

Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

Irrigation NZ Accredited Designer

Woldwide One Limited and Woldwide Two Limited

(WW1&2)

Farm Environmental Management Plan – Appendix N

Version 1.4

1 June 2019 – 31 May 2020

A **Phosphorus Mitigation Plan** prepared by Mr. Cain Duncan (CNMA), Tiaki, Farm Source Sustainable Dairying, forms part of this FEMP. The plan provides specific details regarding on-farm features, mitigation actions and target implementation dates.

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1 Property details

Name	Woldwide One Limited and Woldwide Two Limited (WW1&2)
Physical address	Hundred Line Road East, Heddon Bush, Southland
Description of landholding ownership	The landholding is owned by Woldwide One Limited, Woldwide Two Limited, Dykes (leased) and Woldwide Farm Limited (leased). Woldwide Farm Limited owns the Horner Block.
Landholding owner's details	A and JJ de Wolde 104 Shaws Trees Road, Heddon Bush, RD3 Winton, 9783
Contact Person:	WW1 unit - Jacques Jooste - 027-4554550 WW2 unit- Hamish (Dusty) Wright: 021-440006
Legal Descriptions (WW1&2):	Part Lot 18 DP 942 Section 420 Taringatura SD Part Lot 1 DP 4092 Part Lot 18 DP 942 Part Lot 2 DP 4092 Part Lot 1 DP 4092 Part Section 417 Taringatura SD Section 418 Taringatura SD Section 419 Taringatura SD Lot 1 DP 9925 Lot 1 DP 14660 Lot 1 DP 14661 Lot 1 DP 451158 Lot 1 DP 13077 Lot 1 DP 5610 Lot 3 DP 5610 Lot 1 DP 10885
Horner Block*	Lot 4 DP399915
Land Areas:	Milking platform – 502 hectares (479 ha effective) Horner block 97 ha – slurry discharge only
Resource Consents:	Discharge consent 301663 – expiry 9/11/27 Water permit 301664 – expiry 9/11/27 Discharge consent 300626-V2 – expiry 2/12/21 Water permit 300627-V1 – expiry 2/12/21

WW2 also holds a discharge consent (20171278-01), water permit (20171278-02) and land use consent for expanded dairy farming (20171278-03). All expire on 18/11/27

Note: the consent holder in future consents will be "Woldwide One Limited and Woldwide Two Limited."

*The Horner Block is a nearby cut and carry block, where slurry from the dairy platform is applied at very low depth. It is included in this FEMP for completion, although no stock is grazed there.

This document is designed to be a living document and should be updated at least yearly.

2 Maps

2.1 Accompanying notes to maps

- WW1&2 dairy platform lies north of Hundred Line Road East Road and north and south of Wreys Bush Highway.
- Stock access to land north of Wreys Bush Highway is via an underpass.
- The Horner Block, which is a cut and carry block receives slurry effluent from the dairy platform, lies to the south west of the platform.
- Topography is very flat and soils are well developed. There are minimal critical source areas. CSAs are identified, described and evaluated in the appended Phosphorous Mitigation Plan.
- Waterways are best described as surface drains, are fully fenced and flow in a north to south/south east direction.
- All crossings are culverted; stock do not have access to surface waterways. Locations where lanes cross drains are managed as critical source areas to minimise runoff from tracks and lanes into surface waterways. Further description is provided in the appended Phosphorous Mitigation Plan.
- The location, position and outfall of subsurface drainage is indicated in respective maps. The relative depth of subsurface drainage is drainage is c.800 mm. Subsurface drainage occurs in areas where Braxton soils are found. Drummond/Glenelg soils are free draining and do not have subsurface drainage installed.
- Major infrastructure includes two dairy sheds & yards, two wintering barns, two slurry effluent storage ponds, two silage pads and a stock underpass.

2.2 WW1&2 boundary

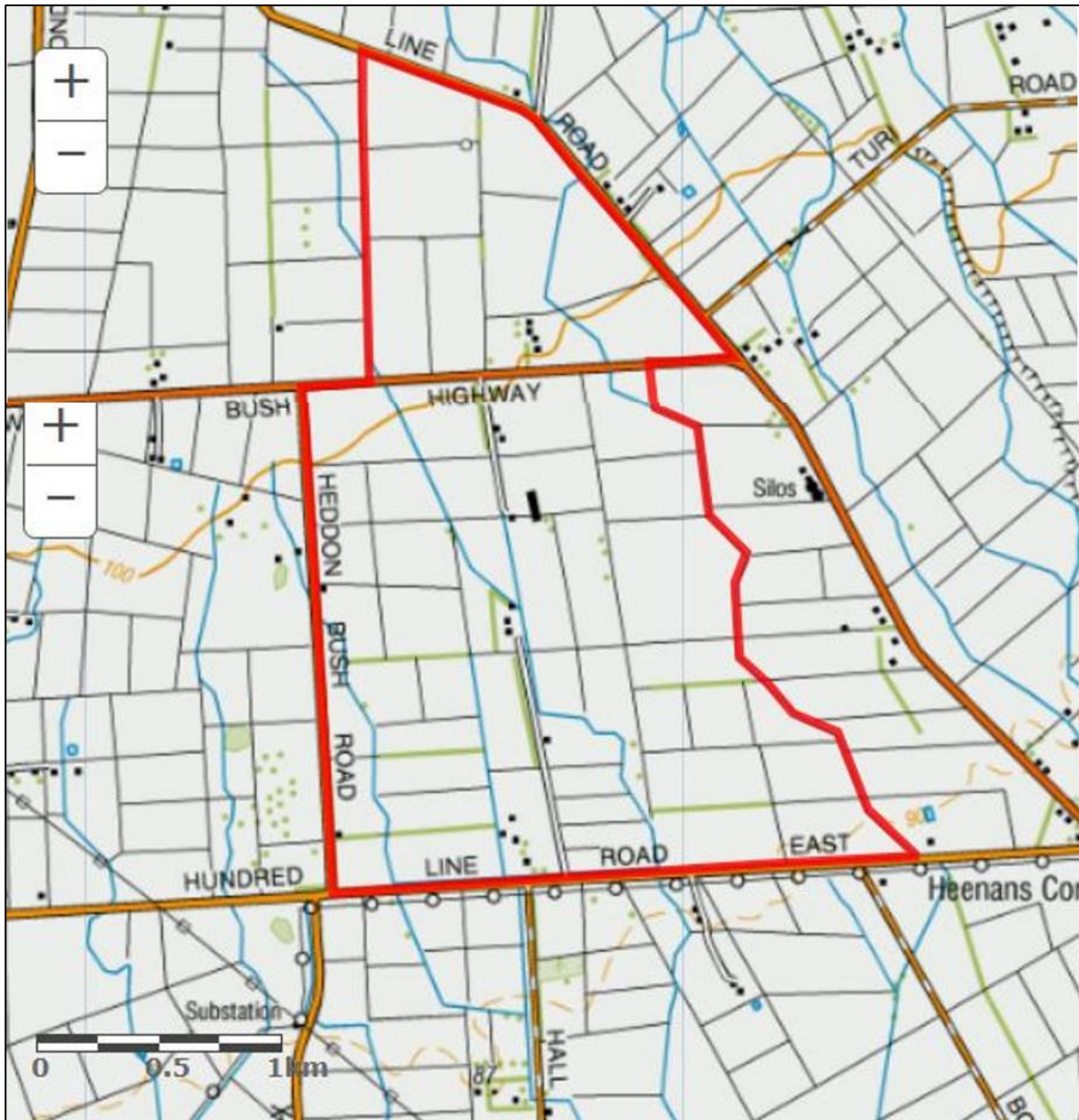


Figure 1a. WW1&2 boundary



Figure 1b. Horner Block boundary

2.3 Waterways, Stock Crossings



Figure 2. Waterways and crossings (Source: Tiaki – Phosphorous Mitigation Plan)

2.4 Critical source areas (CSAs)

For location and descriptions, please the appended Tiaki Phosphorous Mitigation Plan.

2.5 Physiographic Zones

WW1&2 and the Horner Block overlie Oxidising and Central Plains Physiographic Zones.






Figure 3. WW1&2 - PZs



Figure 4. Horner Block - PZs

Physiographic Zones

- | | |
|---|---|
|  Alpine - No Variant |  Lignite - Marine Terraces - Overland Flow |
|  Bedrock/Hill Country - Artificial Drainage |  Old Mataura - No Variant |
|  Bedrock/Hill Country - No Variant |  Oxidising - Artificial Drainage |
|  Bedrock/Hill Country - Overland Flow |  Oxidising - No Variant |
|  Central Plains - No Variant |  Oxidising - Overland Flow |
|  Gleyed - No Variant |  Peat Wetlands - No Variant |
|  Gleyed - Overland Flow |  Riverine - No Variant |
|  Lignite - Marine Terraces - Artificial Drainage |  Riverine - Overland Flow |
|  Lignite - Marine Terraces - No Variant |  Urban Area |

2.6 Tile drains

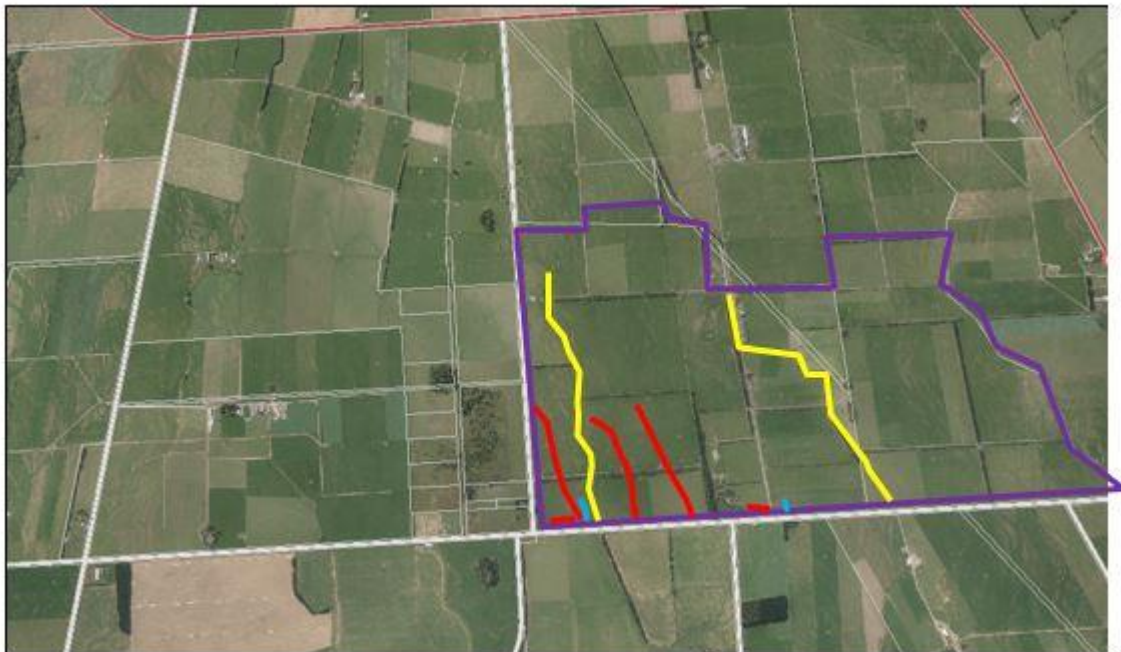


Figure 5. Tile drain locations at WW1 unit (annotated with red lines)



Figure 6. Tile drain locations at WW2 unit (annotated with red lines)

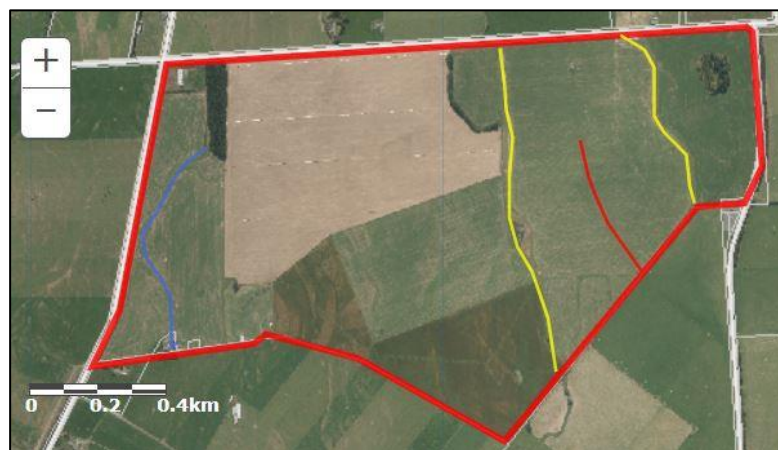


Figure 7. Tile drains at Horner Block (annotated with red line)

2.7 Riparian Vegetation and Fencing

Streams and drains flow in a north to south/south east direction. All streams and drains are fenced off to ensure cows cannot enter the waterways.

2.8 Heritage

There are no known or recorded heritage sites.

2.9 Significant Indigenous Biodiversity

There are no known or recorded sites of significant indigenous biodiversity.

2.10 Soils

The soil types and areas shown on Topoclimate appear to be incorrect, John Scandrett (Scandrett Rural Limited) carried out a field investigation and has mapped the soil as shown in Figure 8.

The soils for the Horner block have been obtained from the Topoclimate layer in Environment Southland's Beacon mapping service. The Horner block has Braxton/Pukemutu, Drmmond/Glenelg and Waiau soils as shown in Figure 9.

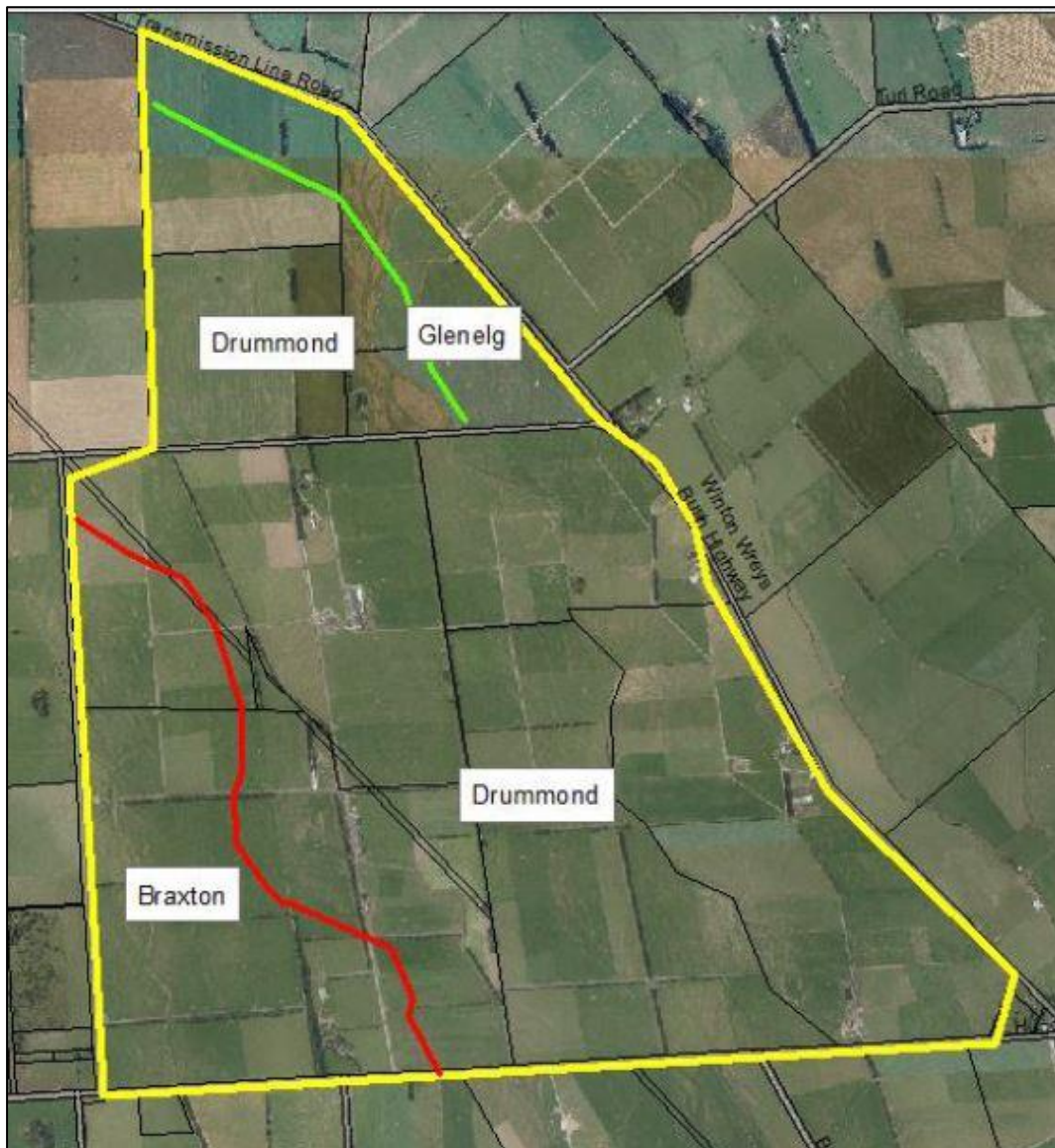


Figure 8. Soil types and boundaries at the WW1&2 according to field investigation by J. Scandrett, January 2017. Map sourced from Environment Southland.

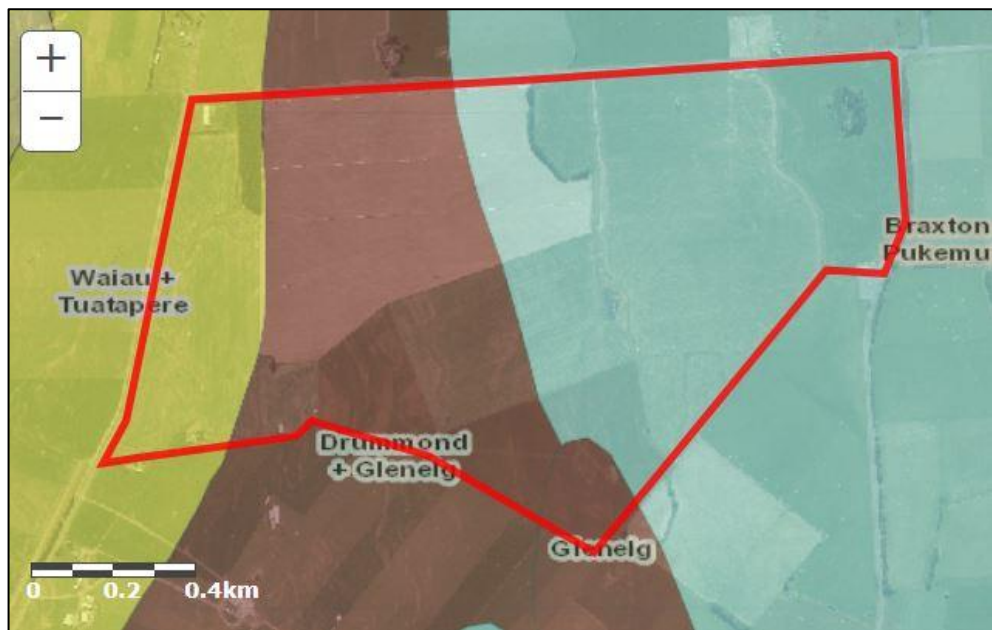


Figure 9. Soil types at the Horner Block

The vulnerability of the soils on the property are shown in Table 1.

Table 1: Vulnerability of soils at WW1&2 and Horner Block

Soil type	Compaction	Nutrient Leaching	Erodibility	Organic Matter Loss	Waterlogging
Braxton	Moderate	Slight	Slight	Slight	Severe
Drummond	Minimal	Moderate	Minimal	Slight	Slight
Glenelg	Slight	Very severe	Minimal	Moderate	Nil
Waiau	Moderate	Very severe	Slight	Moderate	Nil

3 Nutrient Management

3.1 Soils and Properties

The dominant soil types are Braxton (found on the west of the dairy platform and at the Horner Block) and Drummond types (mid to east on the dairy platform and at the Horner Block). Drummond soils may have intergrades to Glenelg soils in places. Glenelg soils are found at the north east of the dairy platform.

Drummond Soils

Drummond soils have deep potential rooting depth, with no major rooting restriction. The soils are well drained, have good aeration, and high plant available water. Textures are generally silty clay to heavy silt loam, with topsoil clay content of 35– 40%. The moderately deep phase will have gravels below 45cm depth, resulting in less rooting depth and available water.

Topsoil organic matter levels are 8–11%; P-retention values 40–70%; pH values usually above 5.7 in all horizons; cation exchange values and base saturation medium to high. Natural levels of phosphorus, potassium and magnesium are moderate, with responses to P and K occurring in intensive farming operations. Micro nutrient levels are generally adequate.

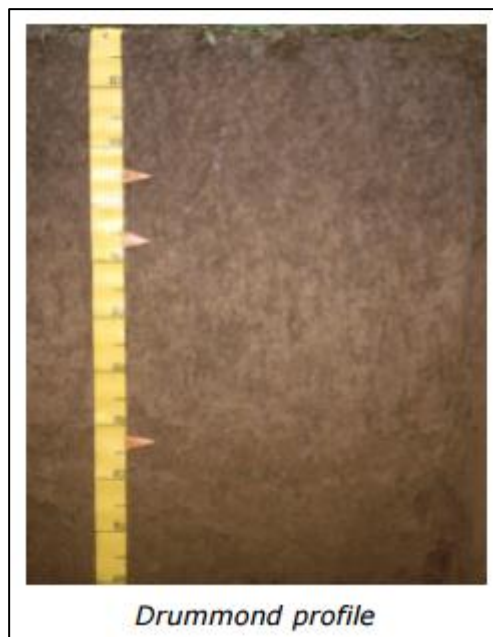


Figure 10. Drummond soil profile.

Braxton Soils

Braxton soils have a deep rooting depth and high available soil water, although the rooting depth may be limited by poor aeration during wet periods due to the poor drainage and slow subsoil permeability. Mottles occur in all horizons – another indication of poor drainage. Texture varies between heavy silt loam

and silty clay in the subsoil, and silt loam topsoil clay content is 22–30%. The soils are typically stone-free, although the moderately deep phase will have gravel between 45 and 90cm depth.

Topsoil organic matter levels range from 7 to 10%; P-retentions 30–60%, with moderate pH values (5.5–6.2) that change little down the profile. Cation exchange values are moderate and base saturation values high. Available magnesium and potassium are low. Reserve phosphorus values are low. Micro-nutrient levels are generally adequate, although boron responses in brassicas and molybdenum responses in legumes are likely.

Braxton soils have swell/crack properties. They can become waterlogged in wet conditions so tend to have subsurface drainage installed. They can crack during dry summer conditions. Deep cracks can provide a pathway for contaminants to reach groundwater via bypass drainage to the underlying aquifer.



Figure 11. Braxton soil profile.

Glenelg Soils

Rooting depth in Glenelg soils is restricted to varying degrees, depending on the gravel content and depth to the cemented pan in the subsoil. Plant available water varies from moderate to low depending on the quantity of gravel present. Textures are loamy silts and silt loams grading to sandy loams and sand. Topsoil clay content is 15–25%. Gravel occurs throughout the profile, with gravel content often above 70% in the subsoil.

Topsoil organic matter levels are 10–16%; P-retention values 50–75% and pH values moderate. Cation exchange values are high in the topsoil but decrease down the profile with base saturation values low. Available calcium, magnesium and potassium are low, as is reserve phosphorus and sulphur. Micro-nutrient levels are generally adequate.



Figure 12. Glenelg soil profile.

Waiau Soils

Waiau soils have a moderate to slightly deep rooting depth, depending on the gravelness of the subsoil. Plant available water will vary from moderate to low depending on the amount of gravel present. The soils are well drained (sometimes excessively) and aerated. Textures are usually silt loams to sandy loams in the topsoil, grading to sand in deeper horizons, with topsoil clay content of 20–28%. Topsoils often are slightly too moderately gravelly, and moderately to extremely gravelly below.

Topsoil organic matter content is 8–13%, P-retention 40–70% and pH moderate (high 5s). Cation exchange levels are moderate, but low in the subsoil, with base saturation levels similar. Reserve calcium levels are high, magnesium levels moderate and potassium levels low. Soil reserve phosphate and sulphur levels are low. Micronutrient levels are generally adequate.



Figure 13. Waiau soil profile.

Plant Available Water (PAW)

The PAW in the top 30 cm of the soil profile values for the soils have been obtained from the Landcare SMap database and are provided in Table 2.

Table 2: PAW values

Soil Type	PAW ₃₀
Braxton	92 mm
Drummond	146 mm
Glenelg	53 mm
Waiau	50 mm

3.2 Environmental Management Actions

To mitigate the potential loss of nutrients the following actions will be implemented:

- i. Soil and herbage testing to monitor soil chemistry and inform on decisions regarding fertiliser and lime application to maintain optimum soil fertility levels. Testing should be annual until an understanding and trends have been established;
- ii. Fertiliser and lime management plan prepared annually with guidance from Overseer output reports;
- iii. Exclude stock from streams;
- iv. Monitor soils for the formation of cracks, particularly deep cracks that can form in Braxton soil types in dry summer conditions. If and where deep cracks form avoid grazing stock and discharging effluent to the area;
- v. Tracks and lanes sited away from streams where possible. Lanes constructed and maintained to divert run off away from potential waterway ingress. Water tables will be designed to shed water to pasture for riparian treatment;
- vi. Effluent application depth is managed for optimum use of nutrients;
- vii. Stock will be managed in a placid manner to reduce the collection of effluent at the dairy shed; and
- viii. Winter cows off paddocks in barns. Use barns in the shoulders of the season to avoid soil compaction/runoff and optimise nutrient management.

3.3 Fertiliser Application Best Management Practices

The following practices will be implemented:

- i. The spreaders used to apply fertiliser are 'Spread Mark' accredited and have Tracmap or a similar recording system to show proof of placement;
- ii. Buffer distances are maintained such that there is no direct contamination of waterways from the application of fertiliser;
- iii. A minimum 10 m buffer between fertiliser placement and waterways is maintained when there is no riparian strip with a minimum 5- metre setback at all times;
- iv. Fertiliser is not applied to saturated soils;
- v. Nitrogen-containing fertilisers are only applied to actively growing pastures;
- vi. Fertiliser is not applied from 1 June to 31 July, and only in the months of May and August when soil temperature and moisture conditions are suitable;
- vii. Fertiliser is not applied when or where air drift can occur beyond the farm boundaries;
- viii. The need for large fertiliser dressings will be achieved through split dressings rather than a single application; and
- ix. Observe 'The Code of Practice for Nutrient Management (With Emphasis of Fertiliser Use)' Fertiliser Association, 2013, ISBN 978-0-47328345-2'.

Note: The application of fertilisers is deemed a permitted activity by Environment Southland provided:

- Application must not occur within 30 m of a neighbouring residential unit without approval. Spray drift must also be minimised.

- There must be no direct discharge to water and no discharge when soil moisture exceeds field capacity. For permanently flowing waterbodies (including artificial drains), fertiliser in riparian plantings where stock is excluded can only be applied to establish the planting. If there is no riparian planting, a setback of 10 m is required.

3.4 Effluent Application Best Management Practices

To mitigate the potential effects of the discharge of effluent to land the following practices will be implemented:

- i. Effluent nutrient concentrations have been tested and apply the depth that corresponds with the nutrient content of the effluent. This accounts for the higher strength nature of pond slurry compared to dairy shed effluent;
- ii. The soil test values for the paddocks receiving effluent will be considered and the depth of application adjusted to suit;
- iii. Defer irrigation where soil and climatic conditions are unsuitable for irrigation;
- iv. At all times the management of the effluent system will comply with the discharge consent conditions, including annual N loadings per hectare at the dairy platform and the Horner Block;
- v. Low depth application effluent irrigation systems and deferred storage are utilised. Very low depth application of pond slurry (1.7 mm per application) is achieved by applying slurry with the slurry tanker with the trailing shoe, at a rate of 17.2 m³/hectare;
- vi. Apply slurry at a maximum depth of 2.5 mm per application by applying 25 m³ per hectare;
- vii. Do not apply effluent to areas prone to cracking in dry summer periods. Braxton soils, with swell crack characteristics, are found on the western part of WW1&2 and at the east of the Horner Block. Monitor Braxton areas for signs of cracking and avoid if and where there is evidence of cracks;
- viii. Buffer distances in the discharge consent will be followed;
- ix. 7 -10 days post grazing before liquid effluent application;
- x. Application of sludge solids – less than 10 mm depth to suitable ground, with consideration of climate conditions;
- xi. Apply maintenance rates of nutrient to a large area rather than load up a smaller area with all the effluent/nutrient;
- xii. Do not use the slurry tanker when there is risk of soil compaction due to its weight; instead employ the service of an umbilical system contractor;
- xiii. Carry out maintenance on effluent management systems regularly; and
- xiv. Implement, review and update an effluent management plan.

3.5 Potential Nutrient Loss Effects of Dairying

Nutrient budgets were prepared in OverseerFM Version 6.3.1 by Mr. Cain Duncan, Tiaki Fonterra, Certified Nutrient Advisor, in accordance with the latest version of the OVERSEERFM Guidance/Best Practice Data Input Standards.

Four nutrient budgets were prepared to reflect actual lawful use of land over 4 prior years at WW1&2. One nutrient budget has been prepared for the proposed farming system should consent be granted.

A nutrient budget analysis report has been prepared by Mr. Duncan and is available for review. Please refer to the report for an analysis of nutrient losses, including inputs and outputs. Nutrient budgets are available in Overseer FM for review.

A summary of the nutrient loss from Overseer calculations is provided in Table 3.

Table 3: Nutrient loss summary for WW1&2

Indices	WW1&2 – pre-expansion average over 4 years	WW1&2 - proposed	% change
N loss to water (kg/ha/y)	41	38	-7.3
N loss to water (kg/y)	20,427	18,938	
P loss (kg/ha/y)	0.7	0.7	-2.2 (-6.1)
P loss (kg/y)	360	352 (338)*	
Pasture production (kg DM/ha/y)	15,109	15,513	

*Additional P reductions calculated outside of Overseer (See Phosphorus Mitigation Plan)

3.6 Key mitigation measures

Should consent be granted, the proposed farming system will be implemented, which is expected to achieve a reduction in N and P loss on average compared to prior land use at the landholding.

Key drivers for the 7.3% reduction in nitrogen loss are:

- Removal of winter and summer crop
- Removal of cows & young stock wintered outside on crop or grass
- Expansion of the size and use of the wintering barn facilities
- More efficient use of nitrogen fertiliser

Key drivers for the 2.2% reduction in phosphorus loss are:

- Decrease in winter crop area
- Maintaining Olsen P at a target level of 30
- Expansion in the size and use of the wintering barn facilities (less wintering)

Additional P mitigation is proposed, which has calculated outside Overseer. This increases the level of P mitigation up to 6.1%. Please see WW1&2's Phosphorous Mitigation Plan for details of measures.

3.7 The Effect of Effluent Application

Effluent will be applied to the best suited soil types and topography based on time of the year, e.g. soil moisture conditions, climate conditions and pasture growth.

Account for the higher strength nature of slurry effluent when applying slurry, applying no more than 25 m³/ha as a control to approximately 400 hectares available at WW1&2 and Horner Block.

3.8 Deep drainage of nitrogen – cracking and fissures

To reduce the occurrence of deep drainage of nitrogen and microbes, the formation of deep cracks and fissures will be prevented as much as possible. This will be achieved by:

- Maintaining a high level of pasture cover;
- Discharging effluent little and often to prevent soil from drying out and cracking.

Before each effluent application or stock grazing event, a visual assessment will be carried out to check for any cracks in the soil. If cracks do occur, the areas with cracking will be avoided and/or the activity will be moved to another part of the property where there are no cracks.

If there are substantial cracks and no areas suitable to discharge effluent, then effluent will be stored until the soil moisture level improves and cracking disappears. Given the cracks are likely to occur after prolonged dry periods in the summer, the effluent storage facility is likely to provide adequate storage volume for these events.

4 Good Management Practices

4.1 Land

Key strategies to achieve this objective:

- i. Fence off all waterways;
- ii. Maintain riparian vegetation;
- iii. Always maintain good pasture coverage. Plant roots help to prevent soils from cracking during dry summer periods and help to avoid the formation of deep cracks;
- iv. Soil test regularly and operate a fertiliser management plan;
- v. Exclude stock from high risk critical collection source areas and swales when the soil is near or at field capacity. Where necessary, increase setbacks and fence off CSAs;
- vi. Carry out maintenance on crossings and culverts to ensure runoff to waterways in minimised and there are no blockages;
- vii. Ensure adequate buffer zones from waterways during tillage;
- viii. Maintain sustainable stocking rate; and
- ix. Stock management to avoid excessive pugging over high-risk months, e.g. winter cows in barn, use barns in the shoulders of the season.

4.2 Effluent and Nutrients

Key strategies to achieve this objective:

- i. Prepare, implement and monitor a Nutrient Management Budget to maximise the returns and minimise losses from the resource, particularly N, P and K;
- ii. Controlled, judicious and justifiable use of fertiliser and other imported nutrients including nutrients in supplementary feed;
- iii. Implement an effluent management plan;
- iv. Subject to soil moisture and weather conditions, irrigate effluent at every practical opportunity to keep storage ponds as empty as possible;
- v. Ensure that all appropriate staff are trained and competent in the effluent system operation, and are aware of the need to continuously monitor the effluent management system, the farm's drainage networks and the potential for Braxton soil types to develop cracks;
- vi. Record each application of dairy effluent, including the location of travelling irrigators and the depth applied;
- vii. Record each application of slurry effluent, including paddock number and quantity (and depth) applied. Apply a standard depth if possible;
- viii. Ensure by regular and programmed checks that the supporting effluent infrastructure is in good condition, is inspected regularly and maintained under a preventative maintenance schedule;
- ix. Ensure by regular inspection (that coincides with effluent application) that the farm's drains do not contain any obvious signs of dairy effluent contamination; and
- x. Remain alert to new and emerging technologies that can be incorporated into the system to reduce risk, improve environmental and farm outcomes, whilst reducing input efforts and costs.

4.3 Physiographic Zones and Transport Pathways

Physiographic zones are shown on a map in figures 3 and 4. These zones have the potential for N and P to leach to waterways and groundwater through artificial drainage, deep drainage and overland flow (to a lesser extent) as shown in Table 4. Good Management Practices for these transport pathways are listed in section 4.6.

Table 4: Physiographic zones and transport pathways

Physiographic Zone	Variant	Key Transport Pathway
Central Plains	N/A	Artificial drainage, deep drainage
Oxidising	N/A	Deep drainage, overland flow

Note: Due to the flat topography, overland flow is not deemed to be a particular risk for soils except close to waterways and around CSAs following periods of prolonged, heavy rain.

4.4 Review

General good management practices and those specific to the transport pathways to be implemented in the current year are contained in the tables in sections 4.5 and 4.6. These good management practices will be reviewed annually as part of the overall review of the Farm Environmental Management Plan.

4.5 General Good Management Practices

A policy of general good management practice has been implemented since 3 June 2016. Most of the practices are described in the table 5 below have been implemented since 3 June 2016.

However, some practices described in table 5 have not been fully implemented since 3 June 2016:

- *Not all cows have been wintered off paddocks in barns since 3 June 2016;
- *IWG on fodder crop has occurred since 3 June 2016;
- *Young stock has been grazing on farm since 3 June 2016, including IWG.
- * Some individual features (e.g. lanes, CSAs) and locations have been identified in the Tiaki Phosphorous Mitigation Plan as requiring mitigation. Please refer to the plan for details, including target implementation dates.

A policy of good management practice will be undertaken on farm over the coming 12-month period (see table 5). All policies will be reviewed in June 2020

Table 5. General good management practices (1 June 2019 – 31 May 2020).

Strategy	Summary of Management Practices
Type	
Capital	Fence and enhance riparian areas;
	Upgrade FDE handling equipment as new technology improves the utility and reduces risks of these systems.

Strategy Type	Summary of Management Practices
Operational	Utilising a nutrient management plan;
	Soil testing is carried out each year; soil Olsen P levels are maintained at a biological optimum and no higher;
	Surface waterways are fully fenced and with good grass cover, fencing is maintained and stock are excluded from the riparian areas;
	*Wide riparian buffers are maintained;
	All surface waterways are culverted;
	Sufficient land area is available for the dairy operation;
	*Young stock is grazed off farm from weaning;
	*Cows are wintered off paddocks in wintering barns;
	*No intensive wintering grazing of cows on fodder crops;
	Ongoing implementation of good soil management practices;
	Nutrients from wintering of cows are stored and returned to pastures at the dairy platform and the Horner block, where they are used to promote grass growth when plants are actively growing and taking up nutrients;
	Tracks and lanes are predominantly sited away from waterways;
	Use specialist machinery when harvesting grass at the Horner Block to avoid soil compaction;
	*Lane runoff diverted to land with remedial work at lane/culvert/bridge crossings carried out as required;
	Good management practice of silage pads is implemented;
	Restricted grazing of draining pastures in autumn/spring;
	Wintering barns are used as stand-off pads during severe adverse weather events;
	Care in irrigation of FDE, especially when the ground is near or at field capacity;
	A large land application area is available to ensure N & K returns are not excessive;
	Effluent volumes are minimized at source through efficient water use;
	Appropriate FDE storage volume to allow for deferred irrigation for effluent;
	All data and maps are kept up to date and all staff are trained and informed of any changes;

Strategy	Summary of Management Practices
Type	
	Programmed maintenance is done in and around FDE, and piping infrastructure around the dairy shed, silage bunkers, cow yards etc.;

4.6 Good management Practices for Key Transport Pathways (1 June 2019 – 31 May 2020)

WW1&2 is classed in the Oxidising and Central Plains physiographic zones. The Horner block also is classed both in the Oxidising and Central Plains physiographic zones.

Both physiographic types are susceptible to nitrate accumulation in soils and aquifers. Nitrates are transported to the underlying aquifer via deep drainage. Central Plain's type soils (Braxton) may have risk of nitrate and contaminant (pathogen) loss to groundwater via cracks that can form in silty clay soils over extended dry summer periods. Subsequent heavy rainfall can transport nitrate or microbes down to the underlying aquifer. There is risk of contaminant loss (nutrients N and P, sediment and microbes) to surfacewaters via artificial drainage in Central Plain's type soils following heavy or prolonged rainfall.

Given the very flat topography and the tendency of soils to have good phosphorous retention, there is lower risk of contaminant loss to surface waters via overland flow. Any risk of contaminant loss to surface waters from tracks and lanes via overland flow should be mitigated by good management of areas where tracks and lanes are close to surface waters.

Recommendations described on Good Practice Management factsheets issues by Environment are implemented where practical. These measures will be reviewed annually with the inclusion of new measures where appropriate.

Table 6. Good management practices for key contaminant transport pathways.

Mitigation	Good Management Practise	Key transport pathway
Reduce accumulation of surplus N in the soil, particularly during autumn and winter, leading to reduced loss of N to groundwater and at times to surfacewaters	Inputs of N, such as fertiliser or nitrogen contained in imported feed, to be maintained at a level to minimise leaching losses	Deep drainage of nitrogen Artificial subsurface drainage
	Control the duration of grazing of pasture (on-off grazing)	
	Winter all cows in wintering barn	
	Optimise timing and amounts of effluent application to minimise leaching losses, accounting for the higher nutrient content of slurry compared to dairy shed effluent.	
	Wintering barns are also used to house cows during April, May, August and September as required, and as stand-off pads during wet weather at other times	

Mitigation	Good Management Practise	Key transport pathway
	Cut and carry feed to cows in barns	
	Time N application to meet pasture demand using split applications. Do not apply N in high risk months.	
	Reduce inputs of N where possible through optimal fertilizer application on farm, use little and often approach	
	Only apply nitrogen fertiliser if soil temperature is above 6 °C	
	Re-sow areas of bare or damaged soil in September or October, depending on climatic conditions	
Protect soil structure, particularly in swales and near stream areas to reduce contaminant loss (P, sediment, microbes) in runoff to surfacewaters.	Only re-sow 10 % of property at most each year	Artificial subsurface drainage Overland flow
	Cultivate before 1st March to avoid Autumn loss of nutrients	
	Fence off waterways. Stock will not graze riparian strips and riparian strips are sufficiently large and well vegetated;	
	Re-sow areas of bare or damaged soil in Sept/Oct, depending on climatic conditions	
	No IWG on fodder crop is carried out	
	Avoid heavy grazing on vulnerable or wet soils. Match stock management to land use capability, e.g. avoid grazing cows on more vulnerable soils, especially when wet. Wintering barns are used during wet periods to prevent pastures from pugging.	
Reduce phosphorus use to reduce potential loss to receiving surfacewaters	Soil test whole farm every 4 years, reduce use of P fertiliser where Olsen P values are above agronomic optimum	Artificial subsurface drainage Overland flow
	Stand cows off pastures during wet periods to prevent pastures from pugging	
	Fertilise only when there is minimal risk of nutrient loss to water. Fertilise outside high-risk months in autumn.	
	Manage CSAs close to surface drains to prevent runoff. Fence off major CSAs to prevent compaction and runoff.	

Mitigation	Good Management Practise	Key transport pathway
Avoid preferential flow of effluent through drains or soil cracks to prevent contaminant loss (N, P, microbes) to groundwater and/or surfacewaters	Defer effluent application when soil moisture levels are high	Artificial subsurface drainage Deep drainage
	Observe buffer zones and placement guidelines e.g. do not over tile drains or over areas where cracks have formed in the soil during high risk periods.	
	At all times observe discharge consent conditions.	
	Apply slurry effluent at very low application depth (< 2.5 mm per application)	
	Apply dairy shed effluent at low application depth (at all times < 10 mm per application and less than 50% PAW)	
Manage CSAs; low areas overlying tiles close to outfalls at surface drains to protect soils, prevent erosion and reduce contaminant loss (N, P, sediment and microbes) to surfacewaters	Restrict grazing of pasture critical source areas when soils are near saturation	Overland flow
	Avoid working critical source areas and their margins	
	Leave grassed areas (or native vegetation) around critical source areas and margins	
	Reduce runoff from tracks and races (using cut offs and shaping)	
Avoid loss of contaminants (nitrate and faecal microbes) to groundwater via cracks formed in summer dry periods in Braxton soil types.	Monitor paddocks for deep cracks in summer/autumn. If and where they form, avoid grazing the area and irrigating effluent to the area.	Deep drainage

4.7 Key mitigation measures associated with expansion

It is proposed to milk an additional 160 cows at WW1&2 in the 2019/20 season. Changes will be made to the farming system to offset a potential increase in nutrient losses and associated effects. As summarised in sections 3.5 and 3.6 and explained in detail in the nutrient budget analysis report and the phosphorous mitigation plan, the proposed system is expected to lose less N and P than the pre-expansion system.

Key drivers of controlling nutrient losses are regarded as key mitigation measures. These are as follows:

N loss – key changes/mitigations leading to 7.3% reduction

- i. Removal of summer and winter crop from WW1&2;
- ii. Removal of cows & young stock wintered outside on crop (IWG) or on grass;
- iii. Expansion of size and use of wintering barn facilities. The barns and effluent systems have already been upgraded to accommodate additional cows and effluent. Use of the barns will also occur in April, May, August and September;
- iv. More efficient use of N fertiliser.

P loss – key mitigations leading to 6.1% reduction

- v. Removal of winter crop area;
- vi. Maintaining Olsen P at target level of 30;
- vii. Expansion of size and use of wintering barn facilities.
- viii. Additional P mitigation is proposed by mitigating runoff from specific locations and features, which has calculated been outside Overseer. Please see WW1&2's Phosphorous Mitigation Plan for details of measures, including target dates for implementation.

If consent is granted for the proposed farming system, these key mitigation measures (i to viii inclusive) will be implemented in the 2019/2020 season.

In the future any material change to the farming system will be modelled in Overseer prior to the changes being made, to ensure that the change(s) will not result in an increase in N or P loss.

5 Riparian Management

5.1 Streams, Creeks and Drains

- i. All waterways are riparian fenced on both sides;
- ii. Regular riparian fencing checks will be completed, and any damaged sections or breakages/breaches are repaired immediately;
- iii. Calves or other stock that are found in the riparian areas will be removed immediately;
- iv. Check all crossings are contoured to channel run-off onto pasture;
- v. Carry out weed control as required following best practice methods;
- vi. Remove drain cleanings and spread over paddocks to utilize the nutrients and to prevent material returning to the water way; and
- vii. Make sure fish have passage through all culverts and underneath bridges;
- viii. Plant riparian areas and maintain rank grass to reduce runoff of contaminants – see phosphorous mitigation plan for details.

5.2 Weeds and Pests

Weeds (e.g. gorse, broom, blackberry, ragwort, thistles etc.) are controlled by manually removing them or by using sprays:

- i. When sprays are used to control weeds, care is taken to ensure all sprays are certified to be aquatic safe and that appropriate staff training is given to ensure good health and safety practices are fully implemented;
- ii. Spraying is best carried out when there is active growth (e.g. mid/late spring). The aim is to spray plants when they are small as less chemical is required;

6 Cultivation

6.1 Cultivation

Area under cultivation

For winter 2020, no fodder crop cultivation (beet, root or brassica) is planned.

However, the move to grass to grass re-grassing is dependent on the farming system changing pending the granting of consent; it is proposed that cow numbers are increased by 160 and cows wintered in the barn are increased by 225. If the farming system remains as per the 2017/2018 season, then there may be some fodder crops sown and IWG in the future.

Re-grassing

An extensive re-grassing policy has been carried out, with most paddocks having been re-grassed at the time of writing. Approximately 5% of the farm's effective area will undergo cultivation into new grass each year. Where re-grassing occurs, paddocks are sprayed off and direct drilled with grass seed or undergo full cultivation depending on factors such as soils, drainage, paddock performance.

Forage brassica or beet crop

This is not planned in the future:

- Paddocks are sprayed off in October/November;
- Paddocks are direct drilled or fully cultivated into fodder crop from mid-October to mid-November;
- Fodder crop is IWG in over winter by cows;
- Paddocks are subsequently re-grassed in September/October;

Surplus grass is harvested as baleage.

Grass harvested at the Horner Block is fed fresh to cows in the barns or is stored as silage at the silage pad or goes to other dairy farms. Specialist machinery is used to avoid the risk of soil compaction when harvesting grass if required.

Grass production, soil structure and fertility are the primary factors in paddock selection, with poorly performing pastures targeted for renewal. Soil moisture content is also a factor in the choice of paddock selection and timing of cultivation.

6.2 Cultivation Good Management Practices

If any fodder crop is sown in the future, good management practices will be followed:

- i. Where drainage depressions in crop paddocks are likely to channel sediments and nutrients to drainage, these will be left uncultivated to act as sediment traps;
- ii. Direct drill paddocks where this approach is deemed to be suitable;
- iii. Choose paddocks away from waterways to plant winter feed crops;
- iv. Plough lines will be kept 5 metres back from the top of drain banks. This ensures at least a 5 m buffer along waterways;
- v. Observe permitted activity rules as per Rule 25 clauses (a) and/or (b) of the pSWLP.

7 Intensive Winter Grazing

7.1 Stock Grazing Management

The Environment Southland Intensive Winter Grazing Rule covers the period from 1 May until 30 September. It is intended that all stock will be wintered in wintering barns during June and July 2020. Barns will also be partly used during April, May, August and September 2020.

However, if consent is not granted IWG may occur in the future to utilise land. If and where this occurs within the Environment Southland defined winter period, the following management will be employed. These procedures would also be applicable to returning stock in early spring.

7.2 IWG

Paddock selection

Judicious paddock selection based on the soil moisture content is a key tool. This is important not only to avoid overland flow, pugging etc. but to ensure that the pasture and soils are not damaged to any extent that would inhibit spring pasture growth. The range in soil types gives some flexibility of being able to move away from waterways to better draining soils during wet weather.

Back fencing

The eating of the excess feed will not (for spring growth reasons) result in the paddocks being eaten down hard, or pugged.

- Breaks once eaten off, will be back fenced;
- Breaks will be sequenced to ensure grazing is towards the watercourse, leaving a “last bite”;
- If the area to be grazed is located on sloping ground, stock will be progressively grazed from the top of the slope to the bottom, with a 20 metre ‘last-bite’ strip is left at the base of the slope. This is unlikely to be necessary due to the very flat topography;
- If baleage is used, place baleage in the paddock before soil becomes too wet thereby preventing heavy vehicles from damaging the ground;
- Portable feeders will be used to feed baleage/hay/straw to stock.

Water

Where breaks do not encompass a trough, a portable trough will be used to avoid pug lanes between the water troughs and the feed breaks.

Buffer zones

There will be fenced buffer zones (minimum 5-metres) along all water ways, and higher risk areas over tiles, drainage depressions (swales) or cracked soils will be temporarily fenced off.

Wet weather

In wet weather, where there is risk of pasture and soil damage, care must be taking to minimise grazing and avoid supplement feeding and pugging within 10 metres of a waterway or drain.

8 Other Environmental Issues

8.1 Lanes and Races

Run-off from races can in some situations constitute an illegal discharge to land. These will be mitigated by:

- i. Ensuring that lanes and races are not used as feed pads, cow yards, or herd holding areas;
- ii. Ensuring that riparian vegetation is adequate to treat storm water;
- iii. Checking after heavy rain the lane/track edge cut-outs, to ensure they are not blocked and there is no risk of large single point discharges;
- iv. Install nib boarding or kerbing to prevent point source discharges from lanes and tracks to waterways occurring;
- v. Gateways – to avoid compaction around the gateways and reduce lane edge wear, where possible bring the cows out of the paddock at a different gate to which they were let in; and
- vi. Ensure that swales away from culverts are kept clear, and discharge is directed away from the waterway.

Annual maintenance to races can often result in the “run back” shaping over culverts and lane edge discharge cutouts not being restored. All lane edges and culverts should be checked after lane maintenance.

8.2 Silage pad

A concrete silage pad (1,200 m²) is located adjacent to a wintering barn. It is constructed on a dry site. The silage pad has concrete walls and a dual drainage system; one for clean rainwater and one for silage leachate. Under the stack and immediately in front of it, the drains are opened into the leachate channel. This takes leachate to a sump from where it is pumped into the effluent storage pond and irrigated appropriately. The sumps in the rest of the pad are open to the farm drainage system so that clean rainwater can be diverted. Rain landing on the silage cover does not mix with leachate and is diverted to the farm drainage.

A second silage pad has been constructed on a dry site underlain by compacted clay. Rain landing on silage covers does not mix with leachate and is diverted to the farm drainage. It is managed to ensure that no leachate flows off the pad at any time and any leachate is contained at the pad.

Only wilted silage is used and stacks remain covered to minimise leachate

8.3 Underpass

An underpass connects the block north of Wrey’s Bush Highway with the dairy platform south of the highway. The underpass has its own effluent system, with a dedicated sprinkler. The sprinkler irrigates rainwater and effluent that collects on the underpass at low rate and depth to nearby paddocks.

The underpass is inspected regularly to ensure that the effluent system is operating correctly and that there is no ponding of rainwater/effluent at the underpass.

8.3 Cut and Carry

Grass harvesting at the Horner Block is carried out according to best practice management. Specialist equipment is used to minimize the risk of soil compaction. Harvesting is not carried out if the risk of soil compaction cannot be avoided.

Health and safety protocols are adhered to when operating machinery.

8.4 Animal Pests

- i. Rabbits, hares, possums – regular culls using night shooting, poisoning etc.
- ii. Magpies – trap, shoot;
- iii. Rodents – poison according to appropriate health and safety requirements

9 Emergency Response

9.1 Storage Overflow

Where the slurry ponds are approaching full very low application depth effluent irrigation (<1.5 mm depth) will be carried out on the driest part of the farm available. The umbilical system can be contracted to achieve this.

9.2 Ponding

Should light ponding be detected effluent irrigation will immediately stop. Checks should be made to ensure that there is no overland flow or that the ponding is not draining into tile lines etc.

9.3 Drainage

Overland Flow

See Ponding Section 9.2.

Discharge Ex-Tile and/or Effluent in Open Drains

- i. Attempt to immediately contain the contaminants by damming the drain. This will be done by dumping a bale(s) of straw or hay in the drain and pressing down with the front-end loader, depending on drain size;
- ii. Alternately earth and silage wrap will be used to seal or form the required plug; or
- iii. pump out and disburse with the vacuum tanker.

12.4 General Procedures

- i. Follow consent conditions/notes, mitigate effects;
- ii. Advise Regional Council where the consent requires this;
- iii. Seek help; and
- iv. Advise authorities.

12.5 Emergency Contacts

As per contact details in Section 1.

Environment Southland – 0800 768 845 or 03 2115115

Dairy Green Limited – 03 215 4381

10 Review

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

- i. Development targets for coming season/plan.
- ii. Nutrient Management
 - Overseer Inputs
 - New Overseer report if applicable
- iii. Good Management Practices
- iv. Implementation of key mitigation measures
- v. Cultivation Areas
- vi. Intensive Winter Grazing, if applicable
- vii. Effluent System
 - High risk/low risk effluent irrigation areas due to new tiling etc.;
 - Any developments in infrastructure – i.e. new/more irrigators, extensions to effluent system, fencing changes;
 - Training/retraining, etc.
- viii. Emergency Contacts

Version	Date	Reviewed	Distribution List
1.0	22 August 2017	JS	A & JJ de Wolde
1.2	15 July 2018	Nessa Legg, Dairy Green Limited	A & JJ de Wolde
1.3	25 Feb 2019	Nessa Legg, Dairy Green Limited	A & JJ de Wolde
1.4	21/8/19	Nessa Legg, Dairy Green Limited	A & JJ de Wolde