Additional Information provided after Pre-hearing

Dairy Green Ltd
Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation
Irrigation NZ Accredited Designer

26 July 2018

White Waters Ltd – Discharge Consent
Pre Hearing Meeting Further Information Response

Revised Application & Assessment of Environmental Effects

1. Background

A pre-hearing meeting was held on the 23 July 2018 at Environment Southland, the agender items discussed included:

- Compliance
- Effluent storage
- Effluent irrigation methods
- Effluent receiving area including; soil types, subsurface drainage and topography
- Monitoring

The following document aims to provide clarity and certainty around the proposed application following the various amendments, additions and subsequent questions that arose from the meeting.

In late 2011/early 2012 soil scientist Bill Risk surveyed the soils on farm and provided a soil report which was used in the original discharge consent application. A review of the soil areas mapped was carried out on the 24th July 2018 by Quinton Scandrett with assistance from the applicant. The review included digging a number of test holes predominantly within the effluent irrigation area, mapping subsurface drainage and photography of the effluent receiving area. The information collected is provided within this document.

The dairy shed yard catchment areas and pump sumps were also inspected during this visit to ascertain that there are no freshwater springs within, around or flowing onto or into any of these areas.

The on farm review has allowed some amendments to the Massey Dairy Effluent Storage Calculator (DESC) which includes the addition of an area of low risk soils and an increase in yard area/dairy lane catchment used in the scenario. The updated output sheets have been included with this document.

An updated assessment of environmental effects has also been included in this document which reflects the inclusion of low rate irrigation alongside the use of deferred and low depth irrigation. Note that effluent from a calf rearing shed has been included in these calculations. The property does not have a wintering pad, feed pad or calving pad.

A consent duration of 5 years is proposed which is in line with the previous consent term.

Receiving Environment - Land

Soils:
The farm's effluent irrigation area is unchanged from the area previously consented to receive effluent. This area was assessed and mapped in early 2012 by Bill Risk from Rural Management Services, the proposed area includes the most suited soil types and topography within the property for receiving effluent. The proposed irrigation method at the time of Bills' report was a slurry tanker and as such approx. half the farm area was excluded due to its topography, soil type and the location of surface waterways.

Bills assessment of the area identified the property predominantly overlies the Te Anau soil type, with smaller areas of Kakapo and Otanamomo soils. The Kakapo soils are considered to be winter wet-summer dry soils. The variant of the soil is determined by its location and aspect on the topography across the farm and subsequent depth to the underlying glacial till.

Bills overarching comment for the proposed irrigation area was that the soil types are suitable for receiving effluent provided that the soil vulnerabilities are recognized. Soil technical data sheets for the Te Anau and Kakapo soils have been appended to this document.

A review of the soil type assessment within the proposed effluent receiving area was carried out on the 24th of July 2018. Some areas of the farm outside the proposed area were also investigated at the request of the applicant. The property had received approx. 40 mm of rainfall in the 60 hours prior to the site assessment, the Te Anau soils were not saturated however the Kakapo soils were. This highlights the contrasting drainage characteristics of the two soil types. This review identified soil types consistent with those identified and mapped by Bill Risk. The dominant soil type on the property is the well-drained Te Anau silt loam, variants include undulating shallow to moderately deep on landscapes with slope of 0–7^{o} through to the rolling shallow variant on landscapes and knobs of 7-15^{o} slope. Test pits identified the Te Anau soil to have a well structured top soil ranging from 150 – 200 mm deep overlying a silt to sandy gravelly loam. Rooting depth was generally a minimum of 400 mm. Actively growing white pasture roots were identified in each test pit which indicates there is some pasture growth occurring even at this time of the year.

Areas of the Kakapo heavy silt loam soil were also identified and are consistent with areas that have been excluded from the discharge area. These soils are imperfectly drained due to the underlying dense glacial moraine gravels and heavier textures. These soils were identified by Bill as high risk and due to the slurry tanker application method were excluded from the discharge area. These soils although higher risk compared to the Te Anau soils are suitable to receive effluent via a low rate irrigation system, however for simplicity and because there is more than enough area of Te Anau soil it is proposed to keep the discharge area the same and exclude the larger/wider areas of the Kakapo soil type. Other smaller areas of soils identified generally outside of the discharge area included the imperfectly drained Otanamomo deep undulating peat and an area of well-drained Excelsior silt loam.

The rooting depth of the pasture plants growing in the soil needs to be considered to determine the plant available soil water.

Table 1: Total Plant Available Water (PAW) of the Te Anau moderately deep soil type dominant on the White Waters Property.

Soil Type		Depth (mm)	Texture	WHC/100 mm	PAW (mm)	Total PAW (mm)
Te Anau	Topsoil	200	Silt Loam	22	44	**77**
	Subsoil	200	Sandy Loam	15	30	

Figure 1:
Soil Test Pit Locations Map

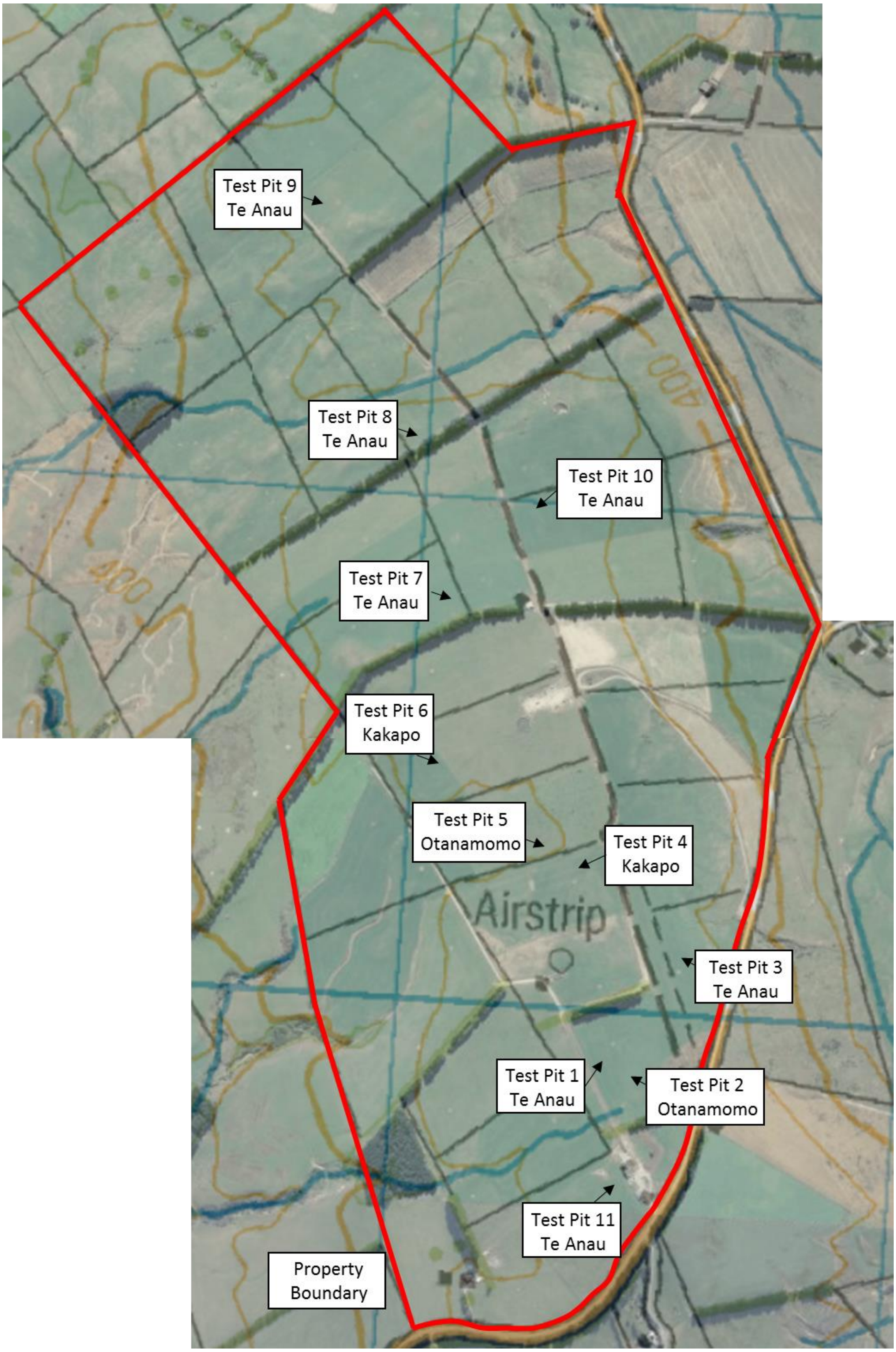


Figure 2:

Te Anau Moderately Deep Undulating Soil Profile from test pit 1 which was excavated using a hydraulic excavator. This is a typical representation of the Te Anau soil on the property.

Figure 3:

Te Anau Moderately Deep Undulating Soil Profile from test pit 3.

Figure 4:

Te Anau Shallow Sloping Soil Profile from test pit 7.

Figure 5:

Kakapo Undulating Moderately Deep soil profile from soil test pit 4.

Figure 6:

Otanamomo Undulating Deep Peat Soil Profile from test pit 2 which was excavated using a hydraulic excavator.

Topography:

Overall the property contains varying areas of flat to sloping land. The proposed effluent irrigation area has been carefully considered and contains the most suited land areas in regards to slope and associated risk such as overland flow. It is estimated 70 percent of the proposed discharge area is under 7^{o} slope. This equates to approx. 70 ha which provides 12 ha per 100 cows, considerably higher than the 8 ha per 100 cows recommended for best practice. As such these areas are suitable to receive effluent using low rate irrigation and a slurry tanker. Steeper areas of land that have been included in the discharge area are still suitable to receive effluent using the low rate system however limiting the application depth becomes more important. It would be recommended to only apply effluent to these areas during low risk times of the year when there is adequate soil moisture deficit and active pasture growth.

The topography of the property has been formed as a result of glacial outwash and moraine gravel deposits. The topography and parent material namely glacial till that form the property have directly influenced the formation of the soils on the property. The climatic conditions within the farms vicinity over time have further influenced the formation of the soils, the soil depth and underlying parent material directly impact on surface and drainage/groundwater water movement on the property. Lateral movement of drainage water occurs on top of the glacial till, this is typically through the winter months due to high rainfall volumes, cooler temperatures and lower evaporation rates. Water that has filtered through the soil profile will recharge the underlying aquifers but also feeds surface water ways. This lateral drainage typically follows the contour of the underlying gravels, although some areas of gravel will have higher permeability than others. The drainage depressions that have formed reflect the natural flow of water from the property forming the tributaries of the Whitestone and Upukerora Rivers. Areas where Otanamomo soils have formed are typically lower lying and do not have natural drainage outfall.

The classification of the proposed irrigation area for receiving effluent includes Categories A (artificial drainage), C (sloping land) and D (well drained flat land).

The underlying physiographic zone is dominated by Bedrock/Hill country however the Kakapo soil would also suggest the Gleyed physiographic zone features in small areas.

The photos that follow highlight the range in topography across the effluent area but importantly demonstrate that there are sufficient areas of flat to undulating land that has historically received effluent using the slurry tanker. It is proposed these land areas will receive effluent via a low rate irrigation system and to a lessor extent slurry tanker over the proposed discharge activities duration.

Figure 7:

View looking south east from the first branch in the main dairy lane, the dairy shed is visible in the left of the photo, Kakapo Road runs alongside the tree line in the background of the photo. The majority of this area has been excluded due to the underlying Kakapo soils and slope of the land.

Figure 8:

View looking west, a significant area alongside the air strip with flat/undulating well drained Te Anau soils. This area can be considered low risk and is suitable for receiving effluent from either the low rate sprinklers or slurry tanker.

Figure 9:

View looking south west, the immediate area in the front of the photo has been excluded from receiving effluent due to the Kakapo and Otanamomo soils. The effluent storage tank is not visible but is located to the right in the top right corner of the photo.

Figure 10:

View looking south taken in close proximity to the photo above, a large area of this undulating land is included in the discharge area, this area has some subsurface drainage installed and as such is considered higher risk, adequate soil moisture deficit will be needed prior to effluent application.

Figure 11:

View looking south east, to a large area of undulating land that the new low rate irrigation system will utilise. The storage tank is to the left of the photo.

Figure 12:

Photo taken from same location as above however view is looking south west. Another area of flat to undulating land that the low rate system will irrigate on.

Figure 13:

The same land area as figure 12 however from the opposite side of the paddocks, view is looking approx. east. The hay barn can be seen in the top left of the photo, this area is predominantly low risk however there are a two of sub surface drains servicing parts of these paddocks.

Figure 14:

Well drained Te Anau soil overlying undulating topography again within the low rate irrigation area. View is looking North. This area can be considered low risk.

Figure 15

Undulating area of land within the Upukerora catchment. Again, predominantly well drained Te Anau soils are underlying this area. This area is included in the proposed discharge area however will not be irrigated with the low rate system in the short term. The view is looking approx. northwest, the trees are located along the property boundary at the back of the farm.

Figure 16:

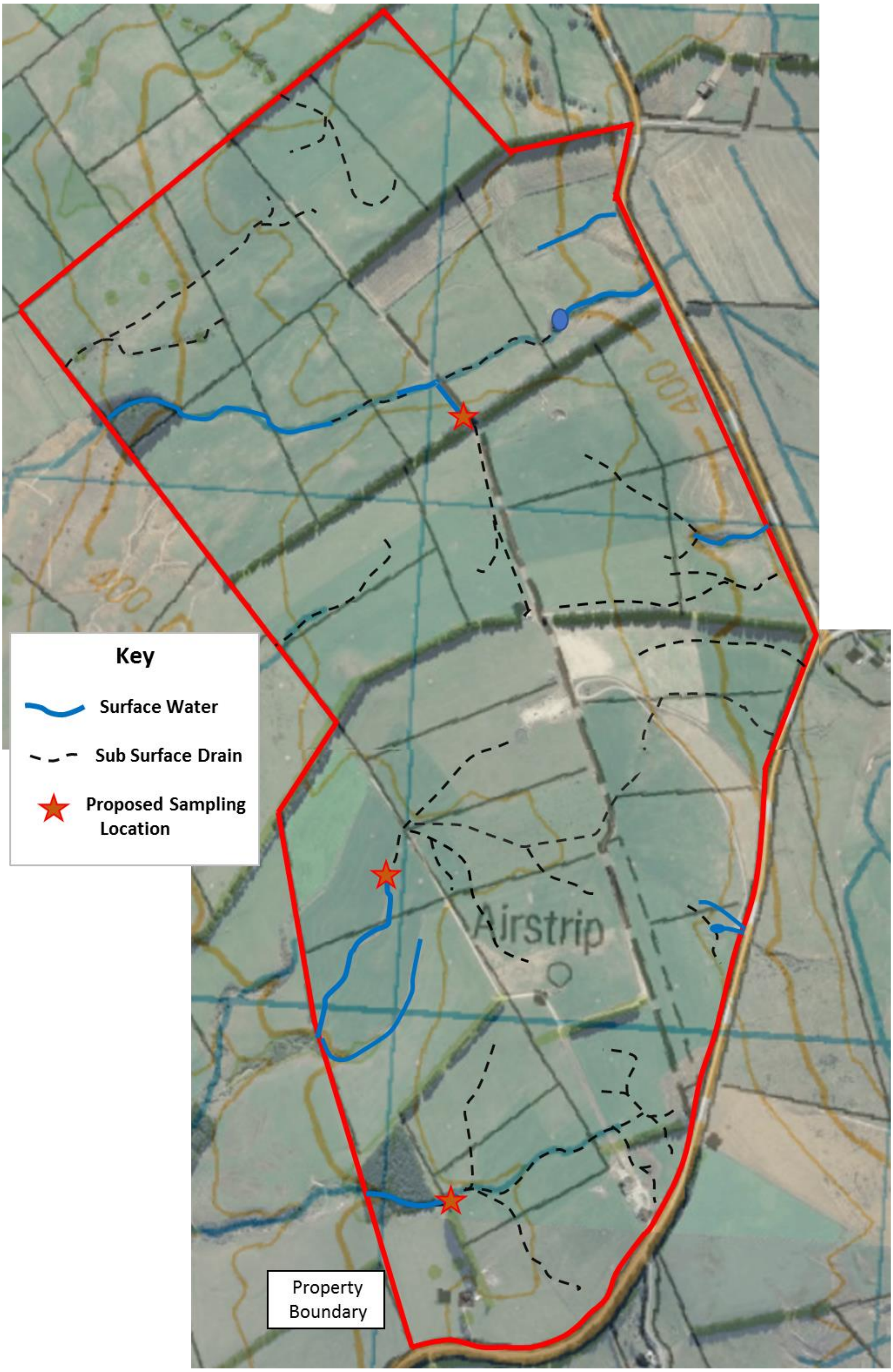
View looking south west, again within the Upukerora catchment. This area of land is excluded from receiving any effluent due to its variable slopes and knobs. One of the surface water ways on the property is also within this area, the water way is hard to distinguish in the photo however is approx. central in the frame and flows from right to left. This area has shallower stonier Te Anau soils, which is evident with the rock piles collected during the development of these paddocks.

Subsurface Drainage:

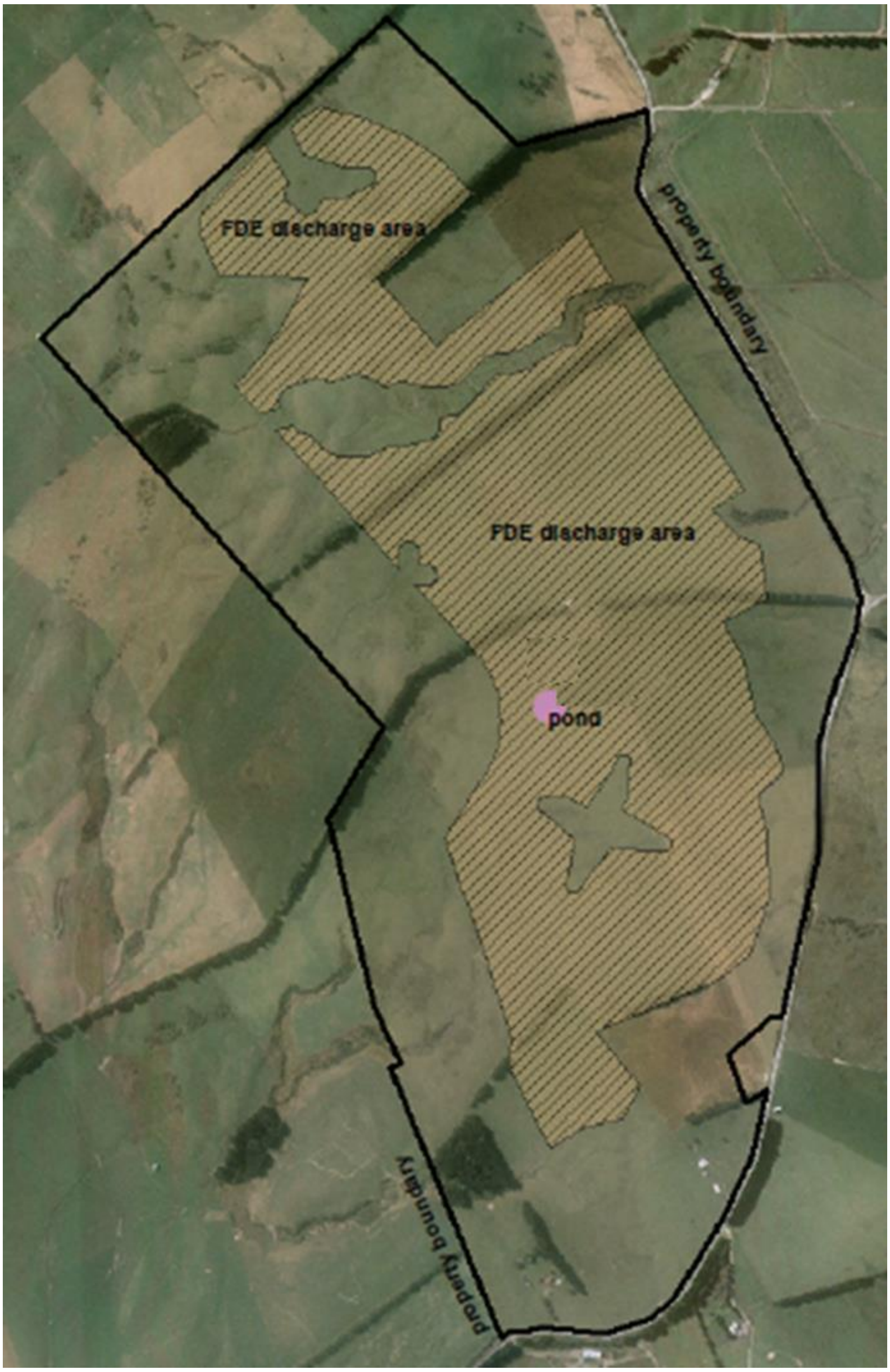
Subsurface drainage has been installed on the property to remove drainage or perched water during wet periods. These drains help with the development and productivity of the farm and its resources. The subsurface drains are important for the development of the soil and subsequent increase in rooting depth and persistence of the desired pasture plants sown across the property. This allows greater utilisation of nutrients cycling within the soil and pasture system and allows up take of nutrients from deeper in the soil profile. Well drained and artificially drained soils allow pasture growth to begin earlier in spring and allow greater productivity due to the increased aeration of the soil profile and reduction in water logging. Soil and pasture damage from cows is also reduced especially in the shoulders of the season as the soils do not remain water logged for long periods.

There are no Freshwater Springs within the discharge area. Subsurface drains have been installed to collect runoff from sloping areas and seepages from perched water especially along the changes in soil type boundaries which result from the variable topography and underlying glacial gravel till of the property. The subsurface drains on the property are deep with approx. 1 m of soil cover over the pipe. Therefore the depth of soil over the drains is typically twice as deep as the soils across the rest of the property. The location of these drains has been recorded as best as possible within the proposed discharge area and wider farm area, these are marked on a map below. The outfall of the drains is into surface drains/waterways on the property which are excluded or buffered from the discharge area. Three major subsurface drainage networks were identified that can be used to monitor the effects of the effluent discharge. One sampling point is made up of drains that underly an area that effluent is not applied too. This could be sampled and used for comparison with samples collected from drains within the discharge area. Two other sampling points are made up of drainage networks that underly the discharge area.

Subsurface Drainage Location Map:



Effluent Irrigation Area Map:



Low Rate Irrigation System:

A new effluent irrigation distribution mainline and hydrants will be installed along the central lane to an area west of the on farm storage pond. Up to 200 m (2 x 100 m lengths) of drag hose will be used to connect between the desired hydrant and the irrigation system. This design will allow a low rate Larall Smart Hydrant irrigation system to be operated within an approx. 25 ha area of the effluent discharge area. This area is just above the minimum requirement of 4 ha per 100 cows which is considered to apply the maximum consented loading of 150 kg of Nitrogen per hectare per annum from effluent. An irrigation pump will draw from the existing effluent storage pond on farm and provide the system with the design flow rate and pressures. The pump will have a high and low pressure fail safe system which will monitor the pumping pressure and shut the pump off if the operating pressure moves out of the pre set range. The pump running time will be controlled using a simple time clock. The total run time can be set to determine the depth applied and a pulse timer can be set to reduce the application rate over a period of time. E.g. 2 hours rest before a second pump cycle.

4 sprinklers will be used which operate for a pre set time of approx. 10 – 15 mins each per hour. The smart hydrant switches between each sprinkler based on the volume of effluent that has been applied. A flow meter on the unit controls this switching. The system design for White Waters is based on 4 large sprinklers as this is considered sufficient for the consented herd numbers and paddock sizes. This also allows easy placement of each individual sprinkler within a paddock to avoid specific riskier areas. The sprinklers are simple to move and require low labour inputs for the application of large volumes of effluent especially compared to the slurry tanker.

An example application setting on the Te Anau undulating soil in spring with a 7 mm soil moisture deficit would be:

1 hours pumping consisting of 15 mins pumping time to each sprinkler, a further resting period using the time clock would prevent the irrigation pump from re-starting until a further hour had elapsed. This cycle could repeat a further 3 times and apply a total of 72 m^3 of effluent with a total depth applied of 6 mm over a total of 6 hours. The sprinklers would then need to be shifted outside of the wetted area before running again. Two settings of the sprinklers per day is easily achievable which results in adequate volumes of effluent being applied when conditions allow. This equates to 144 m^3 or 5.5 days of effluent production.

Applying the total annual volume of effluent to the low rate area alone would result in twice the soils annual maintenance potassium requirement being applied, as such a minimum land area of 48 ha (8 ha/100 cows) will be used annually to ensure sustainable application of potassium from effluent. This has the benefit of spreading the nitrogen loading from the effluent across a larger area of the farm reducing the need for nitrogen fertiliser such as urea and potentially reducing the overall system loss from the dairy farm.

The low rate irrigation system can be used in the shoulders of the season when soil moisture conditions can be variable day to day and week to week. This allows the slurry tanker to be used to apply effluent and nutrient to the lowest risk areas outside of the low rate irrigation area during the lowest risk time, typically the period from December to March. The low depth application method and high soil moisture deficits during this period can be utilised to allow the slurry tanker to apply effluent to areas less than 7^{o} slope. The low rate system could still be used during this time if required.

These two irrigation methods compliment each other to mitigate the risk of applying effluent during variable soil moisture conditions while ensuring the effluent and nutrient loading is spread over a suitably sized irrigation area to mitigate the risk of nitrogen loss.

Low Rate Irrigation Mainline Layout:

Assessment of Environmental Effects:

The assessment of environmental effects that follows is based on the applicant utilising best practice effluent management. This consists of low rate effluent irrigation, low depth effluent irrigation and deferred application of effluent to ensure a suitable soil moisture deficit exists for the depth of effluent applied (and suitable minimum soil temperature). Further to that the effluent receiving area has been carefully considered and the proposed area is suitable for receiving effluent, suitable buffers from surface water ways will be adhered to by way of exclusion from the discharge area. An effluent operational management plan is utilised to provide guidance for maintaining and operating the effluent system on farm.

A simple monitoring approach will be taken to provide water quality data on the potential effects that the proposed activity may have on ground and surface water. This is proposed as taking water samples at 3 – 4 key times during the year. Samples can be taken from the outlets of three subsurface drainage networks that are underlying varying areas of the property. One of these drainage networks is underlying an area predominantly outside of the proposed discharge area, this can be considered the "control". The other two outlets have drainage networks that are from areas underlying consented effluent receiving areas. The control area allows potential comparisons to be made between the other two water sampling points. Suggested sample timings are within the first two weeks of August prior to the stock returning to farm, a second sample in November would enable testing once some effluent application has occurred. An optional sample could be taken in summer dependant on climatic conditions, with the last sample taken in April-May. If results from all three sampling locations do not significantly differ it can be considered the effluent application is not having any negative impacts on water quality.

The DESC has been used to determine the volume of effluent storage required to ensure deferred application is manageable The DESC has been amended as a result of the farm visit on the 24th of July 2018. The two revisions to the DESC which was supplied with the further information request include; a minimum 10 ha area of low risk soils for receiving effluent. An increase in dairy shed yard catchment area which takes into account the additional catchment from the entry/exit lane which has been added to the infrastructure of the yard catchment since the farm was previously consented.

The existing storage structure on the property has a total storage volume of 1,500 m³, an allowance of 0.3 m freeboard provides a useable storage volume of 1,238 m³. The 90% probability volume determined by the DESC is 886 m³. The previous consent utilising only the slurry tanker for effluent irrigation required 1,200 m³ of storage. The storage structure on farm is therefore sufficient in volume to ensure effluent application can be deferred until a suitable soil moisture and temperature exists.

Assessment of Environmental Effects & Mitigations

Effluent Irrigation to Land:

Soil Suitability to Receive Effluent

A report in relation to soil drainage characteristics and associated risks of land application of effluent was produced by David Houlbrooke and Ross Monagahan in 2009 for Environment Southland. This report covered a range of soil drainage characteristics including well drained soils, (which feature on the subject property) matrix flow of liquid down the soil profile and the low associated risks of effluent application to a well drained soil type.

The effluent application methods including low rate and depth irrigation and the slurry tanker with low depth application of 5 mm or less are suited to the soil characteristics on farm.

The dominant Te Anau soil type underlying the effluent receiving area is suitable to receive effluent subject to there being an adequate soil moisture deficit to receive the depth of effluent being applied. The work of Monaghan et al from AgResearch has clearly demonstrated that soils with good drainage characteristics are effective in retaining contaminates present in the effluent where effluent application depth is less than the soil moisture deficit. Further to that uniform infiltration by way of matrix flow of applied effluent due to the well-structured soil profile provides the highest chance for nutrients to be retained in the root zone. Soil texture, soil depth and organic matter content all contribute to good cation exchange capacity and anion storage capacity to hold soluble nutrients. As the subject farm has well-structured soils and the stock are wintered off the property and calving starts later in August the degree of soil compaction from stock is greatly reduced and as such the soil structure especially in the topsoil reflects that. There is less risk of bypass or overland flow of effluent to surface and ground water.

The soil types within the irrigation area are suitable to receive effluent during the higher risk spring period as proposed, on the basis that best management application is followed. The use of deferred irrigation will allow application of effluent to the soil when there is a soil moisture deficit. The low rate and low depth of application will ensure the effluent can infiltrate into the soil and the volume of nutrient applied is not excessive. This will ensure that effluent filtrates through the soil profile allowing adsorption of nutrients and microbes to cation and anion exchange sites storing them and making them readily available for plant uptake. Considering the application of effluent will coincide with the higher pasture growth periods of the year the timing of applications could not be better suited to ensure mineralisation and utilisation of the applied nutrient occurs.

Work by Houlbrooke at Massey University demonstrated that deferred application and low depth application prevents drainage as a result of effluent application. The strategy of irrigating smaller quantities of farm dairy effluent more frequently (7 application of 9 mm depth) in 2001/02 resulted in zero drainage of applied effluent through the mole and tile drainage system, and consequently, no direct loss of nutrients. The effluent was applied using a high instantaneous application rate rotating boom travelling irrigator.

The effluent discharge area is categorised as A, C and D land in terms of application risk. Although there is subsurface drainage on the property effluent will not be applied over them at times when drainage would occur as a result of either the application of effluent, or from rainfall immediately following application so as such the risk to subsurface drains from the activity is negated. A map has been provided with the location of subsurface drains and surface water ways on the property.

Surface water:

Adverse effects on surface water can occur in two ways from the discharge of farm dairy effluent where contaminants present in effluent such as nutrients N and P, sediment and microbes, reach receiving surface waters such as streams, rivers, wetlands and estuaries.

The two ways are identified as direct contamination as a result of untreated effluent entering surface water bodies, or effects as a result of the overall activity occurring. Cumulative effects will be discussed further below. Negative water quality effects such as nutrient or sediment enrichment of surface waters can lead to algal blooms including slime and nuisance aquatic plant growth. Other critical and measurable water quality variables including turbidity, bacterial loadings and pH can also be influenced. The diverse range of native and introduced plants and aquatic instream life that inhabit receiving waters are adversely affected by nuisance plant growth.

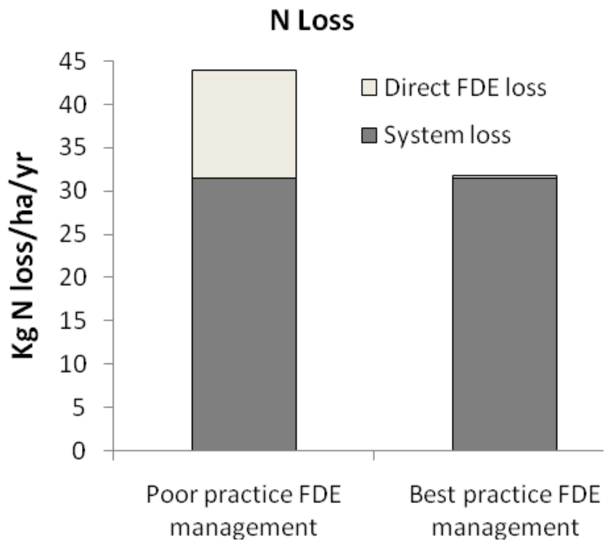
Surface water quality can be monitored using measurable values and biodiversity markers. Core values associated with surface water streams and coastal waters are many and relate to the landscape, biodiversity and history of the people living in the catchment. These values include maintaining the health of water bodies both in-stream and coastal, protecting biodiversity and ecosystems, protecting recreational activities such as fishing, walking and boating; protecting human and animal health, maintaining sustainable farming practices and the socioeconomic well-being of people through preserving values that relate to inshore fishing, farming and tourism. Iwi/cultural values include the principles of protection or kaitiakitanga of the mauri of the water and mana of the land and minimising adverse effects on taonga and mahinga kai.

The proposed discharge activity has been considered in a manner to protect these values; industry best practice standards for farm dairy effluent discharge by using multiple management practices not limited to; the use of buffer distances, limiting nutrient application, deferred irrigation, low rate and low depth application technologies will be used. The use of best practice effluent application as detailed in this application should avoid any adverse effects on the surface water environment.

The principles of the management practices described are well documented in various scientific reports. One such report prepared for Environment Southland during the process of setting policies and rules around effluent discharge to land was one produced in 2009 by Houlbrooke and Monaghan; the report provides context and background to the principle that best practice effluent application should not cause adverse effects on water quality. The graph below is taken from the 2009 Houlbrooke and Monaghan report to illustrate that nutrient loss from FDE application is minor if undertaken using best practice.

The graph represents a dairy farm property, in this example, less than 1% of nutrients applied in effluent reached drainage water on tile and mole drained soils. These soil types were considered high risk, there are a mix of low and risk soil types and topography on the subject property.

Figure 18. Houlbrooke and Monaghan (2009) N loss from dairy farm systems



The applicants intend to apply effluent in accordance with best practice at all times to avoid adverse or cumulative effects on the receiving environment. Houlbrooke and Monaghan (2009) explain that if effluent is applied to soil when a soil moisture deficit exists then the effluent preferentially remains in the soil's root zone as plant available water or adsorbed to soil particles. The soluble nutrients in the effluent can then be taken up by the pasture plant and used to grow and been harvested resulting in nutrient cycling. The applicants will use the on farm Aqua Flex soil moisture tapes to monitor soil moisture levels. The closest Environment Southland soil moisture monitoring site, which is available online through the ES website can also be used to determine whether a suitable soil moisture deficit exists. Effluent application will be deferred if soil moisture levels are too high to safely and correctly apply effluent. Effluent will be only applied when there is a suitable soil moisture deficit and will not induce drainage as a result of application.

The use of low depth irrigation will increase the frequency by which it is safe to apply effluent because a lower soil moisture deficit is required prior to irrigation. By deferring irrigation, losses to drainage water should be considerably less than the 1.1% of the total nutrients applied in the effluent experienced in the above trial. When soils are near or at field capacity and there is risk of contaminant loss via overland flow or drainage through the soil profile to receiving surface waters, irrigation is deferred. Areas where subsurface drainage has been installed will be avoided when irrigating during the shoulders of the season and only applied over when a larger soil moisture deficit occurs and rainfall is not forecast following application. The risk of contaminant loss via artificial drainage is then mitigated.

Best practice irrigation as is described above, minimises the risk of contaminant loss via pathways relevant to the bedrock/hillcountry physiographic zones; overland flow to surface water or subsurface drainage during wet periods. The soil will be monitored for evidence of cracking, following prolonged dry periods. If, and when there is evidence of deep cracks, effluent will not be applied. It is noted, however, due to the higher top soil organic matter, well-developed pastures and good soil structure at the property, there is minimal tendency for deep cracks to form in the subject properties soil types. This reduces the risk of contaminants in effluent directly reaching the underlying glacial till.

In addition to this, buffer distances from the discharge area to surface waterways will be maintained minimising the risk of effluent reaching surface waters directly from overland flow.

The proposed maximum N loading is 150 kg per hectare per year from effluent application which indicates that the N application from effluent in the proposal is not excessive and meets Council's recommendations. The scale of the discharge activity allows for the sustainable use of land to receive effluent. The proposed discharge area (100 ha) is 4 times the required size to ensure N application is below the proposed maximum loading from effluent of 150 kg/N/ha/year. This large area provides scope through-out the season and will ensure that nutrient loading of soils from effluent is not excessive.

In summary, due to its nature (deferred and low rate and low depth irrigation), scale and implementation of good effluent management practice at the property, there will be less than minor effects on the Upukerora River, the Whitestone River or greater Waiau catchment or coastal waters and their values from the proposed discharge activity.

Groundwater

Adverse effects on groundwater can occur from the discharge of farm dairy effluent where contaminants present in effluent such as nutrients N (nitrate) and microbes (bacteria such as campylobacter) reach receiving groundwater via leaching/deep drainage pathways. A major risk of elevated nitrate levels in groundwater is to users (consumers) of groundwater as nitrate becomes toxic to living organisms such as humans, animals and fish at high levels. The New Zealand Drinking Water Standard maximum allowable value for nitrate is 11.3 ppm. Another risk to consumers of groundwater is waterborne gastroenteritis through the ingestion of groundwater contaminated with pathogens such as campylobacter. This was demonstrated in Havelock North in 2016, when over 5,000 people became ill with camplobacteriosis. Adverse effects on other users of groundwater such as other farms, small industries, schools or settlements/domestic users are possible and need to be mitigated.

The property overlies the Te Anau Groundwater Zone, Groundwater nitrate concentrations in the aquifer and in the vicinity of the property are still considered pristine. Aquifers (and streams) in the physiographic zone of the property are at risk of nitrate build-up due to their physical properties and as they do not experience dilution by a major river.

The Te Anau township is a key consumer of groundwater/surface water influenced by groundwater within a 15 km vicinity. The inclusion of a small area of land within the Upukerora catchment for receiving effluent helps mitigate any negative impacts of the overall discharge activity by ensuring a suitable sized effluent receiving area is available. Using best practice effluent management will mitigate any risk on water quality to this registered water abstraction site.

As is described in the previous section (AEE on surface waters), the implementation of best practice effluent discharge means there is minimal risk of bypass drainage to the underlying aquifer occurring as a result of the discharge activity. The direct risk of nitrates or microbial contaminants in effluent reaching groundwater is in this way mitigated. The highest risk time associated with leaching is during winter when the majority of aquifer recharge occurs. Effluent will not be applied during this key recharge period. The cows are also wintered off the property which further reduces the risk of system loss of N. Under these circumstances, it is anticipated cumulative effects of the discharge activity will also be mitigated.

Soil health

There is little or no risk to the life supporting capacity of the subject property's soils due to the proposed effluent discharge activity. The utilisation of land treatment for effluent allows for the sustainability of the soil ecosystem. The soils are suitable for effluent irrigation and the discharge follows current good management practice. These include practices of a general nature and those specific to the contaminant transport pathway for the physiographic zone at the property (overland flow, artificial drainage).

The maximum loading rate of Total Nitrogen applied from effluent over the proposed discharge area meets the recommended regulatory restriction of 150 kg N typically placed on discharge permits by Regional Councils. This has the flow on effect of ensuring the loading of other environmental contaminates to the soil are also low. This helps to make the farming system sustainable in the long term as it allows the effluent to be used both as a fertiliser and a soil conditioner, while not overloading the system.

Natural UV treatment of pathogens and faecal coliforms applied to the soil surface from dairy farm effluent is effective and results in rapid decline of numbers. Roach CG, Longhurst RD, Ledgard SF (2001) reported that elevated pathogen levels on the soil and pasture surface following effluent application rapidly reduced back to background levels of the farming system within 10 days. As such the soil health will not be negatively impacted from the application of pathogens and faecal coliforms present within the effluent.

Cumulative effects from the discharge activity:

Any cumulative effects on the environment from the proposed discharge must be considered as part of this application under the RMA. The proposed discharge will be undertaken using best practice effluent management which has been discussed throughout the application. These management practices allow the activity to occur in a manner that has been proven by science to reduce the negative impacts of the activity, further to that they are measurable or quantifiable and have a simplistic description to provide certainty that consent conditions can be set and enforced with compliance checks where necessary.

This application has proposed management practices for the discharge activity that in turn directly mitigate adverse effects or subsequent cumulative effects. It can be determined that they achieve this in two ways:

1: To prevent any direct loss of freshly applied or untreated effluent to land from reaching ground water and surface water resources within the farm's vicinity.

2: To ensure the ongoing effects of the discharge activity on the farming system will not result in an increase in nutrient losses from the overall farming system.

If both of these points are achieved, a determination can be made that the activity has not had any increase in cumulative effects as a result of the discharge occurring. The key basis to achieving this is to identify the risks associated with the activity, fundamentally we can achieve a positive outcome by understanding what influences the risks, researching the science available and then implementing a strategy to achieve the desired outcome. Farming systems have adapted and evolved on this basis for a number of years, changing/improving on-farm management has had a positive impact on the sustainability and productivity of the land we rely on to support the lifestyle of the entire community and country.

National and Regional Authorities have implemented the Resource Management Act to protect our most valued resources while recognising these resources are relied on to provide for the needs of the country and the country's economy. To support this the government provides a substantial range of funds to various government, education, business and primary production operations to enable research to provide science and new technology to ensure the country continues to improve the sustainability of its primary production systems.

Houlbrooke & Monaghan (2009) had significant findings that enabled Environment Southland to adopt more environmentally sustainable legislation and consent requirements for agricultural effluent discharges to land. Rapid adoption of new technology in the rural community is considered to be a period of 7 years, in Southland it has taken approx. 10 years for one of Houlbrooke & Monaghan's key research recommendations to be near completely implemented; the use of effluent storage structures to enable deferred application of dairy farm effluent. This management practice was expected to directly reduce the potential for cumulative effects on surface and ground water compared to effluent irrigation to land daily no matter what the soil moisture levels were. Although the majority of discharge consents had this management practice implemented when the consent was renewed, there were a large number of voluntary early upgrades to the new technology and adoption when expanding or varying a consent. As such to predict 10 years ago what the reduction in cumulative effects would be from region wide adoption by dairy farms of deferred storage would have only been at best an educated guess.

Undertaking the discharge activity following best practice management to ensure Regional Policy is met is the minimum that must be achieved to consider adverse effects on the environment to be no more than minor.

Additional mitigation steps to this will be helping to reduce the potential cumulative effects of the activity and/or any subsequent new activities/adverse effects that others may develop within the same catchment or environmental area.

SUMMARY OF MITIGATION MEASURES DISCUSSED IN THIS DOCUMENT:

These measures will be implemented and are considered best practice effluent application for the activity:

The management practice is provided along with the mitigation relative to the practice.

- Recognition of contaminant pathways associated with the physiographic zones – Implementation of buffer zones, suitable receiving area is consented

- Low rate effluent application – mitigates the risk of ponding, runoff and matches the application rate to the soils infiltration rate.

- Low depth effluent application – mitigates the risk of ponding, runoff and infiltration rate for the slurry tanker. Depth applied is determined by the soil depth, PAW and moisture deficit.

- Low depth effluent application – helps to reduce nutrient loadings, contaminant loading

- Deferred application – allows effluent to be applied when there is a suitable soil moisture deficit On farm soil moisture monitoring is utilised to achieve this.

- Deferred application – allows effluent to be applied when the soil/pasture base temperature is suitable for example above 7º C.

- Maximum nutrient application restriction – ensures effluent application does not result in excessive nutrient loadings or contaminant loadings.

- Regulatory recommended buffer distances from sensitive areas and on farm and neighbouring property infrastructure such as bores or dwellings. Ensures effluent is not applied to at risk areas or features.

- Sufficiently sized application area – ensures effluent application does not result in excessive nutrient loadings or contaminant loadings.

- Appropriate fail safes and high level alarms on effluent infrastructure – mitigates the risk of point source effluent discharges.

Discharge Consent Proposed Conditions:

1. This resource consent is granted for a period of five years;

Note: Pursuant to Sections 123 and 124 of the Resource Management Act 1991, a new consent will be required at the expiration of this consent. The application will be considered in accordance with the plans in effect at that time, and the adverse effects of the proposed activity.)

2. (a) This consent authorises the discharge of farm dairy effluent onto land, via a land disposal system, as described in the application and pre hearing information request, on land known as Section 2 SO 385807, as shown in Appendix 1.

(Note: *The effluent disposal area shown in Appendix 1 can be altered and/or extended, subject to the approval of the Director of Environmental Management, if the consent holder submits a new plan showing the new effluent disposal area, and providing the written approval(s) of any person whose property boundary will be closer to that area. In the event that written approval cannot be obtained, the effluent disposal area can only be amended by way of limited notification.)*

(b) This consent excludes effluent from winter milking, or any feedlot or wintering pad.

3. (a) No dairy farm effluent shall be discharged to any surface watercourse by overland flow, run-off, or via a pipe, nor shall there be any surface run-off/overland flow, ponding or contamination of water resulting from the exercise of this consent.

(b) The land disposal system shall be operated and maintained to ensure that there is no offensive or objectionable odour beyond the property boundary, or any spray drift into or beyond the buffer zones.

(c) The consent holder shall:

> (i) prior to commencement of the discharge, install and maintain an alarm system on the effluent pond and dairy shed pump sump to warn of the risk of overflow due to high pond levels;
> (ii) prior to use of any irrigation system that operates while in connection with the effluent pond, install and maintain an alarm and automatic switch-off system as a contingency

measure in the event of an effluent system failure such as a sudden pressure drop, irrigator stoppage or breakdown.

4. (a) Subject to condition 3(a), the land disposal system is limited to the following:

(i) a maximum depth of application of 10 mm for each individual application, at an instantaneous rate not exceeding 10 mm/hour for a low rate system;

(ii) a maximum depth of application of 5 mm (measured as an average across the wetted area) for each individual application by slurry tanker;

(Note: The application depth needs to be less than the soil-water deficit (i.e. the depths above are maximum depths and as soil moisture levels approach field capacity, smaller depths will be necessary to avoid losses of contaminants from the root zone. When soil moisture levels reach field capacity, irrigation will need to cease completely to prevent these losses.)

(iii) the maximum loading rate of nitrogen onto any land area shall not exceed 150 kg of nitrogen per hectare per year from dairy shed effluent.

(b) Before this consent is exercised, the consent holder shall measure the application rate of the slurry tanker as installed to confirm the operating conditions required to ensure compliance with condition 4(a).

(ii) the Council may audit the measurement of the application rate to ensure accuracy. The consent holder shall pay the costs of auditing the measurement in accordance with Section 36 of the Resource Management Act.

The result of the measurement shall be forwarded to the Council's Compliance Manager (escompliance@es.govt.nz) within 10 working days of the measurement being completed.

5. The consent holder shall not apply effluent to land where the soils are at or above field capacity, nor shall the discharge increase soil moisture above field capacity. To give effect to this condition the consent holder shall monitor moisture within the effluent disposal area as follows:

(i) within three months of the commencement of this consent the consent holder shall install Aquaflex soil-moisture tapes(s) or an alternative device or method of similar accuracy as agreed by the Council' Compliance Manager. The exact monitoring location shall be to the satisfaction of the Council's Compliance Manager;

(ii) within three months of the commencement of the consent the, the consent holder shall determine the soil moisture reading that equates to field capacity at the site and report this to the Council's Compliance Manager.

6. Effluent may be applied to the land as described in the application and subsequent information provided and generally as shown in Appendix 1, but the following specific buffers shall be observed:

(a) 20 metres of any surface watercourse;
(b) 100 metres of any potable water abstraction point;
(c) 20 metres of any property boundary (unless the adjoining landowner's consent is obtained to do otherwise); and
(d) 100 metres of any residential dwelling other than residential dwellings on the property.

Where there is conflict between Appendix 1 and these specified buffers, the latter shall apply.

7. The amount of dairy shed effluent disposed of onto land shall not exceed that from 599 cows.

8. Prior to exercising this consent, the consent holder shall provide at least 886 m^3 of effluent storage for the purpose of:
(i) avoiding irrigation of effluent when soils are at or above field capacity;
(ii) providing a contingency measure when the irrigation system is inoperative; and/or
(iii) for primary treatment when it is necessary for the proper operation of the effluent disposal system.

9. The consent holder will use an effluent operational management plan to provide guidance on the use and operation of the effluent system. This will be updated annually and supplied to Environment Southlands Compliance division annually. It is recommended this review and updated is completed by the 1st of June each year.

10. The consent holder shall notify the Council, within 10 days of the granting of this consent, the person who is in charge of the operation of the effluent disposal system. If the person in charge of the effluent system changes during the term of this consent, the consent holder shall notify the Council of the new operator no later than five working days after that person takes responsibility. *(Note: The person identified by condition 9 will be the primary contact for Council staff for monitoring purposes and/or in the event of an incident. Nothing in this condition removes or limits the consent holder's liability to ensure compliance with the consent and its conditions.)*

11. The Southland Regional Council may serve notice of its intention to review the conditions of this consent, in accordance with the conditions of this resource consent and Sections 128 and 129 of the Resource Management Act 1991, for the purposes of:

(a) dealing with any adverse or cumulative effects, including the adverse effects of high stocking rates, on the environment which may arise from the exercise of this consent;
(b) considering any changes to information on the effects of land disposal of dairy farm effluent;
(c) complying with the requirements of a regional plan;
(d) amending monitoring requirements; or
(e) imposing a notification requirement for potential effects on registered drinking water supplies.

12. The consent holder shall pay an annual administration and monitoring charge to the Southland Regional Council, payable on invoice. This charge may include the costs of inspecting the operation of this resource consent as follows:

(a) inspecting the operation four times each year for at least three years from the date of commencement of the consent, and thereafter, with the written approval of the Council's Compliance Manager the frequency of inspection may be reduced to twice per year (or otherwise as in accordance with the Council's Annual Plan); and

13. The consent holder will be responsible for taking water samples to be tested for the purpose of monitoring the potential effects of the consented discharge activity.

The location of the monitoring points is to be to the satisfaction of the Council's Compliance Manager.

(i) monitoring samples from 3 subsurface drainage outlets may be undertaken up to 4 times each year;

(ii) representative samples will be taken from the 3 subsurface drainage outlets with two of these drainage networks underlying the discharge area and one drainage network underlying an area outside of the discharge area.

(iii) the samples will be analysed for:

- pH
- electrical conductivity
- ammoniacal nitrogen concentration
- nitrate nitrogen concentration
- dissolved reactive phosphorous concentration
- *E. coli* concentration

14. If an event (such as effluent overflow to water, significant over-application on a free-draining area or pond collapse) occurs that may have significant adverse effect on water quality at the abstraction point of a registered drinking-water supply, the consent holder shall notify, as soon as reasonably practicable, the following:

- Environment Southland's Compliance Manager (ph 03 211 5115 or 03 211 5225 after hours)

(Note: The consent holder is advised to contact Environment Southland's Compliance Manager in the event of any unexpected event that may result in non-compliance with the conditions of this resource consent or the rules of a regional plan.)

Proposed Monitoring:

Surface/groundwater monitoring will be carried out by way of water sampling from 3 subsurface drainage outlets within the subject property. Samples will be taken 3 -4 times per year.

The applicant proposes to carry out the monitoring rather than the Regulatory Authority. The results will be provided to Environment Southland in a timely manner following the return of the results. Dairy Green Ltd will undertake the sampling regime over the life of the proposed consent term. Dairy Green Ltd undertakes a range of soil and water monitoring annually for various clients and government agencies across the region. As such the sample methodology followed and results provided can be trusted to be a true representation of the water sampled at that time.

The location of the sample points have been provided on the subsurface drainage map above and discussed within the subsurface drainage section and AEE section above.

Summary

Overall the adverse effects of the proposed discharge can be mitigated and as such are considered to be less than minor, there is sufficient effluent storage on the White Waters farm as calculated by the DESC. Soil moisture monitoring is available on the property to ensure application only occurs when a soil moisture deficit occurs. The effluent application methods proposed are capable of dealing with the volume and types of effluent generated. An effluent operational management plan will be used to provide guidance on the suitable use and management of the effluents system on farm.

The effluent volume and nutrient content from the dairy shed effluent from a maximum of 599 cows when applied to land will have effects on the environment that are nil to less than minor when applied as described in this application.

References

Houlbrooke DJ, Monaghan RM 2009. The influence of soil drainage characteristics on contaminant leakage risk associated with the land application of farm dairy effluent. Environment Southland, October 2009.

Jill Bean

From: Jess Crawford
Sent: Monday, 2 April 2012 09:22
To: Jill Bean
Subject: W080-003
Attachments: image001.jpg; 20120330071015430.pdf

02 APR 2012

Letter for logging please

From: Ben Melvin [mailto:ben.melvin@opus.co.nz]
Sent: Friday, 30 March 2012 8:22 a.m.
To: Jess Crawford
Subject: White Waters - FINAL Soil Report

Hi Jess,

After some discussion with Bill Risk this week we have decided to exclude Kakapo Soils from the effluent discharge block. This has been reflected in the revised soil report attached.

Regards,

OPUS
Ben Melvin
Civil Engineering Technician
Certified Engineering Technician, AIPENZ
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Rural Management Services

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Email whr@ihug.co.nz

24th March 2012

White Waters Ltd,
C/- J. A. Vernooij,
893 Kakapo Rd,
Te Anau

Report on Suitability of Soils on White Waters Farm for Effluent Application.

Further to your request I have inspected the soils on your property. My comments on the soils and their suitability for effluent application are summarised below.

Farm

The property is situated at 893 Kakapo Road and is 193ha in area. At present up to 50 cows are milked with plans to fully convert the farm to a dairy unit running up to 599 cows. A new milking shed and support facilities are to be constructed. The property is gently rolling with steeper slopes on the eastern and western sides.

Effluent is planned to be applied to suitable areas of the property about 100ha (see map). Excluded areas include a 200mstrip along the western side of the farm, the steeper slopes on the eastern side and an area at the south end adjacent to the homestead and neighbouring property houses.

Soils

The dominant soil on the proposed effluent area is Te Anau soil that is formed on old glacial moraine till. This soil has variants that include shallow (gravel within 45cm) and moderately deep (gravel within 90cm) soils and undulating (slope less then 7degrees) and rolling areas.(slope 7-15 degrees). Scattered large surface rocks are present on ridge areas with greater numbers on the north end section of the farm.

On some small drainage depressions shallow peaty Kakapo soil are found. These are adjacent to natural drainage channels and are about 4ha in area.

Relevant properties of Te Anau and Kakapo soil and their susceptibility to risks associated with effluent application are summarised below.

Te Anau undulating and rolling shallow and moderately deep silt loam

- Moderate water holding capacity
- Moderately well drained
- Low vulnerability to treading damage.
- Good recovery to treading
- Bypass down soil cracks possible in very dry conditions.
- Ponding and runoff can occur if soils are waterlogged.
- High vulnerability to leaching.

Kakapo undulating moderately deep silt loam

- High water holding capacity
- Poorly drained naturally
- Slight vulnerability to structural compaction with treading.
- Moderate recovery to treading.
- Bypass loss down soil cracks can occur when soils are occasionally dry.
- Ponding and runoff likely when soils are very wet.
- Slight vulnerability to leaching reflecting poor drainage and slow permeability.

The Te Anau soil variants have similar properties.

Top-soils have good drainage as well as high P-retention and organic matter content that results in minimal structural compaction. In the subsoil, gravel and stones occurs at varying depths below about 35 to 70cm. Sub-soils tend to be dense with massive structure that restricts water movement and pasture root development. High leaching losses can occur in spite of sub-soil impediments.

Kakapo soils (see map) occur on small basins areas adjacent to drainage channels. They are surrounded by Te Anau soils. They occupy about 4ha on the proposed effluent area. Most areas have been drained with underground pipes or open ditches. Effluent application in wet conditions when runoff is likely could lead to increased nutrient losses because of the short distance to drainage channels. It is recommended that as the area of Kakapo soils is small and more vulnerable to nutrient loss that effluent is not applied to these areas.

Effluent Application

Te Anau soils are suitable for effluent application as long as their limitations are recognised.

Te Anau soils have moderate water holding capacity but are relatively shallow that can lead to leaching losses if excess effluent is applied or if application occurs when soils are wet. Kakapo soils are deeper and have a higher water holding capacity but because of their close proximity to drainage outlets leaching losses and runoff can occur if excess effluent is applied when soils are wet.

Effluent should only be applied when soil moisture level is below field capacity. Field capacity is the maximum amount of water a soil can retain with any further rainfall or effluent lost as runoff or as drainage through the soil as leachate.

Effluent application depth (total amount applied) and rate of application (mm/hr) are both important and should be accommodated within the soil profile.

It is suggested that a prudent approach to effluent application should be followed as this will minimise potential problems in this sensitive area.

At each application a total of up to 10mm of effluent is recommended with an application rate of up to 8mm/hr.

It is proposed to apply dairy effluent from a 12,000l slurry tanker that will be towed by a four wheel drive tractor. This will apply up to 7mm per pass and will allow sensitive areas such as creek margins to be avoided. This system will help minimise potential nutrient losses to drainage channels. It is anticipated that up to three applications will be made each season.

It is proposed that the milking shed yard will be under a roof that will reduce the volume of rain water draining to the effluent pond. This will reduce the quantity of effluent produced.

Environment Southland monitor soil moisture levels at a number of locations across Southland but have no recording sites near White Waters farm. Soil moisture could be recorded on farm with an aqua- tape. It could be installed in a paddock adjacent to the milking shed and linked to a laptop in the shed. This would give soil moisture status at any time and if soils have absorption capacity for effluent application.

An 8-10 day spelling period between grazing and effluent application is recommended by Environment Southland. This allows soil infiltration capability to recover after grazing from any treading damage that is more likely if soils are wet. Actively growing pasture is also more efficient in taking up effluent applied nutrients then slower growing short pasture.

No effluent application areas such as boundaries, the Kakapo soil areas and creek margins should be marked with painted stakes in fence lines or other appropriate positions. These would give guidance to farm staff as to where tanker effluent can and cannot be applied.

The nutrient content of the planned effluent pond should be analysed at regular intervals. This would allow effluent applied nutrients to be included in the farm fertiliser programme and would reduce the quantity of solid fertiliser required.

It is also recommended that the main drainage creeks that traverse the farm be fenced to exclude stock.

Summary

- Farm soils within the proposed effluent area are suitable for effluent application as long as their limitations are recognised.
- Te Anau soil has a moderate water holding capacity is moderately well drained but can have leaching losses in wet conditions.
- Structural compaction is slight because of the high organic matter content and P-retention of the topsoil.
- The small area of Kakapo soils to be excluded from effluent application.
- Ponding and runoff will occur if effluent is applied when soils are wet (at or above field capacity).
- Effluent application should not exceed 10 mm depth and an application rate of 8mm/hr.
- Appropriate buffer zones with farm boundaries, waterways and any water extraction points should be established.

If you want to discuss any matters please get in touch.

Kind Regards

Bill Risk.

Soil name: Kakapo

Overview

Kakapo soils occupy about 100 ha in hollows and depressions on glacial moraine surfaces of the Te Anau basin. Significant areas of this soil also occur as complexes with the Te Anau soils. They are formed into moderately deep silty loess overlying glacial moraine. The soils are poorly drained, with a slightly deep rooting depth and high plant available water capacity. Present use is pastoral grazing with sheep, deer and beef cattle. Climate is cold in the winter with moderate temperatures over the summer when soils are occasionally seasonally dry.

Soil classification

NZ Soil Classification (NZSC):	Typic Orthic Gley; soils with stones; silty over skeletal.
Previous NZ Genetic Classification:	Moderate to strongly gleyed yellow-brown earth.

Classification explanation

Kakapo soils have been reclassified in this survey as the soil properties are consistent with Gley soils. This is because the poor drainage of Kakapo soils is due to water perching on the dense glacial moraine, that occurs at greater than 100cm depth. Kakapo soils have subsoils that show structural development, typically have gravel at between 45 and 90cm depth, and heavy silt loam textures.

Soil phases and variants

Identified units in the Kakapo soils are:

- Kakapo undulating moderately deep (KaU2): has gravel between 45 and 90cm depth; occurs on slopes of 0–7°
- Kakapo rolling moderately deep (KaR2): has gravel between 45 and 90cm depth; occurs on slopes of 7–15°

The soil properties described in this Technical Data Sheet are based on the most common phase, Kakapo undulating moderately deep (KaU2). Values for other phases and variants can be taken as being similar. Where they differ significantly they are recorded with a separate versatility rating.

Associated soils

Some soils that commonly occur in association with Kakapo soils are:

- Te Anau: well drained shallow soil formed on glacial moraines
- Excelsior: well drained soil formed in moderately deep to deep loess with a fragipan
- Otanomomo: very poorly drained soil, formed in deep peat

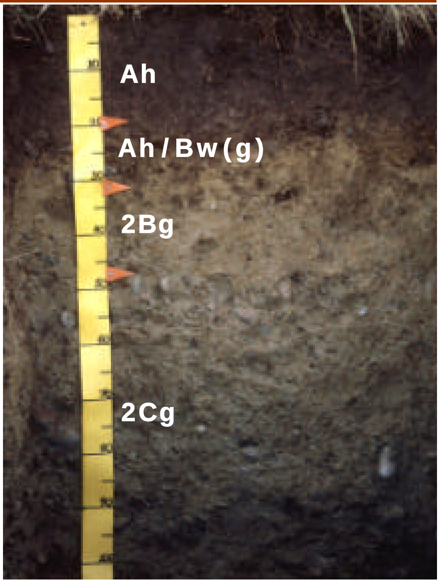
Similar soils

Some soils that have similar properties to Kakapo soils are:

- Otahu: poorly drained soil formed in moderately deep to deep loess with a fragipan

Typical profile features

The following is a 'generic' or composite profile description representing the most common combination of characteristics for this soil type. The actual profiles for which descriptions and data are available are listed at the end of this Technical Data Sheet.

Kakapo profile	Horizon	Depth (cm)	Description
	Ah	0–20	Brownish black very slightly gravelly silt loam; weak soil strength; weakly developed extremely fine to fine polyhedral structure; slightly weathered and subrounded gravels; abundant roots.
	Ah/Bw(g)	20–31	Dull yellow-orange slightly gravelly silt loam; few greyish yellow and few bright brown mottles; few wormcasts; weak soil strength; weakly developed fine to medium polyhedral structure; slightly weathered and subrounded gravel; abundant roots.
	2Bg	31–47	Greyish olive moderately gravelly loamy silt; common bright brown and few dull yellow-orange mottles; moderately developed fine to medium polyhedral structure; slightly weathered and subrounded gravel; many roots.
	2Cg	47–90+	Greyish olive very gravelly loamy silt; common red and few dull yellowish brown mottles; slightly firm soil strength; compact particle packing; slightly weathered and subrounded gravel; few roots.

Key profile features

Kakapo topsoils are about 20cm deep with a weakly developed structure. Sudsoil structure is moderately developed. Gravel content increases with depth. The dominance of grey colours throughout the subsoil reflects the poor drainage of the soils.

Typical physical properties

Note: values in Italics are estimates

Horizon	Depth (cm)	Bulk density	Permeability	Texture	Gravel content
Ah	0–20	Low – Moderate	*Moderate*	Silt loam	Very slightly gravelly
Ah/Bw(g)	20–31	—	*Moderate*	Silt loam	Slightly gravelly
2Bg	31–47	—	*Slow*	Loamy silt	Moderately gravelly
2Cg	47–90+	—	*Slow*	Loamy silt	Very gravelly

Profile drainage: Poor
Plant readily available water: *High*
Potential rooting depth: Slightly deep
Rooting restriction: Gravelly subsoil

Key physical properties

Kakapo soils have a slightly deep rooting depth and high plant available water that is limited to the underlying glacial moraine gravels. The soils are poorly drained due to the slow permeability of the lower subsoil. Textures are silt loam in the topsoil and loamy silts in the subsoil. Topsoil clay content is about 24%. Gravel content increases with depth.

Typical chemical properties

Horizon	Depth (cm)	pH	P retention	CEC	BS	Ca	Mg	K	Na
Ah	0–20	Moderate	Moderate	Moderate	Low	Moderate	Low	High	Very low
Ah/Bw(g)	20–31	Moderate	High	Moderate	Very low	Very low	Very low	Moderate	Very low
2Bg	31–47	Moderate	Moderate	Low	Very low	Very low	Very low	Very low	Low
2Cg	47–90+	Moderate	Moderate	Low	Low	Very low	Very low	Very low	Very low

Key chemical properties

Topsoil organic matter levels are about 14%; P-retention 40–80% and pH moderate (mid 5s). Cation exchange levels are moderate and base saturation low. Topsoil available calcium and potassium levels are moderate to high and magnesium levels low. Subsoil avialable cations are all very low. Soil reserve phosphorus levels are low. Micronutrient levels are generally adequate.

Vulnerability to environmental degradation

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	slight	These soils have a slight vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the high organic matter content and P-retention values.
Nutrient leaching	slight	These soils have a slight vulnerability to leaching to groundwater. This rating reflects the poor drainage, high water-holding capacity and slow permeability.
Topsoil erodibility by water	slight	Due to the high organic matter content, topsoil erodibility in these soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	minimal	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	severe	These soils have a severe vulnerability to waterlogging during wet periods. This rating reflects the poor drainage and slow permeability.

General landuse versatility ratings for Kakapo soils

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive landuse. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification.

Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

KaU2 (Kakapo undulating moderately deep)
KaR2 (Kakapo rolling moderately deep)

Versatility evaluation for soil KaU2, KaR2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Arable	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Intensive pasture	Limited	Risk of short-term waterlogging after heavy rain.
Forestry	Limited	Inadequate aeration during wet periods; restricted rooting depth

Management practices that may improve soil versatility

- Careful management after heavy rain and wet periods will reduce the impact of short-term waterlogging. Intensive stocking, cultivation and heavy vehicular traffic should be minimised during these periods.
- Drainage with open ditches and tiles can be of considerable benefit.

Soil profiles available for Kakapo soils

Soil symbol	Profile ID	Topoclimate map sheet	Profile description available	Physical data available	Chemical data available	Profile photo available
KaR2	AT6	39	✓	✓	✓	✓

Published by Crops for Southland with financial support from Environment Southland.

Crops for Southland
PO Box 1306, Invercargill. New Zealand

www.cropssouthland.co.nz

Soil name: Te Anau

Overview

Te Anau soils occupy about 10,100 ha on rolling terrain in the Te Anau basin. They are formed on glacial moraines, derived from Fiordland rocks. These soils are formed in shallow to moderately deep mixed loess and gravel, overlying the compacted unweathered gravelly glacial till. They are well drained, with silt loam topsoil texture, strongly leached and have a high P-retention. They are suited to pastoral farming with sheep and deer and require a high fertiliser input to maintain pasture production. Winters are cold with summers occasionally seasonally dry in some years.

Soil classification

NZ Soil Classification (NZSC):	Firm Allophanic Brown; rounded-stony; dioritic; silty
Previous NZ Genetic Classification:	Very strongly leached yellow-brown loam

Classification explanation

The NZSC of Te Anau soils is consistent with the previous classification. Te Anau soils are formed in gravelly till that is compacted enough to form a barrier to root penetration. The soils are strongly leached, reflected in P-retention of >85% in the upper subsoil.

Soil phases and variants

Identified units in the Te Anau soils are:

- TeAnau undulating shallow (AuU3): has gravel within 45cm depth; occurs on slopes of 0–7º
- Te Anau undulating moderately deep (AuU2): gravel occurs between 45 and 90cm depth; occurs on slopes of 0–7º
- Te Anau rolling moderately deep (AuR2): gravel occurs between 45 and 90cm depth; occurs on slopes of 7–15º
- Te Anau rolling shallow (AuR3): has gravel within 45cm depth; occurs on slopes of 7–15º
- Te Anau hilly moderately deep (AuH2): gravels occur between 45 and 90cm depth; occurs on slopes of 15–25º
- Te Anau hilly shallow (AuH3): has gravel within 45cm depth; occurs on slopes of 15–25º
- Te Anau steep moderately deep (AuS2): gravels occur between 45 and 90cm depth; occurs on slopes of >25º
- Te Anau steep shallow (AuS3): has gravel within 45cm depth; occurs on slopes of >25º

The soil properties described in this Technical Data Sheet are based on the most common phase, Te Anau undulating shallow (AuU3). Values for other phases and variants can be taken as being similar. Where they differ significantly they are recorded with a separate versatility rating, e.g., Te Anau hilly moderately deep (AuH2).

Associated soils

Some soils that commonly occur in association with Te Anau soils are:

- Kakapo: shallow, poorly drained soils occurring in depressions on old moraine surfaces.
- Excelsior: moderately deep to deep well drained soils with a fragipan
- Otanomomo: A peat soil occurring on low-lying poorly drained depressions

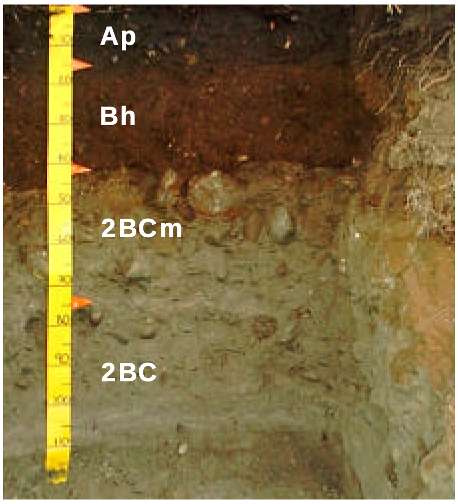
Similar soils

Some soils that have similar properties to Te Anau soils are:

- Monowai: formed on glacial outwash terraces

Typical profile features

The following is a 'generic' or composite profile description representing the most common combination of characteristics for this soil type. The actual profiles for which descriptions and data are available are listed at the end of this Technical Data Sheet.



Te Anau profile	Horizon	Depth (cm)	Description
	Ap	0–15	Dark brown slightly gravelly silt loam; weak soil strength; weakly developed very fine polyhedral structure; gravel slightly weathered and rounded; many roots
	Bh	15–41	Strong brown moderately gravelly silt loam; weak soil strength; moderately developed fine polyhedral structure; gravel slightly weathered and rounded; many roots
	2BCm	41–75	Olive very gravelly sandy loam; common dull brown organic/iron complex staining; very dense particle packing; massive structure; gravel slightly weathered and rounded; no roots
	2BC	75–110	Pale olive very gravelly loamy sand; firm soil strength; compact particle packing; massive structure; gravel slightly to moderately weathered; no roots

Key profile features

Te Anau soils have a dark coloured topsoil, rich in organic matter, that is 10–20 cm deep, with weakly developed structure. Subsoil structure is weakly to moderately developed, with strong brown colours reflecting the strong leaching and accumulation of organic-iron compounds. The underlying till occurs at 40–60cm and has olive colours reflecting the weak weathering.

Typical physical properties

Note: values in Italics are estimates

Horizon	Depth (cm)	Bulk density	Permeability	Texture	Gravel content
Ap	0–15	Moderate	*Moderate*	Silt loam	Slightly gravelly
Bh	15–41	Moderate	*Moderate*	Silt loam	Moderately gravelly
2BCm	41–75	–	*Slow*	Sandy loam	Very gravelly
2BC	75–110	–	*Slow*	Loamy sand	Very gravelly

Profile drainage: Moderately well
Plant readily available water: *Moderately high*
Potential rooting depth: Shallow
Rooting restriction: densely packed glacial till

Key physical properties

Te Anau soils have shallow rooting depth, due the glacial till, but have moderately high plant available water. The moderately deep phases are likely to have slightly deep rooting depth. Soils are moderately well drained, with good aeration in upper horizons, but drainage may be restricted during wet periods due to the slow water permeability through the glacial till. Textures are silt loams in the topsoil, with a clay content of less than 20%. The soil horizons above the glacial till are slightly to moderately gravelly, and boulders are common.

Typical chemical properties

Horizon	Depth (cm)	pH	P retention	CEC	BS	Ca	Mg	K	Na
Ap	0–15	Moderate	High	Moderate	Low	Moderat	Low	Very low	Very low
Bh	15–41	Moderate	Very high	Moderate	Low	Low	Very low	Very low	Very low
2BCm	41–75	Moderate	Moderate	Very low	Very low	Very low	Very low	Very low	Very low
2BC	75–110	Moderate	Moderate	Low	Very low	Very low	Very low	Very low	Very low

Additional chemical properties (as a profile average)
Reserve potassium levels low; sulphate sulphur levels moderate; phosphorus levels low

Key chemical properties

Topsoil organic matter levels are 12–16%; P-retention values above 80% in horizons above the till; pH values are moderate throughout the profile. Cation exchange values are moderate and decrease down the profile, with low base saturation figures. Available calcium, magnesium and potassium levels are low. Reserve potassium and phosphorus values are low. Subsoil sulphate levels are moderate. Micro-nutrient levels are generally adequate.

Vulnerability to environmental degradation

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	minimal	These soils have a minimal vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the good drainage, as well as high organic matter and P-retention in the topsoil.
Nutrient leaching	severe	These soils have a moderate vulnerability to leaching to groundwater. This rating reflects the good drainage and moderate water-holding capacity.
Topsoil erodibility by water	slight	Due to the high organic matter content, the topsoil erodibility of these soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	slight	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties, and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	slight	These soils have a slight vulnerability to waterlogging during wet periods. This rating reflects the good drainage, but slow permeability of the underlying till. The hilly phase is likely to have no vulnerability to waterlogging.

General landuse versatility ratings for Te Anau soils

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification.

Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

AuU3 (Te Anau undulating shallow)
AuU2 (Te Anau undulating moderately deep)

Versatility evaluation for soil AuU3, AuU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Shallow potential rooting depth
Arable	Limited	Shallow potential rooting depth
Intensive pasture	Limited	Shallow potential rooting depth
Forestry	Limited	Shallow potential rooting depth

AuR3 (Te Anau rolling moderately deep)
AuR2 (Te Anau rolling shallow)

Versatility evaluation for soil AuR3, AuR2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Shallow potential rooting depth
Arable	Limited	Shallow potential rooting depth and rolling slopes
Intensive pasture	Limited	Shallow potential rooting depth
Forestry	Limited	Shallow potential rooting depth

AuH2 (Te Anau hilly moderately deep)
AuH3 (Te Anau hilly shallow)
AuS2 (Te Anau steep moderately deep)
AuS3 (Te Anau steep shallow)

Versatility evaluation for soil AuH2, AuH3, AuS2, AuS3		
Landuse	**Versatility rating**	**Main limitation**
Non arable horticulture	Unsuitable	Hilly to steep slopes
Arable	Unsuitable	Hilly to steep slopes
Intensive pasture	Limited	Shallow potential rooting depth and hilly to steep slopes
Forestry	Limited	Shallow potential rooting depth

Management practices that may improve soil versatility

- Organic matter levels should be carefully maintained and enhanced
- Over-cultivation of dry soils in summer may allow wind erosion
- Irrigation for intensive pasture and crop production to overcome summer moisture deficiencies.
- Management of nutrient applications so as to minimise leaching losses

Soil profiles available for Te Anau soils

Soil symbol	Profile ID	Topoclimate map sheet	Profile description available	Physical data available	Chemical data available	Profile photo available
AuU3	SB9574	39	✓	✓	✓	
AuU3	AT2	39	✓	✓	✓	✓
AuU2	AT3	39	✓	✓	✓	✓
AuU2	SB7735	39	✓	✓	✓	✓
AuU2	SB9573	39	✓	✓	✓	✓
AuR2	AT5	39	✓	✓	✓	✓
AuR3	149/74/9	39	✓	✓		
AuH2	AT1	39	✓	✓	✓	✓
AuS3	AT8	39	✓	✓	✓	✓
AuS2	AT8a	39	✓	✓		

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Crops for Southland
PO Box 1306, Invercargill. New Zealand

www.cropssouthland.co.nz

MAKE THE SMART MOVE IN EFFLUENT SPREADING.

You'll enjoy the following benefits with a Larall Smart Hydrant...

- Easy to transport between paddocks
- Low labour required (333m^3 pumped per man hour)
- A month's effluent pumped over three days
- Depth per hour as low as 1.5mm (no ponding or runoff)
- Notifies farmer by text when the guns need shifting
- 16mm nozzles (normal irrigator nozzle size is 11mm)
- Combined area irrigated at one time is greater than 1ha
- No major solids separation (handles solids up to 10mm)

LARALL
SMART HYDRANT

AN EID COMPANY | EXCELLENCE IN DAIRYING

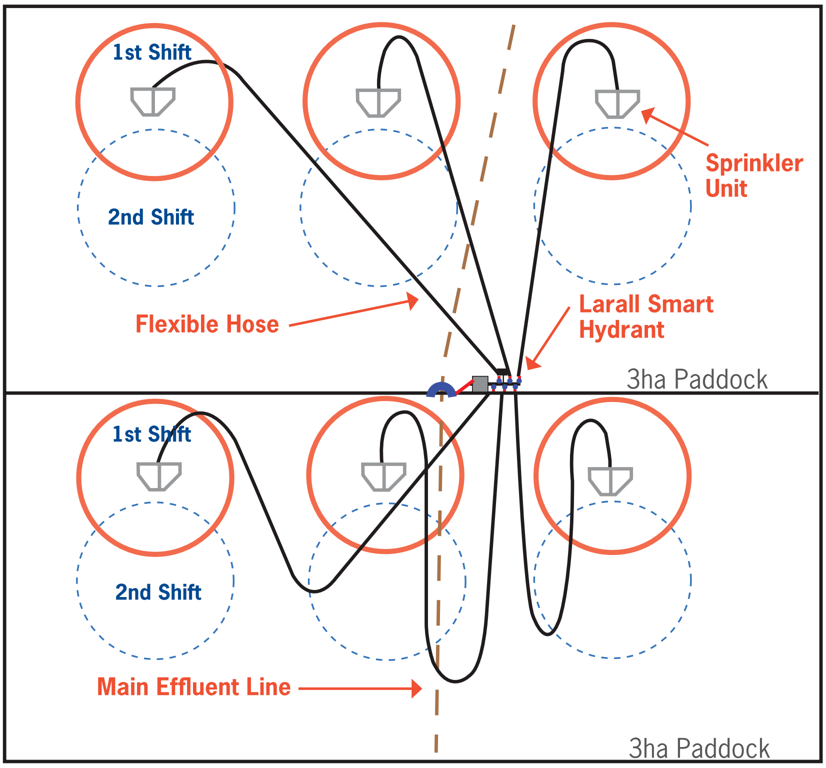
Visit **www.effluentandirrigation.co.nz** for more information.

The new Larall SMART HYDRANT EFFLUENT MANAGEMENT SYSTEM is exactly that...SMART!

Until now there have been irrigation systems that are great at some things but lack in other areas. The Larall Smart Hydrant Effluent System is a real breakthrough when it comes to irrigators as it has many features which are unique and will assist in making irrigation of dairy effluent easy to comply.

System layout and shifting pattern

A typical set up for two 3ha paddocks. They can be irrigated together with a total of six shifts to complete the 6ha.



For two 3ha paddocks, there would be six shifts per gun to complete the paddock.

The application depth is relevant to pumping time and would be based on soil moisture levels. For example, to apply to a depth of 10mm, the pumping time would be 7 hours between shifts. The application rate under each gun is 1.5mm with a 50 minute rest. This means the effluent can be absorbed by any soil type without run off or ponding.

The total pumping time to complete the paddocks would therefore be 42 hours. Pumping approximately 18m^3 per hour, this would equal 756m^3. Based on a herd size of 500 cows producing 35m^3 per day, you would have irrigated 21 days of effluent. In this situation the system is used once every three weeks. If the required application depth is higher, for example 15mm, then the pumping time between shifts would be 10 hrs. The total volume pumped would be 1080m^3 or 30 days worth of effluent.

Sick of effluent systems that are a hassle to move?

Don't be limited to where you can place the irrigation system on your farm. The Larall Smart Hydrant is portable and is not affected by topography. It's easy to transport from paddock to paddock and doesn't require a huge effort.

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LARALL
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Effluent Management System

"NO PONDING NO RUNOFF, NO WORRIES... Too good to be true?"

The Larall Smart Hydrant's ability to limit the amount of effluent applied per shift and to automatically tailor the amount of effluent applied to each paddock means that the amount pumped to each gun can be measured and controlled (you can determine the application depth by time).

The depth per hour can be as low as 1.5mm so there is no ponding or run off to deal with. The combined area that can be irrigated by the Larall Smart Hydrant at one time is greater than 1ha.

A six gun Smart Hydrant set up in paddock.

So how does the Larall Smart Hydrant actually work?

The effluent enters the LSH and it is pressure activated. Only one of the six valves is opened at one time. The LSH directs the effluent through the opened valve to an impact sprinkler for a set time.

One of the great things about the Larall Smart Hydrant is that it is extremely portable and easy to transport from paddock to paddock. In addition to this, the amount of effluent pumped to each gun can be set by time and this means you can determine the application depth per hour. The Larall Smart Hydrant is activated by pressure and has 16mm nozzles as opposed to normal irrigators which have 11mm nozzles. It comes standard as either a 4 or 6 gun unit and can be tailored for any situation.

The Larall Smart Hydrant gives you greater control and more effective management of your effluent. It allows you to limit the amount of effluent applied per shift as well as the ability to automatically tailor the amount of effluent applied to each paddock. No solids separation is required with the Larall Smart Hydrant. The combined area you can irrigate to at one time is greater than 1ha.

HOW IT WORKS

The effluent enters the LSH and it is pressure activated. Only one of the six valves is open at one time. The LSH directs the effluent through the opened valve to an impact sprinkler for a set duration. Once this set time has lapsed, the next valve opens as the open valve closes and continues sending effluent to the opened sprinkler.

For example, the amount of effluent that goes to each sprinkler could be based on 10mins of pumping. At a flow rate of 18m^3/hr each sprinkler would receive 3m^3 (3000L). Based on a 6 sprinkler unit, this would mean between 1.5mm and 2mm of effluent is applied over a 10 min period and would then not receive effluent for another 50 min. This rest time allows the effluent to be absorbed by the soil which limits ponding and run off and maximizes nutrient retention.

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Farm Effluent Operational Management Plan

Dairy Green Ltd

Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation
Irrigation NZ Accredited Designer

White Waters Ltd
Kakapo Road
Te Anau

Farm Effluent Operational Management Plan
2018/2019

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Email: scandrettrural@xtra.co.nz

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A. PROPERTY DETAILS

Entity Name: White Waters Ltd

Contact Person: Hans Vernooij 0212220533

Legal Description: **Freehold**: Section 2 SO 385807,

Resource Consents: Discharge Permit number to be advised

This document is designed to be a living document.

The plan should be updated at least yearly – at the end of the season is often the best.

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B. MAPS

Figure One Effluent Receiving Area:

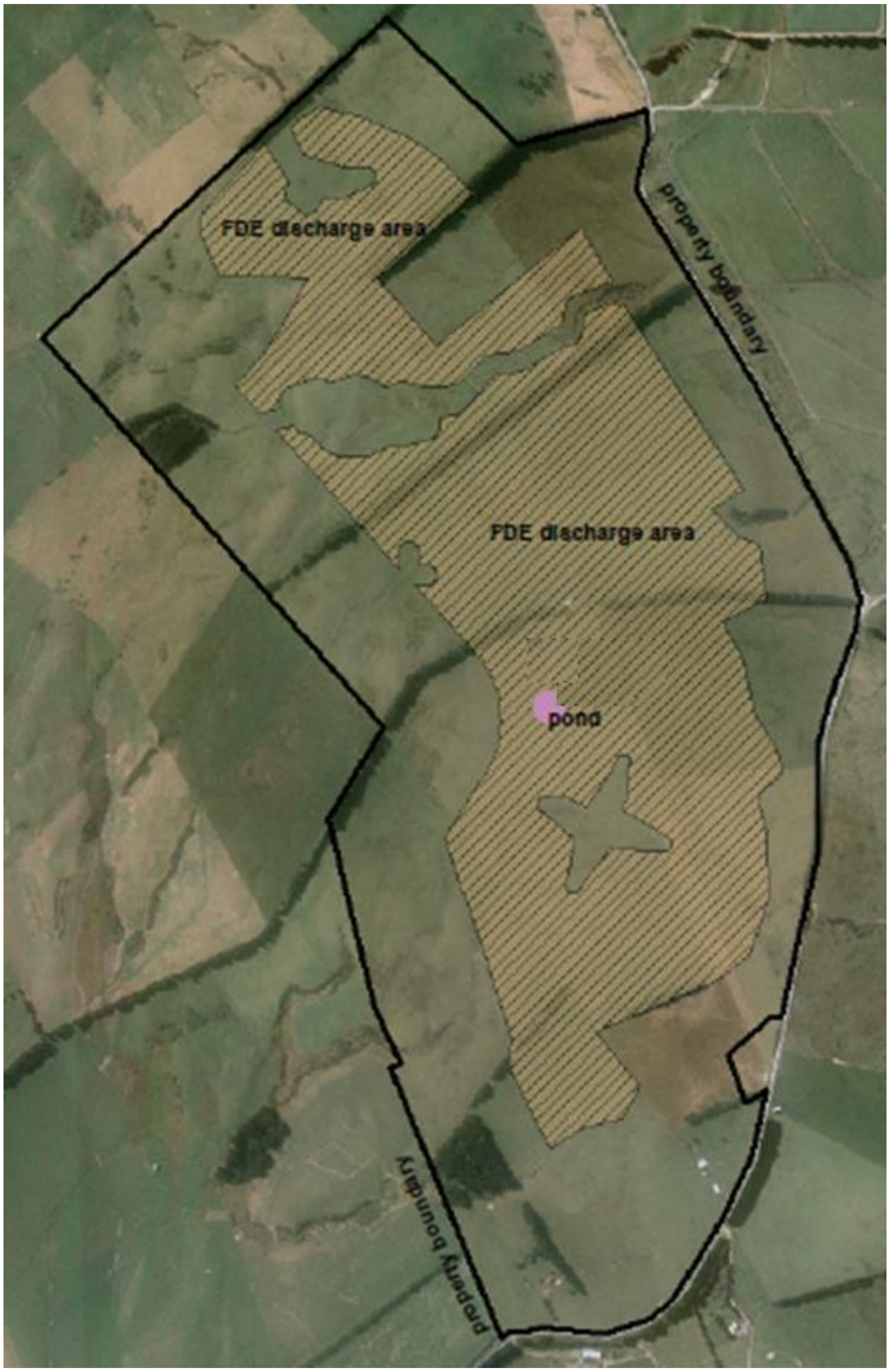

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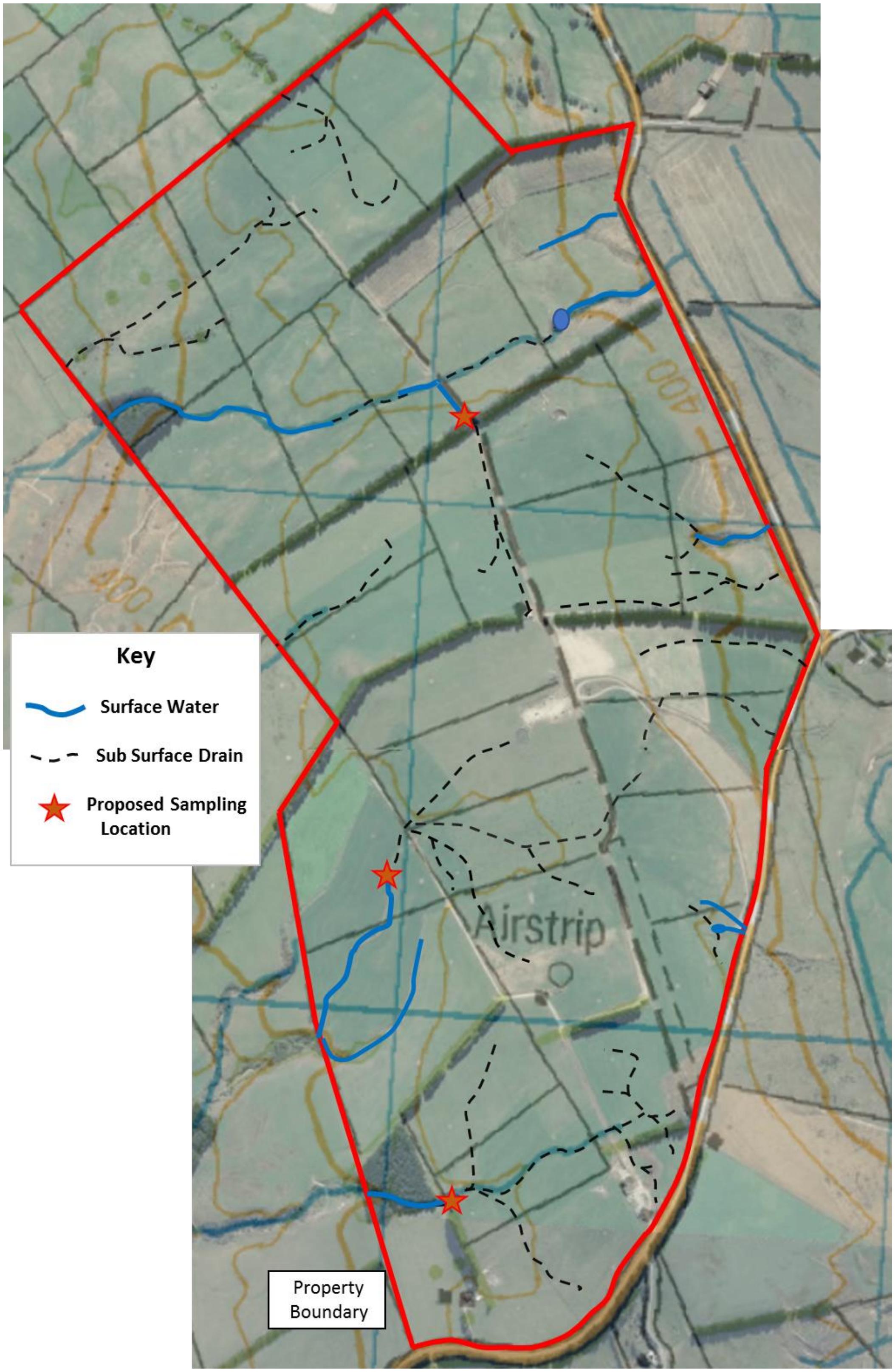
Figure 2 Surface and Subsurface Drainage



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C. COLLECTED AGRICULTURAL EFFLUENT

1. Overview of Effluent Collection, Storage and Irrigation System

- Effluent from the dairy shed and yard is collected in two pump sumps. A sand trap is used to reduce the sediment entering the pump sumps.
- Effluent is transferred to the buffer storage pond using an effluent pump and a connecting pipeline. The pumps are automated and are set to turn on at the half way level in the sump, a high level alarm is installed which sends a text message to the appropriate people.
- A Larall Smart Hydrant is utilised to irrigate effluent from the storage pond. A mainline and hydrants allow the system to be set at various locations within the discharge area.
- The irrigation pump is operated on a time switch to allow a total run time to be set and pulsing times to be set, the pump has a high and low pressure failsafe.
- A slurry tanker is used to apply effluent to flat to undulating areas within the discharge area. Care must be taken and use of the slurry tanker should be restricted to late spring – summer – early autumn.
- The slurry tanker provides a contingency in time of pump failure and a means of maintaining the sludge build up in the dairy shed sumps and main storage tank. The slurry tanker can be used to transfer effluent from the dairy shed sumps to the main storage pond.

2. Irrigation System

I. A low rate Larall irrigation system is utilised for the majority of effluent application, the design flow rate of the system is 18 m^3 per hour. 4 sprinklers are used to apply effluent, switching between sprinklers is triggered by the volume pumped.

II. A Joskin slurry tanker with 12 m^3 capacity is also used to apply effluent to the most suitable topography and soils. A neighboring contractor also has a slurry tanker available with 18 m^3 capacity.

3. Volumes

a: Sources

Animal waste effluent from dairy farming activities.

b: Amount

Dairy shed effluent from up to 599 cows at 40 L/cow per day is 24,000 litres per day.

This is stored in the effluent storage tank until soil moisture conditions allow application.

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c: Storage Volumes

The total volume of the Hynd Mega Pond on farm is 1,500 m³. A useable volume of 1,238 m³ + 0.3 m freeboard is allowed for.

Temporarily filling the pond up to 100 mm from the top could safely occur if the season was particularly wet and irrigation was limited. The effluent is stored whole and typically forms a crust on the top of the pond which reduces the risk of wave action overtopping the pond.

4. Application Rate and Depth

The application depth, uniformity and intensity are recommended to be checked annually in accordance with section 4: Land Application guideline "A Farmer's Guide to Managing Farm Dairy Effluent – A Good Practice Guide for Land Application Systems" (2013).

a: Depth of Application

The depth of application needs to be less than the soil moisture deficit. This should be checked prior to irrigation using the on farm soil moisture monitoring. The Environment Southland website can also be used.

The appropriate depth of application is controlled by the pumping time to each sprinkler per setting for the low rate system and the travel speed of the tractor operating the slurry tanker.

The low rate system will apply a maximum of 10 mm depth per application.

A maximum of 5 mm depth will be applied per pass using the slurry tanker.

The depth of application up to these maximums will be determined by the soil moisture deficit and analysing the effluent annually for N, P & K content.

<u>Example:</u>

The effluent is found to contain 300 mg/l potassium.

Applying 10 mm depth of effluent over 1 ha will apply 30 kg of potassium per hectare.
5 mm depth over 1 ha halves that rate to 15 kg/K/ha.

<u>Estimate</u>

Where the composition of the effluent is not known, use the following conservative figures as a guide.

1 mm of irrigated effluent depth equals

3 kg per hectare of N
3.5 kg per hectare of K
0.2 kg per hectare of P

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If 10 mm depth of effluent is irrigated over 1 ha, the nutrient application will be:

30.0 kg per hectare of N, 35 kg per hectare of K and 2.0 kg per hectare of P

It is advised that no more than half the annual potassium requirement be applied per application of effluent i.e. the annual requirement of potassium (often around 60 – 80 kg per hectare per annum) should be applied in two increments of not more than 30kg of effluent per hectare or as per the above 10mm depth of effluent per application.

b. Application Rate

The application rate of the Larall system is less than 10 mm/hour. Pulsed application further increases the time taken to apply the total depth per setting.

The slurry tanker has a high instantaneous application rate, minimising the depth applied per pass mitigates any effect of this. Assuming that the same travel speed is maintained the application rate/depth will only vary slightly.

5. Records

As each paddock is irrigated the placement location and date is recorded in a farm diary. These provide an annual record of when and where effluent has been applied. The Larall system provides a flow reading which can be recorded. Recording of the number of loads applied using the slurry tanker allows a record of volumes applied.

The following good management practice measures are consistently used:

- Effluent is deferred until there is a suitable soil moisture deficit & until 10cm soil temps are over 7ºC
- The application depths are minimized based on nutrient loadings
- A visual assessment of uniformity and intensity of effluent application is carried out daily to ensure the system is operating properly.
- Care is taken to monitor drainage to ensure there are no adverse effects from effluent application.
- Irrigation records can be used not only in any discussions with compliance authorities, but as data for use in nutrient/fertiliser application planning.

Maintenance Records

Information regarding the storage tank, irrigation pump, transfer pumps and pipelines, servicing and maintenance and slurry tanker maintenance is recorded in a farm diary as carried out.

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D. EFFLUENT IRRIGATION MANAGEMENT

1. Person In Charge

The person in charge of the effluent system is Hans Vernooij.

2. System Training

a: Training

All new staff will be trained in the operation of the system as and when employed. Details are to be recorded in the staff training log.

b: Resources – shed operations manual

I. Effluent system operational instruction sheets.
II. Irrigation map marked up with drainage outfalls, irrigation areas, critical source areas, buffers.
III. Copies of relevant Environment Southland consents

3. Effluent Minimisation

There are management practices and operational methodologies that can be used to minimise effluent voided These include:
.
- Scrapping the dairy shed yard daily to keep it clear of effluent and minimize wash water required
- Minimising the time spent by cows on the dairy shed yard
- Careful handling of cows to reduce stress and effluent volumes

4. Pumping

The transfer pumps on farm have a flow rate of 11,000 l per hour.
The irrigation pump on farm has a flow rate of 18,000 l per hour.

5. Discharge Area

The proposed FDE application area includes approx. 100 ha less the usual ES margins around bores, water courses, boundaries, dwellings, etc. **No effluent is to be applied outside the consented area.**

6. Paddock Selection

Paddocks are selected according to their moisture status and effluent and management history. A sequence of paddocks can be pre-planned for irrigation. Prior to irrigation occurring, a visual assessment of the soil will be made. Environment Southlands' website is accessed along with the on farm infrastructure for soil moisture monitoring and is used to guide effluent irrigation decisions in combination with the visual assessment. If paddocks are pugged or are likely to have very low infiltration rates, the irrigation depth will be reduced or the paddock rescheduled for irrigation after the soil conditions have improved.

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The critical factor is that paddocks should not be irrigated when, or where, irrigation will result in the moisture levels reaching field capacity. Field capacity is the point at which drainage starts either by passing down through the soil profile or flowing over the surface (overland flow).

Paddocks or part paddocks should be classified according to the risk of using the area based on the loss of nutrient to the environment and marked on a map.

a: Low Risk

These can be marked as green areas on the irrigation map. These can be used early season or when the ground is moist.

b: High Risk

Red areas on the irrigation map. These should only be used when the ground is dry in summer.

c: Tile (subsurface) Drains

No effluent is to be applied to areas where tile drains could be underlying when soil moisture levels are near field capacity or rainfall is forecast in the following 24 hours.

e. Wind

Consideration needs to be given when high winds are predicted, for example in the equinox seasons, to ensure that spray drift does not end up in unintended places such as within minimum distances from water ways or outside the farm boundary.

7. Coverage area

There shall not be any discharge of effluent onto land within;

- 20 metres of any surface watercourse
- 100 metres of any potable water abstraction point
- 20 metres of any property boundary, (unless the adjoining landowner's consent is obtained to do otherwise)
- 200 metres of any residential dwelling other than residential dwellings on the property
- Effluent shall not be discharged onto any land area that has been grazed within the previous 5-10 days.
- Effluent shall not be discharged to high risk areas when soil is at or near field capacity.

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8. Off Season Water Diversion

The dairy shed yard has a rainwater diversion installed to prevent the collection of rainwater during the off season.

The yard and catchment areas must be cleaned of any effluent prior to the diversion being used.
Signage will be installed at the dairy shed on the vacuum pump switch notifying when the diversion is in place, this will notify the milk harvester before any effluent is generated.

9. Monitoring, Maintenance and Operating Procedures

Daily

I. Evaluate the soil moisture situation and calculate the optimum irrigation time or travel speed for the next application;

II. Update the effluent irrigation diary records with location, date and any other relevant comments;

III. Check the operation of the dairy shed sump pumps prior to and following milking.

Weekly

a: Storage Facilities

Check facilities for any damage or operational faults.

b: Irrigation

Low Rate

Maintain the irrigation pump and infrastructure to ensure efficient operation

Slurry Tanker

Maintain the key operating parts. Grease where required. Check the nozzle and splash plate are not damaged or misaligned.

c: Safety

I. Guards and fittings;
II. Signage;
III. Equipment including PPE such as gloves

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Annual Maintenance

I. Check pumps and motors and have them serviced by a qualified technician if required;

II. Update irrigation maps for new fences, tiling etc.;

III. Training of new staff in system operation;

IV. Refresher and training of all staff on the location, purpose and use of safety equipment and fittings.

Beginning of Season

Check all effluent systems are operating, identify any issues and repair as necessary.

Breakdowns

Repair as required, organize a contractor where applicable.

Reduce effluent production.

General

I. No effluent application is to occur outside the consented area of the property;

II. There shall be no ponding of effluent in the discharge area;

III. Make full use of the discharge area and identify the most suitable areas used;

IV. There shall be no discharge of effluent to frozen or snow covered ground;

V. The discharge will be managed to ensure aerosols, spray drift and odour do not travel past the property boundary;

VI. The general state of the property is to be monitored, particularly areas where environmental contamination with effluent could be a problem. This includes races, gate ways and critical source areas.

VII. Preventative action should be taken before problems arise.

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E. EMERGENCY RESPONSES

1. Storage Overflow

Where the storage is approaching full and rain events plus continued use could risk overflow, it is recommended that the effluent production ceases. Identify the most suitable low risk soil area if some effluent application has to occur.

2. General Procedures

I. Follow consent conditions/notes.
II. Advise Regional Council where the consent requires this.
III. Seek help.
IV. Advise authorities.

3. Emergency Contacts

Hans Vernooij	0212220533	
Farm Manager		
Environment Southland	0800 768 845	
Dairy Green Ltd	0800 AGENGINEER	

F. REVIEW

Review effluent operational management plan and update by 1 June each year – and complete the version control below.

Ver	Date	Author/Reviewer	Distribution List
1.0	23 July 18	Q Scandrett – Dairy Green Ltd	
2.0			
3.0			
4.0			
5.0			

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