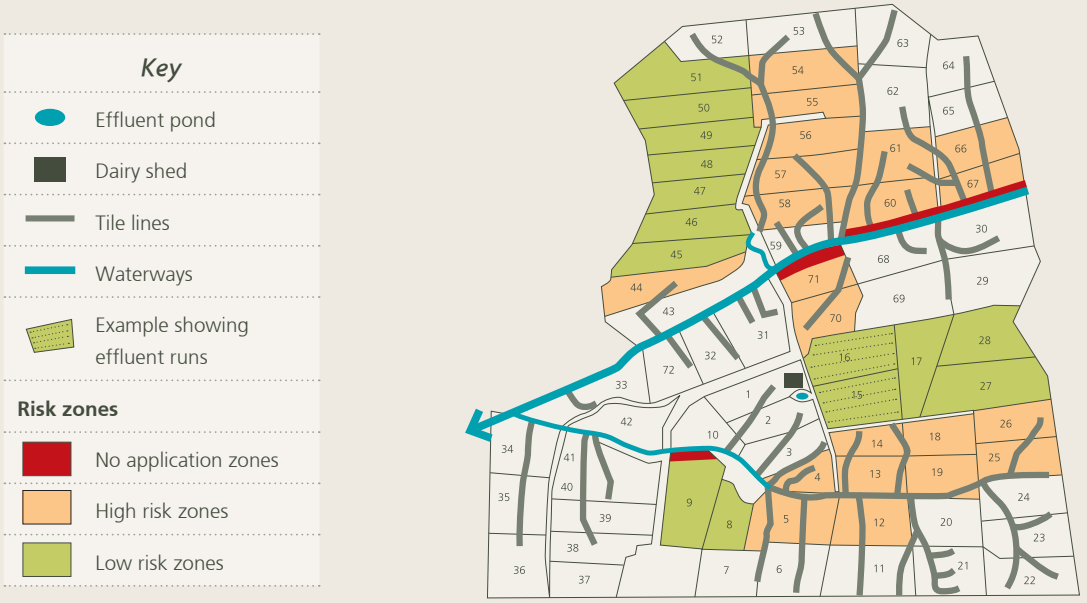
Some helpful soil information can be found on the Bay of Plenty Regional Council website **boprc.govt.nz.**

An effluent application plan

A written effluent application plan can help you identify suitable areas of the farm for effluent application, and can help all staff to see this and to keep accurate records.

From a plan or map of the farm, identify waterways, natural drainage patterns, soil types and sub-surface drainage, prevailing wind direction and neighbours' dwellings.

- Mark out the ideal area for effluent application, noting irrigator runs for each paddock and colour-coded risk zones.
- **No-application zones** include all land within 20m of a drain, waterway or bore, or the boundary of a neighbouring property. (These are marked in red in the map below). **Risk zones** include mole or tile drainage areas, very wet soils or very free-draining areas with porous subsoil and accessible groundwater.



- At the start of each season, work out an irrigation rotation plan that considers different risk zones, desired application rates and storage capacity
- In addition to planning your effluent irrigation, make a plan for maintenance showing tasks, dates to do them and who is responsible, with a space to note when it is done
- Consider conditions on the day that might increase the risk of effluent entering no-application zones (e.g. wind direction and speed).

Collection and storage

There are three key good practice principles of effluent collection and storage:

1. Collect all effluent in a sealed storage facility
2. Reduce effluent volume
3. Have enough storage.

Some dairy farms irrigate effluent directly from the farm dairy sump to land on a daily basis. But daily application is labour-intensive, high maintenance and prone to system failure. Storage offers flexibility for effluent irrigation to fit around farm activities and current conditions.

If excess effluent is applied onto an already wet soil, pathogens and nutrients can enter surface waterways and groundwater. This means that storing effluent over wet periods (also known as 'deferred irrigation') is an essential strategy for keeping waterways clean.

Another advantage of storage is that it allows solids to settle and this reduces blockages and wear and tear on pumps, pipes and spray equipment.

Storage is required because saturated soils cannot absorb effluent. Irrigating effluent in wet conditions is a waste of nutrients and risks polluting waterways. It is better for nutrient efficiency, pasture growth, and the environment if irrigation is deferred until soils are drier.

Storage Principle One: Collect all effluent in a sealed storage facility

The good practice requirement for sealing applies not only to your storage ponds but to all areas where effluent collects such as feed pads, silage bunkers and storage piles for sludge or stone trap cleanings.

Avoid placing these storage facilities in sites with high water tables or at risk of flooding.

Stormwater drains should be installed and maintained to prevent rainwater flowing overland into any of these areas.

All areas where stock spend long periods should be sealed. Effluent on these areas should drain to the storage pond, or be scraped and stored on a sealed surface before application back to land.

Remember:

- Silage leachate should not reach any surface water body, and it should not pond at the pit site or flow overland
- Stock should not be stood off on unsealed areas where effluent can reach waterways or leach through to groundwater
- Putting any stock effluent into farm dumps or offal holes is not permitted under the Bay of Plenty Regional Council rules.

The Bay of Plenty Regional Council requires that all effluent storage ponds within the Rotorua lakes catchments be sealed and strongly recommends that storage ponds elsewhere in the region are also sealed. This is to ensure that leaching of nutrients from effluent to groundwater is prevented. Contact the Bay of Plenty Regional Council for more information on pond sealing

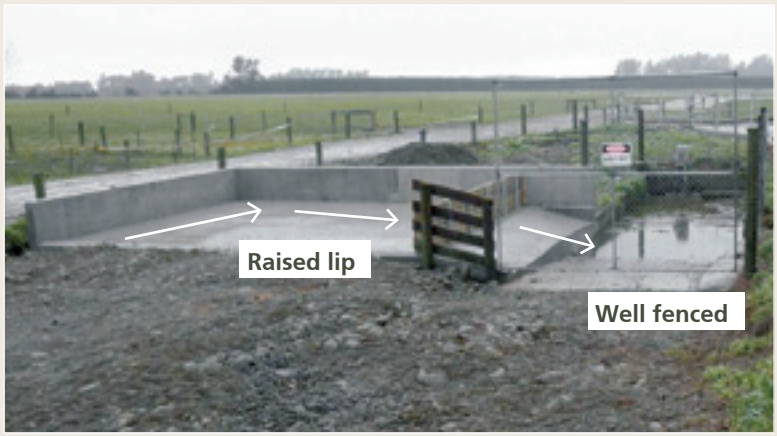
A synthetic (e.g. plastic or rubber) or compacted clay liner, or a concrete pond interior will ensure your ponds are sealed so no nutrients can leach to groundwater. If you are using a clay seal or liner, have the clay type checked by an engineer and get a certificate from them stating that the clay type is suitable and the pond is sealed.

Remember to inform anyone doing any maintenance work on the pond if synthetic or clay liners are present. A ripped liner or split clay can be an expensive mistake. You can use the template for employing effluent contractors on **compliancetoolkit.co.nz** > create forms > effluent contractors acknowledgement form.

For storage of silage and scrapings from stand-off areas, feed pads or stone traps, a concrete pad is best to allow for ease of cleaning by machinery.

Avoiding problems

- Make sure you will be able to clean the sludge from your storage pond with a digger – do not make the pond too wide or too deep
- Put a barrier on the bottom of the pond (e.g. on railway sleepers) to avoid breaking the pond seal when desludging
- Make sure contractors are aware of the care required with pond liners.



A well designed concrete pad for dewatering stone trap solids.

Note: Continuously stirred ponds will not need to be cleaned out as solids will remain in suspension. Consult your effluent system designer to help decide which stirrer will suit your application.

Storage Principle Two: Reduce effluent volume

Using less water around the yard will reduce effluent volume and therefore cut down on how much storage you require. Careful stock management can also help reduce the effluent deposited on the yards and in the dairy.

Reducing effluent volume will save time and money on handling and pumping effluent, and reduce the amount of storage you require. Consider recycling yard water (green water recycling). Ask your milk quality specialist about the food safety requirements, or visit dairynz.co.nz/farmfacts.

For new areas:

- Design the pitch of the yard for easy wash-down
- Install guttering and downpipes to ensure roof water does not enter the system
- Create drains around the yards and ponds to prevent rainwater flowing off the land and entering your storage pond
- Install a stormwater diversion system to take clean rainwater off the yard into stormwater drains and not into the ponds. Manual and automated systems exist – choose an option that works for your farm
- If you are standing your herd off, consider a system that requires less water for effluent collection e.g. scrapable pads or a 'herd home' type system with slatted floors above effluent bunkers.

For existing systems:

- Install a chain on the backing gate to break up pats
- Pre-wet the yard before milking to speed up the hosing down process
- Use a rubber scraper to remove solids before hosing
- Use the right hoses:
  - Length should be less than 10m
  - Hose diameter at least 40mm
  - Nozzle diameter of 20-25mm
  - High flow (3.5-4.5 litres/second) and low pressure (100-150 kpa) works best
  - Turn hoses off when not in use and ensure holding tanks and troughs do not overflow
- Maintain stormwater drains to avoid runoff from surrounding land entering the effluent pond
- Use your stormwater diversion – double check the switching before wash-down to avoid effluent entering the clean stormwater system.

Stock management

Reduce the amount of effluent deposited in the yards and the farm dairy by:

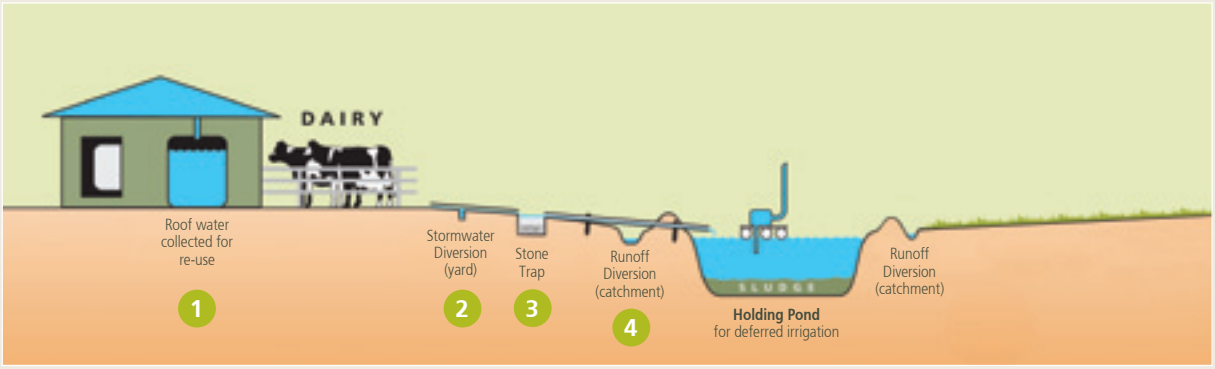
- Planning time and herd management so that stock spend fewer hours in the dairy
- Avoiding stress on cows through careful stockmanship and dog management
- Removing slippery surfaces and sources of excessive noise or stray voltage in the yards.

Stormwater diversion

An effective stormwater diversion system minimises the volume of effluent you have to deal with and your storage requirements.

Stormwater diversion systems can only be used when the yards or feed pads are completely clean. Stormwater diversion requires active management – make it a habit. Train staff to use these systems.

Many methods are used to divert water from the buildings and yards away from the treatment system after the yard is cleaned. Stormwater must be diverted prior to the stone trap. The best systems are close to the dairy and have a visible reminder for staff. Examples include flags or an ear tag on the vacuum pump switch, which staff have to move before starting plant.



1 Roof water collected with effective guttering

2 Stormwater diversion

3 Stone trap placed after stormwater diversion

4 Storage for deferred irrigation with catchment runoff diverted

Storage Principle Three: Have enough storage

You need enough storage to see you through:

- Rainy periods when the soil is too wet to irrigate
- Busy periods when farm labour is stretched and you do not want to irrigate
- Equipment failures (pumps or irrigator) when you cannot irrigate.

Store effluent for use when nutrients are most needed ie drier months or putting down a crop.

Decide how many days' storage you need

A pond storage calculator has been developed by Massey University in conjunction with the dairy industry and regional councils to help you assess your farm's storage requirements. Consent conditions usually specify the volume of storage required, based on the results of the effluent pond storage calculator. Contact the Bay of Plenty Regional Council consent team to use the calculator.

Pond size should take account of local worst-case scenarios. If you are winter milking you will require more storage to see you through the wettest months. Some systems also require freeboard to be maintained i.e. when relying on contractors to pump ponds.

How long soils remain wet depends on local conditions, including:

- Soil types
- Seasonal rainfall and weather patterns
- Water tables.

If effluent blocks have artificial subsurface drains, extra storage is needed so as not to irrigate onto these soils when they are very wet, or very dry and cracked. Under very wet or very dry conditions, effluent can pass easily through the soil into the drains and then enter waterways.

If your water table is high, if your soils are heavy, or if your effluent block has mole or tile drainage, then you need enough storage to carry you through wet periods until you can irrigate safely again.

It may be necessary to have two storage ponds rather than a single large pond if:

- The pond is likely to be too large for effective pumping, de-sludging and/or stirring
- Herd size increases or additional effluent is collected from stand-off areas or feed pads.

Effective effluent storage facilities

A well-fenced pond with a liner to ensure it is sealed. Adequate storage capacity enables effluent to be applied at the most beneficial times for pasture.

Stone trap not emptied and inadequate storage causing system overload. Unsealed storage facilities leach contaminants into groundwater.

Capturing the value of effluent

You can make significant savings from reduced fertiliser bills if you know what your effluent contains. This will also help you comply with your consent conditions.

There are three key principles to capturing the value of effluent:

1. Know what you are putting on – the amount of nutrients applied annually, and how much water and nitrogen are applied in each irrigation pass
2. Keep it in the root zone – plan effluent application according to your soil type
3. Be aware of uneven spray patterns – test your irrigator's output to see how even it is.

Effluent irrigation terms

When applying effluent, it's important to know:

- How much volume is going on to your soil – usually referred to as depth (mm) – similar to the rainfall you collect in a rain gauge e.g. 20mm (see pg 21 for how to measure this)
- How fast it is going on – usually referred to as rate (mm/hr) similar to the intensity of rainfall e.g. 20mm in 24 hours
- How much nutrient is applied in each irrigation event – usually referred to as nutrient loading per pass (to know this accurately, you need to have the effluent concentration tested by a laboratory – see pg 22. Contact DairyNZ for more information)
- How much nutrient is applied each year – usually referred to as annual loading and worked out using a nutrient budget – see pg 19.

Capturing Value Principle One: Know what you are putting on

If you know what you are putting on, you can ensure:

- You have enough area in your effluent block to meet the annual Nitrogen (N) loading recommendation (150kg N/ha/yr on pasture) and to avoid animal health problems from excess K
- You do not apply excess N in a single effluent application (e.g. no more than 50kg N/ha at once) which meets plant demand
- You do not apply more liquid than your soil can absorb and hold – to avoid ponding, runoff and leaching to groundwater.

Take effluent into account in your nutrient management planning

To help you create your farm's nutrient management plan:

- Do annual soil tests and a nutrient budget (e.g. using OVERSEER®) for your effluent block separate to other areas, and adjust your fertiliser accordingly
- Use your nutrient budget to work out the irrigation area needed to keep your effluent inputs within annual nutrient loading recommendations (e.g. 150kg N/ha/yr) – see pg 19
- Consider how to manage K levels (you may need to extend your effluent spreading area, or remove K through crops) – see pg 20
- Consider how much N you want to apply in each irrigation event – similar to your urea applications. Calculate how to manage your system to deliver the optimum amount of N at one time – see pg 22.

Effluent and farm nutrient requirements

Effluent can supply nutrients to help meet farm maintenance levels. In the case of potassium (K), standard effluent applications may supply double the amount required for maintenance.

Nutrients applied compared to farm maintenance requirements

Nutrients applied	**Effluent nutrients: kg/ha from 100 cows spread over 4 ha** (all grass system)	**Maintenance requirements** (1000kg MS/ha)
P	18	50
K	135	80
S	12	60

This shows that in the case of an all-grass system, effluent from 100 cows spread over four hectares can provide one third of the required P, more than the required K and one fifth of the required sulphur. This indicates that while N loading is at an acceptable level, a larger area for effluent spreading would be needed in order to decrease the K loading.

See pg 20 for other ideas to manage K.

Application rates that meet N-loading requirements may cause an excess of pasture K, which should be checked by regular soil tests and preparing a nutrient budget for your effluent block.

Using a nutrient budget for your effluent block

You can use a nutrient budget to check the area and the fertiliser needs of your effluent block. This will ensure you:

- Get the most from the nutrients in your dairy effluent
- Use fertiliser efficiently
- Avoid animal health problems from K build-up
- Comply with consent conditions regarding N loading.

The Bay of Plenty Regional Council recommends a maximum annual N loading of 150 kg N/ha/yr on pasture, and up to 250kg N/ha/yr on cropping blocks. Check your consent to see if a minimum area is specified. Note: Rotorua Lakes catchment has a more restrictive nutrient loss allowance based on farm benchmarking.

Nutrient budget showing an under-sized effluent block

This nutrient budget is for the effluent block on a 112ha dairy farm with flat, well drained soils. The effluent block is currently 12ha. The Bay of Plenty Regional Council recommends a maximum loading of 150kg N/ha/yr to pasture.

Other farm details:

- Stocking rate = 3.2 cows/ha
- Supplement = 1.3t/ha grass silage
- Production = 975kg MS/ha

N loading from the effluent and fertiliser added is currently 292kg N/ha/yr, exceeding the recommendation of 150kg N/ha/yr.

K levels are excessive and can cause metabolic problems

Nutrient budget for effluent original block (12 hectares)

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na	H+
Inputs								
Fertiliser and lime	60	45	0	60	80	0	0	0.0
Farm effluent added	232	28	246	18	37	15	5	-5.7
Atmospheric/clover N	50	0	2	4	2	4	17	0.0
Irrigation	10	0	6	10	37	9	38	0.0
Slow release	0	3	4	0	3	5	6	0.0
Supplements imported	39	3	33	3	7	2	2	-1.2
Outputs								
Product (milk, meat, fibre)	68	11	17	4	14	1	5	0.0
Net transfer	39	4	38	3	6	2	1	-0.9
Supplements removed	0	0	0	0	0	0	0	0.0
Atmospheric	86	0	0	0	0	0	0	-0.6
Leaching/runoff	33	1	68	75	70	16	54	-2.4
Net immobilisation/absorption	165	29	0	13	0	0	0	-0.6
Change in inorganic soil pool	0	35	168	0	75	16	8	-2.5

The increase in P in the soil pool is predicted to raise the Olsen P by 3.5 units per year. This may raise P above optimum levels, depending on soil test values.

Recommendation: The effluent area must be increased to lower K and N loading, and current fertiliser application is excessive. The following example shows the effect of increasing the effluent area from 12 to 19 hectares, reducing P fertiliser and cutting out extra N fertiliser on the effluent block.

N loadings of 146kg N/ha/yr with no additional N fertiliser are now within the recommended loadings.

Effluent K levels have been reduced significantly but are still above pasture requirements. Using the effluent block for silage or a crop will reduce pasture K levels and lower the risk of metabolic problems.

Nutrient budget for an expanded effluent block (19 hectares)

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na	H+
Inputs								
Fertiliser and lime	0	20	0	60	80	0	0	0.0
Farm effluent added	146	18	156	11	23	10	3	-3.6
Atmospheric/clover N	81	0	2	4	2	4	17	0.0
Irrigation	10	0	6	10	37	9	38	0.0
Slow release	0	3	5	0	3	5	6	0.0
Supplements imported	39	3	33	3	7	2	2	-1.2
Output								
Product (milk, meat, fibre)	68	11	17	4	14	1	5	0.0
Net transfer	39	4	39	3	6	2	1	-0.9
Supplements removed	0	0	0	0	0	0	0	0.0
Atmospheric	60	0	0	0	0	0	0	-0.3
Leaching/runoff	27	0	58	71	66	16	54	-1.9
Net immobilisation/absorption	81	28	0	11	0	0	0	-0.3
Changes in inorganic soil pool	0	1	90	0	66	10	6	-1.3

Soil P is not predicted to change much under this scenario, as inputs and outputs are balanced. Using the nutrient budget to reduce fertiliser inputs will result in savings for the farm.

Options for managing potassium (K) levels

Over time the application of farm dairy effluent to land increases both soil and pasture potassium levels – particularly in winter and spring. This can increase the potential for metabolic problems in dairy cows at calving and in early lactation. Some management considerations for K levels are:

- Carry out a nutrient budget for your farm using the latest version of OVERSEER® with your fertiliser rep or consultant. Do separate soil tests and nutrient budgets for your effluent block and adjust fertiliser application rates to take into account the increased nutrients being added through effluent
- Increase the area irrigated – this will reduce the amount of both N and K applied per hectare. The area irrigated may need to double to bring K application rates down to maintenance levels. Aim to keep K levels below QTK 10
- Plan to avoid grazing effluent irrigation areas with springer herd and recently calved cows to avoid milk fever and grass staggers. Where this is not possible, take additional measures to prevent these metabolic disorders, such as increasing magnesium supplementation. Take herbage samples – they shouldn't exceed 3-3.5% K
- Analyse pasture from effluent and non-effluent areas and adjust feed/supplementation in consultation with a farm consultant or veterinarian if necessary
- Harvest silage or hay off your effluent blocks to reduce K levels, or if levels are very high, consider a crop e.g. maize
- Consider using a contractor who is capable of efficiently spreading stored effluent to remote paddocks outside the effluent spray irrigation area.

Work out what your irrigator applies in each pass

This test will allow you to determine the nutrients and effluent volume going onto your effluent blocks so you can use nutrients efficiently and meet your consent conditions.

A simple test can be used both to take a sample of effluent for nutrient analysis, and to determine the actual rate of application from your irrigation equipment.

MEASUREMENT

Irrigation application test

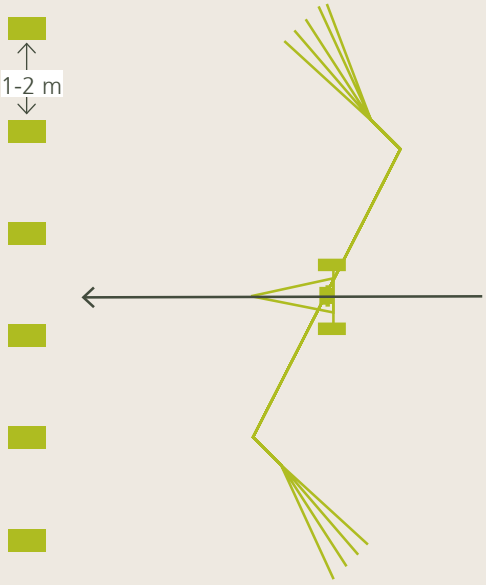
1. Before irrigating, place a row of ice-cream containers in a line across the path of the irrigator (see diagram below). Containers should ideally be only 1-2m apart and cover the entire wetted area of the irrigator spray pattern. Put a stone into each container to prevent them from blowing over. Make sure the drag hose will not tip them over
2. Note the time when the irrigator starts putting effluent into the containers (T1). Run the irrigator as normal over the containers. Note the time when the irrigator has passed and no more effluent is going into the containers (T2)
3. Calculate the time taken (T2 - T1). Divide by 60 to convert minutes to hours e.g. 30 mins ÷ 60 = 0.5 hour
4. Remove the stones, measure and record the depth in each container.

Nutrient samples

5. Combine all the samples in a bucket. Fill a sampling bottle about two thirds full with the effluent from the bucket, squeeze till effluent reaches the top to remove air, then screw the lid on. Put your name and sample identification on bottle
6. Keep sample chilled! This is very important for good quality results
7. Put your details and desired tests onto the lab's Effluent Sampling Form, attach to the sample and send to the lab as soon as possible.

What should be tested?

Useful tests to get done on the effluent sample are % DM, total nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca), magnesium (Mg) and sodium (Na).



CALCULATION

Calculating your application depth, rate and nutrient loading per pass

Using the results of your effluent sampling and your irrigation application test, you can work out the amount of effluent and nutrients going onto your paddocks during an irrigation event. This can help you decide your additional fertiliser needs and whether to change your application rate.

Step 1. Work out the average and maximum application depth

To find the average application depth, add up the individual containers' application depth (mm) and divide by the number of containers you had out.

1		2		3		4		5		6		Total
20mm	+	11mm	+	13mm	+	24mm	+	31mm	+	9mm	=	108mm

Total		Average application depth
108mm	÷6 ice cream containers =	18mm

To find the maximum application depth find the measurement that is the deepest and record this. Compare this with the maximum recommended depth for your soil type (refer to table on pg 23). If it is over the recommended depth you will need to speed up the irrigator. In this case the the maximum is 31mm but the maximum recommended depth (see pg 22) is 24mm, so the irrigator should be sped up.

Step 2. Work out the application rate (intensity)

To find the application rate (mm/hour), divide the application depth by the time (in hours) that effluent was falling on the containers. (Refer to number 3 on previous page – 30mins = 0.5 hour).

Average application depth		Time taken (T2-T1) in hours	=	Average application rate
18mm	÷	0.5 hours		36mm/hr

Step 3. Work out the nutrient loading applied from this irrigation event

The laboratory will report to you the nutrient content of your effluent sample, in kg nutrient per m^3 of effluent.

There are two steps to working out nutrient loading per pass:

1. Multiply the average application depth in mm by 10, this gives you the m^3 of effluent applied per hectare (1mm application depth = 10m^3 per hectare = 10,000L).

Average application depth		m^3 applied per hectare
18mm	x 10 =	180m^3/ha

2. Multiply the kg nutrient content per m^3 (from the lab report) by the m^3 applied per hectare, this gives you the kg nutrient applied per hectare.

m^3 applied per hectare		Nutrient concentration (from lab results)	=	Nutrient loading in this irrigation event
180m^3/ha	x	0.42kg N/m^3		75kg N/ha

In this example, the loading rate of 75 kg N/ha is too much in one pass. The travelling irrigator should be put on a faster run to reduce the N applied in each pass.

If your calculations show you are putting on too much effluent or too much N in one pass, the nutrient value of the fertiliser is wasted and you risk environmental pollution. Speed up your irrigator to apply less effluent in each pass, or consider investing in technologies that can apply lower depths of effluent.

Capturing Value Principle Two: Keep it in the root zone

If too much effluent is applied at one time, it can run off the soil surface, cause ponding and pasture damage, or effluent can leach through to groundwater. If this happens, the nutrient benefit is lost and pollution can result.

Different soils have varying capacities to absorb and hold effluent:

- Sandy soils soak up effluent quickly so you can apply the required amount of effluent in a short period of time. But sandy soils do not hold large volumes and effluent may drain freely through these soils to groundwater. So you can only apply a low depth, or volume of effluent in any one event, though you can put that amount on quite fast (like a short, intense rainfall)
- Clay soils will hold greater volumes of effluent than sandy soils, so overall you can apply a greater depth in any single event. But they absorb liquid slowly, so you cannot apply a high rate. This means if you have a travelling irrigator you need to use a high speed, but if you have sprinklers you can apply a low rate of effluent over a longer time (like a less intense rainfall over a longer period)
- Loamy soils (mixtures of sand, silt and clay) can hold the greatest volumes of effluent overall, and can absorb effluent moderately fast.

Heavy soils have a high risk of ponding and runoff. Runoff is also a risk on sloping soils. Free-draining soils may not show any surface ponding or runoff but there is a risk of effluent draining through into groundwater.

Measure the application depth that your irrigator applies (see pg 22) and then compare the results with the recommendations below for your soil type. The depth is the total amount of effluent to apply in one event, (like mm of rainfall) suited to what your soil type can absorb and hold. Note that if the soil conditions are wet, you need to reduce your effluent application depth by speeding up your irrigator or operating your sprinklers for a shorter time.

Effluent application depth recommendations for various soil textures under pasture cover

Soil texture	Maximum application depth
Sand	15mm
Loamy Sand	18mm
Sandy Loam	24mm
Fine Sandy Loam	24mm
Silt Loam	24mm
Clay Loam	18mm
Clay	18mm

These figures are for soils with 50% water holding capacity prior to the application of effluent, not wet soils!

Check the Bay of Plenty Regional Council website **boprc.govt.nz** (search soil) for soil information in your area. Or better still, have the soils on your farm mapped for accurate information.

If soils are wet, application depth should drop, or application should be deferred until conditions are drier. If soils are very dry and cracked, application depth should drop or application should be deferred.

You can also calculate your system's average application rate (see pg 22), which is the intensity of the application (like mm of rainfall per hour). If you have had your soil infiltration rate measured, your application rate should not be higher than your infiltration rate; otherwise ponding and runoff can occur. If you do not know your infiltration rate, visually check there is no ponding or runoff when you apply effluent.

Remember:

- If you test your travelling irrigator's output and it is delivering more effluent than is shown in the table on pg 23, you need to speed up your irrigator
- Soils over mole and tile drains need to receive light and even applications. Applications should be kept to a depth of 10mm and only when soil conditions allow. Travelling irrigators should be operated at the fastest speed or ideally a low application system is best on these soils. If a low application system is used then 9-12mm can be applied over 3-6 hours

Test what your irrigation equipment delivers (see pg 22). If the average depth is more than the recommended figure for your soil, or if you are observing ponding or runoff, speed up your travelling irrigator, or run your sprinkler system for a shorter time.

Irrigating at times of low soil moisture and at a rate the soil can absorb.

Do not apply more effluent than the soil can absorb. Ponding causes pasture damage and leaching to groundwater.

Capturing Value Principle Three: Be aware of uneven spray patterns

The best use is made of nutrients if they can be applied evenly across the paddock.

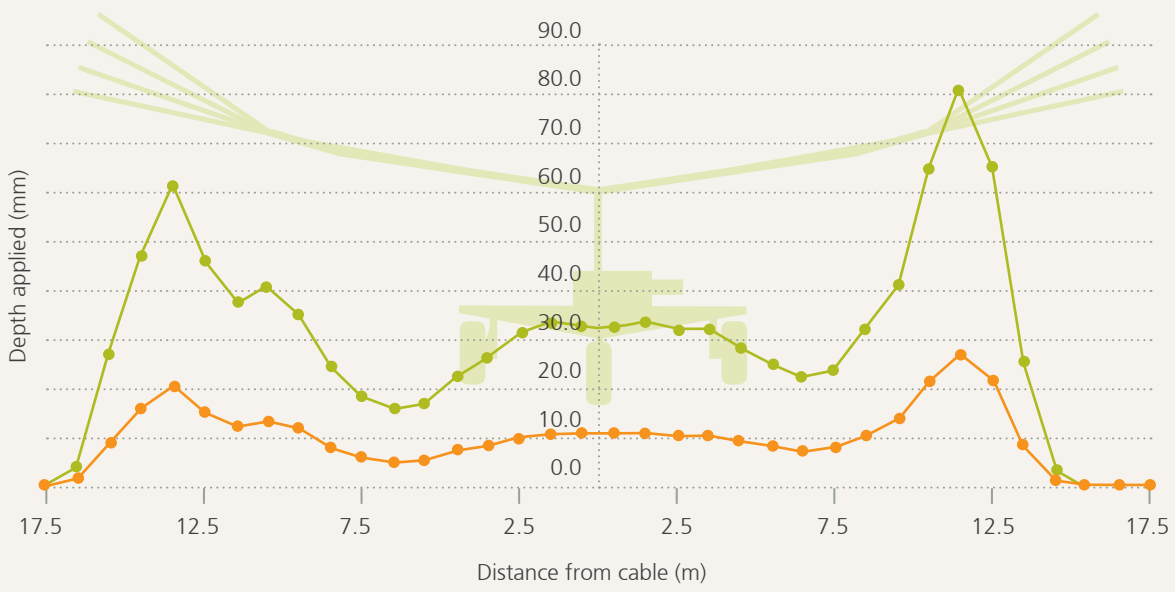
Different equipment has a varying capacity to achieve this. Sprinkler systems and oscillating irrigators have a more even spray pattern than a standard travelling irrigator. A standard travelling irrigator operating at a faster speed will have a more even pattern than the same irrigator at a lower speed.

Effect of uneven spray patterns

Travelling irrigators have an uneven spray pattern, increasing the load applied to certain parts of the paddock. Areas at the outer edge of a travelling irrigator's spray pattern receive effluent for longer periods, so there is a band of heavier effluent loading on each side of the irrigator's run, with lighter loading in the middle.

Typically, the rate at the outer edge of the spray trajectory is double the rate nearer in. It is important to ensure the application does not exceed 25mm per pass at any point. Travelling irrigator runs must be wide enough apart so there is no overlap on the outer edges. Sprinklers or oscillating irrigators can apply effluent more evenly.

Depth of effluent applied from a travelling irrigator



The green line shows actual depth applied during testing. Orange line shows depth applied when the correct travel speed setting was used, after adjustment.

What this means is that you need to test your irrigator's actual output, including the spray pattern it applies, to keep within the maximum depth for your soil.

To work out the depth your system applies, the spray pattern, the rate (how long it takes to apply that depth), and the nutrient loading being applied, refer to pg 21-22.

Operating an effluent system

Daily management of your system is critical to avoiding problems and making the most of the nutrient value of your effluent.

The following are some principles for smooth operation of your effluent system:

1. Adjust your plan according to conditions
2. Set up your irrigation system properly
3. Don't just "set and forget"
4. Stay on top of maintenance so it doesn't get on top of you
5. Manage your storage.

Operating Principle One: Adjust your plan according to conditions

Create a land application plan according to your own farm features. Then adjust your plan depending on day-to-day soil and weather conditions.

The right amount at the right time

Check your consent conditions to see what restrictions there are on applying effluent after rainfall events, and any rest period specified between applications. In the Bay of Plenty it is usually recommended paddocks are rested for 14 days between applications.

Pasture growth and N uptake is slower in winter so you should aim to apply less effluent in wet, cold conditions.

It's important to have a clear decision-making process about when to irrigate (see roles and responsibilities pg 38).

It may be inappropriate to proceed with your planned effluent irrigation if:

- The soil is too wet following rainfall – effluent may pond, run off to waterways, or leach through to groundwater
- The soil is very dry and cracked, especially over tile or mole drains – effluent may travel through soil cracks to underground drains and then flow into waterways

You may need to speed up your irrigator so you do not apply too much effluent for the conditions. Adequate storage facilities give you the flexibility to apply effluent when the time is right.

How can I measure if my soil is dry enough to irrigate?

Before irrigating, check that the soil moisture deficit is greater than the maximum application depth.

The most accurate way to be sure about irrigation is to use monitoring technology. Getting good advice before investing in this type of technology is vital.

- Handheld instantaneous measurement options such as probes cost around $300-$800. They need to be calibrated to your soil type and situation by a qualified technician
- A step up from instant measurements is a ground sensor which can be read either by hand-held devices or by sending readings back to a computer. These options start at $2500 for a tape and hand-held device, moving up to about $4000 for a telemetric system which allows for remote monitoring
- The next step up again is a fully integrated system which monitors climatic data, effluent pond level, soil moisture levels, soil mapping, irrigator positioning and run recording and can be used for full irrigation scheduling, with remote monitoring. You can be sent text alerts and recommendations based on your farm's irrigation system. These systems are more costly but allow for precise monitoring and are particularly good for large operations or absentee owners.

The Bay of Plenty Regional Council have some monitoring sites on their website, boprc.govt.nz > live monitoring > land.

If you do not have a soil moisture meter, you need to observe the conditions.

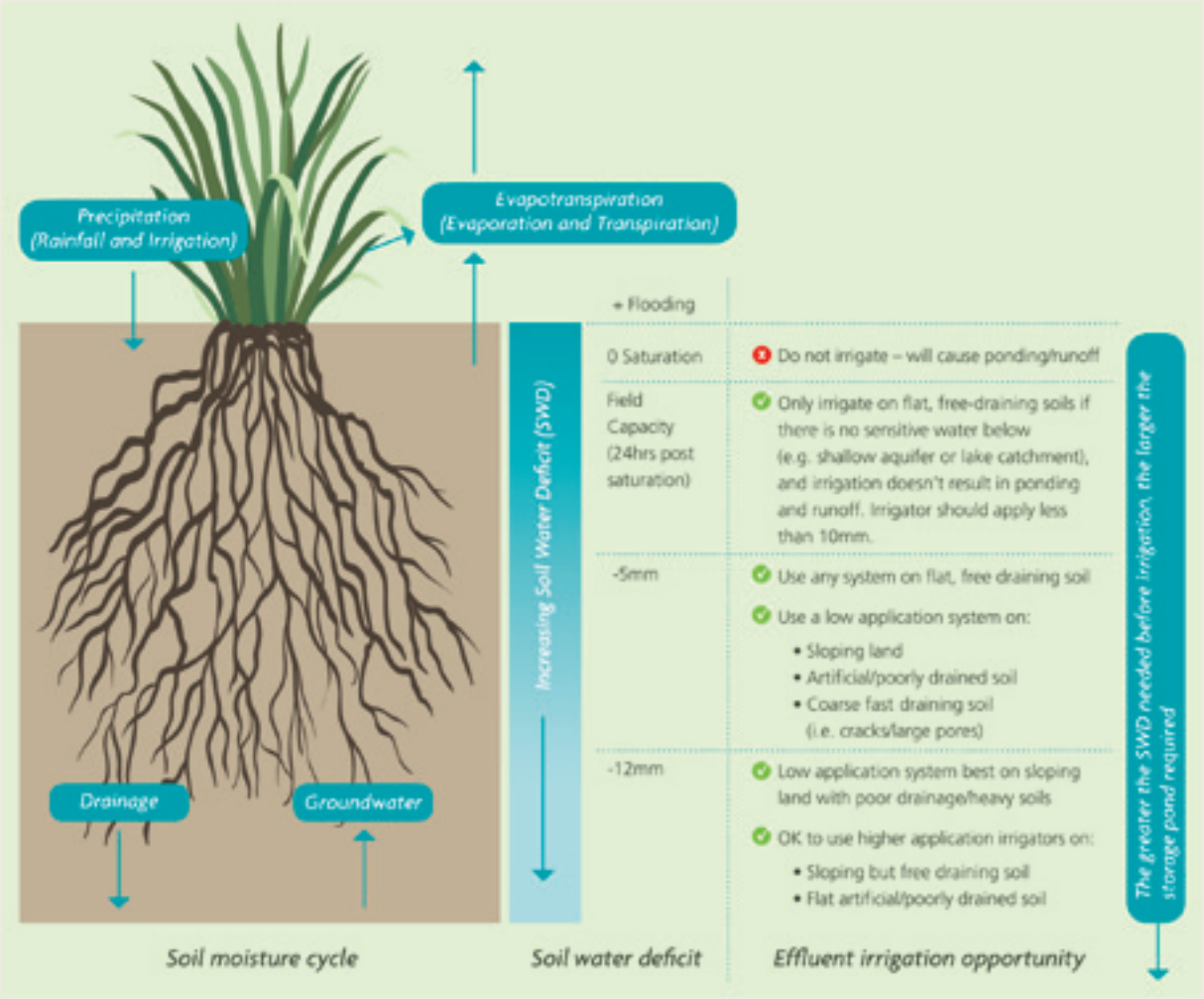
Do not irrigate if:

- Water is ponding or forming puddles on the ground
- You can hear water or wet mud as you walk
- You stamp your foot several times in one spot and water comes to the surface
- There are drowning worms on the surface of the paddock from previous rain or irrigation
- It has been raining heavily or is likely to rain heavily within 24 hours.

Remember any excess N from effluent that is not taken up by pasture is a loss to your production system and a risk to the environment.

Matching soil water deficit to effluent irrigation opportunity

Effluent irrigation should only occur when the soil has some capacity to absorb further liquid, known as a 'soil water deficit' (see picture below).



- **Soil water deficit (SWD)**: is the amount of available water removed from the soil within the crop's active rooting depth. Conversely it is the amount of water required to refill the root zone to bring the current soil moisture conditions to field capacity
- Soil water decreases because of drainage and evapotranspiration (transpiration + evaporation) and increases as precipitation (rainfall or irrigation) or groundwater is added. A SWD occurs when water is exiting the soil profile faster than it is coming in
- SWD is measured in mm
- A deficit is necessary for effluent irrigation, to avoid runoff and ponding on the soil surface. The amount of deficit required depends on your soil type
- The higher the application rate of the irrigator, the greater the SWD required for irrigation
- The greater the SWD required for irrigation, the larger the storage pond required to hold effluent in the mean time.

Avoid ponding and runoff by irrigating only when there is enough soil water deficit to absorb the applied effluent. If you have a soil water deficit and are still getting ponding or runoff, you are applying effluent at too great a rate and need to speed up the irrigator.

Keep good records

As you implement your plan, record keeping is essential - check your resource consent to see what types of records are required.

Keep a running log sheet to record applications (an example is included below).

Keeping records of effluent application

During the season, record actual effluent application runs, noting when each shift occurred and observations about soil conditions. Adjust the plan accordingly.

Effluent recording application recording sheet example

Paddock	Date	Run number	Signature	Comment (e.g. signs of ponding or runoff)
1	*15/8/10*	*7*	*FNP*	
1	*16/10/10*	*8*	*FNP*	
1	*12/12/10*	*4*	*WJP*	
2	*6/9/10*	*10*	*WJP*	*Ponding at south end, too wet?*

See the DairyNZ website dairynz.co.nz for templates you can use for record keeping.

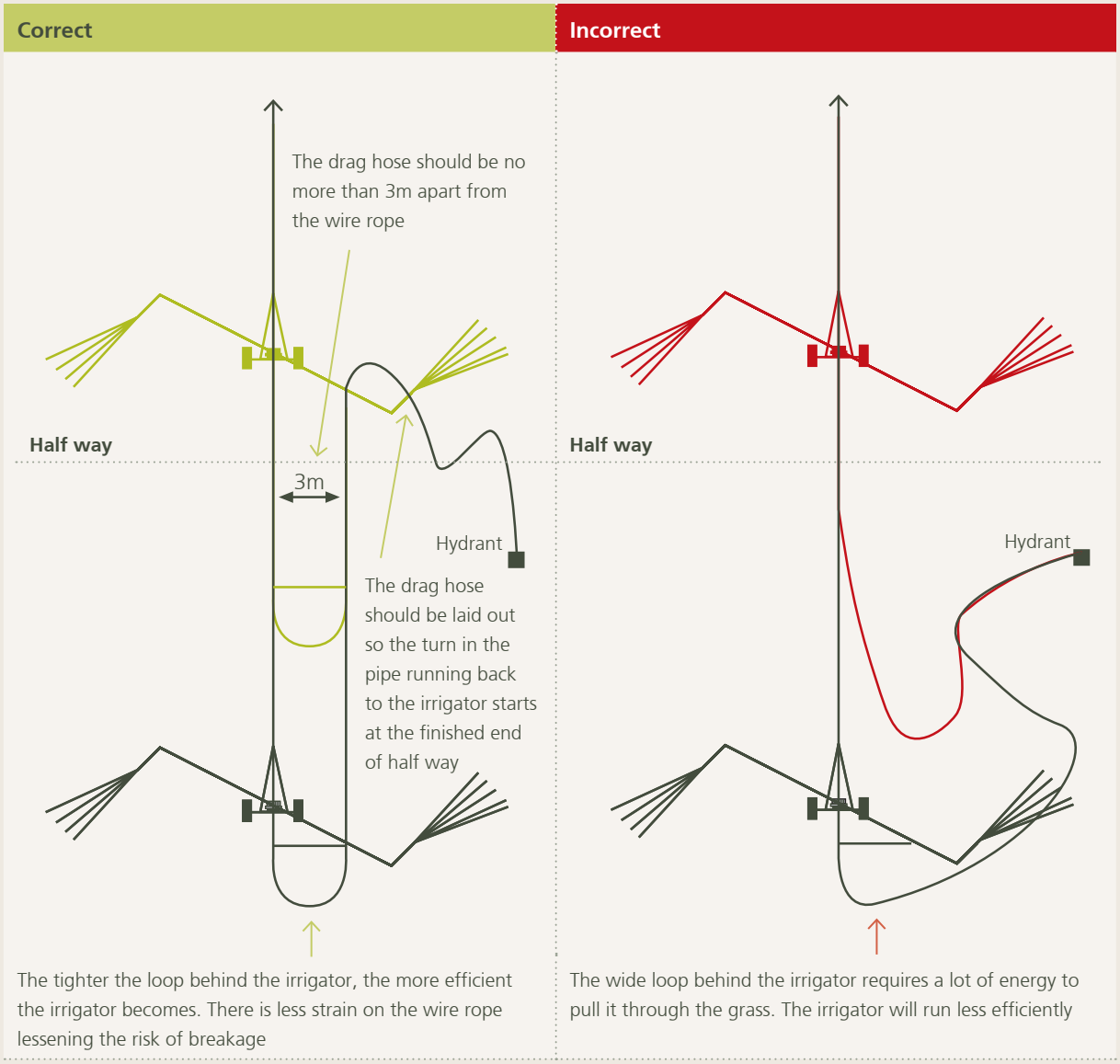
Avoiding problems

- Apply effluent at the lowest possible application rate and only when soil conditions are appropriate (ensure you have adequate storage to be flexible)
- Speed up your irrigator in wet conditions by changing gears – "if in doubt run it flat out"
- Only spread effluent where it cannot enter drains and waterways. Check waterways and drain outlets to ensure no effluent is reaching the water
- Be aware of where your mole and tile drains are, and if possible, run your irrigators across them rather than following along the drains. Soils that have these drains are high-risk areas and should be avoided when irrigating during wet periods – use your farm map to plan and record this
- Record which paddock and irrigator run is used on which day – this will ensure that you are not returning to those runs too early. Refer to the DairyNZ website **dairynz.co.nz** for recording templates
- Apply effluent onto short pasture. Graze the area a few days prior to application
- Withhold cows from grazing pastures treated with fresh farm dairy effluent for at least 10 days to minimise animal health risks
- Mark your run numbers in your effluent block paddocks with ear tags or similar, so you can enter on your recording log which run numbers you have covered each day.

Operating Principle Two: Set up your irrigation system properly

Correct hose layout is critical for travelling irrigators. The sprayline between the mainline and the travelling irrigator can create considerable drag on the applicator. Set up the hose with a tight loop behind the irrigator.

Laying out the sprayline – Good and bad examples



Effluent and Irrigation Design (NZ) Limited.

Avoiding problems

Before starting to irrigate check that:

- The irrigator drag hose layout is correct and the hose will not snag on anything; hose lines are not bent sharply or creased
- The irrigator is securely anchored, away from waterways and the irrigator is in a straight line with the winch rope
- On sloping country, the irrigator is set to run downhill
- The winch is in gear with no overlapping cable, and the cut-off on the winch is working
- The speed setting is correct (speed up the irrigator by changing gears)
- Nozzles are not blocked or damaged
- Hydrant, pipe and hose couplings are properly connected and will not fall off
- Pump, level switches and air break (anti siphon) valve are working
- Water troughs are protected from contamination.

Operating Principle Three: Don't just "set and forget"

Over-application is a common problem and may be caused by the irrigator getting stuck or not being moved on time.

Effluent systems must be managed properly, according to the requirements of your particular equipment:

- Sprinkler systems usually have fixed application rates. The application depth is controlled by the length of time the effluent is applied. Sprinkler systems with timing control can be pulsed e.g. 15 minutes on and 45 minutes off, giving control over the total depth applied and the hourly rate. Spacing and pressure must be correct with these systems
- Travelling irrigators apply varying depth according to the speed they travel (faster speed = lower depth applied). Pressure variations also affect how much effluent is applied in one spot
- Any reduction in pressure at the irrigator can result in effluent being applied at higher application depths and rates. Pressure reduction can result from:
    - Low pump capacity or poor pump performance
    - Nozzle damage
    - Too much hose or incorrect hose layout
    - Irrigators travelling uphill

After starting your irrigator, visually check that it appears to be operating at the correct pressure.

Avoiding problems

- Listen for excessive noise or vibration from the pump
- Watch the irrigator to see it is working as planned
- Check for leaks
- Be sure you have enough run length left for the time you plan to irrigate
- Set a reminder on your cell phone to tell you to shift the irrigator
- When shifting to the next spot, tow the irrigator no faster than walking pace.

A number of irrigator monitoring/control systems are available e.g. "Gator Buddy". These can shut the system down when it malfunctions. Warning can be by flashing light, siren and/or text message.

Use your cell phone alarm to remind you when to shift the irrigator.

Gator Buddy.

Correct operation of irrigation systems

Optimal pressure to deliver the correct depth of effluent.

Sub-optimal pressure and blocked nozzles mean system delivers higher depths of effluent.

Systems operating at the correct spacing and layout to deliver good application depths and a uniform spread.

Sub-optimal pressure or incorrect spacing can give a high depth of effluent even from a low application system.

No ponding. Irrigator set to fastest speed and hose layout is correct.

Poor hose layout creates drag on the irrigator; irrigator slows down and applies too much effluent.

Operating Principle Four:
Stay on top of maintenance so it doesn't get on top of you

Timely maintenance can help reduce stress and ensure the system performs as it should.

Maintenance of land application systems

Daily

- Check for blockages, split pipes or pump problems.

Regularly

- Clean and grease all moving parts on the applicator
- Check that the nozzles are not blocked or damaged
- Ensure above-ground connections are clear of dirt, and the sprayline is free of cuts or splits
- Flush clean water through the delivery line and sprinklers to keep them from blocking
- Check tyre pressure on the irrigator

Six-monthly to annually

- Service the pump; check the pump seals as these are the components most susceptible to wear
- Check wheel bearings on the irrigator
- Have a nutrient analysis done on the stored effluent, soil and pasture
- Measure what your irrigator is actually applying (should be no more than 25mm per application). See pg 21 for instructions
- Train staff in correct effluent management practice
- Check the conditions of any hydrants, couplings or any potential weak spots on the effluent pipe network.

See the DairyNZ website dairynz.co.nz to download sheets showing effluent maintenance tasks.

Correct irrigator maintenance:

Maintenance of pumps, pipelines and irrigators

Check irrigator nozzle (replace at same time that dairy rubberware is replaced).

Check irrigator tyre pressure.

Grease nipples.

Grease the irrigator.

What to do when something does go wrong

A contingency plan should be in place for equipment failure or power cuts. Consider a back-up petrol, diesel or PTO pump. Having extra storage is also a good strategy.

If storage is limited and there is an equipment failure:

- Contact the repairer immediately to assess the problem
- Limit or cease water use in the dairy yard and scrape effluent where possible
- Complete repairs or install back-up before the next milking. Where necessary, arrange for a vacuum tanker to empty the sump and spread effluent to your effluent block.

Dairy effluent escaping to water should be reported to the Pollution Hotline 0800 884 883.

Avoiding problems

- Regularly maintain your irrigation system. Make sure the pipes and sprinklers are not blocked or damaged and that the pump is in good working order
- Have a maintenance schedule posted in the farm dairy and sign off on maintenance tasks as they are done
- Leave a list of important phone contacts in the farm dairy in case of equipment failure
- PTO driven pumps must not run dry, even for very short periods, as the mechanical seals will fail. Grease every time they are used.

Maintenance and management practices

Regularly check your irrigation system and flush clean water through to prevent blockages. Check all moving parts are clean and greased.

A poorly maintained irrigator, with higher potential to break down and cause problems.

Regularly check nozzles and sprinklers for blockages, and replace any damaged or split parts. Do not cut bigger holes in the nozzle as it will not spread properly.

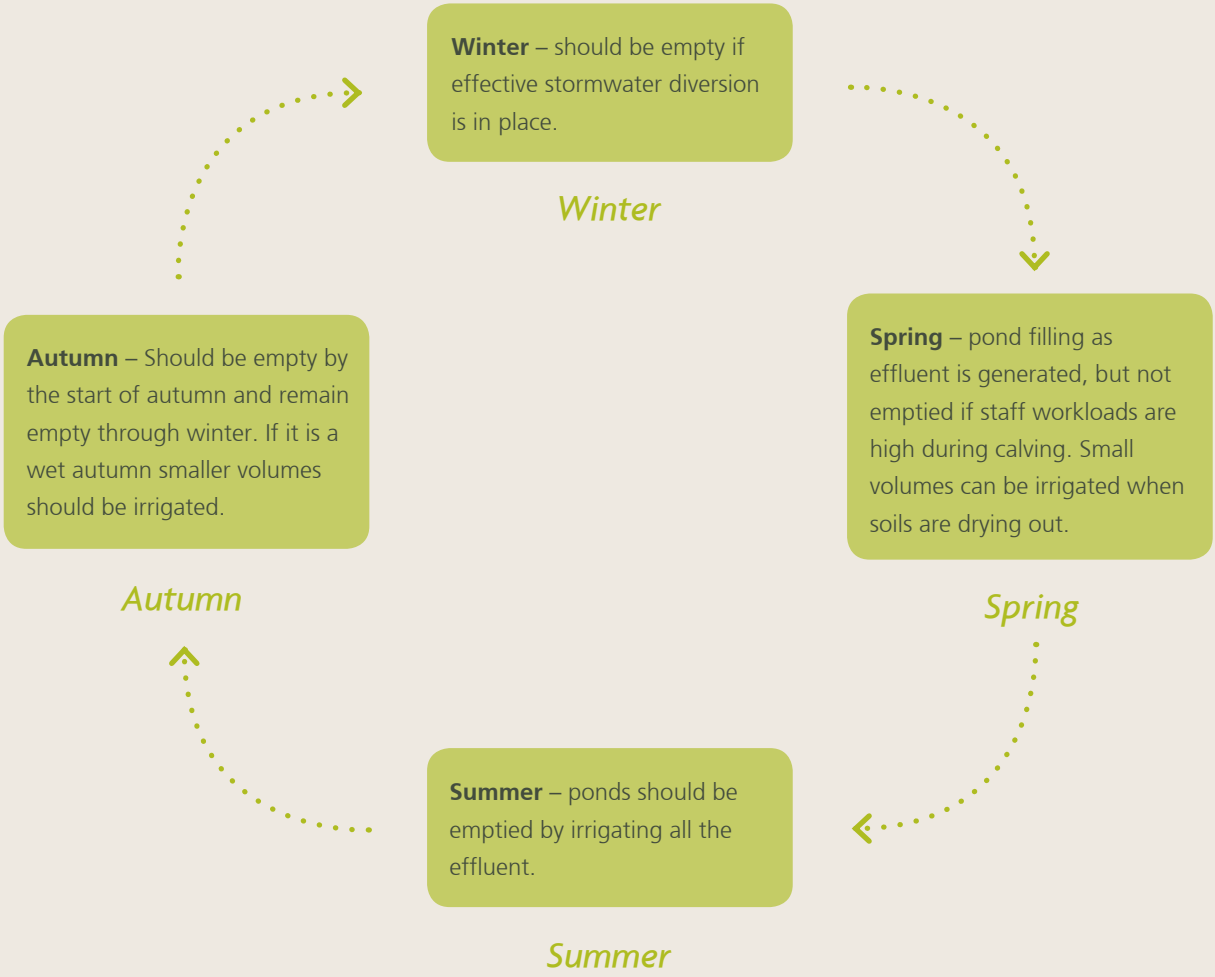
A split pipe causing effluent to pond and leach through to groundwater.

Ensure pumps are regularly oiled and cleaned. Check pump impellers for wear. Listen for any unusual noises when pump is operating.

Effluent escaping due to a damaged hose that has not been properly maintained.

Operating Principle Five: Manage your storage

Manage your storage by irrigating when there is a soil moisture deficit (when soils are not saturated). Emptying ponds over autumn will ensure that storage capacity is available during busy spring periods. Irrigating at drier times also makes the best use of the water in the effluent.



Check your resource consent to see if it specifies the freeboard you need to maintain in your storage ponds.

Your current storage capacity is only the volume left in the pond. If the pond is full, no matter what the size, there is no storage capacity left. Manage your storage so it never overflows, keep it as empty as possible to give you flexibility.

Pond maintenance

Daily

- Before and after every milking, check that the stormwater or washwater diversion is in the correct position.

Weekly to monthly

- Clean and clear the effluent stone trap and gratings; store on a sealed surface or apply directly to land if conditions allow
- Check that the pond walls are stable, and that there is no seepage. Visible wetness or pasture that is growing exceptionally well are indicators of seepage problems
- Control weeds in and around ponds
- Check that the fencing remains stock-proof; exclude stock at all times
- Check levels on storage ponds, and that float switches are clear and working.

Six-monthly to annually

- When the areas around the ponds are dry, graze them in a well controlled manner
- Check that there is not excessive crusting in the pond, especially around the pump intake
- Desludge ponds regularly. This could be every one, two or three years and will vary depending on cow numbers, use of feed pad, pond size etc. Consult your local FDE accredited designer for advice if you're not sure.

Desludging storage ponds

- Mix sludge with liquid effluent before spreading directly onto pasture to prevent plant damage
- If possible, the surface liquid effluent should be removed before desludging by suction drawing it into a vehicle spreader
- Alternatively, pond stirring to mix the various layers of the pond before emptying can remove the need for excavators to desludge ponds. Note that wave action created by pond stirrers can damage imported clay liners
- Use vehicle spreaders when soils are dry
- Sludge usually has a higher nutrient content than liquid effluent, so application rates need to be lower
- Do not allow grazing of pasture recently treated with sludge. Either wait for rain or allow a 10-day stock withholding period before grazing
- If dewatering sludge or scraping from stone traps, it should be placed on an impermeable surface where runoff can flow back to the stone trap.

Avoiding problems

- Maintain drains above the storage facility so that rainwater doesn't enter the pond
- Empty the sump and stone trap regularly – if it is full it is not working
- Prevent rubbish entering the system – have rubbish bins in the farm dairy and yards
- Where ponds are lined with a plastic or imported clay liner, ensure that the pumps, stirrers or other machinery never interfere with the liner. Contractors should be made aware that a liner is present
- Ensure that pond fences are stock-proof and child-proof for safety and to prevent damage to pipework and embankments
- If you are planning to plant trees around a storage pond, consult a local engineer first. Some trees may affect pond bank stability.

Don't use your pond like a rubbish bin. Aim to keep out all items which may cause blockages.

Clear roles and responsibilities

The importance of effluent management needs to be highlighted to the whole farm team. Everyone should understand that effluent is an important resource for production on the farm, and that effluent causes environmental damage if it reaches groundwater or surface waterways. Owners (including absentee owners), sharemilkers, managers and staff can all be held responsible for any non-compliance.

Find out how long it takes to do effluent jobs properly, carrying out the correct checks, and allow this time for the job every day. Explain to staff that it takes this long, so that no short-cuts are taken. Make it a priority.

Good practice includes:

- Setting out clear expectations around effluent management in staff contracts, job descriptions and sharemilker agreements – including daily tasks and supervision responsibilities
- Acknowledging and rewarding good effluent management through staff performance and incentive systems
- Having clear rosters saying who is responsible for effluent management decisions and tasks on a given day and who will carry out scheduled maintenance
- Setting out and displaying a list of roles and responsibilities for each person involved
- Posting the consent conditions on the wall of the farm dairy.

An orientation and training package could include:

- Talking through the consent conditions
- A walk-through of the system and how it works, including important daily jobs like switching the stormwater diversion and shifting the irrigator
- Explaining the scheduled maintenance tasks and how and when to do them
- Clarifying responsibilities and who to ask if a staff member is unsure
- What to look out for in terms of problems
- What to do if there is an equipment failure or problem
- A buddy system for an initial period where new staff are closely supervised

See your local AgITO for courses or contact the professional who installed your system to ask for appropriate training.

See compliancetoolkit.co.nz for templates you can use for effluent record-keeping, staff training and maintenance. The HR Toolkit may also be helpful for training and induction of new staff.

Staff safety

Every year many people are seriously injured or killed carrying out everyday tasks on farm. The effluent system is a particularly hazardous area. A Health and Safety Plan is a legal farm requirement. Use the *DairyNZ Compliance Toolkit* (**compliancetoolkit.co.nz**) to ensure you meet your obligations to keep people safe on your farm.

Some practical things to consider when designing or managing your effluent system are:

- Provide training for system operators that includes instructions on how to operate and maintain the farm dairy effluent system in a safe manner. Safety information, including emergency protocols, should be included in the farm operations manual and farm induction
- Make sure staff and visitors are aware of hidden hazards like pipework, wire ropes, hydrants in the paddock and overhead or buried power lines
- Earth all electrical equipment
- Turn off and secure moving parts when shifting or checking irrigators (boom arms etc)
- Guard moving parts on pumps or machinery
- Install barriers around storage facilities
- Use non-slip surfaces next to storage facilities
- Stabilise pontoons and have an approved gantry for servicing pumps and stirrers
- Ensure exit/rescue options are in place e.g.ropes and ladders for storage facilities.

Working with effluent contractors

No matter who is applying the effluent, consent conditions still apply. Farm owners and contractors can potentially be liable for non-compliance.

It is important to tell the contractor what is required in writing. Ensure the following matters are clear:

- Maximum application depth and rate
- No ponding or runoff
- Keep safe distance from waterways
- Procedure at the end of the job.

Download an Effluent Contractors Acknowledgment template from compliancetoolkit.co.nz (under forms)

Avoiding problems

- Make sure staff and contractors know the rules and consent conditions and how to comply
- Be thorough with orientation and training – supervise staff until they know the system
- Have an effluent management plan that everyone understands, including:
  - Paddock layout and scheduled runs
  - Record keeping of daily runs
  - Maintenance schedule and a record of when tasks are done
- Be clear on responsibilities for deciding when the plan needs to change
- Make sure staff know the contingency plan in case of system break-down or wet conditions.

Stand-off areas and feed pads

The major differences when you add effluent from a feed pad or stand-off area to your existing dairy effluent system are:

- Higher volume
- More nutrients
- Higher solids content.

It is crucial that no effluent from a pad runs off into waterways or leaks through to groundwater. It is far cheaper to set up a good effluent system during pad construction than to try and adapt it later.

Stand-off areas and feed pads should include an effluent management system providing:

- Sealed storage areas for any solid effluent scraped off the area (e.g. sawdust, manure)
- Sufficient capacity in your storage and application system for additional liquid effluent
- Sealing, bunding and collection of liquid effluent from the pad so that it cannot drain into groundwater or surface water. Drains underneath soft surfaces should have a sealed layer below them and should direct effluent to a treatment system. The use of unsealed stand-off areas or "sacrifice paddocks" should be avoided.

Stand-off and feed pads can have different surface materials (such as concrete, limestone, wood chip, bark or sawdust). Each of these requires different management. Some wood-based products are highly absorbent and can be scraped and composted or spread to land. But you may still be asked to demonstrate that you have an appropriate seal and collection system beneath the pad to ensure no effluent is reaching groundwater.

Some roofed herd shelters do not require washing down. In some covered shelters, effluent falls through the slatted concrete floor into bunkers below where the liquid evaporates in the warm conditions created by the shelter's plastic roofing. The semi-dried effluent is then removed and spread to land.

Effluent from feed pads must not run off to waterways or leak into ground water.

Slatted concrete floors where effluent collects and dehydrates before removal.

What will need to change?

If you are putting the effluent from stand-off areas or feed pads into your existing effluent system, you are likely to overload the system and will need to upgrade it to cater for the higher volume, nutrients and solids content.

Every stand-off and feed pad situation is different. The effluent treatment system should be designed for your particular situation. Plan your effluent system around a high-use scenario to allow for future flexibility. Talk to the Bay of Plenty Regional Council prior to putting in a new feed pad or stand-off pad to check what resource consent implications there may be.

To cope with the increased load on your effluent system, you may need:

- Extra storage for liquid and solid effluent
- A means to remove the solids and fibrous material from the effluent before irrigating
- More irrigation area to deal with the extra volume and nutrients.

Dealing with more effluent

The amount of extra storage required will depend on the pad design and use. A pad can generate up to 10 times the effluent coming from a farm dairy, depending on:

- The size of the pad and cow numbers
- The time stock spend on the pad
- The feed given, and any lost feed
- Cleaning methods (scrape vs wash) and wash-down frequency
- Exposure of the surface to rainfall.

You can reduce effluent volume from the pad by:

- Use of a stormwater diversion system when the pad is clean
- Roofing the pad
- Designing the pad for easy scraping to reduce the frequency of washdowns
- Using recycled yard water for washdown.

Dealing with more nutrients

Effluent sampling and nutrient budgets will help you work out the area you will need to spread your effluent and comply with your consent. Include the nutrient value from your pad into your nutrient management planning so you make the best use of the valuable nutrients collected from your pad.

If you are separating solids, you will need to take account of nutrients in the solid and liquid fractions of your effluent. Some of the N will be separated out with the solids, but much of the K is soluble and remains in the liquid. Test liquid effluent for K content.

If you add a feed pad or stand-off pad to your farm system, or significantly increase your herd numbers, contact the Bay of Plenty Regional Council to see if your resource consent needs updating.

Dealing with more coarse solids in effluent

Effluent from pads has more coarse solid material in it. This can cause blockages and wear in the system.

Solids washed off the pad can be:

- Settled out in a separate pond with a baffle or T-piece outlet to retain the solids
- Held behind a "weeping wall" structure
- Removed with other technology such as mechanical solids separation.

Remember, settling ponds receiving effluent from a feed pad will require more frequent desludging.

Retained solids can be dried on a sealed surface and spread on land at a suitable rate to avoid nutrient overloading.

Scrapings from feed pads must be stored on a sealed, bunded area.

Solids separation machines provide easily handled solid and liquid products.

Weeping walls

- Need to be designed and constructed by experts (contact the DairyNZ sustainability team for a recommendation)
- Should have an exit point for effluent leaving the weeping wall that is lower than the weeping wall bed

Please contact the Bay of Plenty Regional Council or a sustainable dairying specialist for advice prior to construction.

Cow shelters which have a slatted floor where effluent is collected and contained and can be spread at a suitable time.

Weeping wall system showing solids retained by the wall and liquid seeping into pond.

Regional Council perspective

The Bay of Plenty Regional Council encourages dairy farmers to irrigate or spread effluent to land wherever this can be done in a sustainable way. Farmers apply for a resource consent to apply effluent to land, and the consent sets out the conditions for your farm. Consents for land application are not normally notified to the public and do not usually require written approval from affected persons.

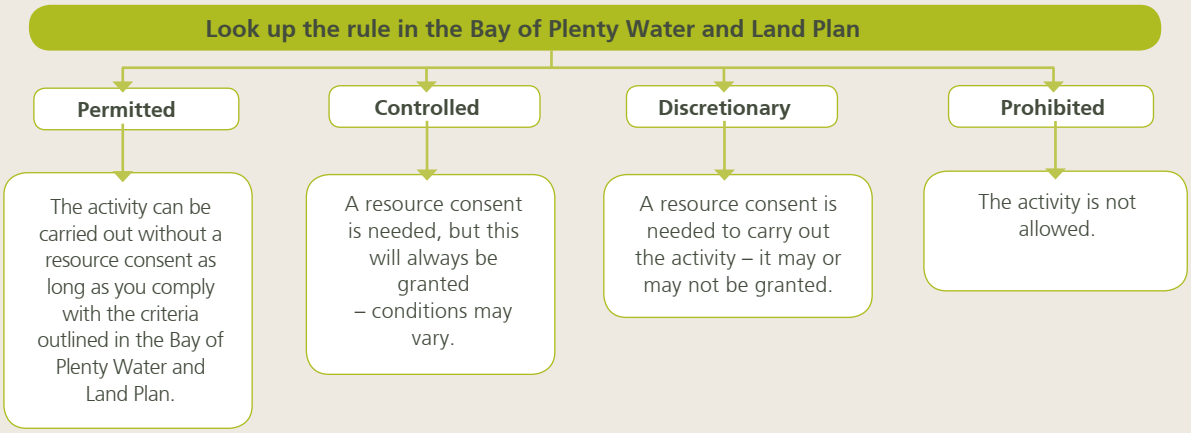
Application of effluent to land is the treatment option preferred by the Bay of Plenty Regional Council, unless specific site conditions make this ineffective.

There are still some discharges from effluent treatment ponds into water. This activity requires resource consent and a full assessment of environmental effects, including consultation with iwi and other affected parties. The duration of a consent to discharge to water is usually shorter than that granted for land application. The consent application may also be notified and could result in a hearing being needed. This can be an expensive process.

If you believe that land treatment may not be effective for your site and you want to pursue a discharge to water, contact a Bay of Plenty Regional Council consent officer and engage a suitably qualified professional to help advise you.

There are also some properties still using land or pond soakage for small herds. These farms are encouraged to transition to land application. This activity should not occur within 20m of streams or drains.

Farm dairy effluent discharges to water, and pond or land soakage systems are not acceptable in the Rotorua lakes catchments i.e. ponds must be sealed. Effluent storage ponds in all other catchments should be fully sealed to prevent seepage to groundwater, and have sufficient capacity to store effluent when conditions are not suitable for land application. Ponds should be sized using the pond storage calculator.



The Bay of Plenty Regional Water and Land Plan

The following is a summary of relevant rules in the Bay of Plenty Regional Water and Land Plan (operative as of December 2008).

Permitted activities

Silage stacks or pits are permitted (no consent needed) under Rule 27, as long as:

- No leachate reaches a surface water body
- There is no ponding or overland flow from the silage pit or stack
- Stormwater is diverted from the silage pit or stack
- It is not located within 50m of:
  - a bore, stream, river, lake, wetland or land drainage canal
  - a geothermal surface feature
  - the coastal marine area
  - a gully, depression or area that is flooded during storm events
  - an area where the groundwater is less than 1m below the base of the pit or stack.

If the above conditions cannot be met then the pit or stack must be sealed and the leachate collected and directed to the farm effluent system. Otherwise, wrapped bales can be used. It is recommended that silage pits and stacks are covered to prevent rainwater entry, and that silage is made in a way that minimises excess moisture.

Controlled activities

Applying effluent to land is a controlled activity (needs a consent, which will be granted with conditions) under Rule 32. Conditions can be set regarding:

- Nitrogen application rate
- Discharge rate and volume
- Location of irrigation in relation to surface water or groundwater bores
- Application site in relation to soil type, slope and area
- Measures to avoid, remedy or mitigate effects on water (for example storage capacity and sealing)
- The duration of the consent
- Monitoring and charges.

Discretionary activities

Discharging effluent to water is discretionary (needs a consent, which may or may not be granted) under Rule 37. Applications must show how the water body will be affected, related to the relevant Water Quality Classification of the water body.

Other activities

The Bay of Plenty Regional Council may not require a resource consent application for calf-rearing facilities as long as:

- There is no ponding or runoff of liquid effluent from the facility and
- All soft materials removed (e.g. sawdust) are spread to land at appropriate application rates to prevent odour and nutrient or bacterial runoff.

Runoff from feed pads needs to be covered by consent. Where the effluent is directed into the farm dairy effluent system, this needs to be considered in the farm's resource consent. You may need to update your consent to include these areas. Contact a Bay of Plenty Regional Council consents officer to discuss further.

Where effluent discharges directly to water, or to land where it may then get to water, resource consent is required under Section 15 of the Resource Management Act. This is why effluent from stand-off areas and feed pads needs to be contained and collected.

Applying for a resource consent

You will need to complete a Base Form and Form II when applying for a resource consent, which you can get from the Bay of Plenty Regional Council. You will need to supply the following information that is specific to consents for discharging effluent:

- The number of animals using the shed or effluent collection area (including any planned growth in herd size or production units), and the volume and quality of the effluent produced by the system
- A description of the effluent collection, storage, treatment and disposal system, including the rate and depth of effluent application
- An explanation of how the system will be managed so that it complies with the standards and terms, including a contingency plan for equipment failure or other emergencies
- Details of any other sources of effluent that need to be consented e.g. feed pad, stand-off pad, silage leachate etc

Other general information required with your consent application includes:

- A description of the activity for which consent is sought, including the methods and processes to be used. The description should identify the location(s) of the discharge(s) by way of a map, and include the correct NZMS reference
- The site characteristics of the discharge location, including hydrogeological information (soil and water properties of your site). Note: this information is required as part of the effluent pond storage calculator.

If you want to discharge from a pond into a waterway you will need to supply:

- The nature of the discharge (contaminants, quantity, frequency, duration, hazardous properties etc.)
- A description of the consultation undertaken in relation to the application, and the outcomes of that consultation
- An assessment of any actual or potential effects which the activity may have on the environment, and the ways in which any adverse effects may be avoided, remedied or mitigated. Note: this is only required when applying for a consent to discharge to surface waters. The effects of effluent discharge to land, when done in a way that complies with the guidelines is already understood.

If you are increasing cow numbers you may need a variation on your consent. If you are increasing your effluent area, but not cow numbers, you do not generally need to apply for a variation on your consent.

Using this booklet to help you comply with your consent conditions

If you know what you are putting on, you can ensure:

- You have enough area in your effluent block to meet the annual Nitrogen (N) loading recommendation (150kg N/ha/yr on pasture)
- You do not apply excess N in a single effluent application (e.g. no more than 50kg N/ha at once)
- You do not apply more liquid than your soil can absorb and hold – to avoid ponding, runoff and leaching to groundwater.

The following definitions can help you decide on the right amount of effluent over the right time and the right area.

If your consent specifies...	This refers to...	Use the pages in this book...
Quantity and rate to be applied	The volume in cubic metres (m^3)	**Calculation – pg 22**
Point of discharge, and distance from waterways	Your effluent application block as shown in your effluent plan	**An effluent application plan – pg 11**
No effluent shall reach surface water by overland flow and rate shall not exceed infiltration of the soil or cause ponding	Applying at a rate that the soil can absorb and hold	**Infiltration rates for your soil – pg 23** **The right amount at the right time – pg 26**
Area and nitrogen loading	Having sufficient land so that nutrient loadings are sustainable	**Nutrient budget for your farm – pg 19**
Deferred irrigation	Having sufficient sealed storage to wait out wet periods	**Collection and storage – pg 12** **The right amount at the right time – pg 26**
Record keeping	Keeping track of actual applications on each paddock throughout the season	**Record keeping – pg 29**
Stormwater	Keeping clean rainwater out of your effluent system. Only divert clean water	**Collection and storage – pg 12** **Stormwater diversion – pg 15**
Maintenance	Ensuring the system operates as it should	**Maintenance of land application systems – pg 33**

What if I don't comply

If you do not comply with the rules and with your consent conditions, then contractors, relief staff, workers, managers, sharemilkers and owners may all be liable. Employers must take all reasonable steps to ensure staff and contractors meet these responsibilities. Make sure you have a contingency plan in place in case of equipment failure or prolonged wet conditions.

For more information about environmental compliance and enforcement, go to compliancetoolkit.co.nz

Tools and resources available to help with effluent management

The following are a series of practical tools which have been developed by DairyNZ with farmers. They are available to download on the **dairynz.co.nz** website under publications and tools, or order a copy by calling 0800 4 DairyNZ (0800 4 324 7969).

Training staff

Effluent Training Record

To help make sure you cover all the bases when training new staff. Serves as a file away record of training should you ever need it

AgITO Dealing with Dairy Farm Effluent

A one day course looking at the reasons why, and how to treat dairy effluent on farm. Suitable for all the farm team. Includes a one-on-one practical assessment on the participant's farm. AgITO 0800 691 111

AgITO Effluent Management Planning

A one day course for farm owners, herd managers, supervisors, sharemilkers etc. Templates and tutor expertise to help you create an effluent management plan for your farm. Includes a follow up session to discuss practical implications. AgITO 0800 691 111

Top Tips for Effluent Irrigators

Make sure your staff get it right every time with this poster for the dairy, outlining top tips for trouble free effluent irrigators

Effluent Management Plan

A visual plan to pin up in the dairy so all staff know the drill with effluent management

Managing and monitoring

Irrigator Run Sheet

Get the best financial return from the fertiliser in effluent by recording where it goes with this one page template for recording irrigator runs. Includes: date, paddock number, run number and sign off area for person responsible for moving the irrigator

A Guide to Managing Farm Dairy Effluent

A good practice guide for farm decision makers. Topics include design, nutrient value, management, monitoring, measuring and storage

Fonterra Dairy Diary

A handy all-in-one place for recording daily monitoring and management information, including effluent

Upgrading your system

Farm Dairy Effluent Systems: Planning the Right System for Your Farm

A farmer guide to the farm dairy effluent system design standards and code of practice. Helps you plan your system with your designer so you get a system which is fit for purpose

Improving farm performance

FarmFacts

A set of fact sheets explaining all things dairy including effluent – one of DairyNZ's most popular resources

Nutrient Management Case Studies

Nutrient use efficiency is all about finding productivity gains on your farm. Pick up some ideas on where you may be able to use your nutrients more effectively from farmers from across the country

Minimising Muck, Maximising Money Guide and Case Studies

Avoid the pitfalls when designing feed pads and stand-off facilities with this guide to design and management of feed pad and stand-off areas, including case studies from farmers around the country

Compliance Toolkit

Are you complying with your legal requirements? Find out with this easy to use online tool for cutting through the red tape. Covers all aspects of farm compliance; employment, health and safety, animal welfare and environment. Download copies of the Compliance Checklist for dairy regions across the country, or use the consent scoping tool to minimise your compliance risks. Visit **compliancetoolkit.co.nz**

Best Management Practices for Maize

Covers using effluent on maize crops so you can optimise the fertiliser value of effluent, crop yield and improve soil condition by adding organic material

Farm Enviro Walk

A good practice self-assessment for environmental performance on farm. Covers effluent, soil, nutrient, waterways and other hotspots on farm. A useful training tool

DairyNZ

Corner Ruakura and Morrinsville Roads
Private Bag 3221
Hamilton 3240

0800 4 DairyNZ (0800 4 324 7969)

dairynz.co.nz

Bay of Plenty Regional Council

Freephone 0800 884 880

Fax 0800 884 882

info@boprc.govt.nz

boprc.govt.nz

Whakatane
5 Quay St
Whakatane

Rotorua
1125 Arawa St
Rotorua

Tauranga
6 Rata St
Mount Maunganui