

Appendix 5

Effluent Management Plan



STROUD DAIRIES

EFFLUENT MANAGEMENT PLAN

for

“STROUD DAIRIES”

PROPOSED LOOSE HOUSING BARN

at

106 BREAM CREEK ROAD, BREAM CREEK, TASMANIA.

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Site: 106 Bream Creek Road, Bream Creek, Tasmania.

Date: 24 October 2025. V4.



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Sorell Council

Development Application: Development
Application - 106 Bream Creek Road, Bream
Creek - P1.pdf
Plans Reference: P1
Date Received: 27/10/2025



Stroud Dairies – Dairy shed and cow yard.



Sorell Council

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SUMMARY.

Stroud Dairies propose the development of a loose housing barn at 106 Bream Creek Road, Bream Creek, Tasmania to house up to 1000 milking cows. The farm currently operates a 780-cow dairy supported by pasture-based grazing and a feedpad. The proposal will involve transitioning cows from the existing pasture-based grazing system into a contained, loose housing, bedded pack barn.

This Effluent Management Plan (EfMP) provides details of the proposed effluent management system, building upon existing effluent system components. This EfMP has been prepared in accordance with the Tasmania Dairy Industry Authority (TDIA) *Farm Dairy Premises Effluent Management Code of Practice 2025* and the Dairy Australia *'Dairy Feedpads and Contained Housing – National Guidelines, Third Edition'*, 2024 publication.

The proposal to shift to a bedded pack barn system is intended to improve environmental management, animal welfare and staff safety standards of management across the business for a system of this type in this region. The business is striving for the highest standards of management possible to support their dairy farming future, their own dairy brand and their social licence to farm.

A conservatively based EfMP has been prepared and is detailed in the report hereon. This EfMP demonstrates that the development carried out and practiced in accordance with the recommendations and ongoing monitoring measures provided, the system will be environmentally sustainable.



1. INTRODUCTION.

1.1. Details of the commission.

This report provides details of an Effluent Management Plan (EfMP) for Stroud Dairies proposed 1000-cow loose housing barn development at 106 Bream Creek Road, Bream Creek, Tasmania. This report was commissioned by Mr. Jack Bignell of Stroud Dairies (“the business”) and carried out by Christian Bannan of South East Soil & Water (SESW). The business trades under “Bream Creek Dairy”, also referred to in this report. The dairy has a small, operational cheese processing facility producing 2500 litres of wastewater per week, also managed within the effluent stream and subject to a previous approval by the Tasmanian Dairy Industry Association (TDIA) in June 2025. This report is intended to accompany an application for planning approval with the Sorell City Council.

This EfMP provides details of the minimum effluent system requirements for effluent ponds, land application and other supporting requirements to sustainably manage effluent management for a 1000-cow loose housing barn. The development is proposed for construction and use during 2026 immediately after an approval is obtained.

Details within the report and advice is provided in accordance with relevant sections of the publication ‘*Dairy Feedpads and Confined Housing, National Guidelines, Third Edition*’, noted as the “National Guideline”, along with several other national and state guidelines from across Australia. Planning elements include liquid effluent, sludge and manure management, overlays, surface water protection and groundwater protection and prevailing wind direction. Specific details around odour management are addressed in a separate odour management plan (OMP) by Progressive Rural Solutions (PRS) (PRS, 2025a) and Environmental Impact Assessment also by PRS (PRS, 2025b).

All calculations in this plan including specific volumes of effluent, sludge and their associated nutrient are supported by the Effluent Toolkit, version 12.3.2 (February 2022) referred to as the “Toolkit”. The Toolkit is an industry-accepted standard for sizing effluent system components for dairy sheds, feedpads and confined dairy facilities across southern Australia (Agriculture Victoria, 2022). Inputs for the Toolkit include point-sourced climatic data from the site accessed from SILO (2025). A flood wash model by Skerman (2008) is also provided for estimating floodwash requirements for feedpads.

1.2. Personnel undertaking this report.

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Agricultural and Environmental Soil Scientist.
Certified Professional Soil Scientist, accreditation number S01479 with Soil Science Australia, 2017-2025 (current).
Accredited Effluent System Designer, Agriculture Victoria, 2018-2025 (current).

Personnel undertaking this assessment hold over 17 years of practical experience with environmental and agricultural site investigation, soil survey, soil assessment, effluent management, land capability assessment for dryland and irrigated agriculture, horticulture, viticulture, contaminated site investigation, wastewater management, re-use and disposal of wastewater for crop production, geotechnical site assessment and forensic site assessment for legal purposes. This experience is maintained with engagement by commercial agencies, the government sector and private enterprise. The author has contributed to the National Guidelines for Dairy Feedpads and Contained Housing (National Guideline), specifically Chapter 5 ‘Site Investigation and Earthworks’ (Dairy Australia, 2024).

1.3. Site location.

The development site is located at 106 Bream Creek Road, Bream Creek, Tasmania. The location of the site with respect to the townships of Bream Creek, Copping and Marion Bay is shown in Figure 1.



Figure 1. Location of land owned and leased by Stroud Dairies with respect to the rural localities of Bream Creek, Copping and Marion Bay (Google Earth, 2025).
Yellow areas are owned by the business. Orange areas are leased by the business.

1.4. Guidelines & resources used in preparation of this report.

- TDIA Farm Dairy Premises Effluent Management Code of Practice 2025, Tasmania Dairy Industry Association.
- TDIA Dairy Effluent Management Guidelines Tasmania 2025, Tasmania Dairy Industry Association.
- Effluent Toolkit Version 12.3.2, Agriculture Victoria, February 2022.
- Dairy Feedpads and Contained Housing – National Guidelines, Third Edition, Dairy Australia, 2024.
- Dairy Soils and Fertiliser Manual: Australian Nutrient Management Guidelines, Dairy Australia, 2013.
- Effluent and Manure Management Database for the Australian Dairy Industry, Dairy Australia, 2008 (editors Birchall, S, Wrigley, R & Dillon, C).
- Effluent Management Guidelines for Dairy Sheds in Australia, National Water Quality Management Strategy, Agricultural and Resource Management Council of Australia and New Zealand, and the Australian and New Zealand Environment and Conservation Council, June 1999.
- Effluent Management Guidelines for Dairy Processing in Australia, National Water Quality Management Strategy, Agricultural and Resource Management Council of Australia and New Zealand, and the Australian and New Zealand Environment and Conservation Council, June 1999.
- Land Information System Tasmania, “theLIST”, accessed from <https://www.thelist.tas.gov.au/>
- Queensland Department of Primary Industries and Fisheries “Dairy Flood Wash”, Version 2.7, April 2008
- Managing Nutrients on Dairy Farms – A Self-Assessment Tool for Dairy Farmers, Department of Primary Industries (McDonald et al, 2005).
- Managing Dairy Shed Wastes, Dairy Research & Development Corporation (Wrigley & Monks, 1993).

1.5. Legislation applicable to Tasmanian dairies.

The “Farm Dairy Premises Effluent Management Code of Practice”, (TDIA, 2025a), referred to as “the code” provides relevant legislation for the management of dairy effluent within dairy premises in Tasmania. In accordance with the code, the following outcomes must be met:

1. Dairy premises effluent must not leave the farm boundaries or enter surface waters or groundwater, unless treated and discharged in a manner approved by the relevant regulatory authorities. There are two minimum requirements within this outcome listed in the code.
2. There must be an appropriately designed and operated system for the responsible management of dairy premises effluent. There are seven minimum requirements within this outcome.
3. Spray irrigation or distribution of dairy premises effluent is carried out in an environmentally sound manner. There are three minimum requirements within this outcome listed in the code.

This effluent management plan is prepared as best as possible in accordance with the code and the supporting guideline (TDIA, 2025a, TDIA, 2025b).

Acts and regulations relating to water and groundwater management in Tasmania considered in preparation of this EfMP are (DAWR, 2013):

- Water Management Act 1999.
- The Environmental Management and Pollution Control Act 1994.
- Land Use Planning and Approvals Act 1993.

- The State Policies and Projects Act 1993.

1.6. Statement of intent.

This EfMP is developed for Stroud Dairies based on the information collected across several site inspections between 2023 and 2025. The plan adopts a recommended decile 9 winter storage requirement for effluent containment set by a pasture water balance within the Toolkit, then adjusted by the author based on manageable irrigation practices and accredited designer guidelines which consider the sites constraints, irrigation methods and opportunities for effluent and nutrient application during the winter storage period. Local rainfall and evaporation data are sourced from SILO (2025).

All recommendations are based on guidelines and best practice, in accordance with those of regulatory authorities in Tasmania and using national effluent guidelines and resources. Any changes or inconsistencies with this plan must be corrected by notifying the author. Prior to implementation of this EfMP, the owner must confirm that all details are true and correct and report any inaccuracy for correction.

2. BACKGROUND DAIRYING INFORMATION, EXISTING CHEESE PROCESSING FACILITY & PROPOSED LOOSE HOUSING BARN.

Stroud Dairies currently operate a 780-cow dairy herd at 106 Bream Creek Road, Bream Creek, Tasmania. The site has been used for dairying by the Bignell family for over 70 years. The dairy is a 60-unit rotary built in 2009. Within the dairy shed is an operational cheese processing facility, approved by the TDIA in June 2025 (email from Mr. Nathan Dick of TDIA dated 2-7-2025).

The dairy site is zoned Rural, where dairying is a permitted land use within the Tasmanian Planning Scheme (TPC, 2025). The total area of land owned by the business is approximately 641.5 hectares, of which approximately 207 hectares is irrigated across 8 centre pivot irrigators. The business also leases 387 hectares adjoining owned land, where 21 hectares is irrigated. Irrigation water is sourced from an entitlement on the Bream Creek and from surface rights from the Copping Dam, located on the Ravenscroft Rivulet.

The business has grown naturally over the period of ownership, with the current dairy herd reaching a maximum of 780 milking cows. Cows are fed primarily on pasture with the support of a feedpad for supplement feeding prior to and post milking.

The business proposes to construct a 1000-cow loose housing barn, achieving high production while achieving the highest possible standards of animal welfare, human resources and environmental standards. In conjunction with their nutrition and management consultants, milk production is expected to be more consistent and less variable by gaining greater control over environmental factors which improve cow comfort. Cows will be fed a ration that is adjusted to meet milking cow nutritional requirements to ensure optimal animal health and production are maintained all-year round.

Land will continue to be devoted to fodder production, removing impacts on pastures and the general landscape due to winter grazing and pugging. Effluent generated will be used for irrigating fodder crops including maize and pasture for conservation, producing high levels of dry matter while recycling nutrients sustainably on land.



Management of housed productive dairy cows within a loose housing barn will allow the business to meet all targets with relation to best-practice dairy farming and management. These are summarised below:

1. To improve animal welfare and hygiene standards, minimising cow exposure to weather elements (heat and cold) experienced within the current operation.
2. To prevent grazing during winter months in far south-east Tasmania, where cold, wet weather makes provides challenges to pasture-based dairy farming.
3. To better utilise the land, infrastructure, water and natural assets within the farming operation with a particular focus on increasing water use efficiency and dry matter production per unit of land.
4. To increase the operation capacity and efficiency without the additional purchase of land or the creation of new dairies.
5. To sustainably increase cow numbers while adopting best practice cow welfare and biosecurity.
6. To maintain total control of the ration received with less variability in milk production.
7. To achieve sustainable nutrient recycling from effluent, sludge and manure.
8. To decrease grazing impacts to farming areas and potential environmental impacts.
9. To provide a dairy production system suitable for future generations to continue dairying.
10. To reduce odour emitting surfaces including tracks and laneways.
11. To provide a safer workplace for staff, including the removal of motorbikes and ATV's when mustering cows for milking.

The business will employ approximately 6 full-time equivalent staff to support the facility at peak operation. This excludes sub-contractors, harvest and sowing operations across cropping land where seasonal increases in worker numbers will increase.

Following the construction of the loose housing barn, the existing feedpad will be converted to a loose housing barn for maternity cows within the following 5 years. This barn will be used year-round and house calving cows as they calve over a 1-week period. This facility will continue to be scraped twice-daily following use.

Dry cows and young stock will be grazed on dryland country. Stock will be removed from grazing within irrigated areas under centre pivot sites where nutrient will be applied from effluent to meet nutrient removal requirements for a double-cropping system for fodder production, in accordance with livestock effluent system designer standards which limit grazing in areas where high rates of K are applied, to prevent metabolic disorders within grazing animals. Standard 21-day withholding periods for grazing post effluent application will also not impact the function of the business.

3. PROPERTY DETAILS.

3.1. Land addresses, identification numbers, planning zones, title references, planning code overlays & ownership status.

Details of property addresses, identification numbers, planning zones, title references, planning code overlays and ownership status are listed in Table 1. Details have been sourced from the Tasmanian Building Commission (Plan Build, 2024). The site lies within the Sorell City Council local government area.

Table 1. Land addresses, certificate of title reference numbers and other property details.

SESW Ref. No.	Address	Property Identification Number	Locality	Planning Zone	Approximate Area (m2)	Approximate Area (Ha)	Certificate of Title Reference (Volume/Folio)	Municipality	Planning Codes Overlay	Ownership Status
1	106 Bream Creek Rd, Bream Creek, Tas. 7175 DAIRY SITE.	3370760	Bream Creek	Rural	439086	43.9	156894/1 35298/1 35297/2	Sorell	Scenic protection area Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area Medium landslip hazard band	Owned
2	124 Bream Creek Rd, Bream Creek, Tas. 7175	3370752	Bream Creek	Rural	166393	16.6	106067/2 106069/1	Sorell	Scenic protection area Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area	Owned
3	247 Burnt Hill Rd, Bream Creek, Tas. 7175	2179649	Bream Creek	Rural	24708	2.5	138933/1	Sorell	Scenic protection area Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area	Owned
4	198 Burnt Hill Rd, Bream Creek, Tas. 7175	3370779	Bream Creek	Rural; Agriculture	2028476	202.8	156893/1 107420/1 106067/1 106068/1 36107/1 65104/1 106412/3 53479/3 53479/1 36176/1 151068/1 156892/1	Sorell	Scenic protection area Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area Medium landslip hazard band	Owned
5	51 Bream Creek Rd, Bream Creek, Tas. 7175	7873947	Bream Creek	Rural; Agriculture	1692139	169.2	53774/4 37042/2 37042/3 36341/4 36107/1 100903/1 37042/1 46004/1 53774/1 37042/4 53774/2 235982/1 238854/1 155706/2	Sorell	Scenic protection area Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area Medium landslip hazard band	Owned
6	12 Townsend Lane, Copping, Tas. 7174	5960959	Copping	Agriculture	1455740	145.6	127848/1 127849/1 241387/1	Sorell	Bushfire-prone areas Low landslip hazard band Waterway and coastal protection area Medium landslip hazard band	Owned
7	460 Marion Bay Rd, Marion Bay, Tas. 7175	3192124	Marion Bay	Agriculture	608900	60.9	161908/1	Sorell	Bushfire-prone areas Low landslip hazard band Waterway and coastal protection area Medium landslip hazard band	Owned
8	212 Marion Bay Rd, Bream Creek, Tas. 7175	5960991	Bream Creek	Rural; Agriculture	580200	58.0	147764/1	Sorell	Bushfire-prone areas Low landslip hazard band Waterway and coastal protection area Medium landslip hazard band	Leased
9	234 Marion Bay Rd, Bream Creek, Tas. 7175	7544481	Bream Creek	Rural	556200	55.6	35026/2	Sorell	Bushfire-prone areas Low landslip hazard band Priority vegetation area Waterway and coastal protection area Medium landslip hazard band	Leased
10	225 Marchwell Rd, Bream Creek, Tas. 7175	3081213	Bream Creek	Environmental Management; Agriculture	2737000	273.7	159559/2	Sorell	Priority vegetation area High coastal inundation hazard band Scenic protection area Future coastal refugia area Low coastal inundation hazard band Low coastal erosion hazard band Waterway and coastal protection area Bushfire-prone areas Medium landslip hazard band Medium coastal erosion hazard band High coastal erosion hazard band Medium coastal inundation hazard band Low landslip hazard band	Leased

Total hectares: 1029



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3.2. Dairy site and cheese production facility details.

The site of the dairy and cheese production facility is located at 106 Bream Creek Road, Bream Creek, Tasmania. Details:

- Property Number: 3370760
- Title Reference: 35297/2
- Planning Zone: Rural. Agricultural activities including dairying and dairy processing are supported within this zone.

3.3. Planning zones covering other land on the property.

Planning zones covering the property and lease land include:

- **Rural:** This planning zone covers the dairy site and a large proportion of land to the north of Marion Bay Road including the dairy site where cheese production occurs.
- **Agricultural:** This planning zone covers land to the south of Marion Bay Road.
- **Environmental Management:** This planning zone covers a lease property listed as 225 Marchweil Road, Bream Creek.

3.4. Overlays.

Sites proposed for effluent irrigation will be restricted to land owned by the business. Overlays recorded at addresses owned by the business are summarised in Table 1 and include:

- Bushfire-prone areas
- Scenic protection area
- Priority vegetation areas
- Waterway and costal protection areas
- Low landslip hazard band
- Medium landslip hazard band.

Overlays recorded on owned land will not impact use of land for dairy production and effluent irrigation, specifically where irrigators are currently in operation.

Additional overlays in addition to those previously mentioned on land leased by the business are listed below. These sites may be used for sludge or manure application to meet pasture and crop nutrient requirements.

- Future costal refugia area
- Low costal inundation hazard band
- Medium costal inundation hazard band
- High costal inundation hazard band
- Low costal erosion hazard band
- Medium costal erosion hazard band
- High costal erosion hazard band.

4. ENVIRONMENTAL VARIABLES.

4.1. Rainfall, evaporation and potential evapotranspiration.

Historic rainfall and evaporation data for this site has been sourced from SILO (Scientific Information for Landowners) from coordinates -42.80, 147.85, located on land adjacent to the Bignell property on leased land (QLD Gov, 2025). The data set ranges from January 1900-December 2024. “Worst case” winter storage is required for dairy effluent pond sizing southern Australia to support containment over winter months where rainfall exceeds evapotranspiration. To calculate a worst-case water balance and determine the containment and non-irrigation period, months with a surplus in soil moisture (no deficit) based on 90th percentile monthly rainfall and 10th percentile monthly evaporation are deemed storage months. Irrigation is not sustainable during this period while soil profiles are saturated, but may occur where there is a period of soil moisture extraction allowing for soils to be refilled. This period is highlighted in orange in Table 2. A crop factor of 1.05 has been adopted for this site to reflect perennial pasture, the most relevant set of crop coefficient values to reflect a double-cropping operation. The average annual rainfall for the site is 743mm and evaporation is approximately 1080mm. Results are presented in Table 2.

Table 2. Irrigation water budget and winter storage calculations for effluent for a decile-9 rainfall and decile 1 evaporation rainfall scenario for this site.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Monthly Rainfall (mm) (a)	54.5	54.2	58.0	66.2	59.0	68.5	63.0	63.8	53.2	66.9	62.0	73.6	743
Average Monthly Evaporation (mm) (a)	164.5	128.4	105.2	66.1	44.1	29.6	34.6	49.7	73.5	104.8	125.3	154.4	1080
													-
Adj. 90 th Percentile Monthly Rainfall (mm)	79.9	76.9	81.2	90.1	81.7	90.2	74.8	85.8	65.5	80.2	74.2	108.5	989
Adj. 10 th Percentile Monthly Evaporation (mm)	154.6	126.9	98.9	61.1	37.6	25.5	30.6	46.5	65.6	94.7	116.9	144.1	1003
K Pan Evaporation Factor (b)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
ETo 10 th Percentile Monthly Evaporation (mm)	124	102	79	49	30	20	24	37	53	76	94	115	802
Crop Coefficient – Perennial Pasture I	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	
ETc 10 th Percentile Adj (mm)	130	107	83	51	32	21	26	39	55	80	98	121	843
Irrigation Deficit (mm)	50	30	2	-39	-50	-69	-49	-47	-10	-1	24	13	
Storage Months	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	
Storage Days	0	0	0	30	31	30	31	31	30	0	0	0	183

References:

- QLD Gov, 2025.
- Estimate by author using FAO data and industry information from south-eastern Australia.
- Allen et al, 1998.

Interpretation:

Effluent storage months where a rainfall surplus is calculated, indicating that soils are at field capacity.

Storage months with a rainfall surplus of <10mm where sprinkler irrigation will permit application across previous storage months, eliminating this month from the winter storage period.

Months where there is deficit in rainfall on a decile 9 scenario, where rainfall will be up taken by vegetation.

4.2. Monthly rainfall and evaporation.

Average and worst-case monthly rainfall and evaporation are presented in Figure 2.

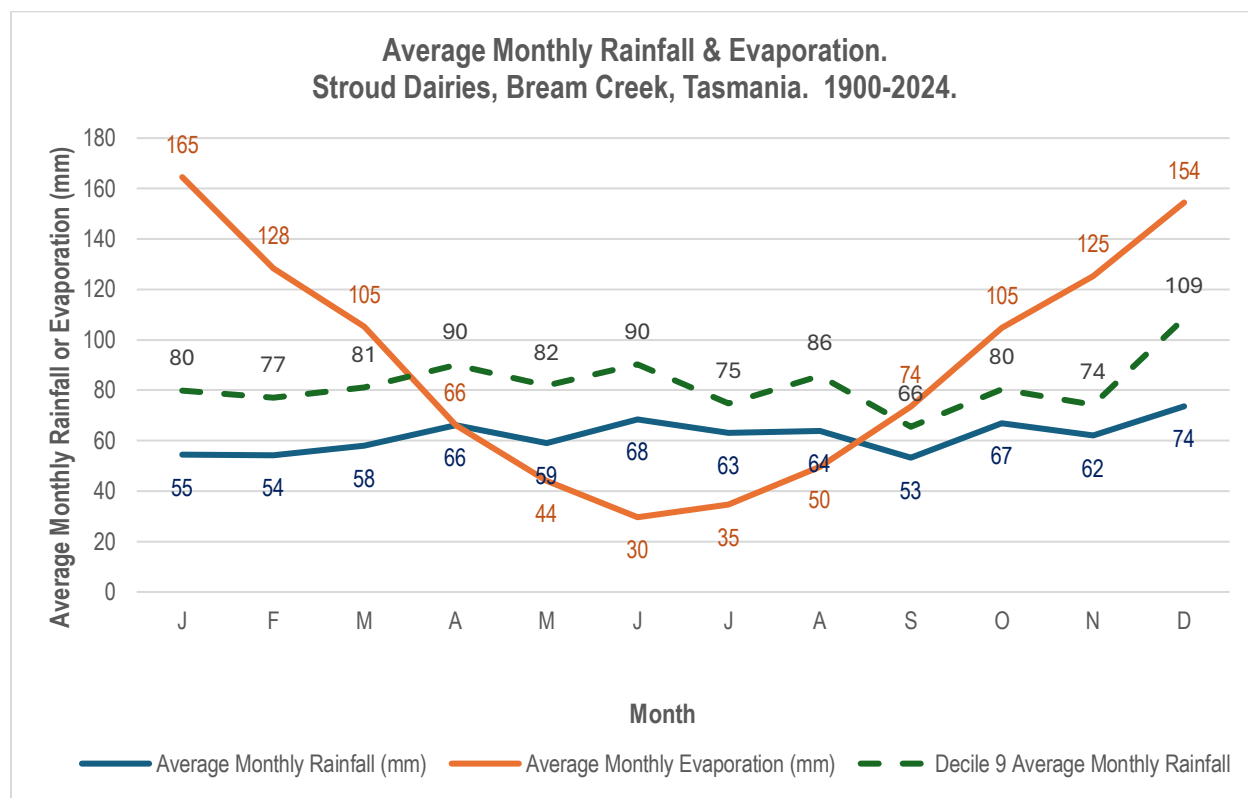


Figure 2. Average rainfall and evaporation and decile 9 rainfall for the site (SILO, 2025).

Under average rainfall conditions, the period where these data sets overlap covers approximately 4 months from May to August. In these months the surplus moisture in excess of evaporation ranges from 14-39mm per month, or 96mm in total. Irrigation of effluent onto paddocks may not be possible in this period from saturated soil conditions and risks of waterlogging, particularly where surface irrigation methods are utilised.

Operational planning for irrigating effluent during the winter storage period is required to ensure that effluent is sustainably managed, particularly in decile 9 rainfall scenarios when the full capacities of ponds are relied upon for sustainable management. Agronomic guidance is also required to support effluent irrigation both outside and within the winter storage period, ensuring that ponds are emptied prior to April 1 at the commencement of the winter storage period. Double cropping proposed by the business will maximise effluent and nutrient uptake by crops and provide opportunities for irrigating effluent during winter when a soil moisture drawdown of 10mm occurs triggering an opportunity for effluent irrigation.

4.3. Geology.

Site geology has been mapped by Mineral Resources of Tasmania (MRT, 2010) within the Sorell 1:50,000 geology map, with an extract included in Figure 3. In accordance with available mapping, the dominant geology units covering the property are listed as follows:

- "Qtb": Quaternary, talus of basalt.
- "Tb": Tertiary basalt.
- "Rss": Triassic, quartz sandstone.
- "Qha": Quaternary, river alluvium, swamp marsh, beach and spit deposits.
- "Ts": Tertiary, sandstone, claystone, conglomerate and pyroclastic rocks.

Available literature indicates that soils across the site are variable, depending on their geology. The most likely geological units on the dairy site and pond areas are basalt soils of quaternary origin.

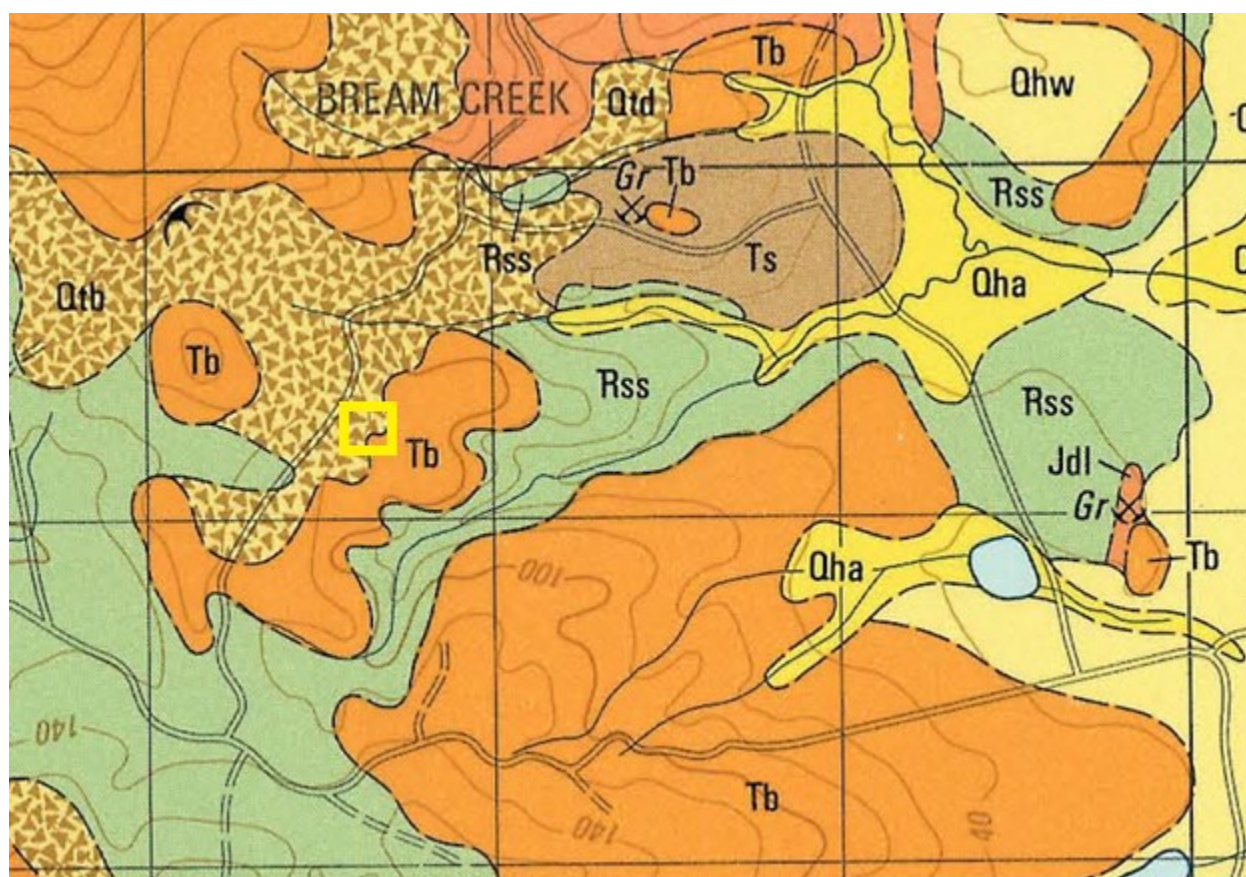


Figure 3. Extract of surface geology map covering the site (MRT, 2010).

4.4. Soils.

4.4.1. Available literature.

Soil information covering the site has been accessed from:

- Stephens (1941) titled “The Soils of Tasmania”, reviewed in hard copy.
- Swanswick (1999) in the publication “Sorell Soil Report – Reconnaissance Soil Map Series of Tasmania”, by the Department of Primary Industries, Water and Environment, 1999. Information from this publication is derived from Loveday (1954) “Soil map of Bream Creek Area, Tasmania”. Unpublished CSIRO, Division of Soils, Adelaide. This is not available for citing either electronically or in hard copy. The Sorell Soil Report has an accompanying map.
- Derosé and Todd (2001) “Nugent Report”, Land Capability Survey of Tasmania, Department of Primary Industries, Water and Environment, Tasmania. This report has an accompanying map, cited as Derosé and Todd (2002).

Soil details within these publications are listed below.

4.4.2. The Soils of Tasmania.

Stephens (1941) lists the soils covering the property as “Normal Podzols”, broadly consistent with the later soil classification of “Podzol” listed within Stephens (1953). Stephens (1941) lists Normal Podzols previously described by Taylor and Stephens (1935) with the following characteristics:

- A₁ horizons: Grey to dark grey silty loams to sands.
- A₂ horizons: Grey, yellow and light grey sand, sandy loam and silty loam, some with hard pans and some with inclusions of yellow clay.
- B horizons: Grey, yellow and pale-yellow clay or clay loam.

4.4.3. Soil map of Bream Creek Area, Tasmania and the Sorell Soil Report.

Swanswick (1999) list the soil associations along with their dominant and minor soil types as follows. Soils information within this publication covering the Bream Creek area is derived from Loveday (1954). An extract of soil association mapping from this report covering the site is provided in Figure 4.

- **Soils on sandstone:**
 - Podzolic soils on sandstone, abbreviated as “Pss”. The dominant soil type is listed as a Podzol, with textures noted as:
 - A horizons: Dark grey sands, with a bleached subsurface horizon.
 - B horizon subsoils: Increasing in clay content to clayey sand, sandy clay or clay.
- **Soils on basalt:**
 - Black and grey brown soils on basalt, abbreviated as “Bgb”. These are described as moderate to imperfectly drained, black cracking soils with co-dominant, well-drained, dark grey brown soils developed on Tertiary basalt bedrock and colluvium on undulating to rolling land. The dominant soil type is noted with the following characteristics:
 - A horizons: Black clay-loam or clay surface.
 - B horizon subsoils: Dark yellow-grey or dark brown subsoil clay.



- **Soils on dolerite:**

- Podzolic soils on dolerite 1, abbreviated as “Pd1”. These are described as imperfectly drained texture contrast soils developed on Jurassic dolerite bedrock and colluvium on rolling to steep land. Soils are listed as grey and brown podzolic soils, or “Chromosols” in accordance with the Australian Soil Classification. The dominant soil type is noted with the following characteristics:
 - A horizons: Grey-brown sandy loam or fine sandy loam, with a bleached subsurface horizon containing ferruginous (ironstone) gravel.
 - B horizon subsoils: Yellow-grey and yellow-brown clay, mottled.

- **Soils on recent alluvium:**

- Undifferentiated alluvial soils, abbreviated as “A”. This group contains a wide variety of soils ranging from clays to gravels, some with bleached subsurface horizons over clay subsoils.

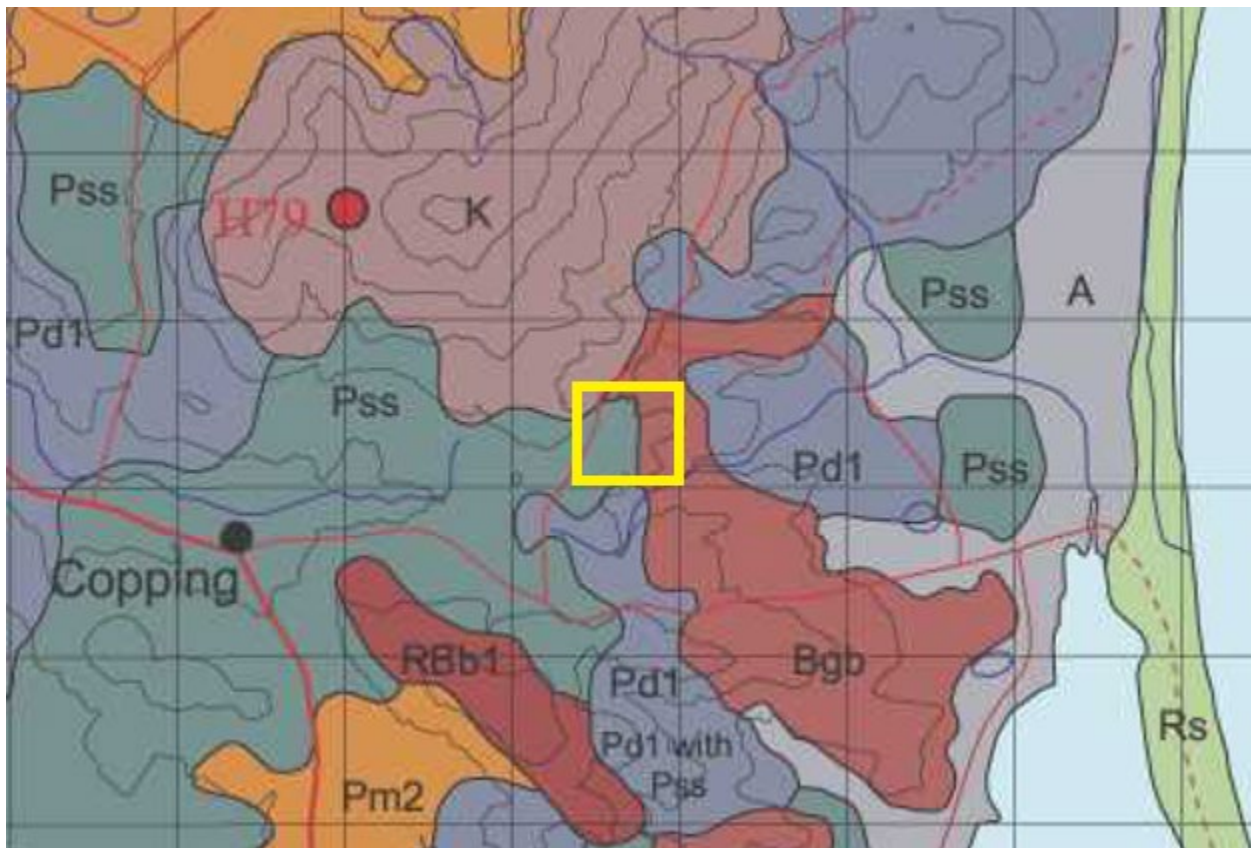


Figure 4. Soil reconnaissance mapping extract covering the property (Swanswick, 1999).



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4.4.4. *Nugent Soil Report.*

Derose and Todd (2002) map the capability of the land into classes, with the following results covering the dairy site and broader farming areas owned and leased by the business.

1. **Moderate to lower sloping land towards Burnt Hill Road and Marion Bay Road: Class 3.**

A summary of key land capability elements is listed as follows:

- Land suitable for cropping and intensive grazing.
- Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use.
- Land is moderately productive, requiring a higher level of inputs than Classes 1 and 2.
- Limitations either restrict the range of crops that can be grown, or the risk of damage to the soil resource is such that cropping should be confined to three to five years out of ten in a rotation with pasture or equivalent during normal years.

2. **Mid-sloping land east of the dairy towards Copping: Class 4.**

A summary of key land capability elements is listed as follows:

- Land primarily suitable for grazing but which may be used for occasional cropping.
- Severe limitations restrict the length of cropping phase and/or severely restrict the range of crops that could be grown.
- Major conservation treatments and / or careful management are required to minimise degradation.
- Cropping rotations should be restricted to one to two years out of ten in a rotation with pasture or equivalent, during 'normal' years to avoid damage to the soil resource.
- In some areas longer cropping phases may be possible but the versatility of the land is very limited.

3. **Rising land west of the dairy: Class 5.**

A summary of key land capability elements is listed as follows:

- Land is unsuitable for cropping, although some areas on easier slopes may be cultivated for pasture establishment or renewal and occasional fodder crops may be possible.
- Land may have slight to moderate limitations for pastoral use.
- The effects of limitations on the grazing potential may be reduced by applying appropriate soil conservation measures and land management practices.

4. **Dairy and pond zones: Class 4 + 3.**

This unit is a complex of two units identified which cannot be delineated separately at the scale provided. The dominant unit is Class 4, as previously discussed.

5. **Rising land immediately east of the dairy: Class 5 + 6.**

This unit is a complex of two units identified which cannot be delineated separately at the scale provided. The dominant unit is Class 5, as previously discussed.

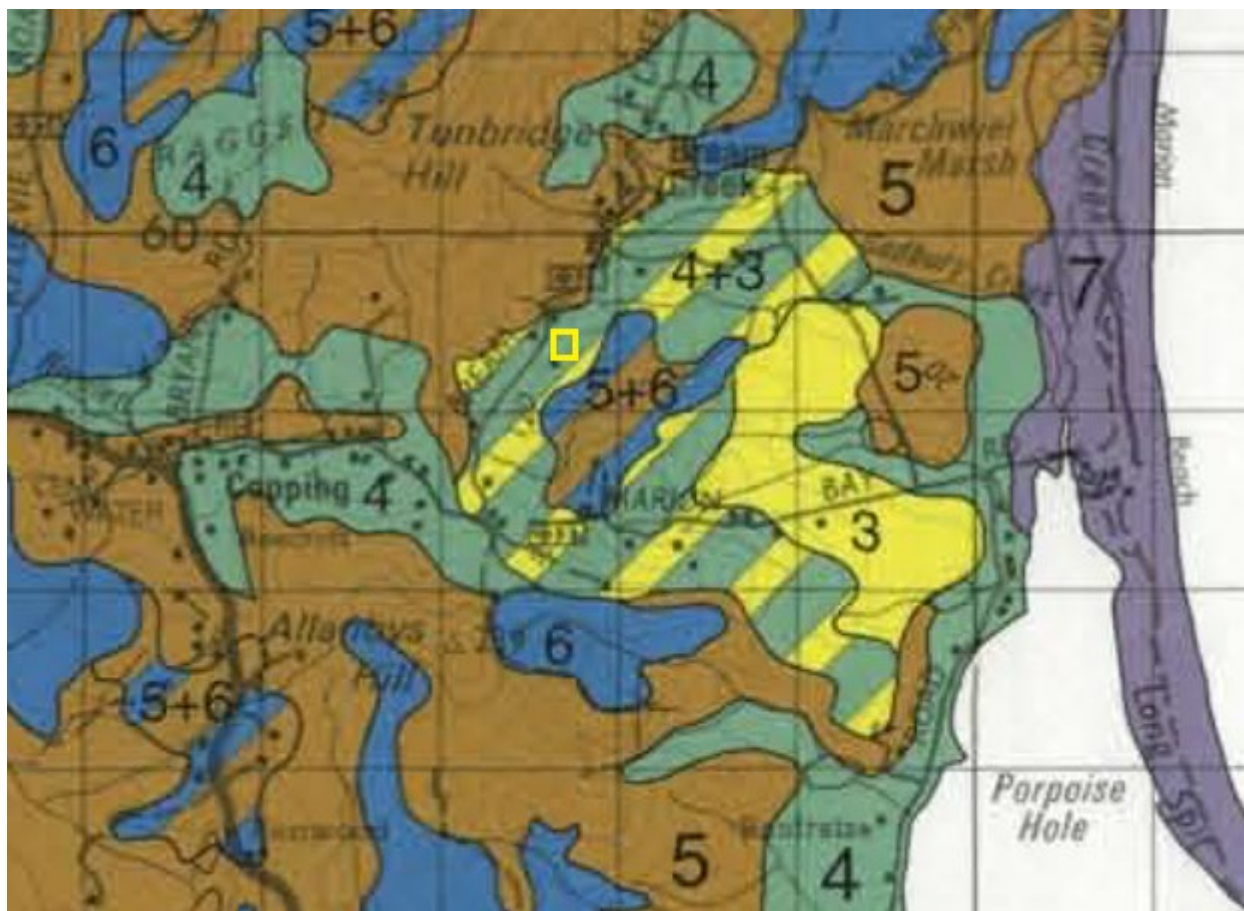


Figure 5. Extract of land capability mapping (Derose and Todd, 2002). The location of Bream Creek Dairy is shown in yellow.

4.5. Watercourses, open waterbodies and drainage lines.

4.5.1. Watercourses.

Figure 6 is an extract of surface water mapping available on the state government database (LISTmap, 2025). Across the property there are several marked watercourses, all which require protection measures to avoid impacts from dairy effluent.

In accordance with the code (TDIA, 2025a), dairy premises effluent must not leave the farm boundaries or enter surface waters. To mitigate impacts to watercourses, a 30-metre setback will be applied within this EfMP, along with other protection measures around the timing of application relative to soil moisture and rainfall. The 30-metre setback has been subject to previous EfMP approval on this site. This separation distance provides 30 metres of vegetative filter strip for site runoff.

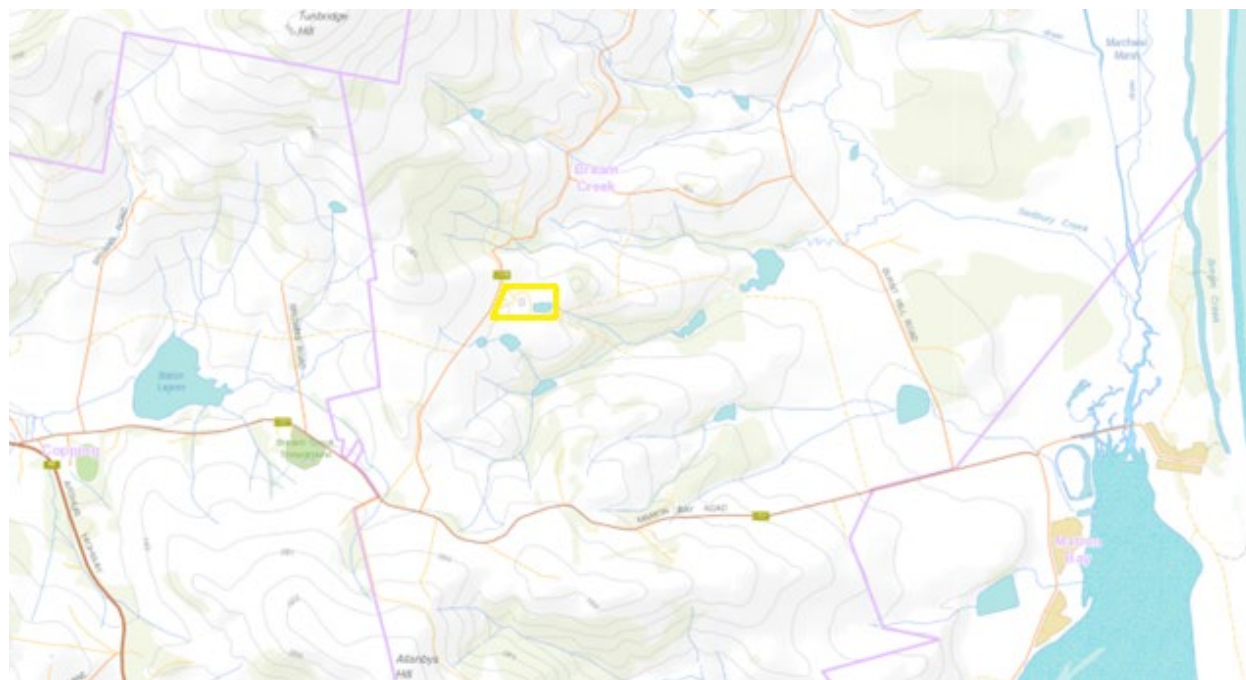


Figure 6. Waterways, open waterbodies and contours covering land owned and leased by the business, marked in dark blue (LISTmap, 2025).

4.5.2. Open waterbodies and drainage lines.

Separation distances to open waterbodies and drainage lines are considered in the preparation of this report. To view these, all markings in blue in Figure 6 are considered as watercourses or open waterbodies and protection measures are required to ensure these are not impacted by dairy effluent. One exception to this is the existing effluent pond on the site. This pond has raised banks and no overflow, being disconnected from the watercourse below.

For open waterbodies and drainage lines, a 30-metre setback will be applied for the application of effluent, along with other protection measures around the timing of application relative to soil moisture and rainfall to mitigate impacts from effluent application, consistent with those applied for watercourse protection (see Section 9.2).

4.6. Flooding potential.

In accordance with state database information on LISTmap, there are no flood overlays marked on land owned or managed by the business. Consistent with contours and site observations, the site is undulating with steep slopes and unlikely to be impacted from flooding given the rapid speed which surface drainage is expected to leave the property following rainfall. Contours on 10-metre intervals can be viewed in Figure 6. Land levels can also be viewed in Appendix C, D and E.

4.7. Groundwater Information.

Groundwater information from the site and surrounding region has been accessed from “The Groundwater Information Access Portal” (DNRE, 2025). An extract of available mapping is included in Figure 7, with bore details summarised in Table 3. Of all bores listed, none are on land owned by the business.

Table 3. Groundwater data from bores located on and close to this site.

No.	Bore ID.	Location from dairy (m)	Yield (l/s)	Depth (m)	Salinity (mg/l TDS)	Standing Water Level (m)	Operating status
1	2939	900m south	Dry	30-45	Unknown	Unknown	Abandoned
2	40854	1000m north	1-2	60-90	1500-3000	20-30	Capped
3	40657	1050m south-east	<0.5	90-120	1000-1500	30-40	Capped
4	3358	1050m south-west	<0.5	30-45	1500-3000	Unknown	Functioning
5	17364	1200m south-east	<0.5	60-90	Unknown	Unknown	Functioning
6	16510	1200m south-west	<0.5	30-45	500-1000	5-10	Capped
7	2938	1400m south-east	Unknown	30-45	Unknown	Unknown	Abandoned
8	40790	1400m south-east	Dry	60-90	Unknown	Unknown	Abandoned
9	2883	1400m south-west	<0.5	30-45	1500-3000	Unknown	Abandoned
10	3333	2200m south-west	<0.5	15-30	<500	Unknown	Capped
11	31336	2300m west	<0.5	60-90	Unknown	Unknown	Abandoned
12	41876	2500m south-west	<0.5	60-90	1000-1500	10-20	Capped
13	3351	2550m south-west	0.5-1.0	60-90	<500	10-20	Capped
14	40729	2850m west	2-5	30-45	<500	<5	Capped

Results confirm the following:

- Many bores are abandoned or capped.
- Two bores are listed as functioning, located 1050m south-west and 1200m south-east of the dairy. These bores have very low flow rates of <0.5 l/s,
- Salinity levels are mostly recorded at 1500-3000 mg/l TDS or lower.
- Bores with shallow standing water levels are:
 - Bore ID 40729, recorded at <5 metres.
 - Bore ID 16510, recorded at 5-10 metres.

Results indicate that there are no active bores close to the dairy which are functioning, with high yields and high quality, low salinity water. Most are either capped or abandoned.

To protect local groundwater, all new ponds must be lined with an impervious clay or other impervious membranes to prevent seepage losses. A geotechnical investigation by Geoton (January 2025, Appendix H) provides details of the sites characteristics and suitability of materials for engineered fill banks for effluent ponds and feedpads to mitigate risks of nutrient movement to groundwater.

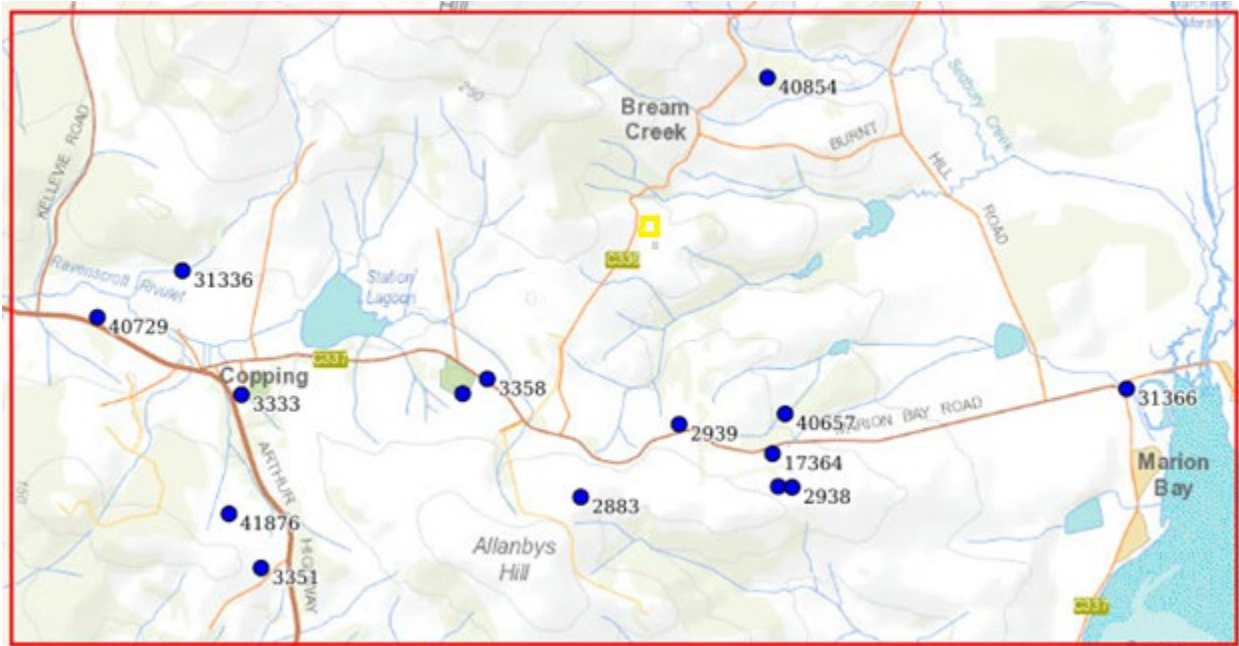


Figure 7. Local groundwater bores and their identification number. The location of Bream Creek Dairy is shown in yellow.

4.8. Prevailing wind direction.

Representative wind roses for the site have been accessed from the Australian Government Bureau of Meteorology website data for the “Hobart Airport West” station, located approximately 26 kilometres west at coordinates 42.83 °S, 147.50°E (BOM, 2025). Wind roses for 9am and 3pm and their respective number of measurements are recorded for the following times:

- 9am: 22,666 observations. Wind rose presented in Figure 8.
- 3pm. 22,663 observations. Wind rose presented in Figure 9.

Key observations are listed as follows:

- Wind at 9am is:
 - Calm at 6% of time.
 - Dominantly from the north-west, blowing from this direction approximately 44% from all historic records. Of these, winds are:
 - Light at 12% of all measurements.
 - Gentle at approximately 22% of all measurements
 - Moderate at 20-30km/h at approximately 10% of all measurements.
 - Wind blows from the north approximately 16% of the time, with winds mostly light or gentle.
- Wind at 3pm shifts and is dominantly from the south-east. Winds are:
 - Calm at 2% of time.
 - Dominantly from the south-east, blowing from this direction approximately 23% of all measurements. Of these, winds are:
 - Light at 4% of all measurements.
 - Gentle at approximately 10% of all measurements
 - Moderate at 20-30km/h at approximately 9% of all measurements.
 - Winds are also commonly recorded blowing from:

- North-west approximately 19% of the time,
- South approximately 15% of the time, and
- West approximately 13% of the time.
- Moderate breeze of 20-30 km/h is most common.

Information obtained suggests that the region is subject to mostly gently and light breezes at 9am from a north-westerly direction. Wind direction at 3pm shifts to various direction in the afternoon including the south-east, north-west (consistent with 9am readings), south and west. Of all 3pm readings, moderate winds of 20-30 km/h are most common reflecting the sites proximity to the ocean and the associated coastal wind. Wind intensity generally decreases in the afternoon.

Activities including spreading of sludge, manure and irrigation of effluent are likely to be best in the mornings when wind speed is most commonly gentle or light at less than 20 km/h, or below 5 m/s while temperatures are warming to best disperse odour. Although higher wind speeds are effective at dispersing odour, neighbouring landowners at further distances may detect spreading activities.

Given the prevalence of fog in this region during mornings, it will be important to spread sludge or manure after fog has lifted to prevent an odour inversion layer from forming.

Rose of Wind direction versus Wind speed in km/h (01 Jun 1958 to 03 Aug 2022)

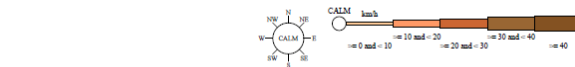
Custom times selected, refer to attached note for details

HOBART AIRPORT WEST

Site No: 094008 - Opened Jan 1958 - Still Open - Latitude: -42.8339° - Longitude: 147.5033° - Elevation 4m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



9 am
22666 Total Observations

Calm 6%

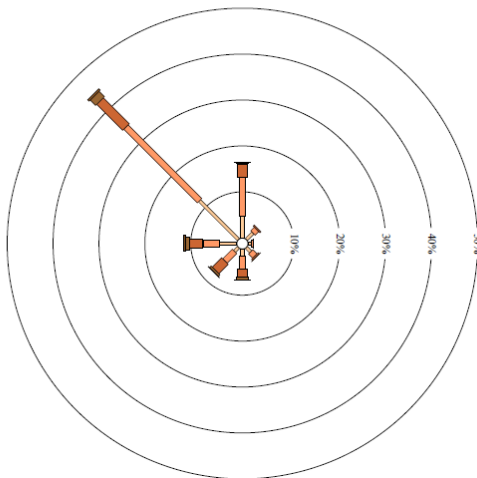


Figure 8. Annual Wind Rose for Hobart Airport West weather station at 9am, 1958-2022 (BOM, 2025).

Rose of Wind direction versus Wind speed in km/h (01 Jun 1958 to 03 Aug 2022)

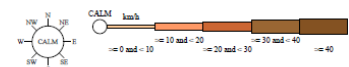
Custom times selected, refer to attached note for details

HOBART AIRPORT WEST

Site No: 094008 - Opened Jan 1958 - Still Open - Latitude: -42.8339° - Longitude: 147.5033° - Elevation 4m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



3 pm
22663 Total Observations

Calm 2%

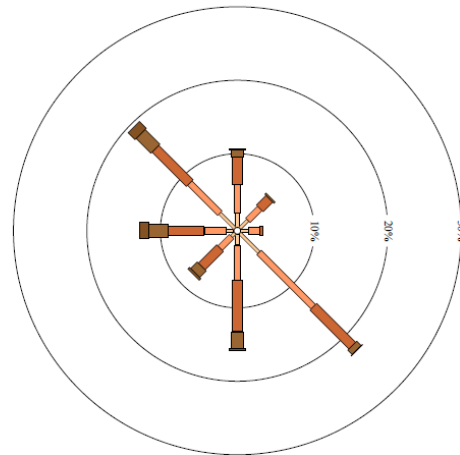


Figure 9. Annual Wind Rose for Hobart Airport West weather station at 3pm, 1958-2022 (BOM, 2025).



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5. EXISTING FARMING OPERATION, DAIRY SYSTEM, MILKING DETAILS & WATER USE.

5.1. Existing farming system details.

Sections 5.1 and 5.2 details the existing farming operation. Specific details of the proposed system changes are commented on throughout Section 5.3, then described in Sections 6-9. All details associated with the existing farming area, water supply, irrigation, dairy, water use and effluent generation are listed in Tables 4-7. Figure 10 shows the location of the dairy and associated infrastructure including the feedpad, sump and screw press, existing effluent ponds, freshwater storage dam, laneways and other concreted and impervious areas all marked in yellow. A plan of the existing system is provided in Appendix C.

Table 4. Farm size, irrigation supply and irrigation areas.

<u>Farming Size & Irrigation Areas.</u>	<u>Description</u>
Total property area owned by the business- approximate (Ha):	Stroud Dairies – 641.5 hectares (see Figure 1).
Total property area leased by the business- approximate (Ha):	387.3 hectares (see Figure 1).
Total land used by the business for dairy farming:	1029 hectares.
Irrigation supply details:	Irrigation water supplied via licenced take and use from the Bream Creek and from a storage located on the Ravenscroft Rivulet.
Total irrigation area (Ha):	Approximately 207.3 hectares, all under centre-pivot sprinkler irrigation.

Table 5. Existing milking operation details.

<u>Milking Operation Details</u>	<u>Description</u>
Maximum herd number:	780
Dairy type:	Rotary.
Number of units:	60.
Milk production:	Friesian cows. Average of 32 litres/cow/day. 30% of the diet is fed on the feedpad. Annual production average of 9,760 litres/cow/year. Total annual production 7,612,800 litres.
Milking frequency:	Twice-daily.
Median cow time on yards:	1.5 hours/cow/milking, or 3 hours per day, inclusive of walking into the feedpad and feeding both before and after milking.
Feedpad type and size:	Concrete with a total area of approximately 3200 m ² . Feedpad constructed in 2009.
Feedpad use (% of diet fed):	30%
Summary of concrete, impervious and pervious catchment areas collecting effluent and rainfall runoff contributing to the effluent system (approximate):	Cow yard and old dairy yard: 1898 m ² Open feedpad: 3200 m ² Entrance yard between cow yard, dairy yard and feedpad: 440 m ² Eastern concrete laneway entrance: 227 m ² Earthen manure pad: 900 m ² There are no earthen laneways with runoff contributing to the effluent system.
Rooftop rainfall collection:	Diverted into fresh rainwater tanks for use at the dairy. Overflow is discharged into natural drainage lines and kept separate to the effluent system.
Calving pattern:	50:50 autumn and spring calving.

Calf rearing:	A calf rearing shed is used for rearing calves, located immediately west of the dairy and old dairy shed (see Figure 10).
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Table 6. Water generation and washdown details.

<u>Water Use Item</u>	<u>Description</u>
Dairy water supply (hoses):	Fresh water, sourced from licenced catchment dams.
Dairy plant washdown water:	Fresh rainwater from rainfall rooftop catchment.
Cheese processing facility brine generation:	2500 L/week, or 357 L/day.
Yard wash and cleaning method:	Yard blasters with fresh dam water – top of yard each milking. Front end loader scraper – once daily (AM).
Feedpad cleaning:	Dry scraping, with all solids pushed into a trafficable solids trap / sump (see Table 7).
Current freshwater use contributing to the effluent stream:	37,743 litres per day, inclusive of dairy processing wastewater of 357 L/day (see Section 6 for details). Average of 48 L/cow/day.

Table 7. Effluent system details – collection and containment.

<u>Effluent System Component</u>	<u>Description</u>
Solids collection:	Trafficable solids trap and sump with a volume of 85,050 litres. Collection and agitation sump with a volume of 111,375 litres. All effluent is agitated before pumping through a screw press.
Manure stockpile pad:	Existing earthen manure pad against the screw press, drained back into the effluent sump. Area is approximately 900m ²
Effluent drainage system:	All drainage within the cow yard flows into a drain between the cow yard and feedpad, discharging to the TST and sump. All feedpad drainage flows into the TST and sump.
Drainage from earthen laneways	Managed with woodchip pack, used to collect solids for reuse upon scraping and spreading. All runoff is diverted into paddocks where nutrient is utilised by pasture.
Solids separation:	Following agitation, all effluent is pumped through a screw press, removing a minimum of 20% solids from the effluent stream.
Effluent system:	Single-pond system for managing effluent. - Requirement: 12.55 ML at a 6-month winter storage period from April-September for both effluent and sludge. - Capacity: 15.0 ML with 0.6m of freeboard (see Section 8.4.2.1 and Appendix C).
Current effluent irrigation area (Ha):	Applied across 60.5 hectares which includes the following sites: - Big Paddock pivot. 41.3 hectares. This is a full centre-pivot. This is an underslung line. - China Paddock pivot. 19.2 hectares. This is a half centre-pivot. Effluent is applied through this pivot when blended with fresh irrigation water. The current requirement for liquid effluent irrigation is 52.2 hectares annually.
Current sludge and manure spreading area (Ha):	Sludge is spread on irrigation and dryland areas at rates supported by annual soil testing and agronomic advice. The minimum required land area for annual application is 9.8 hectares on high-production irrigation land.

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Figure 10. Dairy and associated infrastructure. Zones bordered in yellow are concrete catchment areas contributing to the existing effluent system.

5.2. Existing daily freshwater contribution to the effluent system.

Freshwater contribution to the effluent stream for the existing dairy and cheese processing facility wastewater are listed in Table 8.

Table 8. Daily water contribution to the effluent system (litres).

BREAM CREEK DAIRY.

Platform speed graph milking time: 2 hrs 36 mins at 10 seconds per bail

CURRENT OPERATION. 780 COWS.

Budget based on 2 hrs 45 mins

	Cows	Time/Milking (Hours)	Milking Minutes	Milkings	Large Hoses - mins/hour - Wet Up	Large Hoses - mins/hour during milking	Large Hoses - mins/hour end milking	Small Handheld Hoses Down Minutes	Yard Blaster Time	Milking Time Per Cow (Mins)
	780	2.75	165	2	5	2	10	2	2	4.73

Item	Volume (l/day)	Details of Testing & Notes	l/sec	l/min	l/milking	x 2 milkings	SOURCE
Rotary Hose 1 Platform	14850	0.75	0.75	45	7425	14850	Catchment
Rotary Hose 2 Cups	0	Disconnected		0	0	0	Catchment
Rotary Hose 3 Bottom	0	Disconnected		0	0	0	Catchment
Dairy Shed Hose/Platform/Top of Yard - Wet Up	2400	Hoses running at 4 L/s	4.00	240	1200	2400	Catchment
Dairy Shed Hoses during milking	2640	Hoses running at 4 L/s	4.00	240	1320	2640	Catchment
Dairy Shed Hoses end of milking - Platform, Shed, Top of Yard	4800	Hoses running at 4 L/s	4.00	240	2400	4800	Catchment
Small Handheld Hoses in Dairy	36	0.15 L/s	0.15	9	18	36	Catchment
Yard Blasters	7920	11 kv pump, 33 L/s	33	1980	3960	7920	Catchment
Vat Wash	1500	Approx 1500 litres per wash, once per day			750	1500	Catchment
Plant Wash	3000	3 washes x 500 litres per wash, x 2			1500	3000	Catchment
Calf milk washdown	240	1 minutes with large handheld hose	4	240	120	240	Catchment
Plate cooler water	0	Dam water recycled back into farm dam			0	0	Catchment
Cheese processing facility wastewater	357	Estimated volume proposed			179	357	Brine
Total Water Generation/Day (litres):	37743				18872	37743	

Median Cow Time on Yards/Milking	Time on Yards/Day (hours)
1.5	3

Average per cow (litres): 48

Total of large hoses in dairy (litres): 9840

Total effluent water generation/day (L) - excluding wastewater: 37386

Total effluent water generation/week (L) - excluding wastewater: 261702

Proposed water use is acceptable, averaging 48 litres/cow/day. Proposed water use is below the 75th percentile water use for a rotary dairy with a herd size of up to 800 cows.

No water reduction measures are recommended for this dairy.



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5.3. Existing dairy system components.

5.3.1. Dairy shed details, water use components and drainage.

The dairy is a 60-unit rotary with twice-daily milking. The median cow time on yards is 1.5 hours per milking, totalling 3 hours per day. This average includes time to feed on the feedpad either prior to or post milking.

Figure 11 and Figure 12 are photographs of the rotary platform. Figure 13 shows the platform and a single hose on the rotary providing effective washdown of the platform and cups, running at 0.75 L/s. Figure 14 shows handheld hoses within the dairy used to wash the shed. Washdown practices are deemed effective.

All washdown flows into a drain beneath the rotary platform and is discharged into a drain between the dairy yard and feedpad, flowing south into a TST and sump. The dairy shed drain discharging into the yards is deemed effective, with very low risk of blockage or backflow.

Rooftop rainfall from the dairy shed and all other sheds on-site is collected in freshwater tanks at the dairy, used for washdown of the plant and vat. All other fresh water used is catchment water taken by licenced extraction.

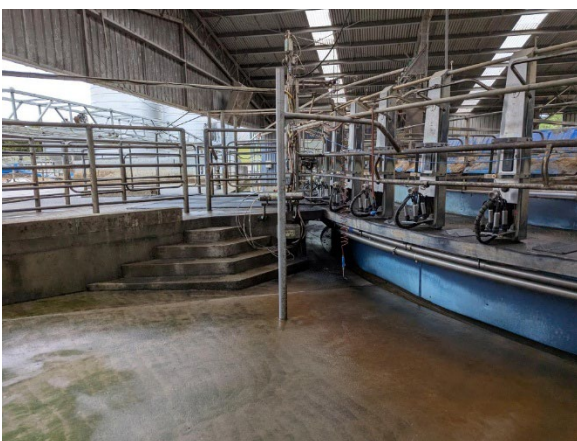


Figure 11. 60-unit rotary – exit race side.



Figure 12. 60-unit rotary dairy with hoses at the cups on station.



Figure 13. One rotary hose running at 0.75 L/s.



Figure 14. Dairy shed hoses.

For the proposed development described in Sections 6-12, an increase in water use on the rotary is proposed. Water use will also proportionally increase with an increase in milking time.

5.3.2. Concrete cow yard, side yard (old dairy yard) and drainage.

The areas available for used to yard cows include the following:

- Cow yard: 1173m².
- Side yard (old dairy yard) and cow entrance concrete: 1065m².

The total yard area available for holding cows is 2338m² and includes an old dairy yard. For 780 cows, the total space per cow is 2.99m² per cow. This is sufficient to hold the entire herd before, during and after milking (Dairy NZ, 2021). The ability to hold the entire herd before and after milking on the concreted dairy yard reduces the amount of time spent on earthen laneways approaching the dairy, reducing manure deposits and mud developing in these areas.

For the proposed development, the total space per cow will decrease to 2.33 m²/cow, which remains significantly higher than the minimum requirement of 1.5 m²/cow recommended (Dairy NZ, 2021). The entire herd will be able to be contained within the dairy yard and old cow yard, should cleanout of the barn be required and cows contained elsewhere. This also does not include the existing feedpad which will also be available.

The yard slopes at approximately 1 metre in 50, or 2.0% grade to the south. The cow yard is washed with yard blasters across the upper part, then scraped with a front-end loader mounted tyre scraper to clean the mid and lower sections along with the feedpad. Existing concrete yards have adequate nib-walling to prevent any overflow during yard cleaning.

A photograph of the cow yard is included in Figure 15. A photograph of the old dairy yard is included in Figure 16. All drainage flows into a culvert and drain between the cow yard and feedpad, shown in Figure 17. Drainage is discharges into a Trafficable Solids Trap (TST) and sump shown in Figure 20. A photograph of the yard post scraping is shown in Figure 18. This was observed while on-site and is deemed to be an effective system of waste management.



Figure 15. Cow yard.



Figure 16. Side Yard (Old Dairy Yard).



Figure 17. Drain collecting dairy and yard washdown, discharging to the TST and sump.



Figure 18. Cow yard after yard blasting the upper part and dry scraping the lower section by front-end loader.

5.3.3. Feedpad.

The business uses a feedpad for feeding out approximately 30% of the diet. The feedpad consists of two feed lanes and 4 feed faces, all which are scraped once daily each morning. A photograph of the feedpad taken after scraping is shown in Figure 19.

For the proposed development, this feedpad will remain in place until Barn 1 is constructed. Following the construction of the loose housing barn, this feedpad will have a roof placed over it and be used for the feeding and housing of heifers. Pond sizing calculated in Section 8 accounts for all rainfall collected on this surface. Following construction of a cover over this feedpad, rainfall collection will reduce by 1.22 ML over the winter storage period, freeing up this space within effluent storage ponds for effluent containment.



Figure 19. Feedpad, post dry scraping.



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5.3.4. *Trafficable solids trap, sump and solids separation.*

A photograph of the TST and sump are included in Figure 20 and Figure 21 respectively. The TST and sump have the following capacities, based on 0.2m of freeboard:

- TST: 85,050 litres, based on length of 30 metres, width of 3.5m, depth of 2.0 metres and ramp slope of 15:1 grade with no horizontal section at the low end. A photograph of the TST is shown in Figure 20.
- Sump: 111,375 litres, based on length of 4.5 metres, width of 4.5 metres and depth of 6.0 metres. A photograph of the agitation sump and screw press are shown in Figure 21.

The total capacity of the TST and sump is 196,425 litres.

The TST is used predominately as a stone trap. The trap has a weeping wall which also overtops, with most manure passing into the agitation sump by overflow. Effluent is agitated and pumped through a solids separation system (screw press), designed to remove a minimum of 20% solids from the effluent stream.

For the proposed development, a doubling of the TST size is proposed. No changes are proposed to the screw press. Details are provided in Section 8.2.

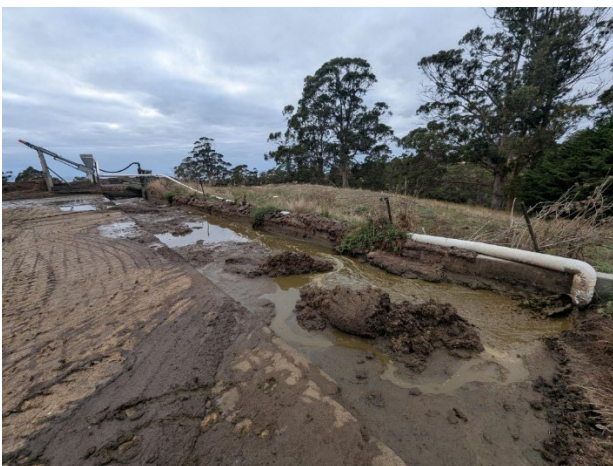


Figure 20. TST with solids collected during scraping.



Figure 21. Sump on the eastern end of the TST with a screw press.

5.3.5. *Earthen manure storage pad.*

An earthen manure pad has been in use by the business for storing screened manure since the feedpad was constructed. This pad drains to the north-east corner and drainage is collected by a collection pit and 300mm pipe which discharges into the existing effluent pond. The pad contains screened manure and spent woodchips over the winter storage period while land application is restricted. The pad is approximately 900m² in size and has dimensions of approximately 30 x 30 metres. A photograph of the pad is shown in Figure 22.

For the proposed development, this manure pad will be replaced with a 30 x 30-metre concrete hardstand area, with drainage directed into the same pit and pipeline previously noted. This pipeline also forms an emergency overflow between the sump and agitation pit and existing pond, should the screw press fail or suffer a power outage. Proposed changes are detailed in Section 8.2.



Figure 22. Manure pad.

5.3.6. *Single pond effluent storage.*

Following screening, liquid effluent is stored in a single-pond effluent system currently containing both sludge and manure. This pond has a capacity of 15.0 ML at contour level 113.35 metres, in accordance with plans by NJC Irrigation Solutions (Appendix C). A high-quality sludge is contained within the pond following screening. A photograph of this pond is included in Figure 23. Section 8.3 provides further details.

For the proposed development, the effluent system will be converted into a multi-pond system, with one new sedimentation pond (to become Pond 1) and two storage ponds (Ponds 2 and 3). The existing pond will become Pond 2. These details are provided in Section 8.4. No changes are proposed to the configuration or capacity of Pond 2. Pond 2 will require entire cleanout of liquid and sludge prior to commencement of the proposed development, ensuring the full pond volume is available for liquid effluent storage.



Figure 23. Single effluent pond.

5.3.7. *Calf rearing facility.*

Calves are reared under cover in a shed close to the dairy, as shown in the site plan in Appendix C. Drainage water is not permitted to enter the shed. Rooftop rainfall is diverted away from the effluent system. All urine and manure generated is absorbed by a woodchip pack with a thickness of 300mm, topped up between batches of calves and cleaned out once per season to reduce the incidence of disease. A photograph of the calf shed and rearing area is shown in Figure 24.

For the proposed development, no changes are proposed.



Figure 24. Calf rearing shed.

5.3.8. *Laneways and management.*

Laneways are currently used for walking cows to and from the dairy to the east and west (turning south-west). Laneways are managed by elevated and compacted gravel bases which are drained onto pasture to ensure nutrient is adsorbed by soil and up taken by pasture. Pastures are used to act as a vegetative filter strip prior to runoff entering watercourses. Woodchips are applied in high-traffic areas where approaching the dairy to absorb manure and urine and improve cow comfort. Woodchips on high-traffic areas are regularly scraped, stockpiled on the manure pad and spread on land every 3-6 month or as required, then topped up again with fresh material. Scraped woodchips are applied to land at sustainable rates based on soil test results, mainly on dryland areas which produce pasture. A photograph of the laneway running south-west of the dairy is shown in Figure 25.

For the proposed development, earthen laneways for walking cows to and from the dairy for milking will become obsolete. Cows will be shifted between the barn and dairy on a concrete laneway, with drainage collected and contained within the effluent system. These measures will significantly reduce odour emitting surfaces around the site. Changes are described in Section 6.



Figure 25. Laneway to the south-east of the dairy parallel to Bream Creek Road.

5.3.9. *Existing effluent irrigation area.*

There are two existing centre pivot irrigators on the site used for effluent irrigation totalling 60.5 hectares. These include:

- Big Paddock pivot. 41.3 hectares. This is a full centre-pivot with an underslung line for effluent, shown in Figure 26.
- China Paddock pivot. 19.2 hectares. This is a half centre-pivot shown in Figure 27. Effluent is applied through this pivot when blended with fresh irrigation water.

All centre pivots are linked by connecting pipelines allowing effluent to be transferred to all irrigator sites.

For the proposed development there will be an increase in effluent irrigation area across other available sites, providing approximately 139 hectares of irrigated land excluding proposed setback distances.

Proposed changes are provided in Section 9.



Figure 26. Irrigator with an underslung effluent line – Big Paddock.



Figure 27. Irrigator on the China Paddock.

6. PROPOSED SITE PLANS & CHANGES IN EFFLUENT COLLECTION & MANAGEMENT.

6.1. Changes to the existing system of operation and proposed operational improvement.

Changes to the existing system dairy, effluent system and management of cows and operational improvement measures include:

1. Construction of a loose housing barn, shifting all cows from pasture-based feeding and grazing to a contained system of operation on a total mixed ration (TMR) on a compacted, impervious earthen pad. This includes a single tractor lane for feeding out and two cow feeding lanes. A concrete laneway will connect the barn with the dairy and feedpad. This facility is intended to provide operational improvements to animal health, production and staff. All urine and manure produced on concrete surfaces within the barn, concrete laneway between the barn and dairy and the dairy yard will be collected by the effluent system.
2. Upgrades to effluent system components, including:
 - a. Trafficable solids trap. This will be increased in capacity by doubling the existing trap size, allowing for space for all floodwash water from the barn to be contained within the trap, covering 1 day of effluent generation (twice-daily floodwashing). In practice, on-demand pumping will create airspace during and following milking, ensuring the TST and sump can always hold the effluent and floodwash generated from each milking.
 - b. Installation of a concrete manure storage pad to replace the existing earthen pad, with drainage collected and diverted into the effluent system.
 - c. Construction of an impervious earthen pad for emergency or temporary storage of spent bedding from the cow barn or maternity barn, should this be required. This pad will be positioned alongside the maternity barn.
 - d. Construction of a new effluent sedimentation pond, with a capacity of 9.11 ML.
 - e. Construction of a new effluent storage pond, with a capacity of 29.3 ML.
 - f. A runoff pond to collect drainage water from the new silage area, with a capacity of 5.54 ML, with a pump and pipeline which allows for this water to be supplied into the irrigation network for sustainable land application.
3. Expansion of the effluent irrigation area currently used for applying effluent. This will expand from the use of two pivots covering 60.5 hectares, to all pivots and cover 139 hectares, excluding 30-metre setbacks from watercourses and waterbodies. Sustainable land application will be practiced with additional land for effluent irrigation.
4. Eliminating use of earthen tracks and laneways for walking milking cows to and from the dairy, reducing odour emitting surfaces and improving cow health. Cows will not be required to walk significant distances or up steep slopes twice-daily for milking.
5. Reconfiguration and construction of a roof over the existing feedpad, to be used periodically throughout each year to house calving cows for short periods while calving and for veterinary management. A cover over this facility will reduce rainfall collection, pond sizing and feed spoilage.
6. Increasing water use within the dairy, providing higher quality effluent with reduced odour for effluent recycling (floodwashing) and irrigation. Effluent with high levels of fresh water dilution may

reduce odour emissions by reducing in nutrient loading, organic loading, BOD levels and odorous gas emission per unit of liquid effluent contained.

7. Elimination of grazing by productive dairy cows, which will reduce paddock pressure and result in maintenance or improvements in soil structure and production. All irrigated areas will transition from pasture-based, cell-grazing to a cropping operation.

Elements of the dairy and effluent system that will remain unchanged:

1. Dairy and yards. No changes are proposed to the dairy, yards or method of cleaning. There will also no change to the old dairy yard.
2. The existing effluent pond will remain unchanged and become Pond 2 of a multi-pond system of three effluent ponds.
3. Grazing will remain across all dryland areas for young stock and dry cows.

6.2. Proposed site plan.

The proposed site plan by NJC Irrigation Solutions is provided in Appendix D.

6.3. Proposed barn plan.

Proposed barn construction plans are provided Appendix G. An extract of the plans by Quingdao RT Steel showing a cross section of one end of the barn is shown in Figure 28. Feeding lanes for floodwashing are 4.0 metres in width. The tractor feed alley is 6.0 metres in width. There are two loose housing areas for cow loafing with widths of 21.0 metres either side of the feed lanes.

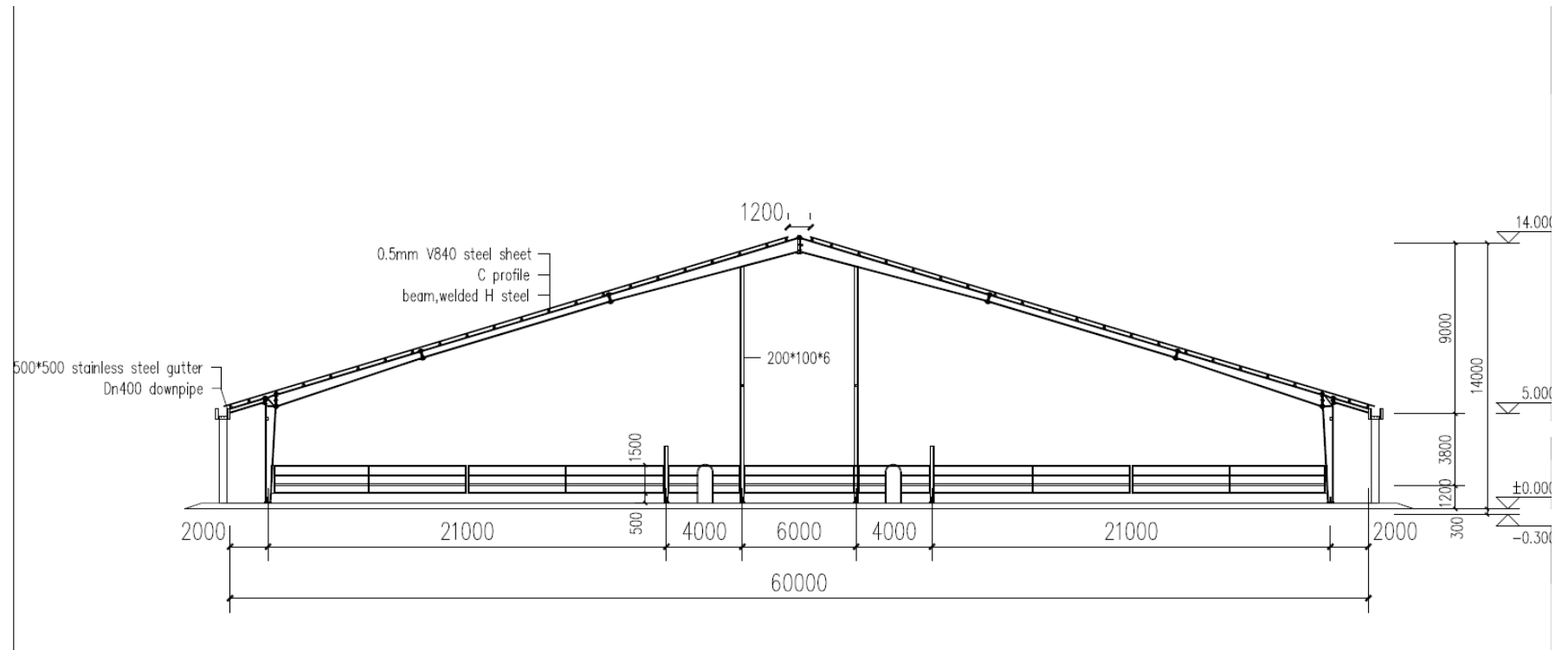


Figure 28. End section of the proposed barn (Quingdao RT Steel, supplied by Stroud Dairies).



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7. PROPOSED DAILY FRESHWATER CONTRIBUTION TO THE EFFLUENT SYSTEM.

A breakdown of proposed daily freshwater contribution to the effluent system upon completion of the loose housing barn is provided in Table 9. The proposed daily freshwater generation is 117,818 litres per day.

Table 9. Proposed water use following construction of the loose housing barn.
NOTE: All calculations include use of recycled effluent for flood washing the barn feed lanes.

	Cows	Time/Milking (Hours)	Milking Minutes	Milkings	Large Hoses - Shed Wet Up (mins)	Large Hoses - during milking (mins/hour)	Large Hoses - end milking (mins)	Small Handheld Hose Down (mins)	Yard Blaster Time (mins)
	1000	3.75	225	2	5	2	15	2	2

Item	Volume (l/day)	Details of Testing & Notes	l/sec	l/min	l/milking	x 2 milkings	SOURCE	Calf Feeder Washdown (mins)	Calf Shed Hosedown (mins)
Rotary Hose 1	40500	1.5 L/s	1.50	90	20250	40500	Catchment	2	120
Rotary Hose 2	27000	1.0 L/s	1.00	60	13500	27000	Catchment		
Rotary Hose 3	20250	0.75 L/s	0.75	45	10125	20250	Catchment		
Dairy Shed Wet Up: Shed, Platform & Top of Yard	3000	Hoses running at 5 L/s	5.00	300	1500	3000	Catchment		
Dairy Shed Hoses during milking	4500	Hoses running at 5 L/s	5.00	300	2250	4500	Catchment		
Dairy Shed Hoses end of milking - Platform, Shed, Top of Yard	9000	Hoses running at 5 L/s	5.00	300	4500	9000	Catchment		
Small Handheld Hoses in Dairy	180	0.15 L/s	0.2	12	90	180	Catchment		
Calf milk feeder washdown	600	Hoses running at 5 L/s	5.00	300	300	600	Catchment		
Calf shed hose down (4 times per year)	11	High pressure hot water hose at 8.3 L/min	0.14	8.3	5.4	11	Catchment		
Yard Blasters	7920	11 kv pump, 33 L/s	33	1980	3960	7920	Catchment		
Vat Wash	1500	Approx 1500 litres per wash, once per day			750	1500	Catchment		
Plant Wash	3000	3 washes x 500 litres per wash, x 2			1500	3000	Catchment		
Plate cooler water	0	Dam water recycled back into farm dam			0	0	Catchment		
Cheese processing facility wastewater	357	Estimated volume proposed			179	357	Brine		
Loose housing barn feed lane floodwashing (twice daily)	160000	Recycled effluent. Calculation provided below.			80000	160000	Recycled effluent		
Total daily water contribution to the effluent stream (litres):	117818				58909	117818			
Average daily water use per cow, inc wastewater (litres):	118								
Total weekly water contributing to the effluent stream (litres):	824726								
Total effluent water generation/day (L) - excluding wastewater:	117461								
Total effluent water generation/week (L) - excluding wastewater:	822226								
Total of large hoses in dairy (litres):	16500								
Total of rotary hoses in dairy (litres):	87750								

RATIONALE
Handheld hoses at 2 minutes per hour of milking with extra rotary hoses.
Handheld hosing 15 minutes at end of milking, includes top of yard.
Small handheld hoses 2 mins per milking. With large hoses total 4 mins.
Plant wash fills 3 times of 500 litres, total 1500 litres per milking.
Vat work on 750 L, twice daily.
Calf feeder washdown based on being washed daily.

BARN FLOODWASH WATER USE	
Lane Length (m):	300
Lane Width (m):	4
Slope (%):	2
Minimum flow depth (mm):	100
Floodwash per Lane (litres):	40000
No of Lanes:	2
Recycled Effluent for 1 washdown:	80000
Washes/day:	2
Recycled Effluent for 2 washdowns:	160000



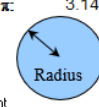
8. PROPOSED EFFLUENT MANAGEMENT SYSTEM: SIZING, CONTAINMENT & COMPLIANCE.

8.1. Effluent Toolkit: Data entry.

Table 10 is an extract from the Toolkit for the proposed 1000-cow loose housing barn operation.

Table 10. Extract from Toolkit front page: Herd details, water use, recommended storage period, catchment areas and solids separation details.

Herd details		Location and Storage details									
Current herd size	1000	Location	2. Bream Creek Tas 1								
Proposed max herd size	1000	Crop type (K _c)	Temperate perennia								
Current annual milk sales (L)	13,870,000	Storage period	User selected								
Average time on yards (hrs/day)	6	K value	0.52								
Days herd dry during storage period		Recommended storage months <table border="1"> <tr> <td>May</td> <td>Jun</td> <td>Jul</td> <td>Aug</td> </tr> <tr> <td>Sep</td> <td>Oct</td> <td></td> <td></td> </tr> </table>		May	Jun	Jul	Aug	Sep	Oct		
May	Jun	Jul	Aug								
Sep	Oct										
Average % total diet fed on feedpad	100%	User selected storage months ☐ January ☐ February ☐ March ☒ April ☒ May ☒ June ☒ July ☒ August ☒ September ☐ October ☐ November ☐ December									
% feed wastage on feedpad	5%	Recommended storage months 8 Chosen storage months 6									
Calving pattern	Year round										
Milkings per day	Twice a day										
Dairy type	rotary										
Estimated waste & calf milk (L)	208,050										
Production per cow	39 L/day										

Daily water use		Catchment area	
Litres of water used daily that will enter the effluent system		Include any areas where runoff enters the effluent system (feedpads, dairy yard, tracks etc) Only include shed roof area if no diversion is in place	
Teat washing	11		
Vat wash	1,500		
Plant rinses (hot & cold)	3,000		
Dairy pit & platform wash	16,500		
Plate cooler water	600		
Platform sprays (rotaries)	87,750		
Cup sprays (rotaries)	180		
Other	357		
Yard wash - clean water	7,920		
yard wash - recycled effluent			
frequency of yard wash	Twice a day		
Total clean water use L/day	117,818		

Rainwater Diversion		Solids Separation	
Rainwater diverter	N	Type	Screw press
Diverter Use	Not applicable	Enter details for "other" solids separation here	
Hours diverted daily when in use		TS removed	20%
		VS removed	20%

Table 10 confirms the following:

- The proposed daily freshwater generation includes the existing cheese-processing wastewater. This small quantity of wastewater will only be further diluted by the effluent system given the increase in fresh water.
- The recommended effluent storage interval by the Toolkit is 8 months, extending from March to October. A worst-case water budget in Table 2 confirms the following:
 - March has an irrigation deficit of 2mm. The Toolkit automatically assumes any month with an irrigation deficit of 1-10mm to be a recommended storage month, unless sprinkler irrigation is installed allowing small volumes to be applied strategically over the storage period. Consequently, March is removed from the storage period.

- The month of October has a rainfall surplus of 1mm across the course of the month, triggering a storage month. During this month, this minor surplus is manageable for strategic application after a period of 5-days with fine weather during the winter storage period with sprinkler irrigation in accordance with details in Section 9.2. A policy to ensure application of at least 1mm of effluent over the storage period will need to be adopted by the business. Consequently, October is removed from the storage period.
- Excluding March and October, storage months where decile 9 rainfall exceeds decile 1 evapotranspiration cover 6 months from April-September. This is the “user selected” winter storage period adopted for this site to best suit the businesses operation, providing a practicable outcome. During this period, low-rate applications of effluent may occur when weather conditions permit, without generating runoff.
- The equivalent impervious catchment areas total 9323m², excluding the silage area which has rainfall runoff calculated separately (see Section 8.5) and an independent storage area.
- The time on yards, or the time in which manure and urine is collected is 6 hours, which includes:
 - 2 x milkings at 1.5 hours, totalling 3 hours, and
 - 6 x feedings at 30 minutes per feeding, totalling 3 hours.

8.2. Trafficable solids trap and sump.

8.2.1. Trafficable solids trap (TST).

The TST is proposed for upgrading, by doubling the existing capacity. This will involve widening the existing structure by an additional 3.5 metres to an overall width of 7.0 metres. Calculations showing the proposed TST capacity are provided in Figure 29, based on a 7-day cleanout interval. Requirements and capacity are:

- Requirement: 91,658 litres.
- Capacity: 170,100 litres.

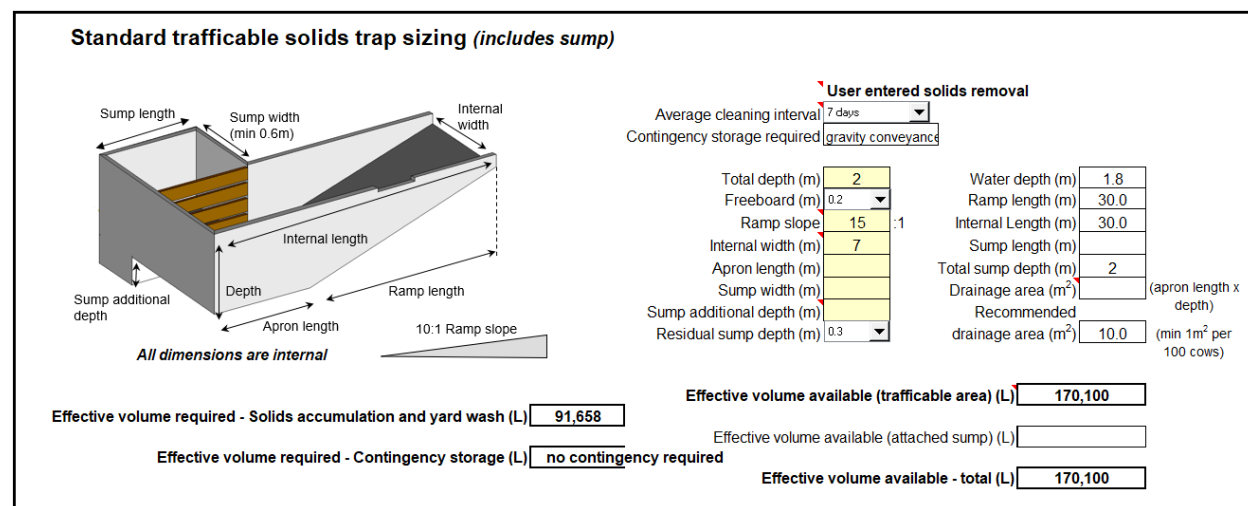


Figure 29. TST size parametres, requirement and volume.



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8.2.2. Sump.

Calculations showing the existing sump volume are provided in Figure 30, based on a 7-day cleanout interval. The sump will remain unchanged. The sumps capacity is 111,375 litres with 0.2m of freeboard and a residual depth of 0.3m after pumping.

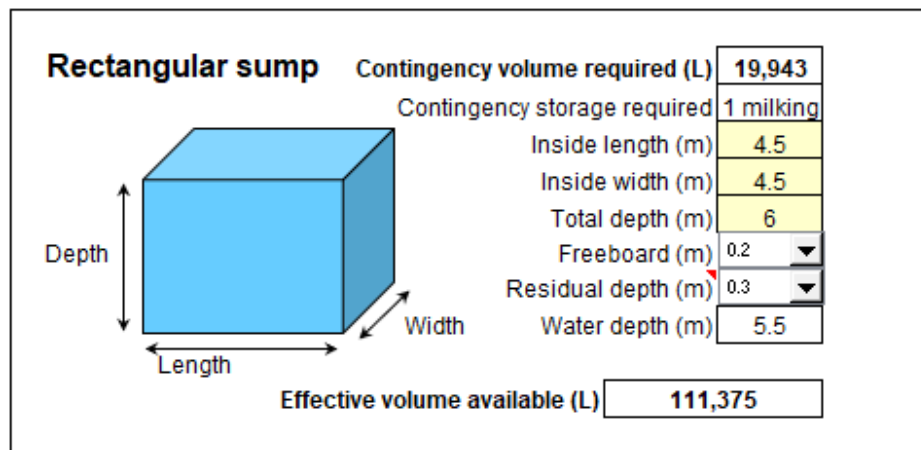


Figure 30. Sump sizing.

8.2.3. TST and sump: Total capacity.

The total capacity of the TST and sump are calculated as follows:

Proposed TST sizing:	170,100 litres.
Existing sump:	111,375 litres.
Total capacity:	281,475 litres.

The daily washdown generation collected within the TST and sump is calculated as follows:

Dairy shed washdown:	119,961 litres/day.
Barn floodwash:	160,000 litres/day.
Total daily washdown generation:	279,961 litres/day.

The system will have capacity to hold 1 day of effluent washdown water.

To provide assurance that this system has adequate capacity and contingency, the following measures must be installed:

- On-demand pumping, ensuring effluent pumping and solids screening occur immediately following inflow providing airspace within the system during and following milking.
- a back-up pump to be kept on-hand.
- an emergency overflow placed at full supply level, directing liquid effluent to Pond 2, which is already in place. Activation of this overflow is a measure of last resort.

8.3. Solids separation, concrete manure storage pad and emergency spent bedding pad.

8.3.1. Solids separation.

A screw press is used to provide solids separation. This system will be maintained as part of the effluent system as described in Section 5.3.4. This system is used to remove a minimum of 20% solids from the effluent stream. No changes are proposed.

8.3.2. Concrete manure pad.

A concrete manure storage pad will be installed to replace the existing clay-based earthen pad, with the location pushed to the south of the existing site. The pad will have a total surface area of 900m², with dimensions of 30 x 30 metres. Drainage from this pad will flow directly into the existing effluent pond as per the current drainage arrangements. The existing effluent pond will become effluent pond 2 (storage pond 1).

This concrete pad will store:

- Screened manure, which will be shifted to paddocks as required.
- Sludge and foreign matter from the TST. The TST is designed to capture foreign matter, with organic material (manure and spent feed) passing through into the sump for pumping through the screen.

8.3.2. Emergency spent bedding storage pad.

The business proposes to install an impervious earthen pad to provide emergency storage of spent bedding, should this ever be required. The pad will have an area of 1400m², with the position shown in Figure 32.

The pad is for emergency or temporary use only should unforeseen circumstances arise should changeover and stockpiling of spent bedding be required during the winter storage period.

The rationale for sizing this pad is based on the following information:

- Volume required for stockpiling:
 - Worst case of 75% of bedding material requiring changeover at any one time.
 - Barn area: 12,600 m²
 - Barn bedding depth: 0.6m
 - Spent bedding volume for emergency storage: **7560 m³.**
- Earthen pad sizing requirement:
 - Stockpiled manure batters: 1.5:1 grade (56°) at 50% dry matter.
 - Earthen pad width: 17 metres.
 - Height at 1.5:1 batters: 12.75 metres.
 - Volume linear metre of pad: 108.37 m³.
 - Required pad length: **69.76 metres**, plus end batters.
- Proposed earthen pad length: **82 metres (82m x 17m = 1400m²).**

A pad of 1400m² with a width of 17 metres will be suitable for emergency storage of spent bedding, should this occur. In practice, only part of the bedding exposed to prevailing weather or preferential cow grazing is likely to fail at any one time.

8.4. Multi-pond effluent system.

8.4.1. Pond 1: Primary pond – sedimentation.

The minimum sizing requirement for a primary pond to support this system are outlined in Figure 31. The volume required is based on a 1-year cleanout, 0.6m minimum depth to sludge (to prevent sludge passing into storage ponds), internal batters of 3:1 and freeboard of 0.6m in accordance with DPIW (2008).

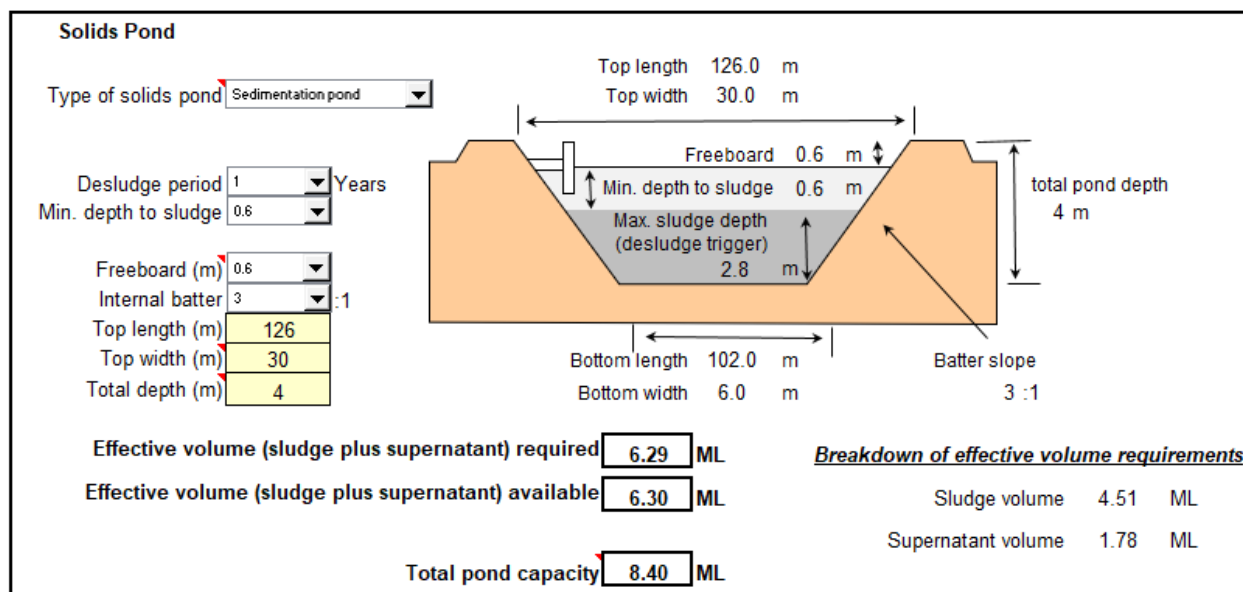


Figure 31. Pond 1 calculations.

The minimum requirement for Pond 1 is 6.29 ML, with 0.6 metres of freeboard provided in addition. Following solids separation, Pond 1 will contain high quality sludge following initial removal of coarser material by the solids separation system.

In accordance with plans by NJC Irrigation Solutions provided in Appendix D and E1, the proposed sedimentation pond is **9.1 ML** in capacity at 0.6m of freeboard. This exceeds the minimum requirement. An extract of plans from Google Earth are shown in Figure 32. Specifications for this pond are:

- Crest level: 114.84m AHD.
- Full supply level: 114.24m AHD.
- Freeboard: 0.6 metres.
- Fill batters (external): 3:1 H:V.
- Cut batters (internal): 2:1 H:V.

This pond will have a T-piece overflow system which will pass through the bank and discharge into Pond 2 (existing pond, to be used for effluent storage).



Figure 32. Pond 1 – Proposed sedimentation pond, also showing the maternity barn area and emergency spent bedding pad.

8.4.2. Ponds 2 & 3: Secondary ponds – liquid effluent storage.

The minimum sizing requirement for liquid effluent storage for this development is **33.01 ML**, excluding runoff from the proposed silage area. Calculations are based on a square pond section with a depth of 4.0 metres and batters of 3:1 H:V. An extract of the Toolkit with the total effluent storage requirement and inputs is shown in Figure 33. The following sections demonstrate how the minimum effluent storage requirement will be met.

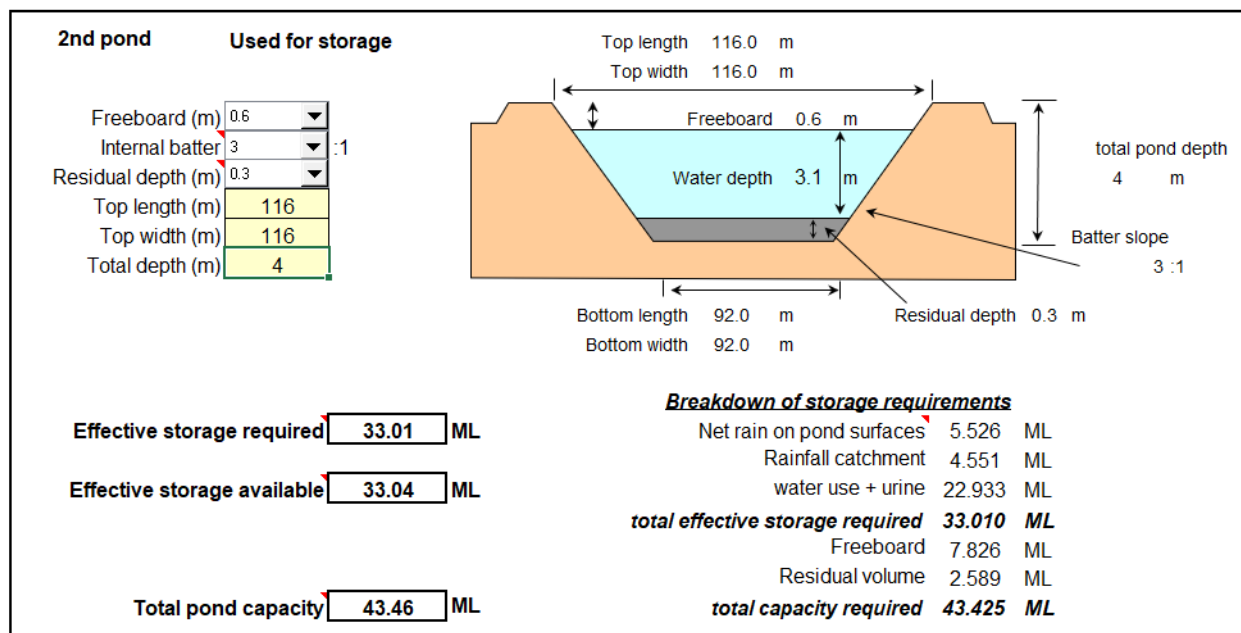


Figure 33. Effluent storage requirements for Pond 2 and 3, excluding silage area runoff.



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8.4.2.1. Pond 2. Existing effluent pond.

Volume of the existing effluent pond is sourced from plans by NJC Irrigation Solutions, included as Appendix D. The existing pond has a capacity of 15.0 ML at full supply level of 113.35m AHD. This pond is not subject to change. Calculation of the total pond volume is relied on by NJC Irrigation Solutions, given that the pond is not a perfect square section and contains several curved banks. Specifications for this pond are:

- Crest level: 113.95m AHD.
- Full supply level: 113.35m AHD.
- Freeboard: 0.6 metres.

This pond requires a T-piece overflow into Pond 3 when full supply level is reached. A pump will be installed on Pond 2 to transfer effluent for recycled floodwashing, or for pumping to irrigation.

This pond along with the crest level, full supply level and capacity are shown in Figure 34.

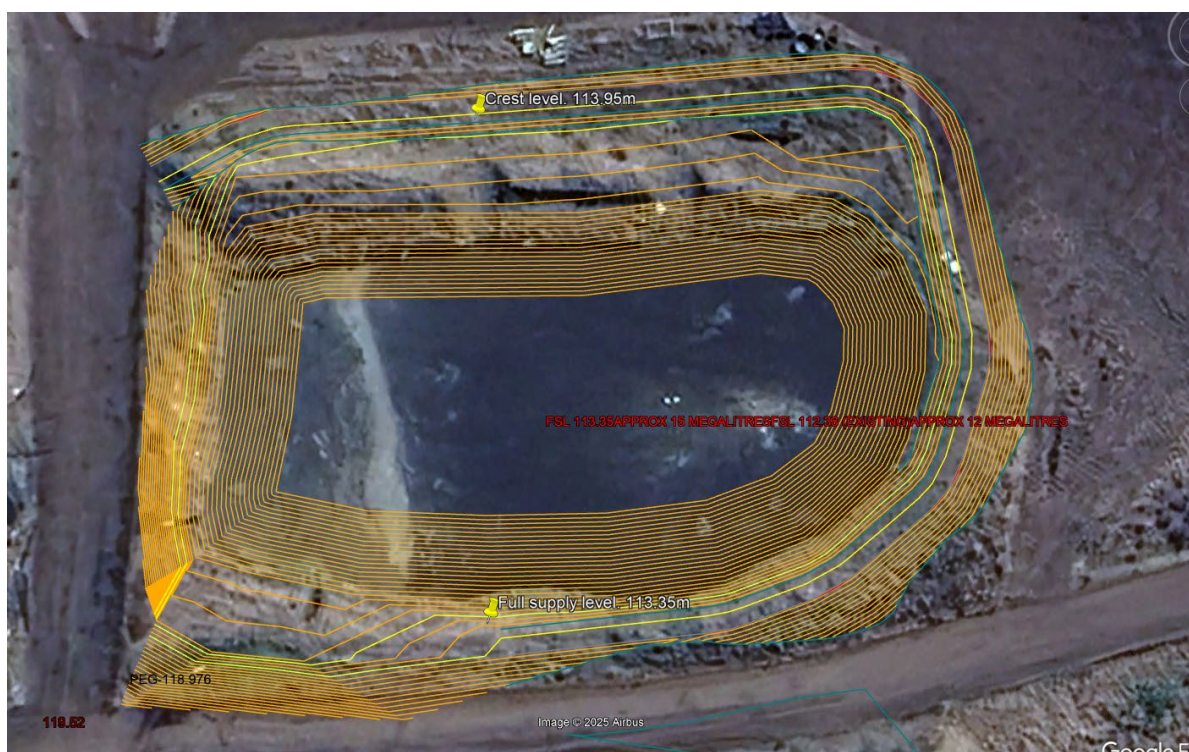


Figure 34. Pond 2 - Existing effluent storage pond, with survey levels and details.

8.4.2.2. Pond 3. New effluent pond.

Pond volume is sourced from plans by NJC Irrigation Solutions in Appendix D and E2. The proposed pond has a capacity of **29.3 ML** at full supply level. The pond has curved banks, providing the most efficient build option in this location working with the contour of the land. Specifications for this pond are:

- Crest level: 112.45m AHD.
- Full supply level: 111.85m AHD.
- Freeboard: 0.6 metres.

The surplus of pond capacity will be:

- Total capacity of Pond 2 and 3: 44.3 ML.
- Required capacity of Pond 2 and 3: 33.01 ML.
- Surplus effluent winter storage capacity: 11.29 ML.

An extract of plans from Google Earth are shown in Figure 35. A pump will be installed on Pond 3 to transfer effluent for recycled floodwashing, or for pumping to irrigation.

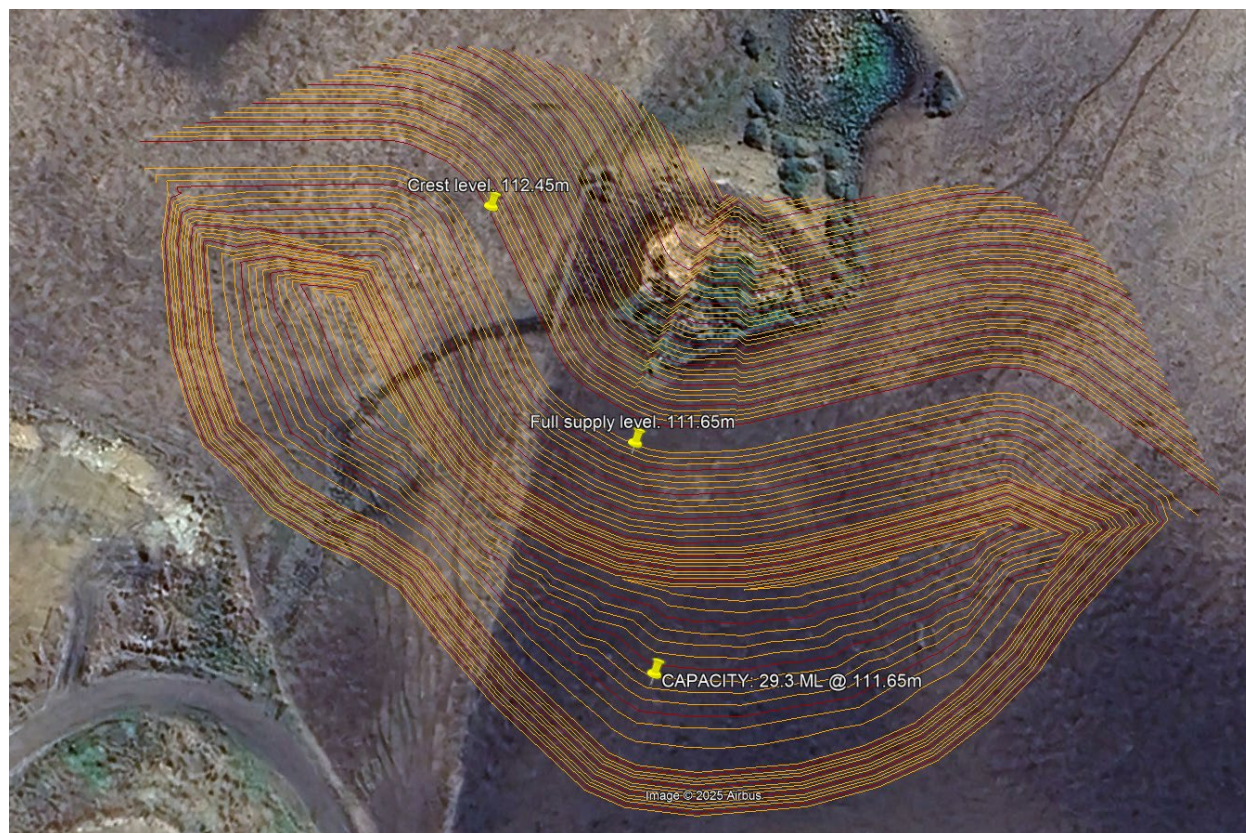


Figure 35. Pond 3 – Proposed additional effluent storage pond.



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8.5. Silage area runoff pond.

A runoff storage pond is required for collection of stormwater from across the silage area. This pond will form a borrow pit for accessing earth for use in construction of the barn pad. In accordance with DPIW (2008), batters of borrow pits should be no steeper than 2:1 horizontal to vertical grade, required for this pond. A runoff coefficient of 0.9 has been used as a conservative factor for runoff modelling in accordance with Dairy Australia (2008), which includes a compacted gravel base on top of compacted clay, also recognising that part of the area will be covered by an impervious silage cover for variable periods throughout each season. Inputs for this calculation are shown in Figure 36.

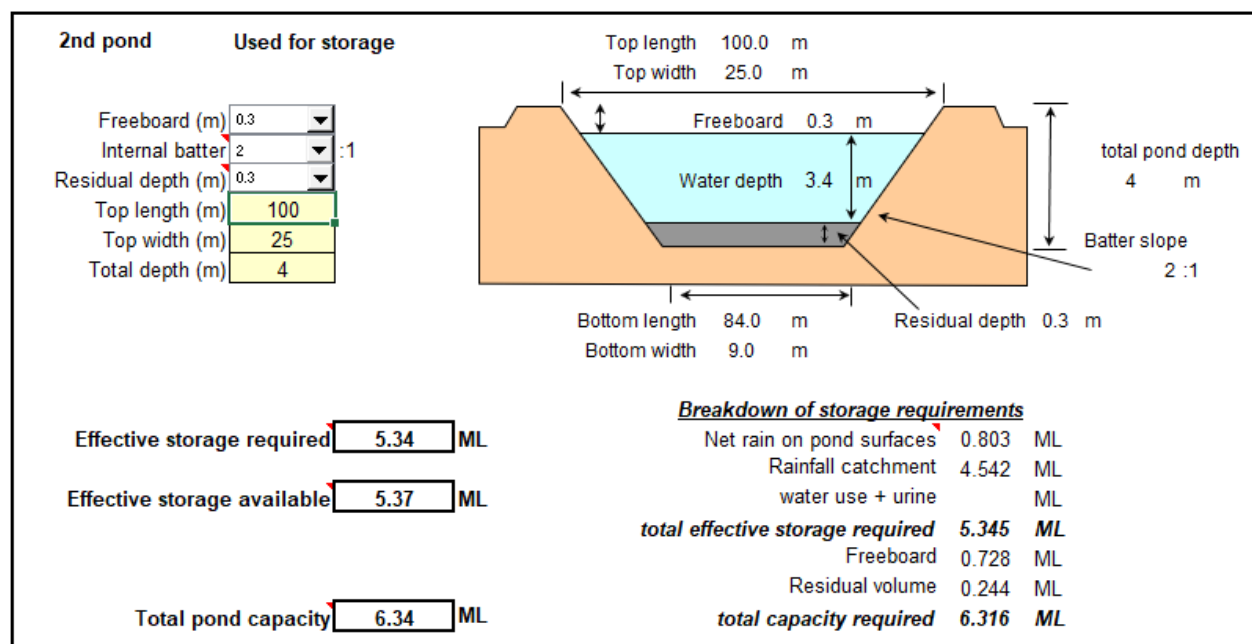


Figure 36. Silage area runoff pond inputs and minimum requirements.

Plans within Appendix D and E3 showing the approximate sump positioning and adopting a width of 25 metres, the required capacity is 5.34 ML. The runoff pond size provided within plans is 5.54 ML with a minimum freeboard of 0.6m.

9. LAND APPLICATION OF EFFLUENT, SLUDGE & MANURE.

9.1. Nutrient budgeting and limitations.

Land application for annual pasture and maize silage is calculated using the following rationale, with calculations provided in Table 11 (Dairy Australia, 2013; Future Dairy, 2016 and GRDC, 2018). Guidance is also sourced from DPIWE (2002). Rationale includes:

- double cropping, with three crops every 2-years. This includes ryegrass grazed, corn cut for silage and ryegrass, grazed.
- nutrient balance is based on ryegrass pasture crop 1 at 80% of full nutrient requirement, as it may be cut short for summer cropping of corn.
- 100% nutrient requirement for corn as crop 2, applied at a low-end yield potential to remain conservative.
- consistent nutrient application for ryegrass crop 3 based on ryegrass crop 1, and
- total nutrient generation calculated over 2 years, averaged per year.

Table 11. Nutrient removal by ryegrass pasture and corn silage in a 2-year rotation.

Potential Yields (tonne/Ha):

Ryegrass Pasture	10	10-15 t/Ha range. Low end selected - double cropping
Corn whole crop silage (kg/tonne)	20	20-25 t/Ha range. Low end selected

Nutrients removed per tonne of produ	N	P	K
Ryegrass Pasture	30	3	25
Corn whole crop silage (kg/tonne)	12	3	10

Crop rotation on effluent irrigation areas also used for grazing:

Crop Rotation:	Ryegrass, corn, ryegrass - 3 crops in 2 years.	
Nutrient uptake (estimates)	Ryegrass Year 1:	80% of nutrient requirement
	Corn - Summer Year 1-2	100% of nutrient requirement
	Ryegrass Year 2:	80% of nutrient requirement

Nutrient Removal (kg/Ha):	N	P	K
Crop 1 - Ryegrass:	240	24	200
Crop 2 - Corn:	240	60	200
Crop 3 - Ryegrass:	240	24	200
Total Nutrient Removed (2 Years):	720	108	600

Total Nutrient Removed (1 Year):	360	54	300
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Note:

In the summer following this rotation, corn will not be grown, but rotated to other sites.

80% of ryegrass nutrient requirement is selected, based on terminating crop 1 early to plant corn and then planting crop 3 later following maize harvest.

Nutrient removal values in Table 11 are applied to the Toolkit, with the output shown in Table 12. The required land area for effluent is **97.5** hectares. Effluent will be applied by irrigation. Grazing will cease on paddocks used for fodder production with effluent applied.

For effluent, phosphorus is the land limiting nutrient. When applying all effluent across the required land area previously noted, the actual levels of N, P and K applied with respect to nutrient removal are:

- Nitrogen: 264 kg/ha, or approximately 73% of nutrient removal.
- Phosphorus: 54 kg/ha, or approximately 100% of nutrient removal.
- Potassium: 226 kg/ha, or approximately 75% of the annual nutrient deficit.

The required land areas for sludge and manure application is **34.1** hectares. The land limiting nutrient is phosphorus. Phosphorus sorption is not required to ensure this system remains sustainable. Sludge will be applied by tanker. Manure will be applied by spreader.

Nutrient partitioning and removal in Table 12 accounts for losses in nitrogen.

Table 12. Land application areas for liquid effluent and sludge for sustainable application on pasture or corn.

System details				Nutrient partitioning (%)			
Annual production	14,078	L/cow		N	P	K	
No. of cows	1000			Sludge	20	30	10
Proportion of day on yards	25%			Liquid	50	60	90
System type	Single pond - not agitated			Loss	30	10	
Desludge period	1	years					

Fate of Nutrients entering the effluent system				Target application rates			
	N	P	K				
Total nutrient entering effluent system (kg/year)	51583	8777	24467	Liquid effluent area: Maximum annual nutrient application rate (kg/ha)			
Nutrient retained in liquid effluent (kg/year)	25792	5266	22021	N	P	K	
	360	54	300				
Nutrient contained in sludge upon cleanout (kg)	10317	2633	2447	Sludge: Maximum annual nutrient application rate (separate to liquid effluent application area, maximum target nutrient available in year of application)			
Sludge nutrient available in year of application (%)	40%	70%	100%	N	P	K	
Sludge nutrient available in year of application (kg)	4127	1843	2447	360	54	300	

Liquid effluent reuse area requirements			
Minimum area required for liquid effluent (green water) application system			97.5 ha
If liquid effluent is spread over the entire area suggested above it will apply an annual estimated nutrient application rate of (kg/ha):			
N	P	K	
264	54	226	

Sludge reuse area requirements			
Assumptions/Notes:		Area required for solids / sludge / slurry application at desludge	
- Includes all sludge captured by the effluent system including that removed by solids trap or other solids separation methods		34.1 ha	
- A different area of the farm is available for application at each desludge event		N	P
- Area calculated based on nutrient available in year of application		121	54
		181	23
		302	77

For sustainable application of effluent, sludge and manure, the business requires a minimum of **131.6 hectares** of land under irrigation to sustainably utilise the annual nutrient generation to support removal rates (or target application rates) listed in Table 12.

The business has approximately 207 hectares of irrigation land, of which approximately **139 hectares is available for effluent application by centre pivots, external to the setback distances. This exceeds the minimum requirement.** Part of the effluent land area can be utilised for sludge application. Centre pivots will require pivot technology including solenoids and valves on certain spans and end guns to ensure buffers are not encroached. All effluent should be applied by shandyng with irrigation water. Where technology cannot be adopted, spreading of effluent will need to occur by tanker. All sludge will be spread by tanker.

In addition to irrigated land, the business has additional **434.5** hectares of dryland available for sludge application. Should this be preferred, application rates must match dryland nutrient removal. Application must be supported by agronomic soils advice and regular soil testing.

Grazing is not proposed for any irrigated area devoted to fodder production and effluent application at the rates previously noted. Across dryland areas, should sludge or effluent be spread at sustainable rates, grazing of crops or pastures with dry cattle must not occur within 21 days of application. Grazing should be further avoided on areas following sludge application where:

- no rainfall or irrigation has occurred since application, and
- where application of K has exceeded 120 kg/Ha within a 12-month period.

To minimise the risk of infection with Johne's disease, calves and stock up to 12 months of age must not be grazed on land where effluent has been applied.

9.2. Proposed setback distances and environmental protection measures.

For environmental protection, the following measures will need to be applied to ensure that effluent, sludge and manure is sustainably applied to land owned and leased by the business:

- Excluding application of effluent, sludge and manure within 30-metres of watercourses and open waterbodies.
- Excluding application of effluent, sludge and manure within 10-metres of a property boundary.
- Effluent application will occur at times when soil moisture deficit of 10mm occurs, allowing for an 8mm irrigation to be applied by centre pivots without runoff.
- Effluent application will not occur prior to forecast rainfall of >10mm within 24 hours.
- Effluent will not be applied when forecast wind speed of speed exceeds 5 m/s, or 18 km/h reflecting gentle breeze, to avoiding risks of effluent becoming airborne and passing across land boundaries.
- Sludge and manure will not be applied in the when soil profiles are at field capacity.
- Sludge and manure will not be applied on days where wind speed exceeds 5 m/s, or 18 km/h reflecting gentle breeze, to avoiding risks of odour emissions.

Furthermore, effluent application should be:

- Absorbed by soil (liquid), to reduce the likelihood of loss to surface runoff or groundwater, and
- Adsorbed by clay or soil particles (nutrients), minimising off-site loss of nutrient through runoff or leaching to groundwater.

Sludge and manure application are favoured immediately prior to soil cultivation or planting, to achieve incorporation and minimise loss via runoff or volatilisation. Sludge will be applied using a tanker.

Effluent can be sustainably applied to land over the winter storage period, if a water deficit exists and conditions permit.

Figure 37 is an image showing proposed areas for effluent and sludge application. Areas marked in orange are those available for manure application, but may also have sludge applied at dryland rates. The business has an abundance of land to support sustainable land application of nutrient generated. Land areas available for effluent, sludge and manure application under centre pivot irrigation are summarised in Section 9.3.

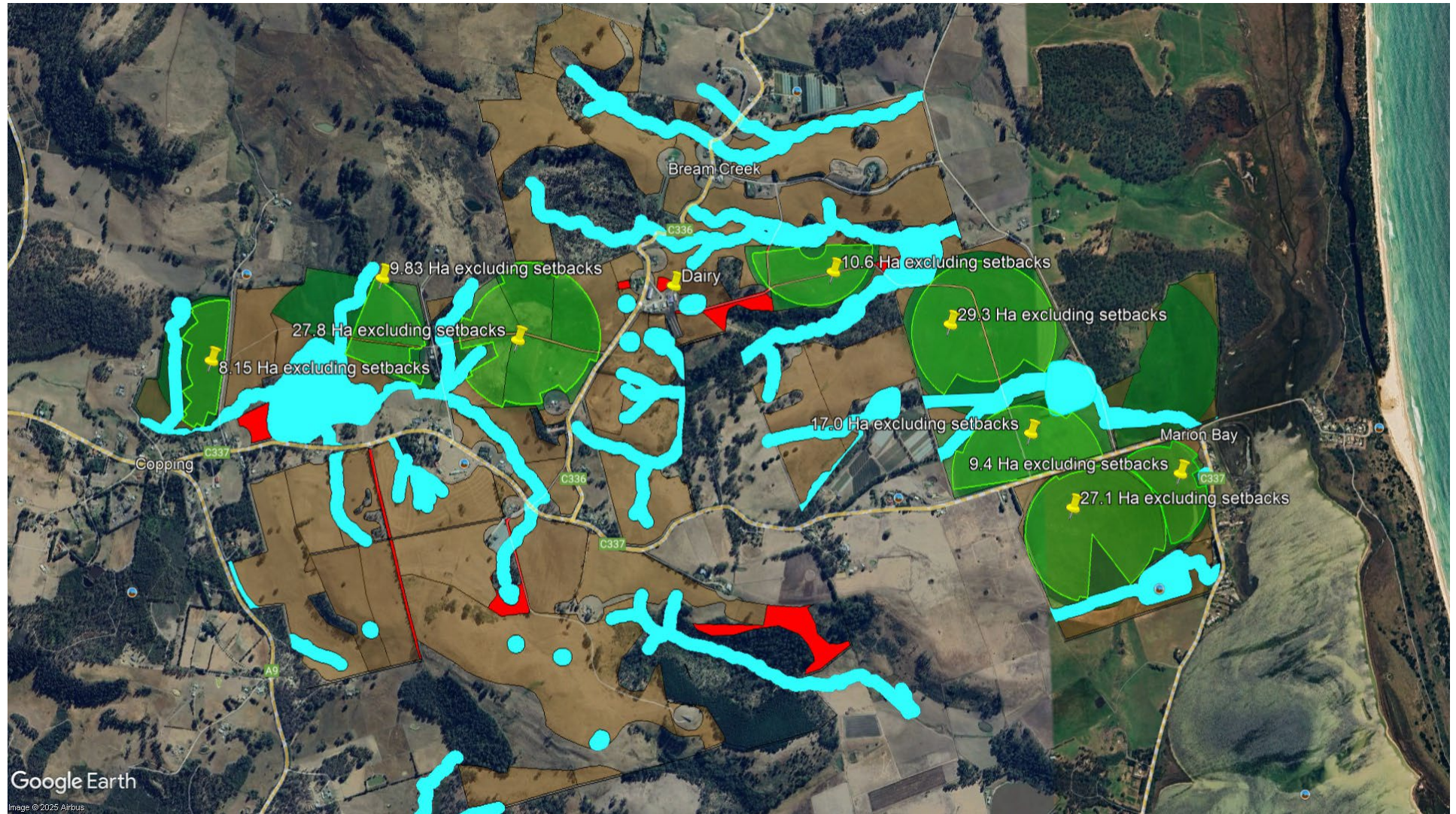


Figure 37. Effluent irrigation and sludge application areas marked in light green, overlying pivot irrigation areas. All marked areas include 30-metre setbacks from watercourses and waterbodies marked in blue. Dryland areas owned and leased by the business are marked in orange.

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9.3. Land areas available for effluent, sludge and manure application to support double cropping under centre pivot irrigation.

Land areas available for effluent, sludge and manure application to support double cropping under centre pivot irrigation are listed in Table 13.

Table 13. Land areas available under centre pivot irrigation for effluent, sludge and manure application at rates to support double-cropping.

Irrigation area	Pivot name	Ownership status	Area (Ha)	Area excluding buffers (Ha)
1	Dicks	Owned	14.0	8.15
2	Copping	Owned	20.7	9.83
3	Dairy	Owned	32.3	27.8
4	Sandy Paddock	Owned	13.6	10.6
5	Big Paddock	Owned	41.3	29.3
6	China Paddock	Owned	19.2	17.0
7	Backcurrants	Owned	34.0	27.1
8	Bottom Corn	Owned	11.0	9.4
Total:			186.1	139.2

Owned land (Ha): **641.5** **641.5**
 % Irrigated: 29.0% 21.7%

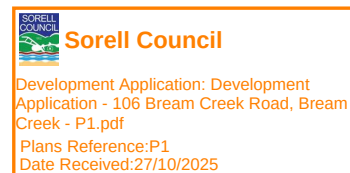
Dryland area owned by the business (Ha): **455.4** **502.3**

9.4. Soil testing and monitoring programs.

Nutrient reuse on dairy farms must occur in accordance with state guidelines and best practice. Nutrients must be utilised by crops and pastures, minimising risks of leaching, entrainment in surface runoff or the risk of soils reaching nutrient sorption capacities. Nutrients contained within effluent, sludge and manure can be used to supplement standard nutrient requirements, or in some cases meet the entire nutrient requirement of a crop or pasture.

Nutrient application rates in this report are based on budgeted levels of removal only. Annual soil testing on areas for effluent, sludge and manure application should include the following parameters, which are standard for sites in receipt of sites receiving dairy effluent at high-rate applications:

- Soil pH (water and CaCl₂).
- Electrical conductivity (salinity).
- Chloride (mg/kg).
- Total Phosphorus (mg/kg).
- Available phosphorus (mg/kg) – Colwell or Olsen.
- Phosphorus sorption capacity (mg/kg).
- Nitrate nitrogen (mg/kg).
- Ammonium nitrogen (mg/kg).
- Organic Carbon (%).
- Exchangeable cations (cmol/kg), including calcium, magnesium, potassium, sodium (Exchangeable Sodium Percentage – ESP), and aluminium.



- Trace elements (DTPA, mg/kg), including zinc, copper, manganese, iron and boron.

Should there be any question arise about phosphorus adsorption and leaching, phosphorus sorption testing should be carried out.

All soil sampling should include the following recording systems:

- The date and time of the sample,
- The point/location at which the sample was taken,
- The name of the person collecting samples.

Records of all nutrients applied within the operation from fertiliser, effluent, sludge and manure should be kept in file.

Effluent should also be tested regularly to detect changes in quality and ensure rates of application are sustainable on a nutrient, salinity and sodicity basis. Salinity and sodicity management details are not provided and should be subject of a separate soil assessment.

9.5. 2024 soil test results and interpretation.

Soil testing was carried out by Ag Assist in September 2024 following a request by SESW to carry the standard biennial soil testing program, with some additions and additional instructions for deep soil testing. Results are presented in Appendix I1 and I2.

9.5.1. *Electrical conductivity (salinity).*

Electrical conductivity results are summarised as follows:

- Irrigated pivot sites – 0-10cm: EC (saturated extract) levels average 1.9 dS/m, acceptable for dairy pasture and maize for silage, both being moderately tolerant to elevated EC levels. Levels will need to be managed back to an optimum level of 1.7 dS/m or less. Most of the data set is below 2.0 dS/m. This will occur by:
 - Rotating effluent across the entire effluent application area.
 - Strategic application of gypsum.
- Irrigated pivot sites – 10-60cm: EC 1:5 results average 0.28 dS/m, deemed low to moderate and acceptable. There is one site, the Big Paddock Pivot where levels are high as a result of elevated chloride levels where leaching irrigations and gypsum should be considered.
- Dryland sites – 0-10cm: EC 1:5 results average 0.15 dS/m, deemed low and acceptable. There is one site, “Dairy” deemed moderate to slightly high. All sludge and effluent should be kept off the Dairy paddock until levels reduce. Gypsum should be considered on the Dairy site.

Soil salinity results are all generally low to moderate across all areas. It is normal to see slightly elevated EC levels on land intensively grazed with dairy cows and where effluent has been irrigated or spread, where salts are returned to paddocks. Salinity is a dynamic property and subject to change over time. No problems are foreseeable on this site as a result of salinity.

9.5.2. *Soil pH (water).*

Soil pH (water) levels are summarised as follows:



- Irrigated pivot sites – 0-10cm: Average of 6.34, deemed slightly acidic. Most areas are below 6.3 and will respond to application of agricultural lime. The average pH (CaCl₂) is 5.66, with a variance of 0.68 units which reflects some salts detected within test results.
- Irrigated pivot sites – 10-60cm: Average of 6.02, slight to moderately acidic. Results indicate that subsoils, most expected to be clays, are slightly acidic based on their geology, chemistry, rainfall and level of leaching. Adjustment of pH is unlikely to be practical or cost-effective, however if agricultural lime can be ripped or incorporated into subsoils, improvements in pH and nutrient availability are expected.
- Dryland sites – 0-10cm: Average of 5.9, moderately acidic. Dryland sites will generally show benefit from the application of agricultural lime. Most sites record levels of less than 6.0, indicating that rates of approximately 2.0 t/ha are deemed suitable for increasing soil pH by up to 1.0 unit.
- EC 1:5 results average 0.15 dS/m, deemed low and acceptable. Sites which are moderate to strongly acidic and should be prioritised for agricultural lime application include Bream Creek Corner, Ritchies and Treschows Front paddocks.

9.5.3. Chloride.

Chloride results follow a similar trend to EC (soil salinity). Levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Chloride levels average 123 mg/kg, deemed moderate. Most levels are within the low or moderate range of up to 300 mg/kg, with one site (Big Paddock) recording a high level of 350 mg/kg corresponding with high EC levels.
- Irrigated pivot sites – 10-60cm: Chloride levels are generally low to moderate, averaging 218 mg/kg. Similar to the 0-10cm data set, the Big Paddock has a high chloride level of 1400 mg/kg. This should be addressed by rotating this site out of summer crop prior to barn construction, along with applying gypsum and providing leaching irrigations.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be low corresponding with low soil salinity levels.

9.5.4. Organic carbon and organic matter.

Organic carbon levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels are high and optimal, averaging 5.3%. This is normal for long term dairy pasture.
- Irrigated pivot sites – 10-60cm: Not tested. Testing of organic carbon is not required in subsoils.
- Dryland sites – 0-10cm: Levels are high and optimal, averaging 5.6%.

No changes or improvements in organic carbon are required. Results are reflective of long-term pastures with minimal soil disturbance in a high rainfall zone. Levels also reflect optimal nutrition and management.

9.5.5. Nitrate nitrogen and ammonium nitrogen.

Nitrate nitrogen and ammonium nitrogen levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels range from acceptable to very low, with most data recorded as very low. The average nitrate N level is 22 mg/kg while the average ammonium N level is 17 mg/kg. Levels confirm that N has been up taken by pastures or crops.
- Irrigated pivot sites – 10-60cm: Levels are all low to deficient. The average nitrate N level is 9.4 mg/kg and ammonium N level is 1.7 mg/kg. Levels below 20 mg/kg are deemed low.
- Dryland sites – 0-10cm: Not tested.

Test results confirm that nitrogen can be applied to support crop or pasture removal to produce fodder. Effluent should be the primary source of nitrogen. Agronomic support is required to top-up nitrogen using applied fertilisers. Within the proposed setbacks from watercourses and open waterbodies, all nitrogen will require application via applied fertilisers.

9.5.6. *Colwell Phosphorus.*

Colwell phosphorus levels are summarised as follows:

- Irrigated pivot sites – 0-10cm:
 - Levels are high, averaging 121 mg/kg. Levels range from slightly low at 21 mg/kg, to very high at 210 mg/kg. Levels are likely to be high from a long history of phosphorus application from applied fertilisers. For the proposed development, phosphorus-based fertilisers should be substituted for effluent application, with the intent of achieving part or full replacement over time. A sustainable system can be achieved by applying phosphorus at levels to meet removal, where levels are high on sites such as this site.
 - Phosphorus Buffer Index (PBI) levels are moderate averaging 195, indicating that critical P levels are in the Colwell range of 30-40 mg/kg. These levels are exceeded across the sites indicating that P deficiency is unlikely.
 - Phosphorus Environmental Risk Index (PERI) results confirm that most sites record levels of 0.65 or less, indicating that the risk of P loss via leaching is very low. Where levels are higher but less than 2.0, risks of movement increase to moderate, generally based on soil texture. Where clay subsoils exist, as observed across this property, risks of loss remain low as clay subsoil will adsorb any P which moves from topsoil. One site, the Sand Paddock, recorded a high PERI result indicating that loss via leaching is possible. This is expected on sandy soils. Similarly, clay subsoil is expected to adsorb phosphorus.
- Irrigated pivot sites – 10-60cm: Not tested. It is not normal to test for subsoil P, however this could be included in future testing. Experience shows that on soils characteristic of this site where duplex conditions exist with clay-dominant subsoil conditions, phosphorus is almost immobile and unlikely to have moved into subsoils.
- Dryland sites – 0-10cm: Not tested.

Test results confirm that decisions around phosphorus should include greater reliance, or potentially full reliance on P from effluent, sludge or manure. Within the proposed setbacks from watercourses and open waterbodies, phosphorus will require application via applied fertilisers.

Phosphorus sorption testing was not recommended by SESW given that effluent, sludge and manure application recommended in this EfMP are based on based on nutrient removal and a sustainable phosphorus balance where application equals removal. At any stage where P levels are observed increasing from the application of effluent, Total Phosphorus (mg/kg) and Phosphorus Sorption (mg/kg) testing should be carried out to determine the sustainable life which P can be applied to soils in excess of nutrient removal. At all times a sustainable nutrient balance should be maintained for nitrogen.

9.5.7. *Sulphur.*

Sulphur levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels are slightly low, averaging 14.3 mg/kg. Levels may be increased for optimal production.

- Irrigated pivot sites – 10-60cm: Not tested. It is recommended to include subsoil sulphur in future testing to determine leaching of sulphur through profiles.
- Dryland sites – 0-10cm: Levels are low, averaging 8.2 mg/kg. Levels should be increased for optimal production.

Test results indicate that sulphur should be considered in a program. The content of sulphur in effluent, sludge and manure should be verified from testing. Within the proposed setbacks from watercourses and open waterbodies, sulphur will require application via applied fertilisers.

9.5.8. *Exchangeable cations.*

9.5.8.1. Exchangeable calcium.

Exchangeable calcium levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 2343 mg/kg and 50% as a base saturation percentage, deemed slight to moderately low. Calcium application by agricultural lime or gypsum will improve calcium levels and cation balance.
- Irrigated pivot sites – 10-60cm: Levels average 1292 mg/kg and 25% as a base saturation percentage, deemed very low to deficient. Responses to calcium will be observed, should calcium be incorporated into subsoils.
- Dryland sites – 0-10cm: Levels average 1992 mg/kg and 53% as a base saturation percentage, deemed slightly low to low. Calcium application by agricultural lime or gypsum will improve calcium levels and cation balance.

9.5.8.2. Exchangeable magnesium.

Exchangeable magnesium levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 1147 mg/kg and 40% as a base saturation percentage, very high. Despite the soils texture and high level of organic carbon, soils will be sticky when wet and hard-setting when dry.
- Irrigated pivot sites – 10-60cm: Levels average 1684 mg/kg and 53% as a base saturation percentage, extremely high. These levels are normal for basaltic clay subsoils.
- Dryland sites – 0-10cm: Levels average 902 mg/kg and 37% as a base saturation percentage, very high. Similar to the irrigated sites, soils will be sticky when wet and hard-setting when dry, particularly when low in organic matter from heavy grazing.

9.5.8.3. Exchangeable potassium.

Exchangeable potassium levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 358 mg/kg and 3.9% as a base saturation percentage, deemed acceptable. No adjustment is required. Potassium will continue to be applied through effluent. Removal is essential for sustainable application.
- Irrigated pivot sites – 10-60cm: Levels average 151 mg/kg and 2.2% as a base saturation percentage, deemed acceptable to slightly low.
- Dryland sites – 0-10cm: Levels average 352 mg/kg and 5.2% as a base saturation percentage, deemed acceptable. Similar to the irrigated topsoils, potassium can be applied sustainably where nutrient removal occurs.

9.5.8.4. Exchangeable sodium.

Exchangeable sodium levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 311 mg/kg and 5.6% as a base saturation percentage, deemed acceptable to slightly high. Soils will require calcium application to reduce the proportion of sodium to other cations and lower ESP levels to approximately 4% or less. At levels above 5% as recorded, soils may start to disperse.
- Irrigated pivot sites – 10-60cm: Levels average 550 mg/kg and 9.0% as a base saturation percentage, both deemed slightly high to high. These levels are normal for basaltic clay subsoils. Dispersion of clay is expected, particularly under low EC levels. In these circumstances soils should be treated periodically with gypsum.
- Dryland sites – 0-10cm: Levels average 134 mg/kg and 3.3% as a base saturation percentage, deemed acceptable. Sodium is unlikely to cause any problems within topsoils on dryland areas.

9.5.8.5. Exchangeable aluminium.

Exchangeable aluminium levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Most levels are generally low, corresponding with an average soil pH (water) of 6.34. Soils are not strongly acidic and do not show widespread levels of high available aluminium.
- Irrigated pivot sites – 10-60cm: Levels increase to an average of 181 mg/kg and 13.4% as a base saturation percentage, high to extremely high. These levels are normal for acidic clay subsoils. Significant nutrient tie-up and limitations to root growth are likely resulting from elevated levels. To offset high levels in subsoils, topsoils must be kept within the optimum pH range to ensure aluminium is rendered of low availability.
- Dryland sites – 0-10cm: Levels average 15 mg/kg and 2.1% as a base saturation percentage, deemed moderate or slightly elevated. Dryland areas will benefit from liming and the rendering of exchangeable aluminium unavailable.

9.5.9. Trace elements.

9.5.9.1. Zinc.

Zinc levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels are generally all acceptable to slightly high, averaging 6 mg/kg and ranging from 1.7-20 mg/kg. Levels are optimal and slightly high from dairy pasture fertiliser application. Future application should consider zinc from applied effluent, sludge and manure.
- Irrigated pivot sites – 10-60cm: Not tested. Levels are expected to be low in clay subsoils.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be low or within an acceptable range.

9.5.9.2. Copper.

Copper levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 1.7 mg/kg, deemed acceptable. No adjustment is required. Future application should consider copper from applied effluent, sludge and manure.
- Irrigated pivot sites – 10-60cm: Not tested. Levels are expected to be low in clay subsoils.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be low or within an acceptable range.



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9.5.9.3. Manganese.

Manganese levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 19.9 mg/kg, deemed low. Future application should consider manganese from applied effluent, sludge and manure.
- Irrigated pivot sites – 10-60cm: Not tested. Levels are expected to be low to acceptable in clay subsoils.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be low.

9.5.9.4. Iron.

Iron levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 330 mg/kg, deemed high and likely due to low pH conditions. Iron is not required.
- Irrigated pivot sites – 10-60cm: Not tested. Levels are expected to be adequate based on experience with basalt clay subsoils.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be acceptable or slightly low.

9.5.9.5. Boron.

Boron levels are summarised as follows:

- Irrigated pivot sites – 0-10cm: Levels average 1.0 mg/kg, deemed acceptable. Most data ranges from slightly low at 0.6 mg/kg to 1.4 mg/kg, deemed acceptable. Boron is not required.
- Irrigated pivot sites – 10-60cm: Not tested. Levels are expected to be adequate based on experience with basalt clay subsoils.
- Dryland sites – 0-10cm: Not tested. Levels are expected to be acceptable or slightly low, similar to topsoils on irrigated sites.

10. LOOSE HOUSING BARN: DESCRIPTION, MANAGEMENT & CONTINGENCY PLANNING.

10.1. Brief system description.

The proposed loose housing barn, or compost bedded pack, involves use of a self-composting base for the loafing under free-ranging confinement. The pack initiates from the importation of an organic based material including sawdust, woodchips, wood shavings, straw or other organic matter sources which naturally break down over time under optimal biological functioning with the addition of moisture and nutrient generated from cow urine and manure. The system is reliant on key inputs including organic matter, nitrogen and moisture, all achieved from animal manure. An additional key input is aeration, achieved by multiple cultivations daily along with optimal air flow and use of fans where required. Maintaining optimal moisture conditions is critical.

This system relies on the action of microbes to maintain bedding quality and consume organic waste derived from cow manure and urine. Organic material absorbs liquid from urine which supports the maintenance of the pack moisture levels, while nutrient generated from urine and manure provides nitrogen required to support microbes and biological activity, required for the breakdown of organic matter. When the pack is functioning at optimum, there is only a very slow increase in the rate which the pack increases in size. Aeration is applied multiple times daily to ensure the pack dries out with moisture levels kept within the optimum range. Over time, the pack becomes self-regulating following the implementation of management measures that support regulation. Adopting stocking rates that do not overload the pack with moisture and nutrient are required for successful operation. For this development the stocking density will be 12.6m² per cow.

The pack, covering the proposed loafing area, must be placed on an impervious surface such as compacted clay to prevent deep loss of nutrient, should the pack not support the retention of moisture or where a preferential pathway for moisture movement develops.

10.2. Management guidelines and requirements.

Minimum guidelines and requirements for managing compost bedded pack barns are listed below, in accordance with available literature covering this field, along with literature around composting and field experience and observation. References include Dairy Australia (2024), Russelle et al (2012), Black et al (2013), Qian and Schoenau (2002), Spiehs et al (2014) and numerous other dairy industry body technical notes. Guidelines include:

- **Depth:** The pack commences by importing organic material, such as woodchips, providing a bedding thickness of at least 500-600mm.
- **Moisture:** Levels should range from 40-60%, depending on region and climate influence on pack moisture levels.
- **Carbon-nitrogen ratios (C:N):** C:N levels should be maintained at between 25:1 and 30:1, consistent with optimal conditions for all forms of composting. These should start with a high C:N ratio material such as woodchips, which increase in breakdown over time with inputs of nitrogen from urine and manure. Green bedding material should be avoided.
- **Temperature:** Levels should be maintained at 40-60 degrees Celsius.
- **Aeration:** The pack should be aerated at least twice-daily by deep cultivation, with optimal ventilation and the support of fans where required.
- **pH:** Levels should be maintained as close to the range of 6.5-7.5 and prevention of the pack from becoming too acidic. Moderate to strongly alkaline levels of >8.0 should also be avoided to minimise ammonia volatilisation and odour generation.

- Cleanout and top-up: There is no set cleanout interval, with a well-functioning pack likely to require cleanout after 5 years. Occasional top-up with a source of organic matter may be required.

Following adoption of the above guidelines, the most critical element for success is the monitoring and management of the pack and adjustments to management where required. Moisture levels and temperature should be monitored at least twice-weekly, with more frequent monitoring recommended during winter months. Whilst dry wood shavings are recommended and likely to reduce facility odour, C:N ratios need to be maintained at no greater than 30:1 for optimal bedded pack functioning.

Elements of barn orientation, cooling, space and shed design are being supported by additional consultants specialising in these fields.

10.3. Contingency planning.

Compost bedded packs are renowned for their management ranging from easy to difficult, depending on the level of monitoring and the management team built around the facility. This facility, being a closely run family operation, is expected to be capable of carrying out daily monitoring checks of the compost bedded pack and undertake preventative measures to ensure the pack maintains optimal functioning. For this site, high moisture and below optimum temperatures are likely to be the primary cause of poor pack breakdown, should this be experienced. Importation of organic matter and appropriate use of fans may potentially be required throughout the winter period.

Contingency plans for poor pack performance will need to include, but not be limited to the following:

- Additional tillage, aeration and drying with fans.
- Importation of additional woodchips and incorporation to reduce moisture, increase C:N ratios, restore temperature to optimal levels or reduce pH levels.
- Immediate cleanout, with:
 - transport of bedding material to paddocks for spreading
 - stockpiling of bedding material on a purpose-built pad for spent bedding, alongside the concrete manure management area.
- A supply of organic material which is kept under cover and dry with a low moisture content, ideally below 20%. Woodchips or straw could be kept on hand. Straw may provide challenges for tillage and aeration.
- Temporary transfer of cows onto the open feedpad (covered maternity barn area, or the dairy yard or old feedpad, while contingency plans are activated.
- Maintain a stockpile of agricultural lime for incorporation into the pack, if the pack becomes too acidic for microbial breakdown.

Risk of fire is more likely where temperature is not monitored and become excessive, corresponding with relatively dry bedding material.

11. BARN FLOODWASH CALCULATIONS.

An extract of a floodwash calculation for one feed lane within the barn is provided in Figure 38. This calculation is based on a lane length of 300 metres, width of 4 metres and slope of 2.0 % in accordance with plans in Appendix D. The model has been developed by the Queensland Department of Primary Industries and Fisheries (Skerman, 2008) and is used as an estimate only, providing the minimum floodwash requirements, recognising that each lane will be flood washed using a constant-flow pump with high volume and low velocity.

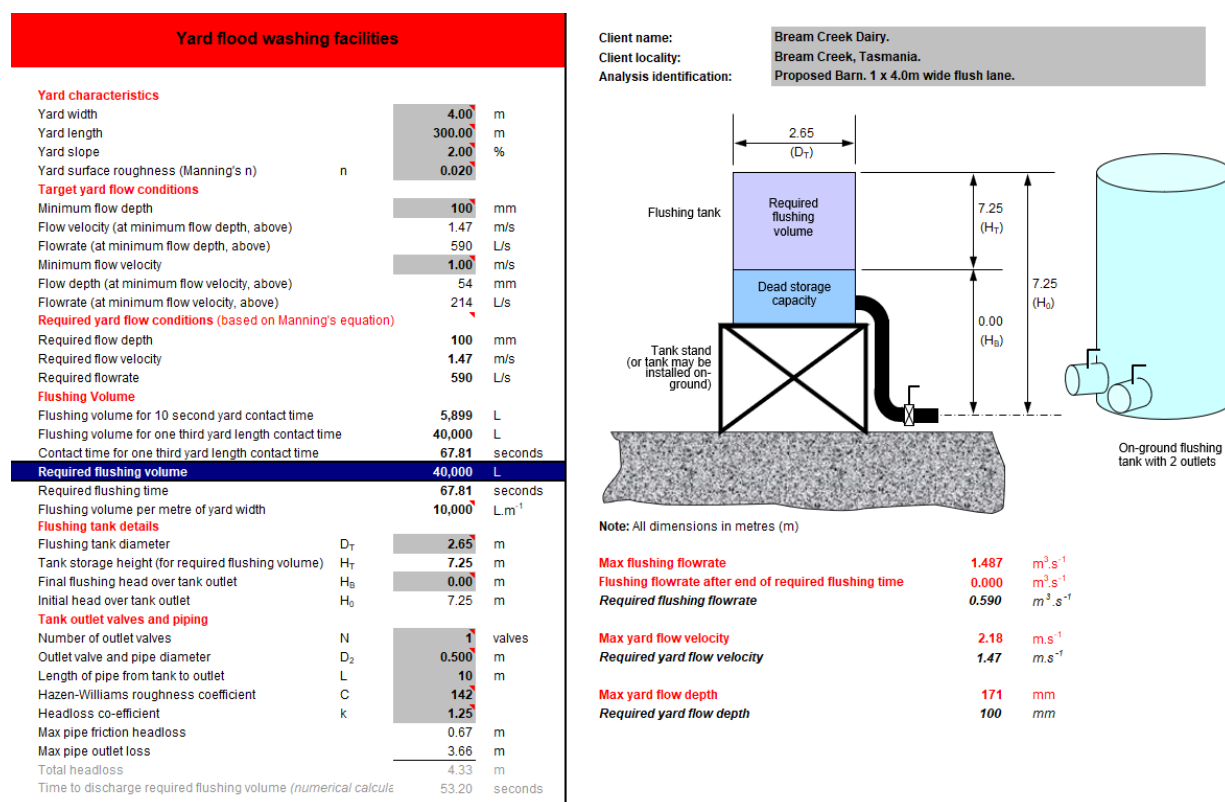


Figure 38. Flood wash model for one feed lane within the barn.

The flood wash model confirms the following minimum requirement for effective cleaning of one feed lane:

- Required flushing volume of 40,000 litres per washdown.
- Flushing time should be approximately 67.8 seconds.
- Flow height adopted is 100mm.
- 1 valve with a diameter of 500mm.

For two feed lanes which will be constructed within the proposed barn, the requirement is 80,000 litres. For twice-daily floodwashing, the daily requirement is 160,000 litres.

In practice, the flow depth of floodwash water could be decreased to as low as 50mm with a floodwash requirement of 21,437 litres, or 54% of the adopted values. A flow depth of 100mm ensures that effective feed lane cleaning occurs under heavy manure loading.

12. EFFLUENT SYSTEM MANAGEMENT NOTES & CONSIDERATIONS.

12.1. Testing of effluent, sludge and manure.

Testing of effluent, sludge and manure should occur annually to support soil nutrient budgeting. The farm currently has baseline soil test results. Accurate nutrient budgeting should continue annually into the future, with land application adjusted according to the characteristics of effluent, sludge or manure. Sustainable practice relies upon nutrient utilisation rather than accumulation.

12.2. Concrete manure pad and solids handling.

Manure: Screened manure must be stockpiled on a concrete manure pad and applied to land during optimal weather conditions. Screened manure is expected to be retained on the concrete manure pad with drainage collection until such time that conditions are optimal.

Sludge:

- Only sludge extracted from the TST will be stored on the concrete manure pad.
- All other sludge generated within effluent Pond 1 must be stored within this pond until land application permits. Sludge will require direct land application at the time of cleanout. There will be no further handling of sludge.

12.3. Animal health and grazing management.

No milking cows will be subject to grazing. Land devoted to effluent irrigation for double cropping will not be used for grazing of any animals. There are no nutrient application limitations on cropping land. Values adopted in this plan are based on nutrient removal and do not rely on soil nutrient sorption or storage.

For dry stock and young stock, dryland areas will be used for grazing only. Across dryland areas, should sludge or effluent be spread at sustainable rates, grazing of crops or pastures with dry cattle must not occur within 21 days of application. Grazing should be further avoided on dryland areas following sludge application where:

- no rainfall or irrigation has occurred since application, and/or
- where application of K has exceeded 120 kg/Ha within a 12-month period.

In the process of irrigating effluent or the spreading of sludge or manure, animal health considerations must be made to avoid potential risks (Agriculture Victoria, 2025d). The risks are associated with pathogens and nutrients which induce a toxicity or deficiency, or when a pathogen is ingested transferring disease.

Some of the risks of applying high levels of potassium to pastures subject to grazing include:

- Milk Fever, caused by calcium deficiency. A range of factors can influence Milk Fever.
- Grass Tetany, caused by magnesium deficiency, often by high potassium intake in feed.
- Bovine Johnes disease, particularly in young stock grazed on paddocks with effluent applied.

To minimise the risk of infection with Johne's disease, calves and stock up to 12 months of age **must not** be grazed on land where effluent has been applied.

There may also be issues with feed quality that will require special management. Veterinary and dairy nutrition experts should be consulted if any problems arise.

12.4. Occupational health and safety (OH&S).

OH&S risks with the operation of effluent systems must be managed on all dairy farms. For this property risks include, but are not limited to the following points. These are noted along with measures for mitigation which should be adopted and include:

- **Farm entrance:**
 - Signage alerting persons entering the farm that effluent / wastewater is used on the property.
- **Dairy:**
 - Optimal drainage must be maintained within the dairy yards, feedpad, concrete laneways to avoid exposure to slippery or dangerous surfaces.
 - Earthen surfaces used for transporting feed should also have drainage measures applied, ensuring these are all-weather.
 - All power should be marked with emergency stop switches in accessible locations.
 - Pumps within and around the dairy should be elevated and have covers and guards installed.
 - All pumps within and around the dairy require a service interval.
- **Dairy washdown:**
 - All handheld washdown within the dairy and yard must occur using fresh water.
 - Recycled effluent must not be used through handheld hoses or yard blasters, to prevent aerosol impacts on staff.
- **Barn washdown:**
 - Washdown will occur using recycled effluent.
 - Signage must be installed alerting staff and visitors of effluent use for washdown, with notes to avoid contact.
- **TST and sump, agitator, pump and screw press:**
 - Signage must be installed alerting persons of the dangers of deep water and equipment.
 - Fencing must be installed around sumps and traps to protect staff, animals and other persons entering these areas.
 - Guards must be installed to provide adequate protection from moving parts.
 - All equipment including pumps, motors and the screw press require a regular service interval.
 - Lifting devices including simple pulley systems should be installed over pumps and agitators to gain access for maintenance, avoiding use of tractors and front-end-loaders.
- **Effluent ponds:**
 - Signage installed around ponds alerting of the dangers of deep water.
 - Ponds must have stock proof fencing installed to prevent:
 - Livestock access, with risk of drowning, or
 - Any non-authorised persons gaining access to the pond.
 - Ponds should be monitored, sampled and emptied by personnel with appropriate skills and training.
 - Lifesaving equipment provided at the access or cleaning point for each pond, located close to the pump and desludge point.
 - Cleanout must occur with two personnel, one as a spotter at all times.
 - Equipment including suction pumps, agitators and other infrastructure must have provision for safe access, maintenance and operation.

- Guards must be placed around any moving parts to avoid injury.
- All motors should have a servicing and maintenance interval.
- An alarm or monitoring system must be installed on Pond 3, ensuring that the business remains alert of real time levels, with alarms providing advice when ponds are nearing capacity.
- All electrical components require elevating and adequate protection from weather.
- Vegetation on the embankment must be limited to pasture with no trees permitted on banks. Vegetation should be maintained by chemical spraying to ensure that:
 - visibility around the pond is high.
 - to avoid drying and desiccation of clay-lined banks.
- All access roads and laneways around all effluent ponds must have all-weather access. Roads and laneways should be elevated, cambered, dry, stable and well maintained to prevent machinery slips into ponds.
- All machinery operating around ponds and on farm should be well maintained with a regular service interval.
- Pond banks must be clearly identified.
- **Effluent irrigation and sludge spreading areas:**
 - Signage should be installed on fencing around effluent irrigation and sludge spreading areas, alerting dairy farm staff and other persons to avoid contact.
 - All motors servicing effluent irrigation infrastructure should have a servicing and maintenance intervals, including travelling irrigators.

12.5. Effluent irrigation and sludge spreading.

Effluent irrigation must occur in an environmentally sound manner. Irrigation must not be applied:

- Within 30 metres of a watercourse or waterbody.
- Within 10-metres of a property boundary.
- When forecast wind speed of speed exceeds 5 m/s, or 18 km/h reflecting gentle breeze, to avoiding risks of spray drift over land boundaries.
- Prior to forecast rainfall of >10mm within 24 hours.
- Until a soil moisture deficit of 10mm occurs, allowing for an 8mm irrigation to be applied without runoff.

Effluent application should be:

- Absorbed by soil (liquid), to reduce the likelihood of loss to surface runoff or groundwater, and
- Adsorbed by clay or soil particles (nutrients), minimising off-site loss of nutrient through runoff or leaching to groundwater.

Sludge and manure should:

- Not be applied on days where wind speed exceeds 5 m/s, or 18 km/h reflecting gentle breeze, to avoiding risks of odour transfer across land boundaries.
- Be applied prior to soil cultivation or planting, to achieve incorporation and minimise loss via runoff or volatilisation. Application of sludge, along with cultivation where desired, can occur at any time of the year when conditions previously noted can be complied with.

12.6. Water use.

Water use has been increased for the proposed development, to ensure high quality effluent of a low concentration and odour potential is produced. The business has significant water availability for stock and domestic use. Fresh water use must not exceed the calculated volume of 117,818 litres per day. Should any increase in water use occur, an accredited dairy effluent systems designer should be contacted and this plan be immediately revised. The winter storage capacity for effluent will require review.

12.7. Rainfall diversion from rooftops.

All rainfall from the dairy shed, cow barn, maternity barn and all other structures associated with this facility must be diverted away from the effluent system and along natural drainage pathways.

12.8. Effluent pond and cleanout interval.

This effluent system must be cleaned on the minimum intervals:

- Pond 1 – Solids: Desludging every 12-months.
- Ponds 2 and 3 – Storage: Empty every 6 months, emptied on 1 April each year prior to the winter storage period.

Should the system be operated in this fashion, no problems are envisaged.

Effluent discharge to watercourses is not permitted.

12.9. Contingency planning.

Contingency plans are required if unforeseen problems arise with the effluent system (Agriculture Victoria, 2025a). No effluent system is failsafe. Contingency plans allow for support to be obtained and corrective action to be taken immediately when required. Problems may arise from power failure, breakdown, blockages, breaches or human error.

The existing effluent system relies on the following:

- gravity flow of all effluent from the dairy, yards, feedpad and proposed barn to the TST and sump
- agitation and pumping from the sump to effluent Pond 1
- gravity flow of effluent to Pond 2 and Pond 3.

Regular servicing and maintenance at the TST and sump on all motors and pumps is necessary to avoid problems from developing.

Contingency measures to be adopted for pump breakdown at the TST and sump include:

- a back-up pump to be kept on hand.
- an emergency overflow placed at full supply level, directing liquid effluent to Pond 2, which is already in place. Activation of this overflow is a measure of last resort.

Contingency land application for effluent, sludge and manure involves:

- direct tanker application of effluent or sludge on dryland areas, to meet nutrient removal rates, at the direction of an agronomist.
- manure may be exported off-farm to lease land, or spread on land external to the business.

The names and contact numbers for key contractors should be maintained for all staff working on site to provide prompt assistance when required. Contact details for the business are:

- Jack Bignell. 0427 698 177.

Under the Environmental Management and Pollution Control Act (1994), point 32, effluent release of any type must be reported to local council within 24 hours. Local council contact details are:

- Council: Sorell Council.
- Contact number: 03 6269 0000.

12.10. Emergency effluent management.

Emergency effluent management may be required in unforeseen circumstances, such as unexpected spills from plumbing failures or where unforeseen surface drainage has entered the yard, feedpad, barn or laneway, entering the effluent system. In this instance, all higher land owned and leased by the business should be made available for direct tanker land application, with soil and pasture absorption and grass filtration.

12.11. Emergency milk disposal.

Milk must not be disposed of within the effluent system. Should milk require disposal, incorporation may occur with irrigation water at a rate of at least 1 part milk to 50-parts irrigation water. Milk should be spread or irrigated at very low rates onto pasture in accordance with times suitable for effluent application.

12.12. Struvite management.

Management of struvite (magnesium ammonium phosphate compounds) is a potential risk that requires managing within systems containing high levels of nutrient, particularly where feedpads are utilised. Struvite is the formation of crystalline material which can cause pipe blockages and other associated problems with effluent systems. Struvite formations are caused by constant loading of salts within effluent ponds from saline or high-nutrient feed inputs, or from elevated saline water (Dairy Australia, 2024; Agriculture Victoria, 2025c).

Ponds should be kept at a conductivity level which is deemed low to moderate, or below 3.0 dS/m (3000 uS/cm) where possible. Struvite can be expected at electrical conductivity levels exceeding 3000 uS/cm, with the risk increasing as conductivity levels continue to rise. At levels of over 5000 uS/cm, risks further increase. To lower the conductivity of effluent ponds and salts, dilution is required with fresh water. Ponds will require ongoing monitoring of EC levels to determine when risks of struvite are high. Emergency pumping systems should be available at all times.

12.13. Odour management and buffers.

A separate odour management report is provided by PRS (PRS, 2025a). Odour is expected to be managed by regular emptying in accordance with the cleaning intervals specified in this report. The existing pond requires the liquid portion to be emptied every 6-months and prior to April 1 each year, while the sludge portion requires emptying once-yearly, also prior to April 1.

No effluent system is failsafe from unforeseen odour emissions. Many factors may contribute to an odour emission and could include:

- Changes in cow diet and inputs into the pond.
- Seasonal weather changes and an increasing day and nighttime temperature.

- Changes in organic loading and BOD levels within ponds.
- Changes in salt levels within ponds.

At any stage of an unacceptable odour emission from the effluent pond, the following strategies are recommended:

- Emptying, where possible by irrigation or direct land application, and
- Dilution with fresh water.

The Code does not specify a required buffer distance between effluent ponds and neighbouring receptors. This element is addressed within the OMP and EIS supporting the proposed development (PRS, 2025a; PRS, 2025b).

12.14. Geotechnical engineering requirements.

Site geotechnical assessment has been carried out by Geoteon Pty Ltd in their report titled “*Geotechnical Investigation, Proposed Dairy Shed and Dairy Effluent Storage Facility, 106 Bream Creek Road, Bream Creek*”. A copy of this report is provided in Appendix H. This report sets the minimum requirements for geotechnical construction of effluent ponds and earthen pads for the proposed development.

12.15. Summary of major effluent system requirements.

- Dairy shed, cow yard and feedpad washdown includes:
 - handheld hoses in the dairy using fresh water.
 - yard blaster uses for the top part of the yard with fresh water.
 - dry scraping of the mid and lower yard section, and
 - dry scraping of the feedpad.
- All handheld washdown within the dairy and yard must occur using fresh water. Recycled effluent must not be used through handheld hoses or yard blasters, to prevent aerosol impacts on staff.
- Twice-daily floodwashing of the feed lanes within the loose housing barn is required using recycled effluent.
- Constant, on-demand effluent agitation and pumping are required at the sump to separate manure through a screw press and pump effluent to Pond 1, keeping the sump as empty as possible at all times.
- A concrete manure stockpile area is required for the storage of screened manure, sludge from within the TST and spent bedding.
- Any manure and spent bedding extracted from the barn will require transport to dryland farming areas away elsewhere around the property as soon as practicable following extraction. Land application rates of application should be dictated by soil test results and based on potential crop requirement for nutrient. This should be carried out by a qualified agronomist or soil scientist.
- Pond 1 requires construction. This pond must be desludged every 12-months.
- Ponds 2 and 3 must be emptied prior to the winter storage period, or on 1 April each year.
- Pond 3 requires construction.
- Effluent will be applied to land by irrigation.
- Sludge will be applied to land by slurry tankers.
- Manure will be applied to land using a manure spreader.
- Effluent and sludge must be applied to land at sustainable rates that do not exceed crop removal.

- Sludge may also be spread on dryland areas at rates to match nutrient removal, with agronomic support.
- Effluent and sludge should be tested prior to application with modelled application rates checked for sustainability.
- All areas subject to effluent irrigation must be double cropped to ensure nutrient uptake meets the modelled values listed in the Effluent Management Plan.
- Effluent must not be discharged across farm boundaries or into natural drainage lines or water courses.
- Milk must not be introduced to the effluent system. Should milk require disposal, it should be incorporated with irrigation water at a rate of 1:10 and utilised on suitable paddocks.
- All operational health and safety measures listed in the report should be practiced.
- All motors attached to effluent system components must have safety guards and regular service intervals.

13. CONCLUSION.

This report provides details of an Effluent Management Plan for Stroud Dairies proposed loose housing barn, located at 106 Bream Creek Road, Bream Creek, Tasmania. The plan incorporates 2500 litres per week of cheese factory wastewater, subject to a previous approval. The report confirms that the proposed development of a 1000-cow milking barn can proceed based on upgrades to the effluent system and an increase in land area for application of effluent, sludge and manure. The business has sufficient land area for sustainable nutrient reuse and significant area for contingency application, should any problems arise, or a specific area require resting. Annual soil monitoring is recommended to keep a record of soil chemistry.

All calculations and recommendations in this report have been provided as best as possible in accordance with appropriate references, guidelines and details provided by business. Should any element of this plan require clarification, please contact the author.

Kind regards,



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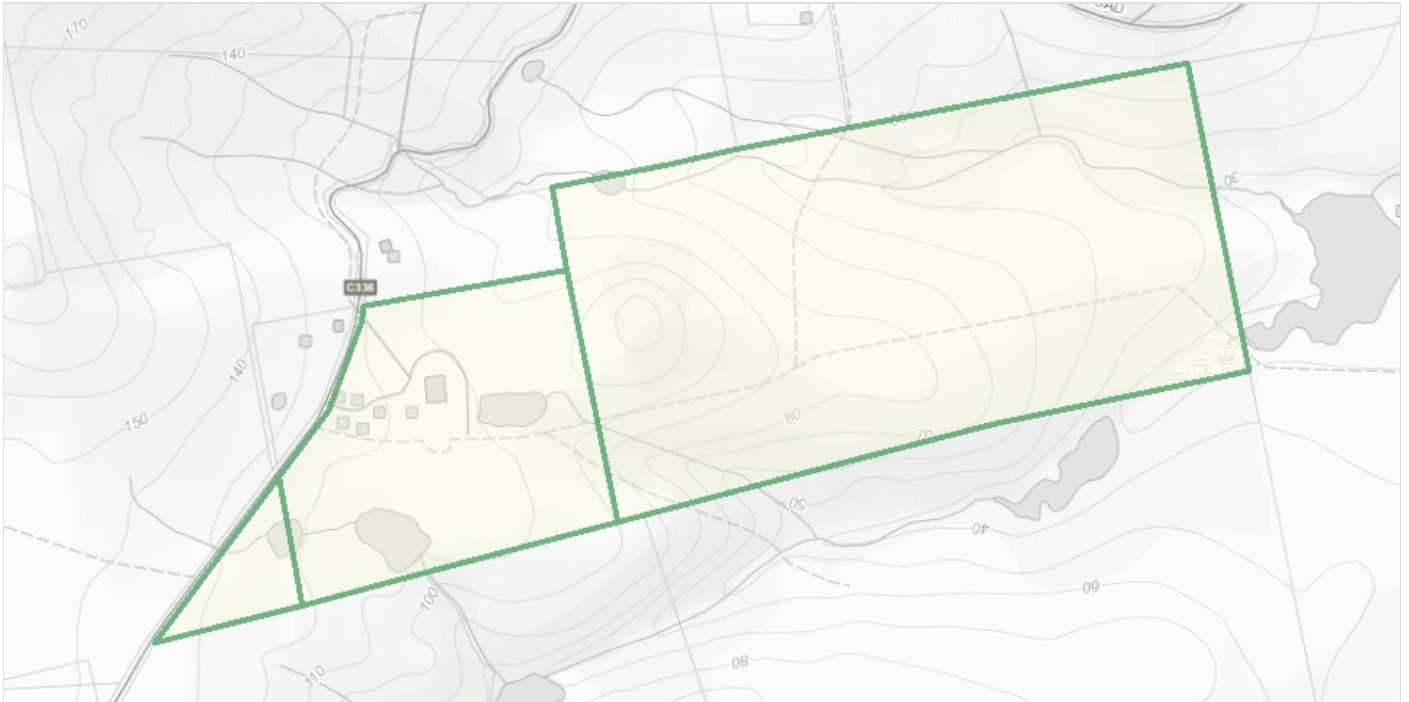
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APPENDIX A. PROPERTY REPORT.

All property planning reports are provided in an attached Zip File.

Property Report for 106 Bream Creek Road, Bream Creek, Tasmania is included below.

Property report for 106 BREAM CREEK RD BREAM CREEK TAS 7175



Property Identification Number

3370760

Locality

Bream Creek

Planning Zones

Rural

Total Area

439086 sqm

Certificate of Title Reference (Volume/Folio)

156894/1, 35298/1, 35297/2

Municipality

Sorell

Planning Codes Overlay

Scenic protection area, Bushfire-prone areas, Low landslip hazard band, Priority vegetation area, Waterway and coastal protection area, Medium landslip hazard band

Planning Scheme

Tasmanian Planning Scheme

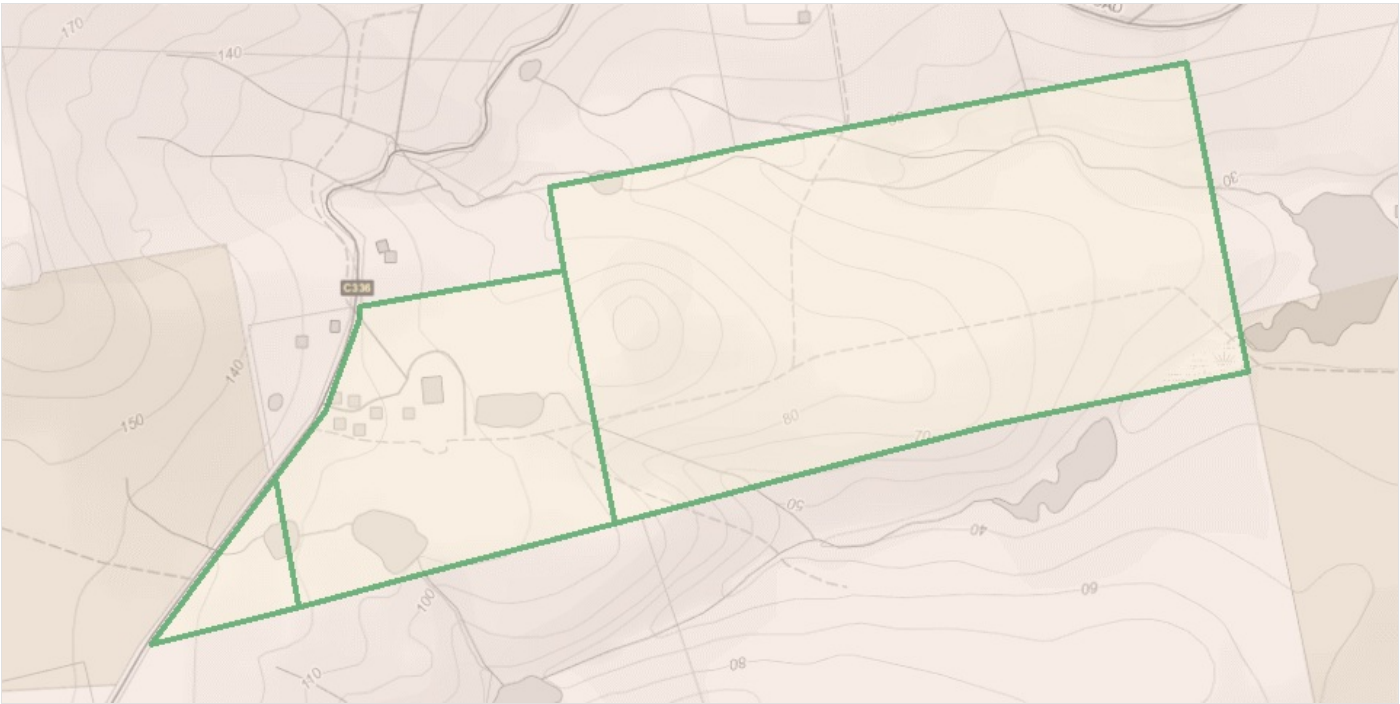
This property is in the **Rural** planning zone under the Tasmanian Planning Scheme.

The Tasmanian Planning Scheme consists of state wide provisions to ensure consistency across Tasmania, and local provisions which spatially apply those through zoning maps along with specific provisions for unique places in each municipality to address local issues.



Location Information

Planning Zone

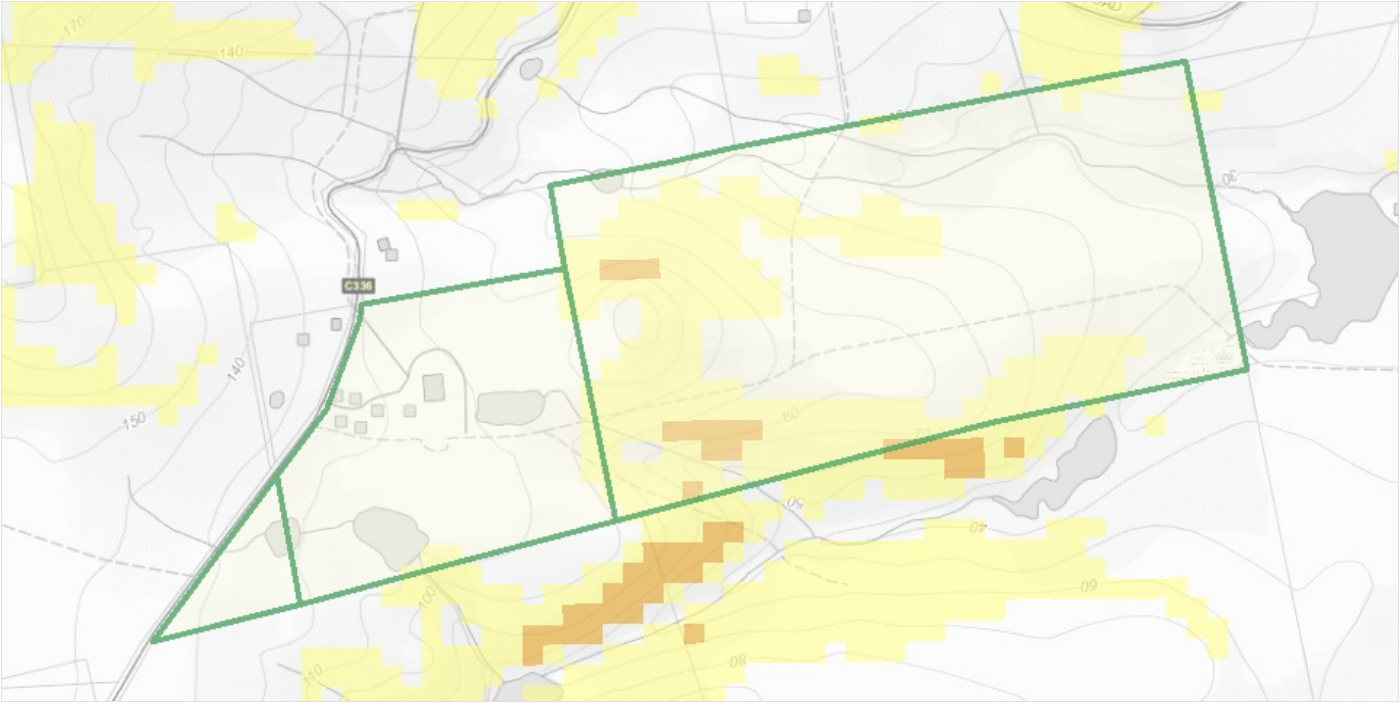


Tasmanian Planning Zone

Zone Number	20
Zone	Rural

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Landslip Hazard



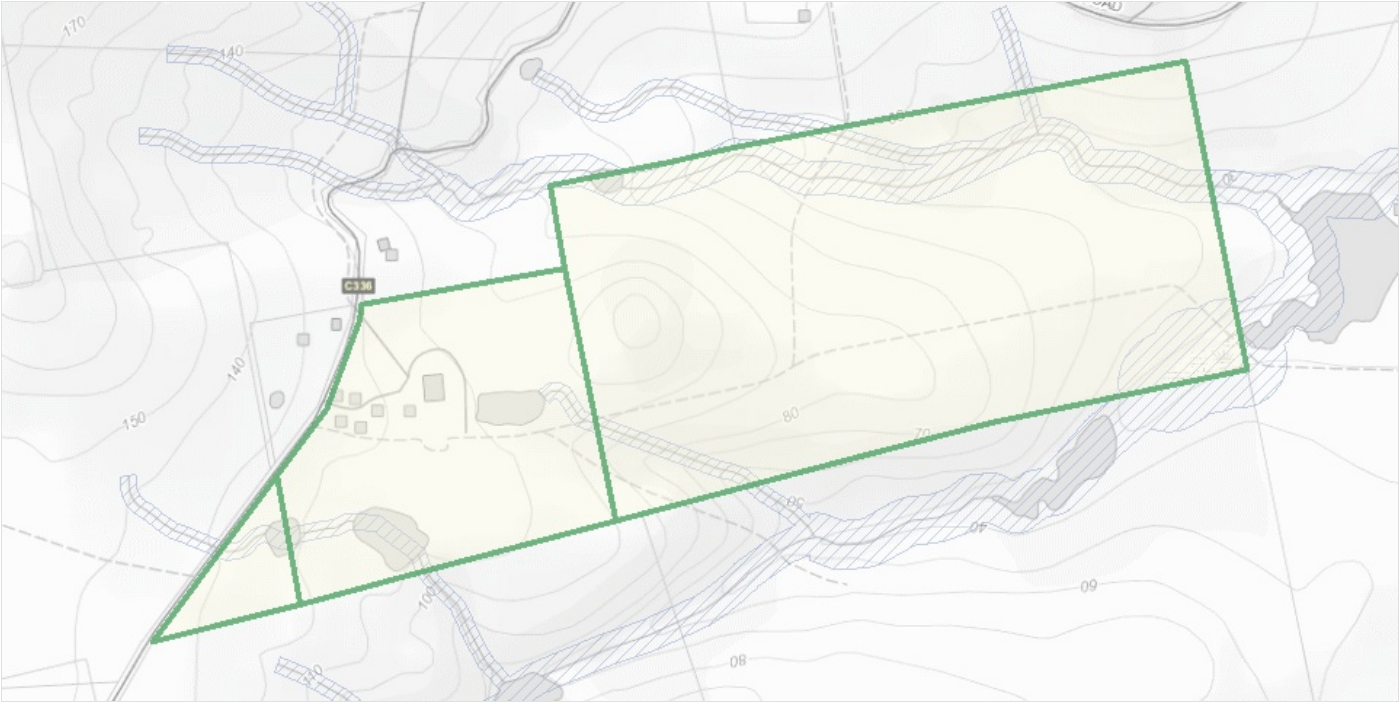
Landslip hazard bands: Colour coding

The coloured areas on the map represent the relevant Landslip Hazard Bands. The Low Risk Hazard Band is yellow, the Medium Risk Hazard Band is orange, the Medium to Active Hazard Band is purple and the High Hazard Band is Red. The presence of a Hazard Code on the property may affect the planning and building approvals required for development.

Hazard Band	Medium
Hazard Exposure	The area has known landslide features, or is within a landslide susceptibility zone, or has legislated controls to limit disturbance of adjacent unstable areas.
Hazard Band	Low
Hazard Exposure	This area has no known active landslides, however it has been identified as being susceptible to landslide by Mineral Resources Tasmania (MRT).

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Waterway and Coastal Protection Area

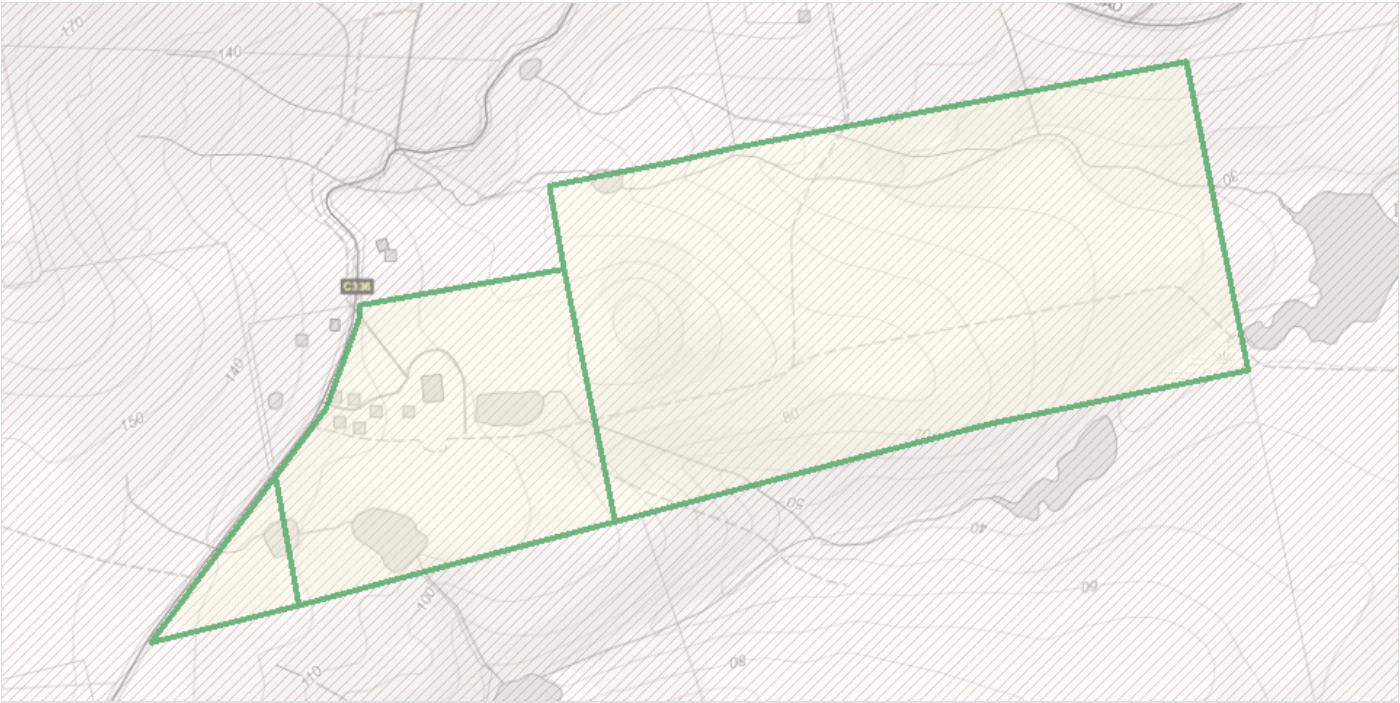


Waterway and coastal protection area

The waterway and coastal protection area overlay includes land within a specified buffer distance from Class 1 to 4 watercourses and wetlands, including Ramsar wetlands. Class 1 watercourses include lakes and tidal waters.

Overlay Name Waterway and coastal protection area

Bushfire Prone Area



Bushfire-prone areas

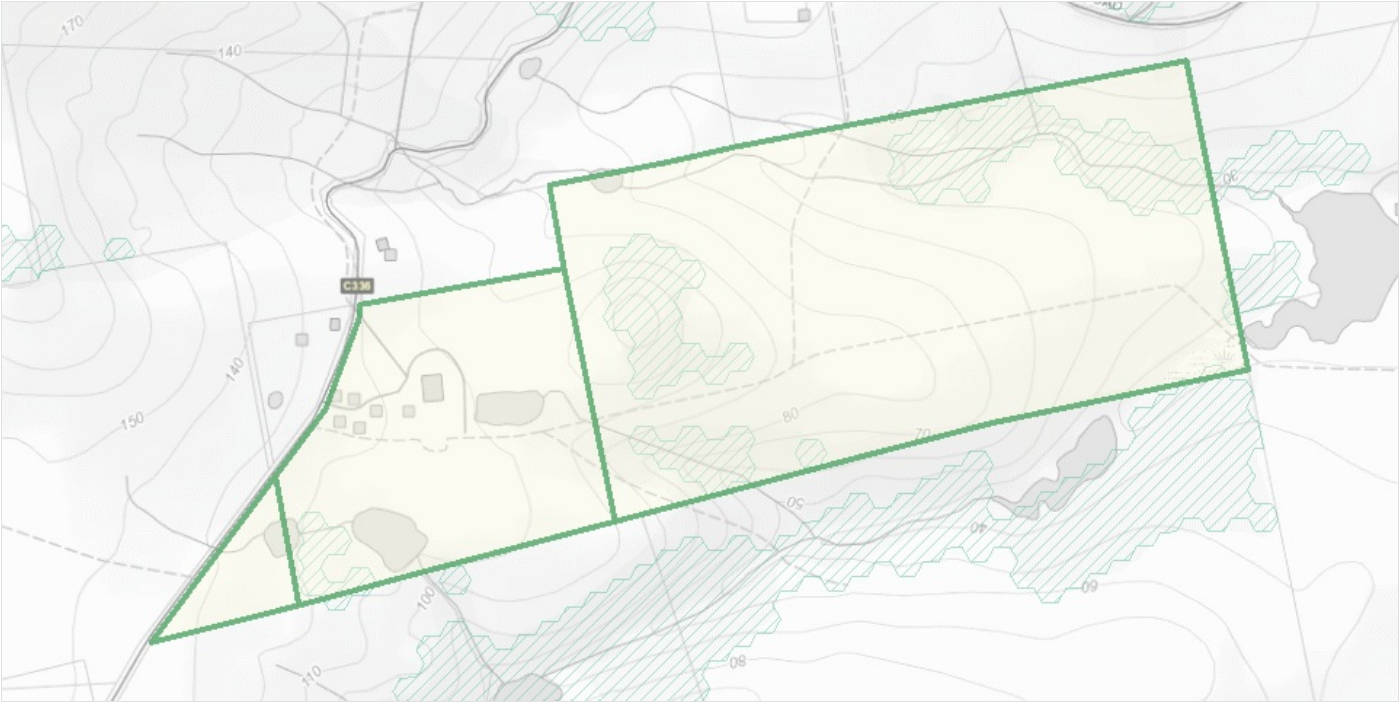
The bushfire-prone area overlay applies in accordance with any overlay map approved by the Tasmania Fire Service for the relevant municipal area. The purpose of the bushfire prone code is to ensure that use and development is appropriately designed, located, serviced, and constructed, to reduce the risk to human life and property, and the cost to the community, caused by bushfires.

Overlay Name Bushfire-prone areas



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Priority Vegetation Area



Priority vegetation area

The priority vegetation area overlay is intended for native vegetation that forms an integral part of a threatened native vegetation community as prescribed under Schedule 3A of the Nature Conservation Act 2002 or is a threatened flora/fauna species.

Description	Priority vegetation data added to rezoned Rural zone
Overlay Name	Priority vegetation area

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Scenic Protection Area



Scenic protection area

The scenic protection area overlay is applied to land identified at the local or regional level as important for the protection of scenic values.

Description	Ragged Tier
Overlay Name	Scenic protection area
LPS Reference	SOR-C8.1.13

Council Details

The local council where your property is located can provide advice on a proposed project.

Consult

Sorell Council

Mailing address

47 Cole Street
Sorell Tasmania 7172

Work:

(03) 6269 0000

Disclaimer

This enquiry tool is a guide only and is not a substitute for professional advice.

This enquiry tool only provides information for common developments undertaken individually, for example, building a deck.

The Tasmanian Planning Commission, a court, council or other relevant authority may have an interpretation of the law that is different from the information provided as part of this enquiry tool.

You should always confirm that you are permitted to commence a development by contacting a relevant authority who may be:

- the local council; or
- an independent Licensed Professional

APPENDIX B.

LETTER TO STROUD DAIRIES. UPDATED 19 JUNE 2025.

**INCLUSION OF DAIRY CHEESE PROCESSING WASTE INTO
THE DAIRY EFFLUENT STREAM FOR LAND APPLICATION.**

Updated 19 June 2025.

To: Stroud Dairies.
Att. Mr. Jack Bignell.
143 Bream Creek Rd,
BREAM CREEK.
Tasmania. 7175.

From: Christian Bannan.
Certified Professional Soil Scientist.
PO Box 5097,
SANDHURST EAST.
Victoria. 3550.



Re: Inclusion of dairy cheese processing waste into the dairy effluent stream for land application.

I, Christian Bannan, work as a Certified Professional Soil Scientist, practicing as an agricultural and environmental soil scientist with experience in the management and land application dairy processing wastewater and land application. I am also an accredited effluent system designer.

In the preparation of this letter, I have reviewed the 'Effluent Management Guidelines for Dairy Sheds in Australia' (ANZECC, 1999a) and the 'Effluent Management Guidelines for Dairy Processing in Australia' (ANZECC, 1999b) and used data from these sources for guidance. ANZECC (1999b) provides guidance for cheese-making facilities. This guideline states that disposal of dairy processing wastewater via the normal dairy effluent treatment system may be allowed provided that there is no detrimental effect to the environment.

Stroud dairies run an 780-cow dairy herd with associated milking shed facilities which generate approximately 37,386 litres of dairy effluent per day (excluding proposed wastewater addition), or 261,702 litres/week (see Appendix A). The site also has an impervious concrete area covering the cow yard, feedpad and other supporting concrete areas with an equivalent impervious surface of 6790m². This surface collects approximately 5.05 ML of rainfall per year under an average annual rainfall of 745mm, equating to 97,279 litres per week. Collectively, the effluent wastewater stream combined with rainfall is approximately 358,981 litres per week, or approximately 0.36 ML. Most of this comprises of fresh water and is stored in an effluent collection pond, with agitation prior to application on pasture or crop via centre pivot irrigator. The business currently irrigates effluent over approximately 139 hectares on centre-pivot sprinklers, which limits irrigation within 30-metres of watercourses and waterbodies. Effluent irrigation also only occurs during months when irrigation is required, between October and March. Nutrient generated from the effluent stream accounts for a small fraction of the pasture or crop nutrient balance across the property.

Stroud Dairies also propose to operate a small-scale dairy processing facility generating 2500 litres of wastewater per week. Wastewater generated is solely from cheese making mainly described as whey. The process relies on the use of ingredients which include salt (sodium chloride). The business proposes to incorporate dairy processing facility waste into the effluent stream for land application. It is understood that the volumes of wastewater generated do not change and are not intended to change into the future. The shandy rate is approximately 0.946% of the total dairy effluent wastewater stream (see Appendix B and C).

The general characteristics of dairy shed effluent extracted from ARMCANZ (1999a) are listed in Table 1. The general characteristics of dairy processing wastes are extracted from ARMCANZ (1999b) and included in Tables 2 and 3. The guideline for EC (salinity) of dairy shed effluent is relatively low at 1.12 dS/m and a more conservative EC of 3.0 dS/m is adopted for calculations. The guideline notes that the BOD5 level in processing

waste may range up to 4790 mg/L. My experience with wastewater and whey from cheese making shows that the Electrical Conductivity (EC) or salinity can range from 8,000 uS/cm to 56,000 uS/cm. Assuming a worst case scenario, I have adopted 56,000 uS/cm for salinity calculations.

Table 1. Characteristics of dairy shed effluent (indicative values only) (ANZECC, 1999a).

Component in wastewater:	(mg/L)
Biochemical oxygen demand (BOD)	3200
Suspended solids	2400
Total nitrogen	187
Ammonia	84
Total phosphorus	26
Sodium	119
Potassium	200
Magnesium	27
Chloride	180
Carbonate/Bicarbonate	155
pH	8
Veterinary chemicals	+
Cleaning materials and disinfectants	++
Bacteria, viruses, helminths	++
Salt (as EC)	1.12 dS/m
Sodium Adsorption Ratio (SAR)	4.3

Source: Wrigley, 1994

Tables 2 & 3. Characteristics of dairy processing plant effluent (indicative values only) (ANZECC, 1999b).

Table 1. Indicative Composition of Dairy Processing Plant Effluent**

Component	Range (mg/L)	Average (mg/L)
Suspended solids	24-5700	-
Volatile suspended solids	17-5260	-
Volatile total solids	57-4700	1497
Total solids	135-8500	2397
BOD ₅	450-4790	1885
Protein	210-560	350
Fat	35-500	209
Carbohydrate	252-931	522
Nitrogen	15-180	76
Phosphorus	11-160	50
Sodium	60-807	-
Chloride	48-469	276
Calcium	57-112	-
Magnesium	25-49	-
Potassium	11-160	67
	range	average
Temperature (°C)	12-49	24
pH	5.3-9.4	7.1

Source: Jones (1974)

Table 2. Indicative BOD Levels of Milk and Milk Products

Product	BOD ₅ in Product (mg/kg)	Wastewater (g/kg milk processed)	BOD ₅ in Wastewater (g/kg milk processed)	BOD ₅ in Wastewater (mg/L)
Whole milk	104 000	500	0.46	920
Butter	-	1450	2.60	1790
Skim milk	67 000	1100	2.15	1950
Heavy cream	399 000	-	-	-
Buttermilk	68 000	1160	1.85	1590
Yoghurt	91 000	1160	1.89	1630
Icecream*	292 000	1150	2.09	1820
Cheddar cheese	-	770	1.25	1620
Whey (cheese)	34 000	2200 [#]	-	28000

Source: Jones (1974), Lyons et al (1989)

* 15% added sugar, # including whey, BOD₅ (five day BOD)



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To determine the final EC and BOD₅ concentration of wastewater, the following calculation is used (Wrigley, 2005). Workings are provided in Appendix B and C respectively.

$$\text{Concentration of the blended water} = \left[\text{Concentration of water (a)} \times \text{Proportion of water (a) used} \right] + \left[\text{Concentration of Water (b)} \times \text{Proportion of water (b) used} \right]$$

Salinity: The final salinity level of stored effluent within the effluent pond is 3502 uS/cm. A net change of 502 uS/cm increase, or 14.3% is expected from the addition of dairy processing wastewater.

Effluent retained within the pond system will be irrigated on land at a rate of 1 part effluent to 10 parts fresh water. The final EC level of irrigation water is expected to be approximately **364** uS/cm upon irrigation. This level is below all thresholds for salinity of irrigation waters applied to crops listed within ANZG (2023), Ayres & Westcot (1989) and Rhoades et al (1992).

Biochemical Oxygen Demand (BOD): The final BOD level of stored effluent within the effluent pond is 3215 mg/L, almost the same as the starting level of effluent. The net change expected is an increase of 0.47%. This is deemed very low and conservative.

Other nutrients including nitrogen, phosphorus and potassium: These have been calculated manually. There is a negligible change in the levels of these nutrients in the dairy effluent stream with the small addition of dairy processing waste into the effluent stream.

Conclusion: The blending of dairy processing waste into the dairy effluent system is deemed to be safe and sustainable at the rates provided by Stroud Dairies. Furthermore, effluent remains suitable for land application at a shandy rate of at least 1 part effluent to 10 parts fresh irrigation water, without detrimental impacts on the effluent system or to the environment. Calculations indicate that there will be a very small change in chemistry within the dairy effluent stream.

With past experience at managing similar products for land application, problems are only likely when milk processing wastewater is blended with effluent or fresh irrigation water at high concentrations (eg. 20% or greater). This proposal blends cheese processing wastewater into effluent at <1%, then effluent into fresh irrigation water at a maximum of 10%, which are extremely low rates of blending and deemed to be of a very low risk.

If there are any queries with relation to this matter, please make contact for clarification.

Kind regards,

Christian Bannan.
Ba Ag (Hons), Adv. Dip. Ag., SSA, CPSS.
Director, Soil Scientist
South East Soil & Water.
Certified Professional Soil Scientist, Soil Science Australia.

REFERENCES:

- ARMCANZ, 1999a. 'Effluent Management Guidelines for Dairy Sheds in Australia', Agriculture and Resource Management Council of Australia and New Zealand, June 1999.
- ARMCANZ, 1999b. 'Effluent Management Guidelines for Dairy Processing in Australia', Agriculture and Resource Management Council of Australia and New Zealand, June 1999.
- ANZG (2023). *Water Quality for Irrigation and General Water Uses: Guidelines*. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand governments and Australian state and territory governments, Canberra.
- Ayres and Westcott, 1985. *Water Quality for Agriculture*, FAO Irrigation and Drainage Paper 29, Revision 2, Food and Agriculture Organisation of the United Nations.
- Rhoades, J.D., Kandiah, A. & Marshali, A.M. 1992, 'The Use of Saline Waters for Crop Production', FAO Irrigation & Drainage Paper Number 48, Food and Agriculture Organisation of the United Nations, Rome.

Appendix A. Stroud Dairies Dairy Shed Fresh Water Generation – Daily & Weekly.

BREAM CREEK DAIRY.

CURRENT OPERATION. 780 COWS.

Platform speed graph milking time: 2 hrs 36 mins at 10 seconds per ball

Budget based on 2 hrs 45 mins

	Cows	Time/Milking (Hours)	Milking Minutes	Milkings	Large Hoses - mins/hour - Wet Up	Large Hoses - mins/hour during milking	Large Hoses - mins/hour end milking	Small Handheld Hose Down Minutes	Yard Blaster Time	Milking Time Per Cow (Mins)
	780	2.75	165	2	5	2	10	2	2	4.73

Item	Volume (l/day)	Details of Testing & Notes	l/sec	l/min	l/milking	x 2 milkings	SOURCE
Rotary Hose 1 Platform	14850	0.75	0.75	45	7425	14850	Catchment
Rotary Hose 2 Cups	0	Disconnected		0	0	0	Catchment
Rotary Hose 3 Bottom	0	Disconnected		0	0	0	Catchment
Dairy Shed Hose/Platform/Top of Yard - Wet Up	2400	Hoses running at 4 L/s	4.00	240	1200	2400	Catchment
Dairy Shed Hoses during milking	2640	Hoses running at 4 L/s	4.00	240	1320	2640	Catchment
Dairy Shed Hoses end of milking - Platform, Shed, Top of Yard	4800	Hoses running at 4 L/s	4.00	240	2400	4800	Catchment
Small Handheld Hoses in Dairy	36	0.15 L/s	0.15	9	18	36	Catchment
Yard Blasters	7920	11 kv pump, 33 L/s	33	1980	3960	7920	Catchment
Vat Wash	1500	Approx 1500 litres per wash, once per day			750	1500	Catchment
Plant Wash	3000	3 washes x 500 litres per wash, x 2			1500	3000	Catchment
Calf milk washdown	240	1 minutes with large handheld hose	4	240	120	240	Catchment
Plate cooler water	0	Dam water recycled back into farm dam			0	0	Catchment
Cheese processing facility wastewater	357	Estimated volume proposed			179	357	Brine
Total Water Generation/Day (litres):	37743				18872	37743	

Average per cow (litres): 48
Total of large hoses in dairy (litres): 9840

Total effluent water generation/day (L) - excluding wastewater: 37386
Total effluent water generation/week (L) - excluding wastewater: 261702

Median Cow Time on Yards/Milking	Time on Yards/Day (hours)
1.5	3



Sorell Council

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Appendix B. EC (Salinity) Calculation: Addition of dairy processing wastewater into the effluent system, then blending with fresh water for irrigation on pasture.

Bignell Dairy Processing Wastewater:

Addition into effluent stream, then irrigation on pasture.

Updated June 2025.

STEP 1. EC - SALINITY OF DAIRY EFFLUENT WITH ADDITION OF DAIRY PROCESSING WASTEWATER.

Daily effluent water generation (L): 37386
Weekly effluent water generation (L): 261702
Weekly milk processing wastewater (L): 2500

Proportion					Proportion	Percentages
	Dairy Effluent (ML)	0.261702	Litres	261702	0.990537543	99.0538%
	Milk Processing Wastewater (ML)	0.0025	Litres	2500	0.009462457	0.9462%
	Total			264202	1	100.0%

EC Levels Dairy Effluent

Milk Processing Wastewater

3000 Adopted as a conservative value for effluent by comparison with ARMCANZ, 1999b.
56000 High level, typical of whey being a highly saline brine.

$$\begin{aligned}
 \text{Concentration of the blended water} &= \left[\text{Concentration of water (a)} \times \text{Proportion of water (a) used} \right] + \left[\text{Concentration of Water (b)} \times \text{Proportion of water (b) used} \right] \\
 \text{Calculation (uS/cm)} &= \left[3000 \times 0.990537543 \right] + \left[56000 \times 0.009462457 \right] = 2971.6 + 529.9 = 3502 \text{ uS/cm} \\
 \text{Equals:} &3502 \text{ uS/cm} \quad \text{New dairy effluent EC level.} \\
 \text{Change:} &502 \text{ uS/cm} \\
 \text{Percentage change:} &14.3\%
 \end{aligned}$$

STEP 2: DAIRY EFFLUENT SHANDY INTO FRESH WATER FOR IRRIGATION ON PASTURE.

Proportion					Proportion	Percentages
	Fresh Irrigation Water	1ML	Litres	1000000	0.8	80.0000%
	Dairy Effluent	0.2 ML	Litres	250000	0.2	20.0000%
	Total			1250000	1	100.0%

EC Levels Fresh Irrigation Water

Dairy Effluent

50 uS/cm
3502 uS/cm

$$\begin{aligned}
 \text{Concentration of the blended water} &= \left[\text{Concentration of water (a)} \times \text{Proportion of water (a) used} \right] + \left[\text{Concentration of Water (b)} \times \text{Proportion of water (b) used} \right] \\
 \text{Calculation (uS/cm)} &= \left[50 \times 0.8 \right] + \left[3502 \times 0.2 \right] = 40 + 700.3 = 740 \text{ uS/cm} \\
 \text{Equals:} &740 \text{ uS/cm}
 \end{aligned}$$



Sorell Council

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Appendix C. BOD Calculation: Addition of dairy processing wastewater into the effluent system, then blending with fresh water for irrigation on pasture.

Bignell Dairy Processing Wastewater:

Addition into effluent stream, then irrigation on pasture.

Updated June 2025.

STEP 1. BOD OF DAIRY EFFLUENT WITH ADDITION OF DAIRY PROCESSING WASTEWATER.

Daily effluent water generation (L): 37386
Weekly effluent water generation (L): 261702
Weekly milk processing wastewater (L): 2500

Proportion				Proportion	Percentages
	Dairy Effluent (ML)	0.261702	Litres	261702	0.990537543
	Milk Processing Wastewater (ML)	0.0025	Litres	2500	0.009462457
	Total			264202	1
					100.0%

BOD Levels (mg/L) Dairy Effluent 3200 ARMCANZ, 1999a.
Milk Processing Wastewater 4790 ARMCANZ, 1999b.

$$\begin{aligned} \text{Concentration of the blended water} &= \left[\text{Concentration of water (a)} \times \text{Proportion of water (a) used} \right] + \left[\text{Concentration of Water (b)} \times \text{Proportion of water (b) used} \right] \\ \text{Calculation (mg/L BOD)} &= \left[3200 \times 0.990537543 \right] + \left[4790 \times 0.009462457 \right] = 3170 + 45.3 = 3215 \text{ mg/L BOD} \\ \text{Equals:} & \text{New dairy effluent BOD level.} \\ \text{Change:} & 15.0 \text{ mg/L BOD} \\ \text{Percentage change:} & 0.47\% \end{aligned}$$

STEP 2: DAIRY EFFLUENT SHANDY INTO FRESH WATER FOR IRRIGATION ON PASTURE.

Proportion				Proportion	Percentages
	Fresh Irrigation Water (ML)	1	Litres	1000000	0.909090909
	Dairy Effluent (ML)	0.1	Litres	100000	0.090909091
	Total			1100000	1
					100.0%

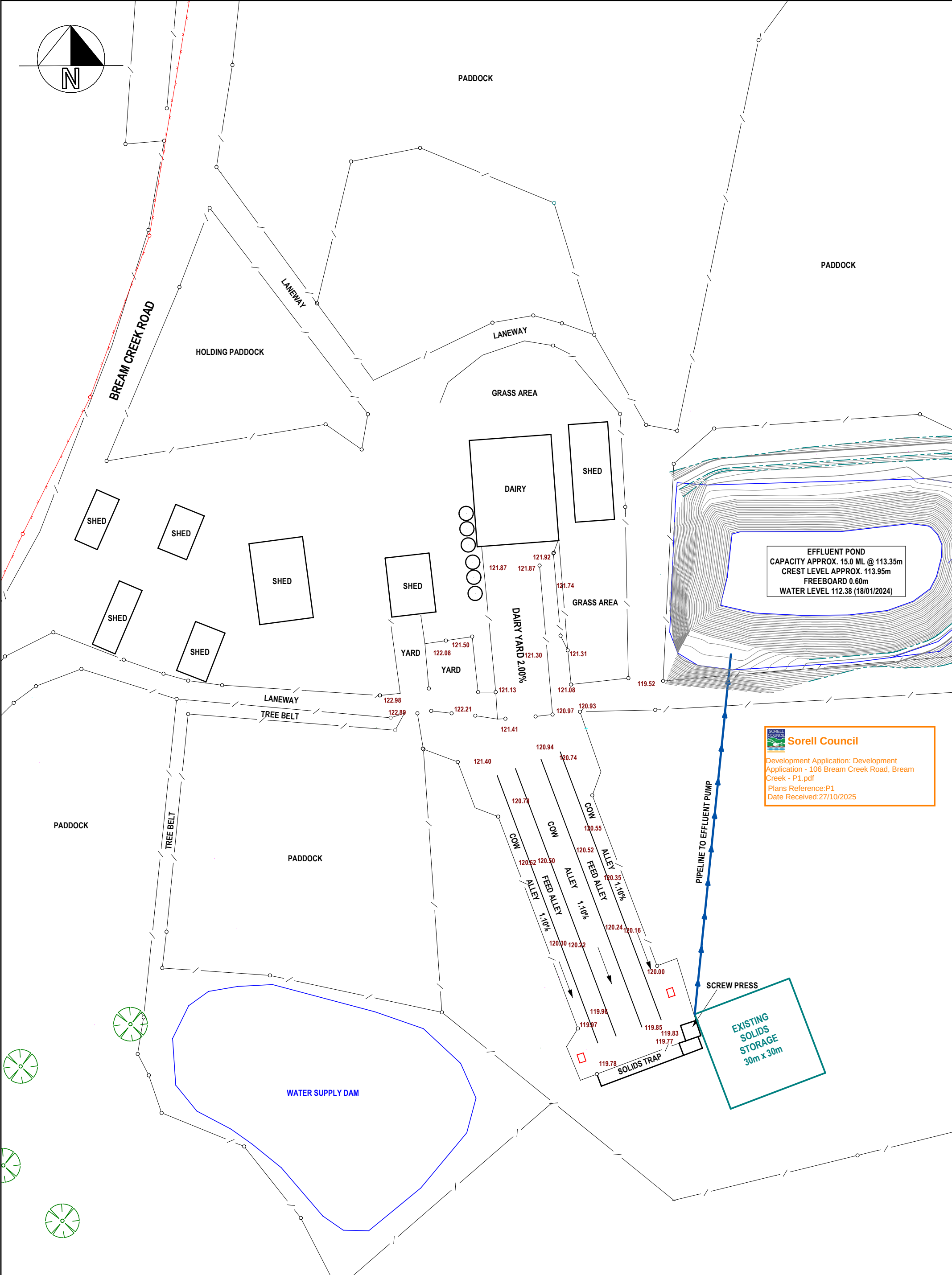
BOD Levels (mg/L) Fresh Irrigation Water 2 mg/L BOD Various sources
Dairy Effluent 3215 mg/L BOD Calculated above

$$\begin{aligned} \text{Concentration of the blended water} &= \left[\text{Concentration of water (a)} \times \text{Proportion of water (a) used} \right] + \left[\text{Concentration of Water (b)} \times \text{Proportion of water (b) used} \right] \\ \text{Calculation (mg/L BOD)} &= \left[2 \times 0.909090909 \right] + \left[3215 \times 0.090909091 \right] = 2 + 292.3 = 294 \text{ mg/L BOD} \\ \text{Equals:} & 294 \text{ mg/L BOD} \end{aligned}$$



APPENDIX C.

EXISTING SITE PLAN – NJC IRRIGATION SOLUTIONS.



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LEGEND

BANK-80.68
BED-80.26

FARM CHANNEL

BED-79.73

FARM DRAIN

FENCELINE

TRACK

TREE LINE

POWERLINE & POLE

TELSTRA

TREE

PEG

TEMPORARY BENCH MARK

BENCH MARK

PUMP

NATURAL SURFACE LEVEL

CONCRETE LEVELS

Sorell Council

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VOLUMES FOR SHED PAD AND RAMPS
CUT AREA = 18,520m² @ 0.20m TOPSOIL STRIP = 3,704m³
FILL AREA = 11,564m² @ 0.020m TOPSOIL STRIP = 2,313m³

CUT VOLUME BELOW STRIPPED TOPSOIL = 31,748m³
FILL VOLUME ABOVE STRIPPED TOPSOIL = 26,480m³ (SOLID INSITU)
PLUS 15% COMPACTION = 30,453m³

MAXIMUM CUT = 5.42m
MAXIMUM FILL = 6.51m

EFFLUENT POND DETAILS - POND 3

BANK HEIGHT = 112.42m, CREST 4.0m WIDE
CORE TRENCH 3.0m WIDE, BATTERS 1 TO 1 DEPTH 1.0m
POND INTERNAL FILL BATTERS 4 TO 1
POND INTERNAL CUT BATTERS 2 TO 1
EXTERNAL BATTERS 3 TO 1

DESIGN CAPACITY = 29.30ML @ 111.85m (0.60 freeboard)
MAXIMUM CUT DEPTH = 3.56m
MAXIMUM FILL DEPTH = 6.51m

VOLUME OF TOPSOIL STRIP UNDER CUT AREAS (7.33m² @ 0.20m) = 1.467m³ (SOLID INSITU)
VOLUME OF TOPSOIL STRIP UNDER FILL AREAS (1.57m² @ 0.20m) = 0.314m³ (SOLID INSITU)

VOLUME IN CORE TRENCH BELOW STRIPPED TOPSOIL = 764m³ (SOLID INSITU)
+12.5% COMPACTION FACTOR = 859m³

VOLUME OF EARTHEN FILL ABOVE STRIPPED NS = 20.80m³ (SOLID INSITU)
+12.5% COMPACTION FACTOR = 23.42m³

VOLUME OF CUT IN FOOT PRINT (below stripped topsoil) = 18.475m³ (SOLID INSITU)
shortfall = 7.349m³

NOTE: ALL FINISHED ELEVATIONS ARE TOP OF EARTHEN FILL

EFFLUENT POND DETAILS - POND 1

DESIGN FSL = 114.24, CREST 4.0m WIDE
CORE TRENCH 3.0m WIDE, BATTERS 1 TO 1, DEPTH 0.6m
INTERNAL BATTERS 3 TO 1
EXTERNAL BATTERS 3 TO 1

DESIGN CAPACITY = 9.11ML @ 114.24m (0.60 freeboard)
= 9.08ML @ 114.50m (0.34 freeboard)
= 10.11ML @ 114.54m (0.30 freeboard)

MAXIMUM CUT DEPTH = 4.45m
MAXIMUM FILL DEPTH = 4.34m

EFFLUENT POND 1 CONSTRUCTION FOOT PRINT AREA = 13,919 m²

VOLUME OF TOPSOIL STRIP UNDER CUT AREAS (2.69m² @ 0.20m) = 0.538m³ (SOLID INSITU)
VOLUME OF TOPSOIL STRIP UNDER FILL AREAS (4.16m² @ 0.20m) = 0.832m³ (SOLID INSITU)

VOLUME IN CORE TRENCH BELOW STRIPPED TOPSOIL = 378m³ (SOLID INSITU)
+12.5% COMPACTION FACTOR = 425m³

VOLUME OF EARTHEN FILL ABOVE STRIPPED NS = 0.763 m³ (SOLID INSITU)
+12.5% COMPACTION FACTOR = 0.859m³

VOLUME OF CUT IN FOOT PRINT (below stripped topsoil) = 6.001 m³ (SOLID INSITU)
SHORTFALL 3.879m³

NOTE: ALL FINISHED ELEVATIONS ARE TOP OF EARTHEN FILL

VOLUMES FOR SILAGE AREA AND DRAINAGE
CUT AREA = 11,815m² @ 0.20m TOPSOIL STRIP = 2,363m³
FILL AREA = 7,265m² @ 0.020m TOPSOIL STRIP = 1,453m³

CUT VOLUME BELOW STRIPPED TOPSOIL = 19,036m³
FILL VOLUME ABOVE STRIPPED TOPSOIL = 9,296m³ (SOLID INSITU)
PLUS 12.5% COMPACTION = 10,458m³

EXCESS SOIL EXCAVATION = 8,578m³ (FOR PONDS 1 AND 3)

MAXIMUM CUT = 4.45m
MAXIMUM FILL = 3.50m

SILAGE RUNOFF CAPACITY @ 132.75 = 6.36ML (0.30 FREEBOARD)
SILAGE RUNOFF CAPACITY @ 132.45 = 5.54ML (0.60 FREEBOARD)

THESE PLANS ARE SUBJECT TO THE RELEVANT AUTHORITIES PLANNING APPROVALS PRIOR TO ANY CONSTRUCTION COMMENCING.

LOCATION OF SERVICES (POWER, TELECOM, ETC) SHOWN ON PLANS ARE APPROXIMATE ONLY. CONTRACTOR MUST VERIFY ACTUAL POSITION OF THESE SERVICES AND ANY OTHER SERVICES NOT SHOWN ON THESE PLANS PRIOR TO ANY CONSTRUCTION COMMENCING.

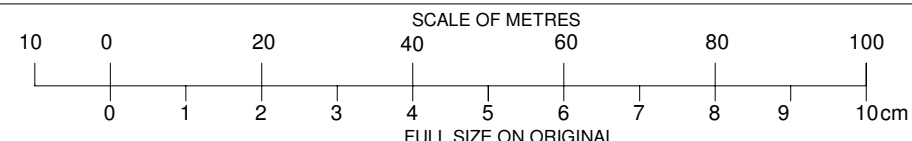
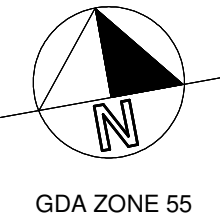
ACTUAL POSITION OF ANY EXISTING BOUNDARIES, EASEMENTS OR ROAD RESERVES HAVE NOT BEEN SHOWN ON THIS PLAN, BUT SHOULD BE DETERMINED ON SITE BY RELEVANT BODIES PRIOR TO ANY CONSTRUCTION COMMENCING.

TITLE BOUNDARIES SHOWN ON PLAN ARE APPROXIMATE ONLY.

NATURAL SURFACE CONTOURS IN GREY - 0.50m INTERVALS
DESIGN CONTOURS SHOWN - 0.50m INTERVAL (ORANGE) 2.0m INTERVAL (BROWN)



REV	DATE	DESCRIPTION	BY	CHECKED
1	12/08/2025	SILAGE PAD AND DRAINAGE ADDED	NHC	RJM
0	25/05/2025	ORIGINAL CREATED	NHC	RJM
REVISIONS				
			DPN	CHKD



SURVEYED BY	DRAWN	DESIGNED
N. H. CARMICHAEL	N. H. CARMICHAEL	N. H. CARMICHAEL
DATUM	GRID INTERVAL	AREA
ARBITRARY	RANDOM	



5 GARVEY ROAD
P.O. BOX 335
KEERANG, VIC 3579
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BREAM CREEK DAIRY
PROPOSED DAIRY BARN AND EFFLUENT LAYOUT PLAN
BREAM CREEK ROAD, BREAM CREEK

CROWN ALLOTMENT	SECTION	PARISH	DRAWING NO.	SHEET NUMBER	FILE REF	REV	SHEET SIZE
			50001-F	1	IS-674	1	A1

APPENDIX E.

EFFLUENT POND PLANS – NJC IRRIGATION SOLUTIONS.

- **Appendix E1. Proposed new effluent solids pond 1.**
- **Appendix E2. Proposed new effluent storage pond 3.**
- **Appendix E3. Proposed commodities area and runoff storage.**

APPENDIX I.

SOIL TEST RESULTS – AG ASSIST. INTERPRETED BY SESW.

- **Appendix I1. All Data.**
- **Appendix I2. Grouped Data.**



APPENDIX 11.
STROUD DAIRIES SOIL TESTING RESULTS - SEPTEMBER 2024. ALL DATA.
SAMPLING BY AG ASSIST.
INTERPRETATION BY SOUTH EAST SOIL & WATER.

Sample Name	Sample Depth From	Sample Depth To	pH (1:5 Water)	pH (1:5 CaCl2)	Electrical Conductivity (1:5 water)	Elec. Cond. (Sat. Ext.)	Chloride	Organic Carbon (W&B)	Organic Matter (OC x 1.72)	Nitrate Nitrogen	Ammonium Nitrogen	Phosphorus (Colwell)	Phosphorus (Olsen)	Phosphorus Buffer Index (PBI-Co)	Available Potassium	Sulphur (KCl)	Calcium (Amm-acet)	Magnesium (Amm-acet)	Potassium (Amm-acet)	Sodium (Amm-acet)	Aluminium (KCl)	Calcium (Amm-acet)	Magnesium (Amm-acet)	Potassium (Amm-acet)	Sodium (Amm-acet)	Aluminium (KCl)	Cation Each. Cap.	Calcium (Amm-acet)	Magnesium (Amm-acet)	Potassium (Amm-acet)	Sodium (Amm-acet)	Aluminium Saturation	Calcium / Magnesium Ratio	Zinc (DTPA)	Copper (DTPA)	Manganese (DTPA)	Iron (DTPA)	Boron (Hot CaCl2)	Soil Colour	Soil Texture	Phosphorus Environmental Risk Index
					dSm	dSm	mg/kg	%	%	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	%	%	%	%	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			
IRRIGATED SITES																																									
Big Dam Pivot	0	10	6.3	5.4	0.15	1.20	120	4.48	7.67	7.8	9.9	37.5	14.0	100	120	6.7	1240	683	121	253	9	6.2	5.4	0.31	1.1	0.1	13	47	42	2.4	8.2	1.8	1.1	4.2	2.9	24.0	340	0.6	Grey	Clay Loam	0.37
Big Dam Pivot	10	60	5.1	4.2	0.18		110			6.3	2.3				84		620	714	86	253	340	3	5.9	0.22	1.1	4.9	15	20	39	1.4	7.1	2.6	0.5				0.3				
Big Pk Pivot	0	10	7.2	6.7	0.48	3.00	300	8.23	15.48	13.0	14.0	190.0	44.3	160	330	20.0	2620	1535	341	587	9	13	15	1.4	2.9	0.1	31.7	41	46	4.3	9.9	1.0	5.9	6.2	1.5	17.0	300	1.1	Grey	Clay	0.94
Big Pk Pivot	10	60	8.0	5.6	1.19		1200			3.9	1.1				190		1190	2257	192	1516	9	5.9	17	0.49	6.6	0.1	30.3	19	57	1.6	22.0	1.9	5.4				0.3				
Blackcunts	0	10	6.9	6.2	0.22	1.40	42	4.77	8.20	35.0	9.0	120.0	47.2	180	350	30.0	4400	1215	352	299	9	22	10	0.9	1.3	0.1	34	64	30	2.6	3.9	1.0	2.2	5.8	1.9	13.0	140	2.4	Brown	Clay	0.85
Blackcunts	10	60	6.6	5.7	0.26		150			13.0	1.6				77		2400	2161	76	1104	10	12	23	0.2	4.8	0.11	40.4	30	30	0.5	11.0	0.3	0.5				1.1				
BurntHl Barn	0	10	6.5	4.8	0.16	1.40	47	5.91	3.24	35.0	26.0	99.0	42.9	400	380	9.9	1760	1114	384	205	45	8.8	9.7	0.75	0.89	0.5	20.7	42	47	3.6	6.3	2.4	0.9	2.0	0.9	9.2	340	0.6	Brown	Clay Loam	0.46
BurntHl Barn	10	60	6.0	4.7	0.11		80			6.3	1.9				120		1660	2266	121	968	460	8.3	19	0.31	2.3	1.8	31.8	26	69	1.0	7.4	6.5	0.4				0.4				
China Pivot	0	10	6.7	5.0	0.32	2.60	190	10.66	15.40	22.0	30.0	42.0	13.2	300	390	20.0	2230	1536	354	330	9	11	14	0.65	2.2	0.1	27.7	39	31	2.4	7.9	1.9	5.9	1.7	0.3	2.6	300	1.3	Grey	Clay Loam	0.16
China Pivot	10	60	6.3	5.5	0.29		240			7.1	2.2				56		1720	3672	55	843	13	8.6	32	0.14	4.1	0.15	45.2	19	71	0.3	3.1	0.3	5.3				0.6				
Dairy Pivot	0	10	6.2	5.6	0.28	2.50	120	5.08	10.41	26.0	16.9	120.0	27.9	250	630	15.0	2200	1351	626	358	9	11	11	1.6	1.6	0.1	25.5	44	44	6.4	6.1	1.0	1.0	3.1	2.7	77.0	130	1.0	Grey	Loam	0.46
Dairy Pivot	10	60	6.1	5.1	0.16		94			1.3	1.0				260		1360	1523	202	345	27	6.9	13	0.72	1.5	0.31	22.2	31	30	0.3	6.6	0.4	0.5				0.6				
Dicks Pivot	0	10	6.2	5.6	0.17	1.80	36	5.77	3.24	19.0	16.0	71.0	16.5	260	130	8.6	2000	683	133	140	9	10	5.4	0.34	0.61	0.1	16.3	61	33	2.1	3.7	1.8	1.9	3.9	1.5	31.0	310	0.7	Grey	Sandy Loam	0.26
Dicks Pivot	10	60	6.6	4.8	0.12		82			17.3	1.3				26		720	336	26	127	84	3.6	2.8	0.067	0.55	0.38	7.39	49	38	0.9	7.4	6.3	0.3				0.2				
Marion Bay Corner Pivot	0	10	6.9	6.3	0.25	1.90	62	4.11	7.07	34.0	9.9	210.0	36.6	100	330	13.0	4620	1536	336	391	9	23	16	1.3	1.7	0.1	42.1	55	39	3.2	4.6	1.9	1.4	5.6	3.6	7.6	200	1.4	Grey	Clay	1.11
Marion Bay Corner Pivot	10	60	7.4	6.5	0.23		120			13.0	3.7				290		3300	2163	290	621	9	16	23	0.75	2.7	0.1	42.8	38	54	1.7	6.4	1.0	5.7				1.1				
New 12 Pivot	0	10	6.3	5.6	0.30	1.90	250	4.13	7.10	6.6	12.9	21.0	7.8	130	150	13.0	2400	1215	162	460	9	12	10	0.39	2	0.1	24.2	49	41	1.6	6.4	1.0	1.2	3.1	1.3	22.0	280	0.9	Grey	Clay	0.16
New 12 Pivot	10	60	6.4	6.4	0.14		75			1.9	1.3				42		1340	1894	63	391	9	6.7	14	0.11	1.7	0.1	23	29	43	0.9	7.5	0.9	0.5				0.4				
Noonans	0	10	6.9	5.1	0.13	1.30	36	4.74	8.15	15.0	20.0	92.0	29.0	180	150	8.0	1360	557	149	38	12	6.8	4.6	0.38	0.41	0.1	12.3	55	37	3.1	3.3	1.1	1.5	4.9	1.0	14.0	310	0.6	Grey	Sandy Loam	0.35
Noonans	10	60	6.3	4.2	0.12		55			5.5	2.2				48		680	678	47	228	460	2.4	5.6	0.12	0.99	7.3	16.4	56	34	0.7	4.9	4.6	0.4	0.5							
Sand Pivot	0	10	6.6	6.2	0.30	3.10	120	6.66	7.29	39.0	11.0	210.0	36.6	75	360	13.0	1640	344	576	253	12	8.2	7.8	2.5	1.1	0.1	19.7	42	46	10.0	5.6	2.7	1.1	30.9	2.6	17.0	210	1.3	Grey	Sandy Loam	1.32
Sand Pivot	10	60	4.9	4.1	0.26		130			8.7	0.7				90		240	315	9.9	192	360	1.2	2.6	1.3	0.66	4.3	10.1	12	26	13.0	6.5	4.0	5.5				0.4				
Shearing Shed	0	10	6.2	5.4	0.12	1.00	37	4.13	7.10	17.0	11.0	63.0	27.8	46	160	6.5	1720	693	164	59	9	8.6	4.9	0.47	0.43	0.1	14.4	60	34	3.3	3.0	1.0	1.8	5.7	0.8	8.3	380	0.6	Grey	Clay Loam	0.86
Shearing Shed	10	60	6.5	4.4	0.17		100			2.9	1.5				78		580	1161	76	391	1020	2.9	9.1	0.2	1.7	4.6	18.5	16	40	1.1	6.5	1.2	0.3				0.5				
DRYLAND SITES																																									
Bream Creek Corner	0	10	6.4	4.5	0.12					4.12	7.08				31.7		130	11.0	160	356	125	37	33	1.7	0.32	0.38	0.36	6.08	55	28	5.3	6.2	0.4	1.9							
Car Park	0	10	6.9	5.1	0.12					5.9	5.26				31.1		250	10.0	1420	336	236	37	7.1	2.8	0.66	0.16	0.1	10.7	66	26	0.1	1.5	1.0	2.5							
Club	0	10	6.9	5.2	0.19					5.9	10.29				32.7		250	8.8	3000	1864	254	175	15	14	0.65	0.76	0.1	30.6	51	40	2.1	2.6	1.0	1.1							
Dairy	0	10	6.6	6.0	0.28					10.25	17.94				192.0		1600	1965	2600	1868	228	13	12	4.7	0.99	0.16	30.8	42	39	10.0	3.2	0.8	1.1								
Factory	0	10	6.0	5.3	0.17					6.05	10.13				21.2		250	13.0	2400	1536	317	186	12	6.6	0.81	0.81	0.1	20.6	60	35	3.9	4.6	1.9	1.8							
Granville	0	10	6.5	5.6	0.10					3.07	5.97				6.6		140	3.5	1690	792	137	120	8.4	6.3	0.35	0.52	0.1	15.8	54	40	2.2	3.3	1.9	1.3							
Highway	0	10	6.7	4.9	0.14					4.38	7.53				49.2		350	9.7	1000	532	353	59	5	4.4	0.98	0.43	0.15	11	46	40	3.9	4.0	1.4	1.1							
Horse Shoe	0	10	6.0	5.2	0.16					5.02	8.14				34.3		900	6.3	3300	2174	547	253	16	18	1.4	1.1	0.1	36.5	41	49	3.9	3.6	1.6	0.9							
Kingsliffe	0	10	6.0	5.4	0.17					4.62	11.36				20.9		260	14.0	2600																						

APPENDIX I2.
STROUD DAIRIES SOIL TESTING RESULTS - SEPTEMBER 2024. GROUPED DATA.
SAMPLING BY AG ASSIST.
INTERPRETATION BY SOUTH EAST SOIL & WATER.

Sample Name	Sample Depth From	Sample Depth To	pH (1:5 Water)	pH (1:5 CaCl ₂)	Electrical Conductivity (1:5 water)	Elec. Cond. (Sat. Est.)	Chloride	Organic Carbon (W&B)	Organic Matter (OC x 1.72)	Nitrate Nitrogen	Ammonium Nitrogen	Phosphorus (Colwell)	Phosphorus (Olsen)	Phosphorus Buffer Index (PBI-Col)	Available Phosphorus	Sulphur (KCl46)	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Calcium Each. Cap.	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Aluminium Saturation	Calcium / Magnesium Ratio	Zinc (DTPA)	Copper (DTPA)	Manganese (DTPA)	Iron (DTPA)	Boron (Hot CaCl ₂)	Soil Colour	Soil Texture	Phosphorus Environmental Risk Index
					dSm	dSm	mg/kg	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	cmol+/kg	%	%	%	%	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			

IRRIGATED SITES - TOPSOILS

Big Dam Pivotal	0	10	6.3	5.4	0.15	130	120	4.46	7.07	8	10	37	14.0	120	120	6.7	1590	653	121	253	9	6.2	5.4	0.31	1.1	0.1	13	47	42	24	8.2	1.0	1.1	4.2	2.5	24.0	90	0.6	Grey	Clay Loam	0.3
Big Park Pivotal	0	10	7.2	6.7	0.48	300	280	6.29	8.61	13	14	142	44.5	180	350	20.4	2020	1815	347	626	9	13	15	1.4	2.9	0.1	31.7	41	46	4.3	34	1.0	6.2	1.5	17.0	30	0.79	Grey	Clay	0.94	
Blackcounrills	0	10	5.9	5.2	0.22	149	142	4.77	8.20	36	9	130	47.2	180	350	30.5	4600	1210	352	299	9	22	10	0.9	1.3	0.1	34	54	30	2.6	3.5	1.0	5.8	1.0	13.0	140	2.4	Brown	Clay	0.83	
BurntHill Barn	0	10	5.5	4.5	0.16	140	47	5.61	3.90	35	26	160	40.9	400	290	9.0	1750	1174	230	205	45	8.8	9.7	0.75	0.89	0.5	20.7	42	47	3.6	4.3	2.4	5.9	2.0	0.0	5.2	380	0.6	Brown	Clay Loam	0.40
Chera Pivotal	0	10	5.7	5.0	0.32	260	190	7.48	12.87	22	30	40	13.2	250	250	20.0	2200	1894	254	256	9	11	14	0.65	2.2	0.1	27.7	39	51	2.4	7.9	1.0	5.8	1.7	0.3	2.6	400	1.3	Grey	Clay Loam	0.14
Dairy Pivotal	0	10	6.2	5.6	0.08	250	120	5.05	10.41	20	16	120	27.9	250	630	15.0	2200	1301	626	368	9	11	11	1.6	1.6	0.1	25.5	44	44	6.4	6.1	1.0	6.1	2.7	77.0	330	1.0	Grey	Loam	0.46	
Dicks Pivotal	0	10	6.2	5.6	0.17	180	96	5.77	8.92	19	16	75	19.5	280	130	16.0	2000	653	133	140	9	10	5.4	0.34	0.61	0.1	16.3	61	33	2.1	3.7	1.0	5.9	1.5	31.0	410	0.7	Grey	Sandy Loam	0.26	
Marion Bay Corner Pivotal	0	10	6.0	5.3	0.25	160	92	4.11	7.07	34	18	290	39.9	190	35	15.0	4600	1936	598	391	9	23	16	1.3	1.7	0.1	42.1	55	35	3.5	1.1	1.0	5.6	1.8	7.0	200	0.69	Grey	Clay	1.11	
New 12 Pivotal	0	10	6.3	5.6	0.39	190	220	4.13	7.10	17	12	21	7.5	130	150	13.0	2400	1561	120	465	9	12	10	0.39	2	0.1	24.2	49	41	1.6	8.4	1.0	6.1	1.3	22.0	380	0.9	Grey	Clay	1.16	
Noonans	0	10	5.9	5.1	0.13	130	96	4.74	8.15	15	35	92	25.0	180	150	9.0	1350	557	149	94	12	6.8	4.6	0.38	0.41	0.1	12.3	55	37	5.1	3.5	1.1	4.6	1.0	14.0	470	0.6	Grey	Sandy Loam	0.59	
Sand Pivotal	0	10	5.8	5.2	0.30	310	120	5.46	8.36	39	11	310	56.1	75	905	12	1540	944	975	253	12	8.2	7.8	2.5	1.1	0.1	19.7	42	40	12.0	5.6	0.7	25.0	2.0	17.0	210	1.3	Grey	Sandy Loam	3.39	
Shearing Shed	0	10	6.2	5.4	0.12	100	37	4.13	7.10	17	11	83	27.8	96	100	6.5	1720	593	164	99	9	8.6	4.9	0.47	0.43	0.1	14.4	60	34	3.3	3.0	1.0	5.7	0.8	8.5	360	0.6	Grey	Clay Loam	0.86	
Average:			6.34	5.66	0.24	190	123	5.3	9.0	22	17	121	36.1	195	357	14.3	2343	1147	358	311	13	11.7	9.5	0.9	1.4	0.1	23.5	50	40	3.9	5.6	1.1	6.0	1.7	10.9	330	1.0			0.83	

Big Dam Pivotal	10	60	5.1	4.2	0.16	110	10	2.3	24	820	714	26	263	400	3	5.9	0.22	1.1	4.9	15	20	34	14	7.1	20.3	25	0.3
Big Park Pivotal	10	60	6.0	5.6	1.19	1600	3.9	1.1	190	1150	2457	192	1918	9	5.9	1.7	0.49	6.6	0.1	30.3	19	37	1.6	22.6	1.9	0.4	0.3
Blackcounrills	10	60	5.6	5.7	0.36	150	13.0	1.6	77	2400	2183	78	1104	10	12	23	0.2	4.8	0.11	40.4	30	58	0.5	12.0	0.3	0.5	1.1
BurntHill Barn	10	60	6.0	4.7	0.11	68	16.0	1.9	120	1660	2294	121	629	160	8.3	19	0.31	2.3	1.8	31.8	26	60	1.0	7.4	0.9	0.4	0.4
Chera Pivotal	10	60	6.3	5.5	0.29	240	7.1	2.2	56	1720	2072	56	943	13	8.6	32	0.14	4.1	0.15	45.2	19	71	0.3	8.7	0.3	0.3	0.6
Dairy Pivotal	10	60	6.1	5.1	0.16	94	5.3	1.0	250	1380	1674	250	346	27	6.9	13	0.72	1.5	0.31	22.2	31	38	3.3	6.8	1.4	0.6	0.6
Dicks Pivotal	10	60	5.6	4.8	0.12	110	17.0	1.3	25	720	339	25	127	56	3.6	2.8	0.067	0.58	0.39	7.39	40	34	0.9	7.4	0.5	0.2	0.2
Marion Bay Corner Pivotal	10	60	5.4	4.5	0.22	120	13.0	3.7	290	3000	2182	250	647	15	16	23	0.75	2.7	0.1	42.8	36	34	1.7	6.4	1.3	0.7	1.3
New 12 Pivotal	10	60	7.4	6.4	0.14	70	9.9	1.3	42	1340	1684	43	301	9	6.7	14	0.11	1.7	0.1	23	29	63	6.5	7.5	1.0	0.5	0.4
Noonans	10	60	5.3	4.2	0.12	55	6.5	2.2	46	480	568	47	228	850	2.4	5.6	0.12	0.99	7.3	16.4	15	34	0.7	6.0	44.0	0.4	0.4
Sand Pivotal	10	60	4.9	4.1	0.20	130	6.7	0.7	500	240	315	508	152	300	1.2	2.6	1.3	0.66	4.3	10.1	12	26	18.0	6.5	43.0	0.5	0.5
Shearing Shed	10	60	5.5	4.4	0.17	110	7.8	1.5	78	950	1190	78	391	0.0	2.9	9.1	0.2	1.7	4.6	18.6	15	49	1.1	8.5	20.5	0.5	0.5
Average:			6.02	5.10	0.26	218	9.4	1.7	149	1292	1884	151	550	181	6.5	13.9	0.4	2.4	2.8	25.3	25	51	2.2	9.0	13.4	0.5	0.5

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