Fonterra Kapuni

Monitoring Programme

Annual Report

2020-2021

Technical Report 2021-08

Working with people | caring for Taranaki

Taranaki Regional Council

Taranaki Regional Council
Private Bag 713
Stratford

ISSN: 1178-1467 (Online)
Document: 2793812 (Word)
Document: 2973667 (Pdf)
March 2022

Fonterra Kapuni

Monitoring Programme

Annual Report

2020-2021

Technical Report 2021-08

Fonterra Kapuni

Monitoring Programme

Annual Report

2020-2021

Technical Report 2021-08

Taranaki Regional Council
Private Bag 713
Stratford

ISSN: 1178-1467 (Online)
Document: 2793812 (Word)
Document: 2973667 (Pdf)
March 2022

Executive summary

Fonterra Limited (the Company) operates a lactose manufacturing factory plant located on Manaia Road at Kapuni, in the Kaupokonui catchment. The plant processes milk and whey permeate from dairy product manufacture around the North Island. There is also an inhalation grade lactose (IGL) plant on the site operated by another entity, with stormwater discharges from the areas around this activity combined with those of the lactose plant under consents held by the Company. Wastewater from the factory site is disposed of by irrigation onto land on two nearby farms. This report for the period July 2020 to June 2021 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

During the monitoring period, the Company demonstrated an overall high level of environmental performance.

During the year under review the Company held 17 resource consents, which included a total of 155 conditions setting out the requirements that the Company must satisfy. The Company holds two consents to allow it to take and use water, five consents to discharge stormwater and/or cooling water into the Kaupokonui and Motumate Streams, four consents to discharge wastes to land, five land use consents, and one consent to discharge emissions into the air at this site. Two of the consents, to discharge factory wastewater to land, were varied in July 2015 to include dairy shed effluent which previously had been discharged to surface water. Another two of the consents were granted in February 2016 to provide for the discharge of farm dairy solids and pond sludge to land. Four of the Company's consents expired in June 2017, with the applications put on hold so that the effects of these activities could be considered in combination with the effects of the seven further activities for which the consents expired in June 2019. Applications to renew these consents were received on 1 February 2019 and were put on hold until 19 December 2019 awaiting further information. There have been a number of further extensions to the timeframe by which the further information will be provided. During the year under review an extension until 30 September 2021 was requested, which was agreed to by Council. There are a total of 11 consented activities where the Company is operating under the expired consents until a decision is made on the renewal, as provided for by Section 124 of the *Resource Management Act 1991* (RMA). The applications indicate that the Company wishes to amalgamate activities under single consents where appropriate.

The Council's monitoring programme for the period under review included 12 inspections, 174 water samples covering groundwater, stream and discharges that were collected for physicochemical analysis, two macroinvertebrate surveys of receiving waters, five ambient air quality analyses, continuous in-stream temperature monitoring at two sites downstream of the site, flow recording in the Kaupokonui Stream, evaluation of the progress of riparian plans that are eligible for funding provided by financial contributions from the Company, and review of data provided by the Company.

Cooling water discharge volume metering had been introduced at the site as per the agreement between the Council and the Company, in relation to assessment of the consumptive nature of the take and future water allocation for the Kaupokonui Stream. Telemetry of abstraction from and discharge to the stream was also installed. Ongoing issues with transmission and validity of the data were resolved during the 2019-2020 year and the provision of data was satisfactory during the year under review. Data recorded across the year under review indicated that there was little, if any, consumptive use outside the ± 10% cumulative measurement error of the metering devices. However, it is noted that this is excluding losses that may be occurring as the cooling water is discharged via the spray nozzles.

Physicochemical and ecological monitoring did not note any problems in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes, from site discharges to the Kaupokonui Stream, or in the Waiokura or Motumate Streams from the discharges of wastewater to land on

the Company's farms. However, in the macroinvertebrate survey reports it was noted that the sites used for the monitoring of the discharges of wastewater to land on Farm 1 should be changed, and eDNA monitoring in the Kaupokonui Stream indicates that the removal of the Glenn Road weir is likely to result in a significant change in the fish community composition that will be able to access the potential fish barriers present in the reach of stream that influenced by the Company's activities. Appropriate changes to the monitoring programme have been recommended for the 2021-2022 year.

Temperature increase limits in the consent permitting cooling water discharges to the Kaupokonui Stream were complied with throughout the review period. The main cooling system was replaced in August 2015 with the system designed to ensure that the temperature differential and downstream temperature limits would be complied with. From November 2018 until part way through the 2019-2020 year, the Company ran the cooling system at the maximum cooling capacity. This resulted in the discharge temperature being significantly reduced, with a measurable reduction in the instream temperature differential. The reduced discharge temperature would have also minimised the potential for a thermal barrier to fish within the mixing zone. During the 2019-2020 year, further structural and operational changes were made to the cooling water discharge system that ensure that the temperature differential restrictions on the consent were being met, whilst enabling the Company to operate the system in the most cost effective way. This more energy efficient operation of the cooling tower during the year under review has continued to result in an improvement when compared to the operation of the cooling system prior to November 2018. However, the temperature of the cooling water was increased when compared to the latter part of the 2018-2019 year, and there was loss of some of the gains that had been made in terms of the reduction in temperature within the mixing zone under the operating conditions adopted in the second half of the 2018-2019 year.

Irrigation onto the two dairy farms was, in general, well managed during the year under review, including the dairy shed effluent. No effect on the receiving waters from irrigation were found during the inspections, sampling or biological monitoring of the Kaupokonui, Motumate and Waiokura Streams. However, at one inspection the 20 m buffer to the bank of water courses was not maintained during irrigation activities. At the time of one of the groundwater sampling surveys there was a leak at the connection to a travelling irrigator several hours after the irrigation event had finished that resulted in ponding, and there was notification of a leak in a site formed bend in the transfer line from the factory site to Farm 3.

Effects on the groundwater in the vicinity of the farms were varied, but most showed an impact on both mineral and organic component levels. This had been addressed through extension of the irrigation disposal system in 2007-2008, and by more intensive wastewater and groundwater monitoring. During the year under review, there was a higher nitrogen load applied to the paddocks than in the 2017-2020 years. The nitrogen application rates increased by about 14% on Farm 1 and 20% on Farms 2 and 3 in the 2019-2020 year, with further increases of 10% on Farm 1, 4% on Farm 2, and 18% on Farm 3 during the year under review. On Farm 3, impact bore (GND0638) was consistently above the drinking water standard for nitrate-N, and the concentration reached a new maximum value of 71 g/m^3 during the year under review. The Company identified a number of factors that were likely to have contributed to this change and reduced nitrogen loadings in the paddocks in the vicinity of this bore. Reductions in the nitrate-N concentrations were found in this bore during the remainder of the year under review, however further reductions are still required. At the time of writing this report the nitrate-N concentration had reduced to 14.0 g/m^3. GND2063, also a Farm 3 impact bore, returned nitrate-N concentrations that were at or above the drinking water standard at the time of each of the groundwater monitoring surveys. The maximum concentration measured in the samples from this monitoring location during the year under review was 13.9 g/m^3.

Two of the control bores (Farm 2 and Farm 3 control bores) continued to show elevations in groundwater nitrate-N concentrations that are, at times, in excess of drinking water standards. This is still to be explained after suitable investigation, with the anticipation that this will be a requirement of the renewed consent.

Stormwater from the site continued to be diverted to containment ponds, with the stormwater batch released after quality checks. Sample results for the discharge samples collected by the Council were within those prescribed by consent conditions with the exception of the suspended solids concentration in the sample collected from the southern stormwater pond. The Company identified a number of factors that could have contributed to this consent exceedance and promptly put measures in place to prevent a reoccurrence.

The lactose deposition rates recorded at all sites were above their respective historical medians and at site AIR002301 was above the guideline value. However, it is noted that the particulate deposition rate is not limited by the Company's consent and no complaints were received by Council in relation to deposited particulates during the year under review. Inspections also found no evidence of depositions. No odours were noted off site during the year under review. Annual isokinetic stack sampling contracted by the Company found that the particulate emission rate of the flash dryer complied with the limit on the consent.

During the year, the Company generally demonstrated a high level of environmental and high level of administrative performance with the resource consents as defined in Section 1.1.4. However, an improvement is required in the management of the Company's activities in relation to the discharge of wastewater to land on Farms 2 and 3. There were four matters that arose during the year under review that related to the Company's management of the discharges of waste to land on Farms 2 and 3. There were two non-compliances relating to fugitive discharges from the wastewater conveyance systems and one that related to a non-compliance with maintaining the 20m buffer zone from stream banks required during spray irrigation. These matters were addressed promptly and there were no adverse environmental effects associated with these non-compliances. The remaining matter related to elevated concentrations of nitrate-N in one of the groundwater monitoring bores, with a new maximum for this monitoring location occurring during the year under review that was over six times the New Zealand drinking water standard. Although the mitigation measures employed during the year under review resulted in the contaminant concentration reducing by approximately one half, further improvement was still required in the groundwater quality in the vicinity of this bore. At the time of writing this report the nitrate-N concentration had reduced to 14.0 g/m^3.

For reference, in the 2020-2021 year, consent holders were found to achieve a high level of environmental performance and compliance for 86% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 11% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the 2021-2022 year.

Table of contents

List of tables

List of figures

List of photos

1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2020 to June 2021 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Fonterra Limited (the Company). The Company operates a lactose processing facility situated on Manaia Road at Kapuni, in the Kaupokonui catchment, along with two operational dairy farms used for wastewater irrigation (Figure 1).

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to abstractions and discharges of water to land and water within the Kaupokonui, Motumate and Waiokura catchments, and the air discharge permit held by the Company to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 28th combined report and 31st water related report by the Council for the Company.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the Company, for their Kapuni lactose plant;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2021-2022 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act 1991 and monitoring

The RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;
c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2020-2021 year, consent holders were found to achieve a high level of environmental performance and compliance for 86% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 11% of the consents, a good level of environmental performance and compliance was achieved. [1]

1.2 Process description

The manufacturing of lactose is based on the processing of milk and whey permeate, which is the by-product of the production of cheese and casein. Whey permeate contains typically contains 78 to 88% lactose; which is most of the lactose present in the original milk source. At this site the lactose is extracted and purified through a process that includes evaporation and crystallisation. The lactose is then dried and packed into different grades that meet a diverse range of customer needs and requirements. The plant typically operates for about 310 days per year. Approximately 50,000 tonnes of lactose is produced per annum with the peak daily processing rate being about 200 tonnes/day of lactose.

The lactose process (Figure 2) uses raw water from the Kaupokonui Stream for the evaporator condensers. Once water has passed through the condensers it is returned to the stream via the cooling tower system. In the summer, the increased stream water temperature may not be suitable for cooling the refined and edible crystallisers in the required time, so bore water may be brought into service. The cooling water systems are single pass, which do not require the use of any treatment chemicals. The cooling water from the

[1] The Council has used these compliance grading criteria for more than 17 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

condensers passes through a cooling tower and is discharged to the stream via spray nozzles that further reduces the temperature of the condenser cooling water so as to minimise temperature rises in the stream.

Steam used for the lactose process is imported to the plant, via a 3 km pipeline, from the Todd Energy Gas Treatment Plant (Todd) at Kapuni. The first delivery of steam was in December 1997. This has reduced the use of water treatment chemicals at the lactose plant considerably, which has therefore reduced the amount of process waste discharged from the site, and reduced the potential for chemical spillages. Steam condensate is returned to Todd via a pipeline for reprocessing.

Plant washdown and other process wastes are disposed of by a land irrigation system. The wastewater is irrigated onto the Company's two farms, which are located close to the lactose plant site. There is a component of the monitoring programme in place to assess the effects of wastewater from the irrigation on groundwater and on surface water quality.

Emissions of lactose powder into the atmosphere from the driers are mitigated by the use of cyclones and a wet scrubber. The cyclones and wet scrubber remove lactose particles from the exhaust of the driers to prevent product loss to the atmosphere.

Figure 1 shows the location of the Company's Kapuni lactose factory, North, South and (extended) No. 3 farms, and the Kaupokonui, Motumate and Waiokura Streams, which are referred to throughout this report.

In the 2014-2015 dairy season, Farm 2 and Farm 3 were merged into one dairy unit and renamed "Kapuni Farms". The name of the other farm remained "Farm 1". Table 1 summarises the nomenclature that has been used to describe the various farms as the farming activities have changed over the years. Due to the way in which the wastewater irrigation information is provided and analysed, and for consistency, where possible the primary nomenclature used in this report is Farm 1, Farm 2 and Farm 3.

Table 1 Farm nomenclature

Primary nomenclature used in this report	Previous nomenclature	Current Farm names
Farm 1	Northern Farm	Kapuni Farm
Farm 2	Southern Farm	Kapuni Farms
Farm 3	No. 3 Farm	
	No. 3 Extension	

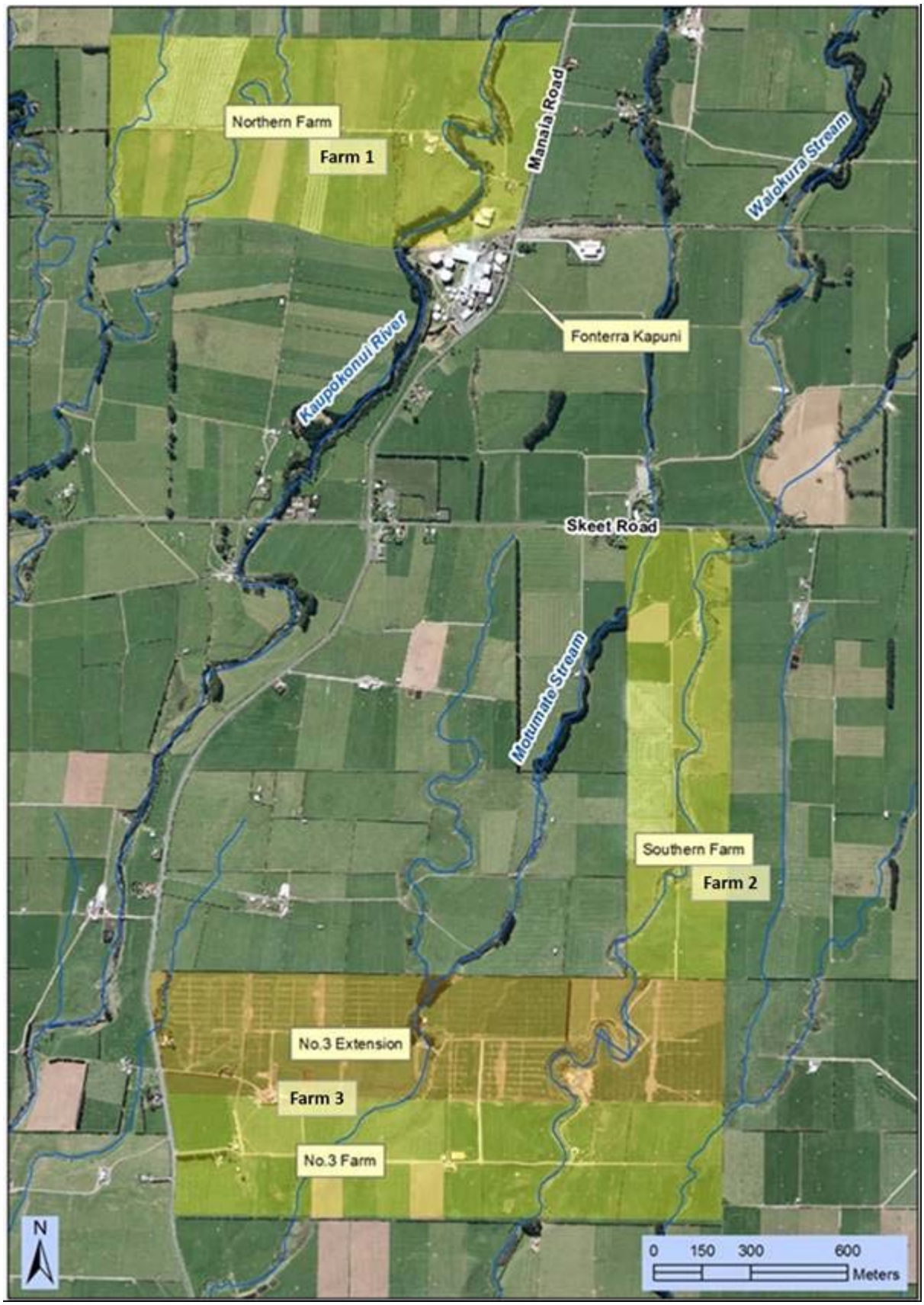

Figure 1 Location of Fonterra Ltd's lactose factory, farms and the Kaupokonui, Motumate and Waiokura Streams

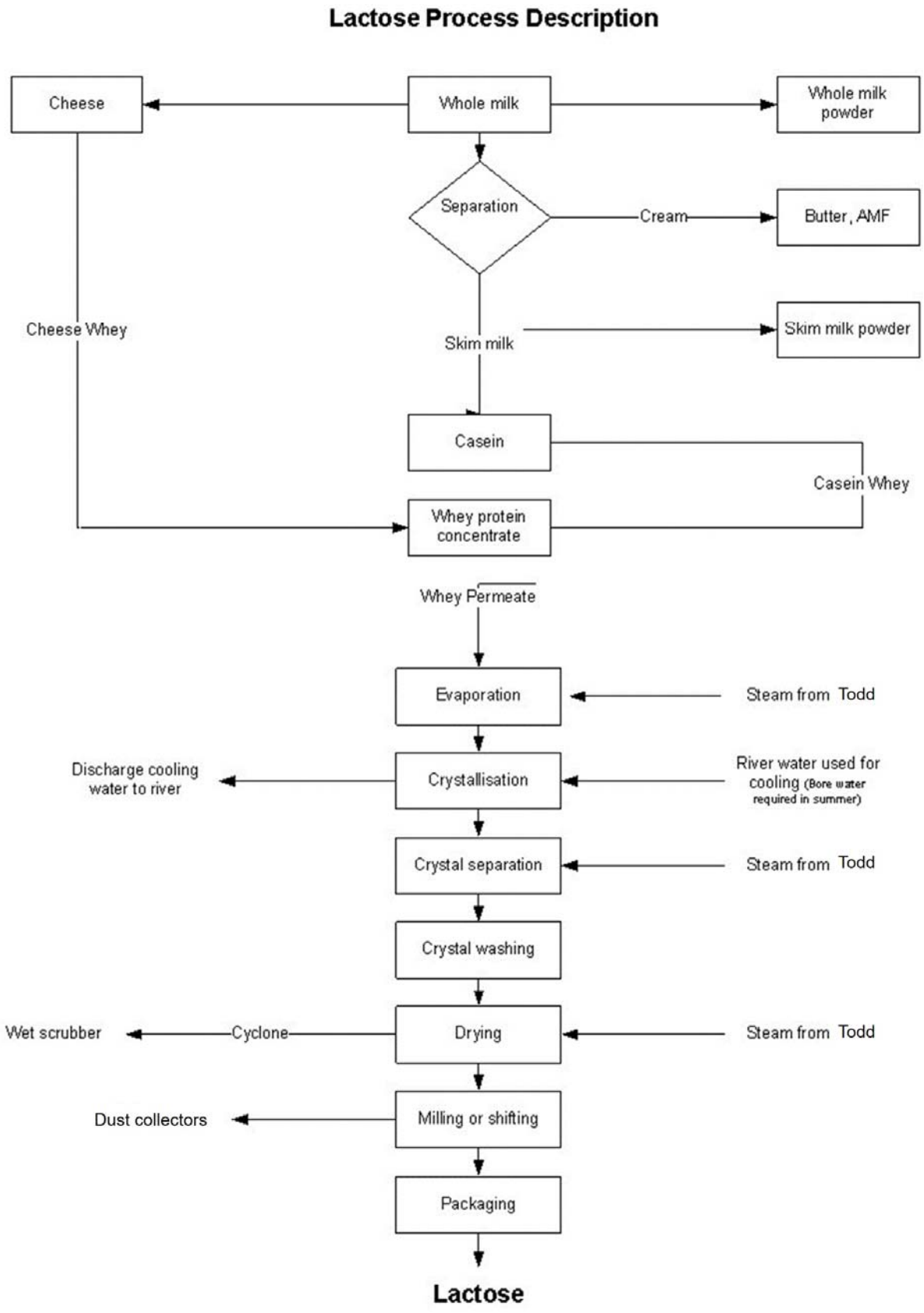

Figure 2 Lactose process diagram

1.3 Resource consents

The Company holds 17 resource consents the details of which, along with relevant consent related activities are summarised in Table 2. Summaries of the conditions attached to each permit are set out in Section 3 of this report, with consent related activities and information that is relevant to the monitoring and compliance assessment for the year under review explained further in this section.

A summary of the various consent types issued by the Council is included in Appendix I, as are copies of all permits held by the Company during the period under review.

1.3.1 Status of expired consents – Section 124 protection

Section 124 of the RMA provides for consent holders to continue to operate under the terms and conditions of the existing consent until a decision is made on the renewal. This applies at the Council's discretion where an application to renew the consent is made between three and six months prior to its expiry, or as a right when the application is made more than six months prior to expiry.

A number of the Company's consents expired on 1 June 2017. Applications to renew these consents were received on 1 December 2016. These applications were put on hold with the Company's agreement so that the applications for these consents could be decided upon at the same time as the consents that were due to expire on 1 June 2019. This was to allow potential cumulative effects of the activities to be considered and addressed in complementary consent conditions. The applications to renew the consents expiring in June 2019 were received on 1 February 2019.

The applications were put on hold under Section 92 of the RMA pending the provision of further information.

The further information requested was:

1. Justification/evidence to demonstrate that the existing water take is 10% consumptive;
2. Justification for retaining (and not lowering) the existing consented water take rate of 225 litres/second;

Council staff have recently put together some data which suggests that in the last couple of years, the rate of take was less than ~150 L/s 95% of the time.

3. A Cultural Impact Assessment;
4. With regards to the assessment of alternatives provided with the application, the Company is to provide a cost/benefit analysis of distributing cooling water over a larger area i.e. expanding the length of stream that the spray booms cover (resulting in a spray area that is less concentrated), and reasons why this option is/is not a viable alternative.

The Company asked for the standard 15 working days specified in the RMA to be extended to 19 December 2019 to allow Ngati Tu sufficient time to complete the cultural impact statement. This was agreed. A number of further extensions have been requested, with the cultural impact statement being received on 28 June 2021. Due to the release of the National Policy Statement on Freshwater Management 2000 (NPS-FM) and associated National Environmental Standards for Freshwater (NES-FW) after the applications were received, it has been agreed that further work is required to address any matters arising from the legislative requirements associated with these documents. The Company has asked for a further extension to allow this work to be completed prior to the continuation of the processing of the applications.

1.3.2 Abstraction consents 0302-3 and 0920-3 and National Regulations

In addition to the consent requirements, the activity must also comply with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 (the Regulations).

The Regulations require the following:

- all water permits allowing the taking of 5 L/s or more to collect and report records to a set minimum requirement;
- measurement at the point of where the water is taken from the river, lake or groundwater system (unless otherwise approved by the Council to be in another location);
- continuous records of daily volumes to be collected using an appropriate flowmeter with the data transferred to the Council on at least an annual basis;
- the flowmeter to meet an accuracy standard, and should be properly installed and calibrated independently every five years; and
- the consent holder is to be responsible for recording and transferring the data to the Council.

All abstractions captured under the Regulations were required to be compliant by 10 November 2016. The Council retains the authority to apply more stringent requirements on consent holders over and above those set out in the Regulations through the setting of consent conditions.

1.3.3 Proposed amalgamation of consents

There have been a number of changes to the site discharge methodologies in recent years namely:

- The diversion of the cooling water previously discharged under consent 0924 to the cooling towers, bringing it under the discharges covered by consent 0919; and
- The diversion of the stormwaters covered by consents 4604, 6423 and the stormwater discharged from one of the outfalls covered by consent 0924 to the northern stormwater pond, which has a single outfall.

This leaves the stormwater discharged from the southern stormwater pond as the only stormwater discharge originally authorised under consent 0924.

In the application to renew the consents for the site, it has been requested that all stormwater discharges be authorised by one consent (replacement of 0924-3, 4604-2, and 6423-3, with 6423-4) and that the discharge of wastewater from the factory and dairy shed effluents to the two farms also be amalgamated under one consent (replacement of consents 0922-3.2 and 0923-3.3 with 0922-4).

Table 2 Summary of consents held by Fonterra Ltd for the lactose plant at Kapuni

Consent number	Purpose	Commencement	Review	Expiry	Renewal application received	Consent status at 30 Jun 2019
Water abstraction permits						
0302-3	To take and use up to 19,500 cubic metres/day [225 litres/second] of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing	9 Jun 1999	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
0920-3	To take up to 700 cubic metres/day of water from a bore in the Kaupokonui Catchment for factory cooling water using plate heat exchangers	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)
Water discharge permits						
0921-3	To discharge up to 850 cubic metres/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)
0919-3	To discharge up to 19,500 cubic metres/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream	9 Jun1999	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
0924-3	To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream	9 Jun 1999	-	1 Jun 2019	1 Dec 2016. Stormwater discharge activity to be combined under 6423-4	Expired - S.124 Protection (on hold further information)
4604-2	To discharge up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream	4 Feb 1999	-	1 Jun 2017	1 Dec 2016. Activity to be combined under 6423-4	Expired - S.124 Protection (on hold further information)
6423-1	To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream	4 Feb 1999	-	1 Jun 2017	1 Dec 2016	Expired - S.124 Protection (on hold further information)

Consent number	Purpose	Commencement	Review	Expiry	Renewal application received	Consent status at 30 Jun 2019
Air discharge permit						
4032-5	To discharge emissions into the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant	2 Jun 2004	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
Discharges of waste to land						
0922-3.2	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land	15 Jul 2015	-	1 Jun 2019	01 Feb 2019	Expired - S.124 Protection (on hold further information)
0923-3.3	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land	15 Jul 2015		1 Jun 2019	1 Feb 2019. Activity to be combined under 0922-4	Expired - S.124 Protection (on hold further information)
10214-1.0	To discharge solid farm dairy effluent onto and into land	5 Feb 2016	June 2023	1 Jun 2041	-	Current
10232-1.0	To discharge pond sludge from farm dairy effluent onto and into land	5 Feb 2016	June 2023	1 Jun 2041	-	Current
Land use permits						
4623-3.0	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes	15 Dec 2017	-	1 Jun 2019	1 Feb 2019	Expired - S.124 Protection (on hold further information)
6948-1	To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater	18 Sep 2006	-	1 Jun 2023	-	Current
7121-1	To erect, place and maintain a stone lined bank on the left bank of Dunns Creek for erosion control purpose	23 May 2007	-	1 Jun 2023	-	Current
9546-1	To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation	18 Apr 2013	June 2023	1 Jun 2029	-	Current
10412-1.0	To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed	10 Mar 2017	June 2023	1 Jun 2035	-	Current

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations and seek information from consent holders.

The monitoring programme for the Company's Kapuni site consisted of five primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The Company's site was visited 12 times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects. An additional annual dairy inspection was also undertaken focusing on the management of the farm dairy effluent systems. An additional site visit was also undertaken to collect stormwater samples from the pond due the limited opportunities to take these samples at the time of scheduled inspection.

1.4.4 Chemical sampling

The Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge point and mixing zone.

A 24 hour composite or grab sample was collected of the spray cooling wastewater on ten occasions. The samples were analysed for BOD_5 (total and filtered), pH, conductivity and turbidity.

The Kaupokonui Stream was sampled on 12 occasions at three sites. The samples were analysed for temperature, BOD_5 (total and filtered), pH, conductivity, turbidity, dissolved reactive phosphorus, nitrates ammonia-N and total nitrogen. The Motumate Stream was sampled at four sites on six occasions. The samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH, turbidity, on six occasions and anion/cation balance on three occasions. The Waiokura Stream sampling is scheduled to be monitored at four sites on six occasions per year. However, in the 2019-

2020 year, the Waiokura Stream was sampled on five occasions, with the sixth survey delayed until early July due to COVID-19 restrictions. This survey has therefore also reported on in this 2020-2021 Annual Report. The Waiokura Stream samples were analysed for temperature, BOD_5, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, pH, sodium and turbidity.

Two samples were collected from the northern stormwater pond outfall and one sample was collected from the southern stormwater pond discharge outfall. These samples were analysed for total BOD_5, conductivity, pH, turbidity, suspended solids and oil and grease.

Groundwater from 11 bores on the three farms was scheduled to be sampled on six occasions and the samples were analysed for temperature, COD, conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate, total nitrogen and pH on each occasion and anion/cation balance on three of those occasions. In the case of two bores only four samples were obtained. An additional bore GND0640 was reintroduced into the programme part way through the year after it had been located and reconditioned. Originally this was a control bore for the Farm 3 discharges prior to the farm extension. It is now an impact bore. In the case of GND0639, the bore was dry at the time of the April and May surveys

Deposition gauges were placed at selected sites in the vicinity of the factory site on one occasion. The collected samples were analysed for COD, enabling the lactose deposition rate to be estimated.

1.4.5 Biomonitoring surveys

A biological survey was performed on two occasions in the Kaupokonui Stream to determine whether or not the discharge of stormwater and cooling water from the site has had a detrimental effect upon the communities of the stream. A biological survey was also performed in the Waiokura Stream to monitor the effects from irrigation of wastewater and stormwater onto land in the Waiokura catchment. During the biomonitoring surveys in the 2019-2020 year, consideration was given as to the value of adding biomonitoring in the Motumate Stream to the programme, given the extent of the irrigation area that this small stream runs through. It was found that the stream habitat in the stretch through the irrigation areas did not have suitable habitat to provide meaningful evaluation of the potential impacts of the irrigation activities at this stage. This was predominantly because any potential environmental effects resulting from the wastewater irrigation would be obscured by the elevated nitrates in the upper catchment of this stream. This was investigated by Council during the 2020-2021 year, with no point source discharges found in the upstream environment. The introduction of biomonitoring in the Motumate Stream will only be re-visited if reductions in the nitrate concentration of the Motumate Stream above the site are observed, and/or if stream habitat improves.

There were no fish monitoring surveys programmed for this monitoring year, relying instead on observations of any fish species spotted above the weir at the time of the site inspections.

Fish surveys had been scheduled to occur on a triennial basis, with the most recent survey being the fifth triennial site fish survey undertaken in the Kaupokonui Stream in March 2020. Under this current schedule, the next survey would have been due next in the 2022-2023 monitoring year.

The fish barrier presented by the Glenn Road weir was addressed by its removal in February 2021. Following the removal of the weir, Environmental DNA (eDNA) monitoring was undertaken in an attempt to assess the effectiveness of removing the barrier on the upstream fish communities. Sampling upstream of the weir indicated that inanga and torrentfish were now present, showing that the enhancement project was successful. It is now expected that these new species, and perhaps higher abundances of other species already present upstream of the Glenn Road weir, would begin to penetrate further up into the catchment, and that they may eventually reach the Fonterra spray cooling water discharges and weir. As a result the scheduling of the fish surveys under this programme has been revised to include an electric fishing survey and two spotlighting surveys in the 2021-2022 year. A recommendation to this effect is attached to this report.

1.4.6 Review of consent holder's data

A large amount of data is supplied by the Company in relation to stream abstraction records, cooling water discharge temperatures and rates, irrigation records, wastewater composition, soil test results, receiving water temperatures, and details on the discharges from the stormwater ponds. This data is assessed by Council staff to confirm compliance with consent conditions, as well as to assess site performance in relation to the "best practicable option" conditions, and to assess if there are any actual or potential environmental effects occurring that are not adequately addressed by the conditions of the consents.

2 Results

2.1 Water

2.1.1 Review of consent holder's data

The Company supplied various data to the Council in the form of monthly environmental reports and electronic data. The data covers information in relation to calibration of the consent holder's instream temperature monitors, stream temperature compliance data, effluent irrigation volumes, effluent composition, stream and bore extraction volumes, and cooling water discharge temperatures and rates. These data were regularly reviewed by Council in terms of compliance with consent conditions and, where necessary, the Company was immediately advised of any necessary follow-up action to be taken. A review of these data follows.

2.1.1.1 Stream abstraction records

The Company holds consent 0302-3 which allows the abstraction of up to 19,500 m^3/day (225 L/s) from the Kaupokonui Stream. Special conditions attached to the consent require the Company to undertake daily monitoring of the water abstracted from the stream, and to forward such monitoring data to the Council. The Company supplies both the daily abstraction volume and the abstraction rate. One minute data is provided, which Council processes to provide the 15 minute average data used to assess consent compliance.

Under the *Resource Management (Measurement and Reporting of Water Takes) Regulations 2010*, the Company was required by 10 November 2012 to take continuous measurements and keep daily records of volume taken, and thereafter supply the daily abstraction data by 31 July each year for the preceding 1 July to 30 June period.

Abstraction rate is measured by a magnetic flow meter on the supply line from the stream pumps to the factory that was commissioned on 24 December 2008. Independent verification of the accuracy of the meter was undertaken on 27 August 2014, and was therefore due again in August 2019. The meter was verified in April 2019, with a copy of the verification report provided to Council. Table 3 contains a summary of statistics from the daily abstraction data electronic record provided by the Company, with the abstraction rates illustrated in Figure 3 and Figure 4[2].

The daily stream abstraction data summaries in Table 3 and Figure 3 illustrate that the Company continued to take a significant volume of water from the stream during the 2020-2021 monitoring period. However, it is noted that the volumes abstracted were again significantly lower than the permitted take of 19,500 m^3/day.

[2] Earlier Annual Reports used a combination of data from the daily abstraction data provided by the Company in a monthly report, and the abstraction rates from the electronic data sent through to Council on a daily basis. In the 2019-2020 Annual Report it was confirmed that any potential reporting discrepancies or data transmission issues were negligible, following the resolution of the issues causing the more significant discrepancies that had been occurring prior to the 2018-2019 year. Therefore the data assessed here is based on the electronic record only.

Table 3 Summary of water abstraction volumes from the Kaupokonui Stream

Month	Average daily abstraction (m^3/day)	Minimum daily abstraction (m^3/day)	Maximum daily abstraction (m^3/day)	Number of days per month daily abstraction >19,500 m^3	Average abstraction rate (L/s)	Maximum abstraction rate (L/s)	Total time per month abstraction rate> 225 L/s	Missing records
Jul 2020	910	126	2,190	0	10	74	0	2.5 hrs
Aug 2020	3,733	1,055	8,994	0	41	161	0	No gaps
Sep 2020	7,517	5,281	9,533	0	87	172	0	8 hrs
Oct 2020	9,213	6,741	11,433	0	106	170	0	No gaps
Nov 2020	8,559	6,218	10,899	0	100	181	0	No gaps
Dec 2020	7,908	6,108	9,335	0	91	146	0	No gaps
Jan 2021	8,243	5,336	11,785	0	95	172	0	No gaps
Feb 2021	7,310	5,155	9,571	0	85	171	0	No gaps
Mar 2021	7,391	5,679	10,082	0	85	156	0	No gaps
Apr 2021	7,232	5,449	8,982	0	84	162	0	No gaps
May 2021	5,587	0	9,315	0	70	148	0	14.75 hrs
Jun 2021	867	0	7,517	0	12	140	0	15 min

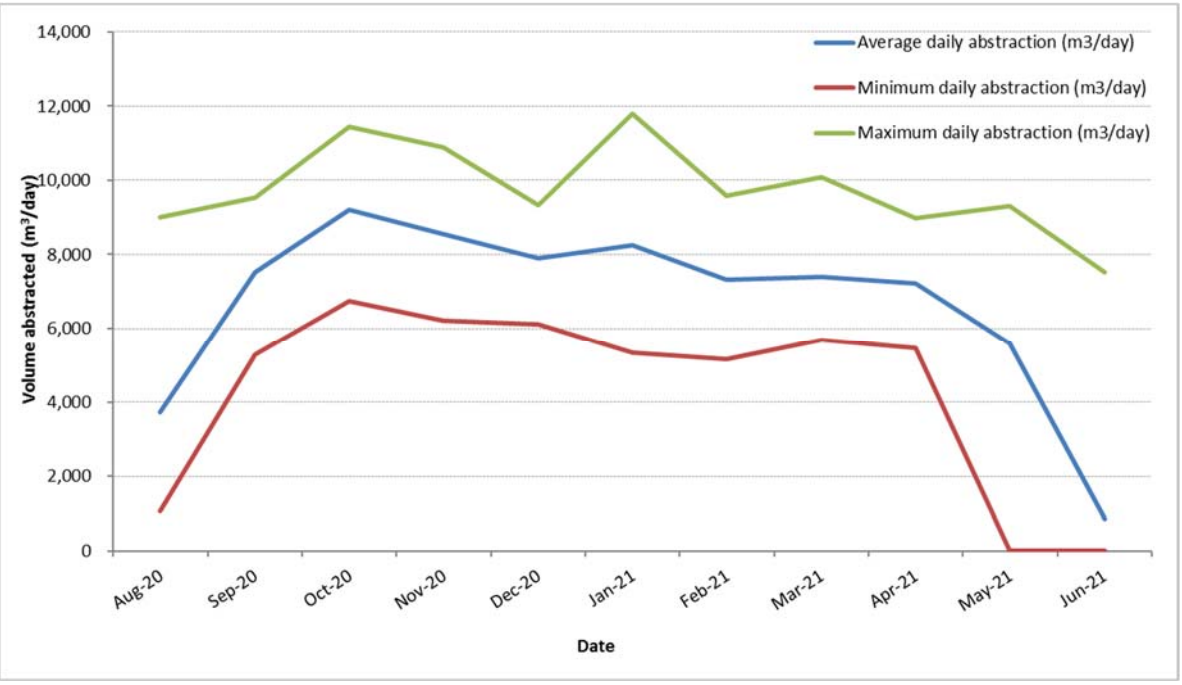

Figure 3 Monthly summary of water abstraction volumes from the Kaupokonui Stream

The total volume of 2,261,598 m^3 abstracted during 2020-2021 was 8% less than the amount taken in 2019-2020, and 20% less than the median annual amount taken during the 2009 to 2020 periods (2,836,803 m^3/year). The daily volume abstracted was maintained well below the 19,500 m^3 daily limit. During 2020-2021, a maximum daily abstraction of 11,785 m^3 was recorded on 12 January 2021, which is 60% of the consent limit.

The changes in the river abstraction volumes since the 2009-2010 year are illustrated in Figure 4, which shows a general trend of decreasing water abstraction at the site since the 2012-2013 year. It is noted that the graph below is based on the data provided in the Company's monthly reports for the 2009-2020 years and the electronic data provided by the Company for the 2020-2021 year.

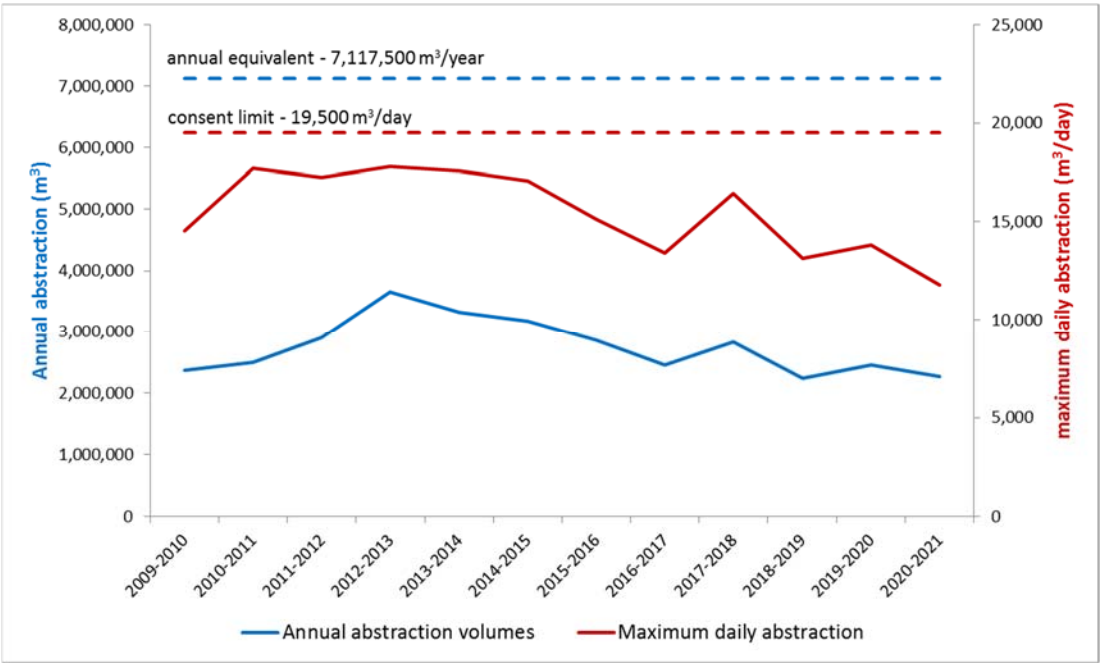

Figure 4 Daily and annual stream abstraction volumes July 2009 to June 2021

The Company's abstraction of water from the Kaupokonui Stream was undertaken in a satisfactory manner and the abstraction rates complied with consent conditions as illustrated in Table 3 and Figure 5. The abstraction rate remained at or below 145 L/s for 99% of the year, with only 1 day, 1 hour and 30 minutes of missing record.

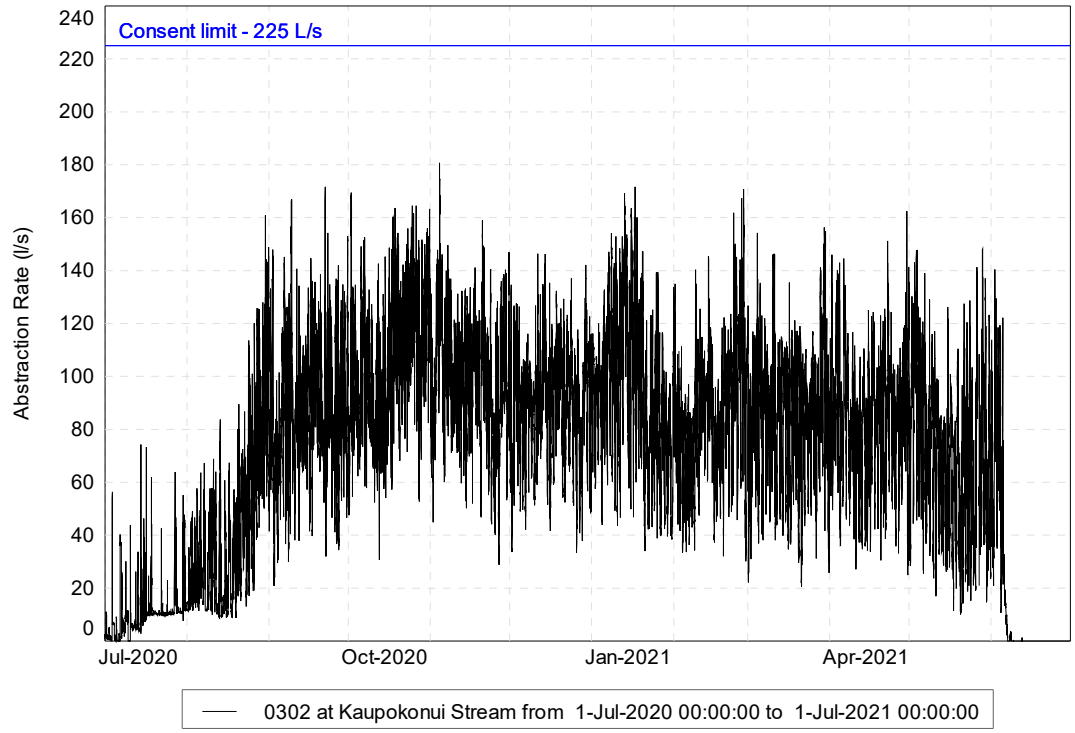

Figure 5 Abstraction rate from the Kaupokonui Stream (consent 0302-3)

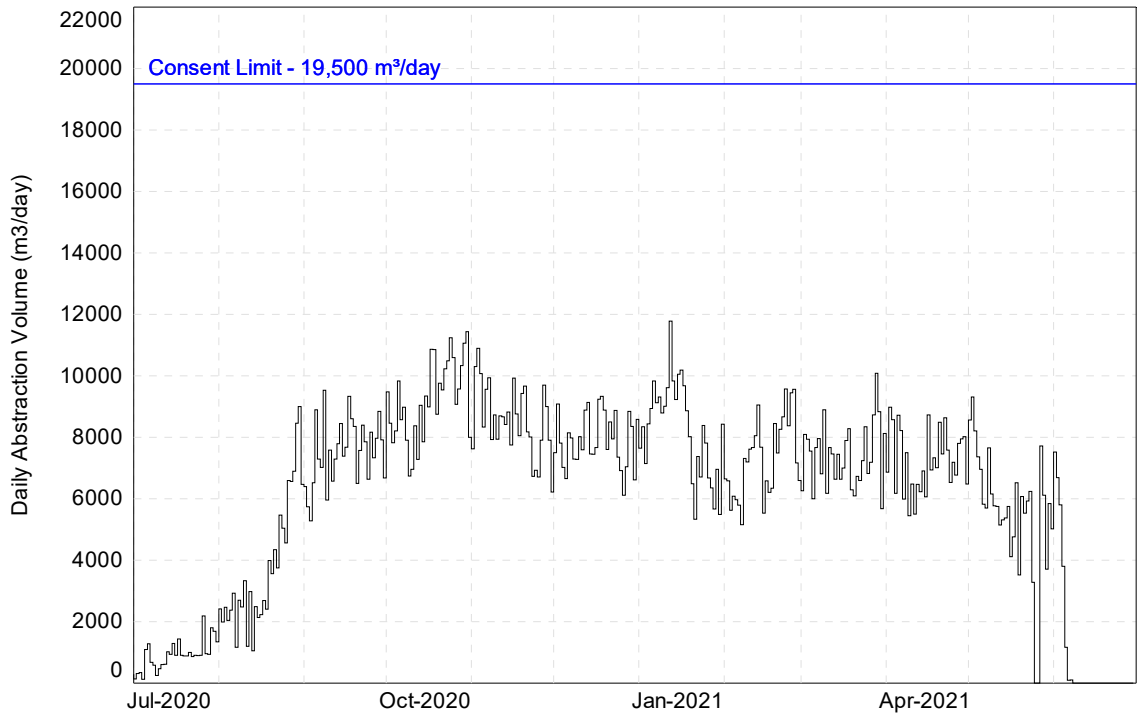

Figure 6 Daily abstraction volumes from the Kaupokonui Stream, electronic record

2.1.1.2 Bore abstraction records

In relation to the exercise of resource consent 0920-3, the Company supplied the Council, on a monthly basis, monitoring data on the daily volume abstracted from the bore in the Kaupokonui catchment.

During the 2020-2021 monitoring period, the bore was not used. At an inspection on 20 September 2019 it was noted that the bore had been closed in, with no further activity reported during the year under review.

2.1.1.3 Cooling water discharge rates

In June 2014, Council invoked the review of consent conditions of consents 0919-3 and 0924-3, which provide for the discharge of the abstracted cooling water back to the Kaupokonui Stream, for water allocation purposes. The notice of review was withdrawn by Council at the Company's request after an agreement was reached that the necessary monitoring information would be provided voluntarily. As condition 1 of these consents require that *"the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the cooling water wastes, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991"*, this agreed monitoring is within the scope of these conditions.

In summary, the agreement related to the provision of electronic data recording the rate and volume of the cooling water discharges from both outfalls with an accuracy of ± 5%, and this was to be implemented by 31 August 2015. The implementation period was extended to 30 September 2015 following delays associated with the installation of a new cooling tower system.

As previously discussed, the purpose of the review of the consents that were initiated in 2014 were to allow conditions to be put on the consent so that sufficient data could be collected regarding the consumptive use of the abstraction to inform the water allocation decisions that need to be made at the time of the abstraction consent renewal. There were a number issues in relation to meeting this monitoring requirement (summarised in Table 4), with compliance being achieved from 14 September 2019.

The detail surrounding these issues are described in the 2019-2020 Annual Report, in which it was also concluded that the data was now sufficiently robust to enable an estimate of the consumptive water use at the site to be determined. However, it must also be borne in mind that further evaporative and/or wind drift losses will occur to varying degrees depending on the weather conditions.

Table 4 Summary of matters affecting reliability of historic cooling water discharge rate records

Date	Progress	Finding	Concern
14 January 2016	Provision of an electronic record commenced	Frequent gaps in the telemetered record	"Real time" record not able to be maintained by Council
2017-2018	Cause identified and resolved by the Company	Fouling of meter resulting in inaccurate discharge rates	Consumptive use being overestimated
2018-2019	Monthly cleaning of meter	Meter could not be verified as was on partially filled pipe and was also upstream of the cooling tower	Required accuracy could not be maintained and did not include cooling tower evaporative losses
16 September 2019	New meter installed in appropriate location downstream of the cooling tower came on line	Meter verification and review of data provided showed monitoring requirement was met and that the data was reliable enough to be used for the intended purpose	None – Compliance achieved

The abstraction rate record for the year under review is shown in Figure 7.

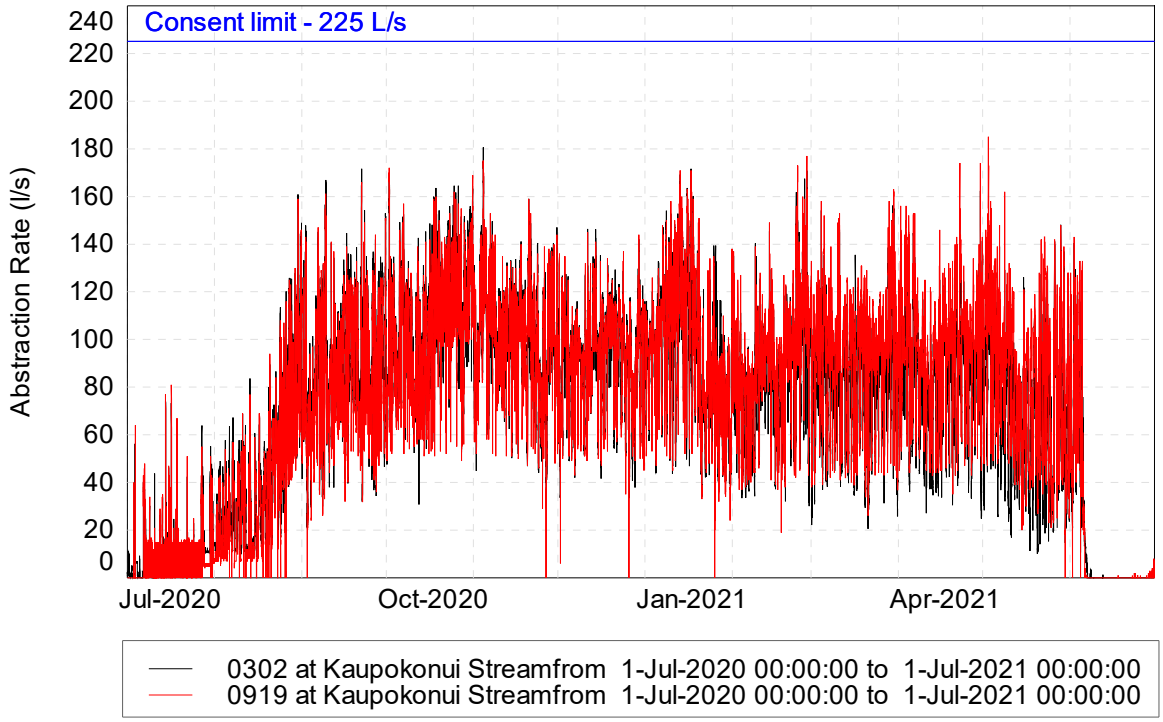

Figure 7 Discharge rates (flow from the cooling tower) for consent 0919-3, along with the abstraction rate for consent 0302-3, electronic record for the year under review

During the year under review, a total of 2,320,981 m^3 (± 5%) was recorded as having discharged from the cooling tower. This is in comparison to the recorded annual abstraction of 2,261,598 m^3 (±5%). Overall, the total annual discharge is 2.6% more than the recorded total annual abstraction, indicating that overall the usage, if any, is within the limits of the accuracy of the measuring devices.

Figure 8 shows the differential between the discharge and abstraction rates for the year under review, with negative values indicating consumptive use and positive values indicating an increase return rate. The maximum permitted error on the differential between the meters is ± 10 %. The error margins, if the abstraction and discharge were approximating to the maximum take rate of 225 L/s, are also shown in Figure 7, although it is noted that the highest average daily abstraction rate was only 132 L/s. For the majority of the year under review, the measured differential in the recorded flow rates was also predominantly within the margin of error of the recording devices.

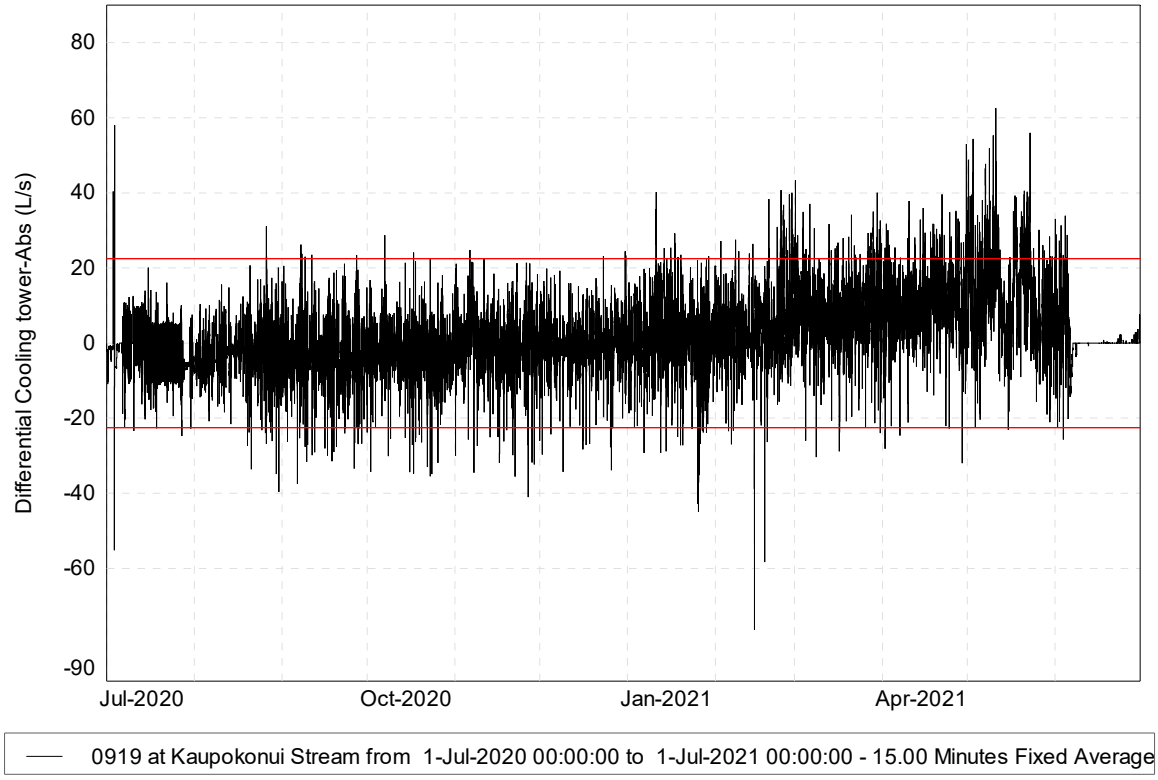

Figure 8 Differential between the rate of discharge from the cooling tower and the abstraction rate

Figure 9 show the percentage of the time that the usage or additional return is at a given rate for the year under review.

During the year under review, it was found that the maximum 15 minute average for water usage was 76 L/s and the maximum additional return was 63 L/s.

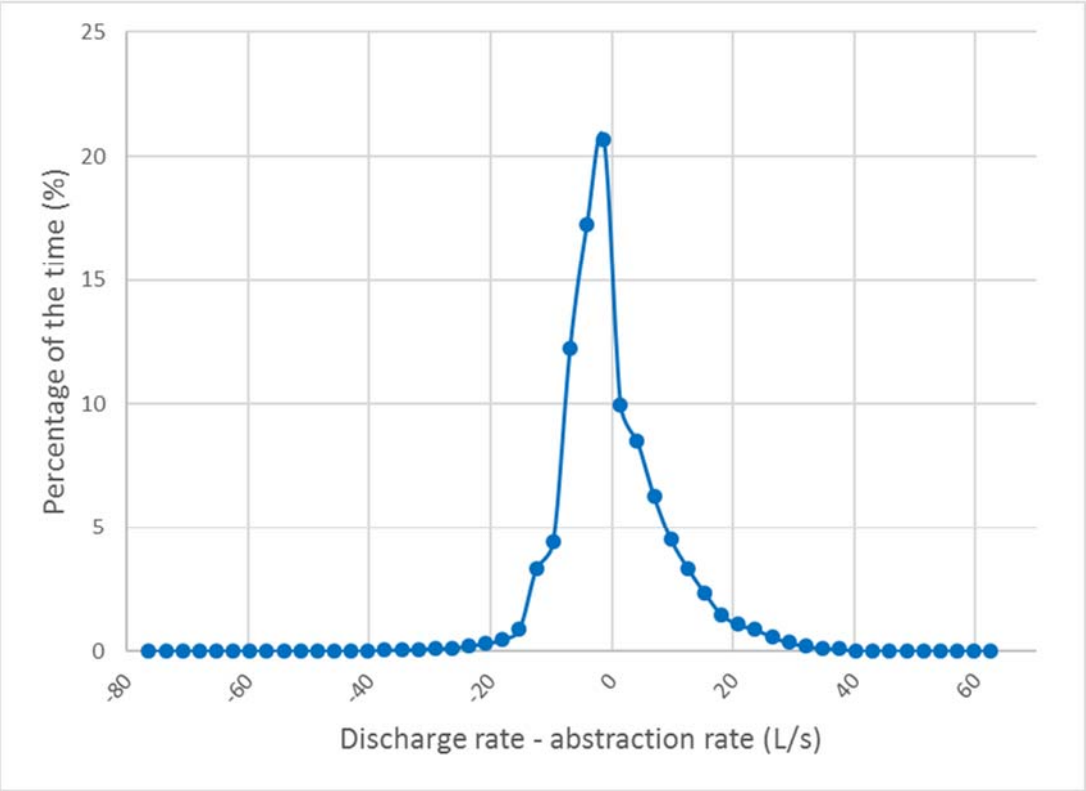

Figure 9 Probability density for the difference between the rate of flow from the cooling tower and the abstraction rate

2.1.1.4 Cooling water discharge temperatures

In addition to providing the new cooling water discharge rate monitoring data, the Company also started to voluntarily monitor the temperature of the cooling water discharged under consent 0919-3 downstream of the cooling tower, upstream of the sprayers. This monitoring is likely to be required by the renewed consent, and in the meantime informs the assessment of effects for the renewal of the consent.

It must also be borne in mind that the discharge method itself (spray discharge) will provide further cooling that is not measured, prior to the cooling water entering into the stream.

The cooling water discharge temperature data has been provided to Council electronically on a 2-hourly basis for the year under review. One minute data is provided by the Company that the Council then processes to provide the 15 minute average temperature so it is comparable to the data used to assess consent compliance in the receiving water as per the conditions of the consent. The median monthly discharge temperatures are given in Table 5.

Table 5 Cooling water temperature monthly statistical summary

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Jul-20	3.1	34.1	10.1	15 hrs 30 min
Aug-20	8.2	39.3	28.3	no gaps
Sep-20	17.2	39.5	30.8	no gaps
Oct-20	19.0	38.9	31.0	no gaps
Nov-20	14.9	39.8	34.6	no gaps
Dec-20	17.9	39.5	32.6	no gaps

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Jan-21	13.7	39.9	27.8	no gaps
Feb-21	3.6	37.2	26.3	6 hrs 15 min
Mar-21	15.1	39.7	24.9	no gaps
Apr-21	16.8	38.7	26.4	no gaps
May-21	11.0	36.6	25.0	no gaps
Jun-21	4.0	30.6	12.2	no gaps

As already indicated, this data is not specifically required either by the current consents or the agreement made with the Company in lieu of the consent review. However, it will be useful to compare with the stream temperatures when evaluating potential environmental effects, the Company's implementation of the "best practicable option" to minimise effects, and the requirement that the discharge does not present a thermal barrier to fish passage within the mixing zone. In the assessment of environmental effects for the pending reissue of consent 0919 it was stated that the cooling tower design parameters are such that with fluid entering at 50˚C, and the fans running at 100%, the discharge should be at 33˚C at a wet bulb temperature of 22˚C.

In November 2018, the Company identified that there was a time lag in the control system for the utilisation options available for running the cooling tower efficiently based on the upstream downstream temperature differentials to take effect. The options related to the proportion of cooling water that was passed through the cooling tower, versus passing through a bypass line, and in the operation of the fans on the cooling tower. The time lag was due to the response time between the activation of the change and the time it took for the change to have an effect on the cooling water discharge temperature. The Company has since made a number of operational changes relating to their management of the cooling system. These are summarised in Table 6, along with the impact these changes have had on the measured cooling water discharge temperatures. The changes observed in the monitoring data over this period of time are also illustrated in Figure 10 to Figure 14.

Table 6 Summary of cooling tower operational changes and their effects on discharge temperature

Timeframe	Change in operational management of cooling tower	Observable effects on the monthly median discharge temperatures	Observable effects on the monthly maximum discharge temperatures	Percentage of the time that the cooling water discharge was at or above 35˚C	Percentage of the time that the cooling water discharge was at or above 33˚C during low flow*
Nov 2018	Manual diversion of all flow from the cooling water flows to the cooling tower. Cooling tower operating at maximum cooling conditions at all times	Reduced from 30-37˚C to 23 -25.5˚C	Reduced from 44-54˚C to 27-43˚C	Reduced from 28% to 7%	Reduced from 48% to 1%

Timeframe	Change in operational management of cooling tower	Observable effects on the monthly median discharge temperatures	Observable effects on the monthly maximum discharge temperatures	Percentage of the time that the cooling water discharge was at or above 35˚C	Percentage of the time that the cooling water discharge was at or above 33˚C during low flow*
2019-2020	Removal of cooling tower bypass line Addition of variable speed pump to control cooling tower residence time Operation of cooling tower fans based on river temperature differential	Increased to 28-33˚C	Increased to 34-40˚C	6%	35%
2020-2021	No further operational changes	25-28˚C	30-40˚C	11%	16%

Key *1 December to 30 March

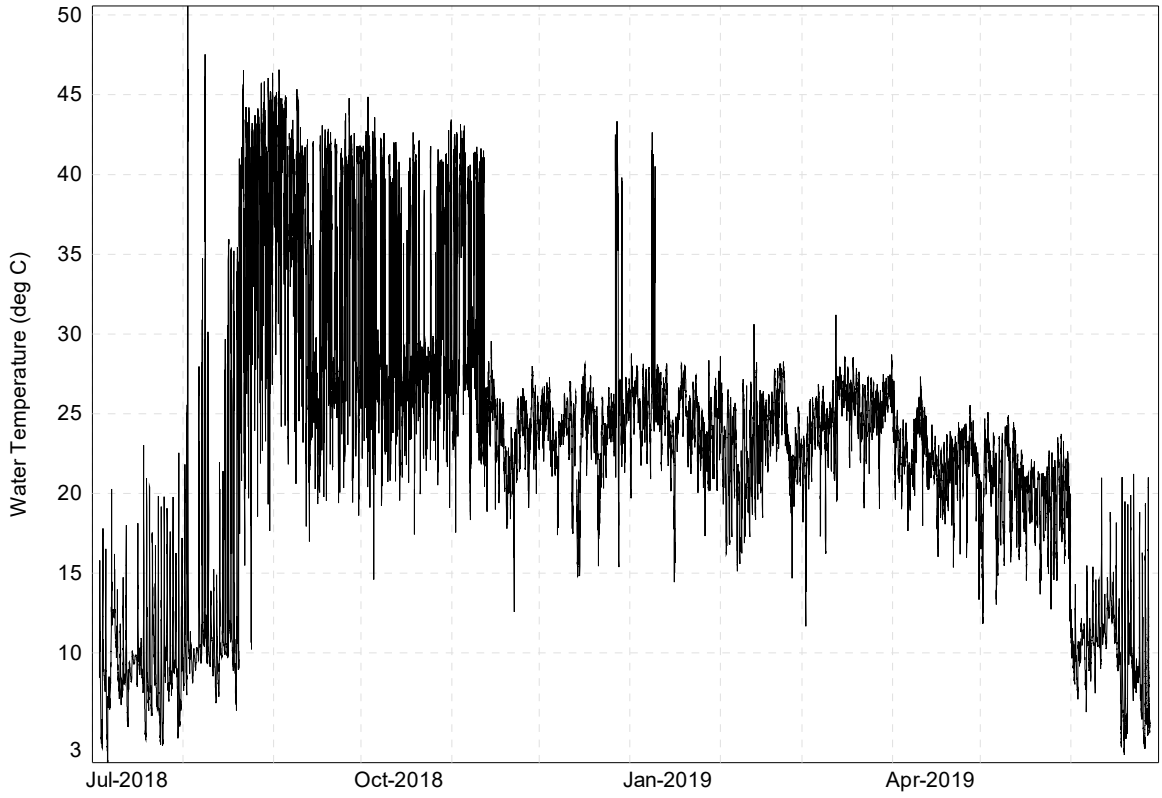

Figure 10 Temperature of the cooling water discharge permitted by consent 0919-3, 2018-2019

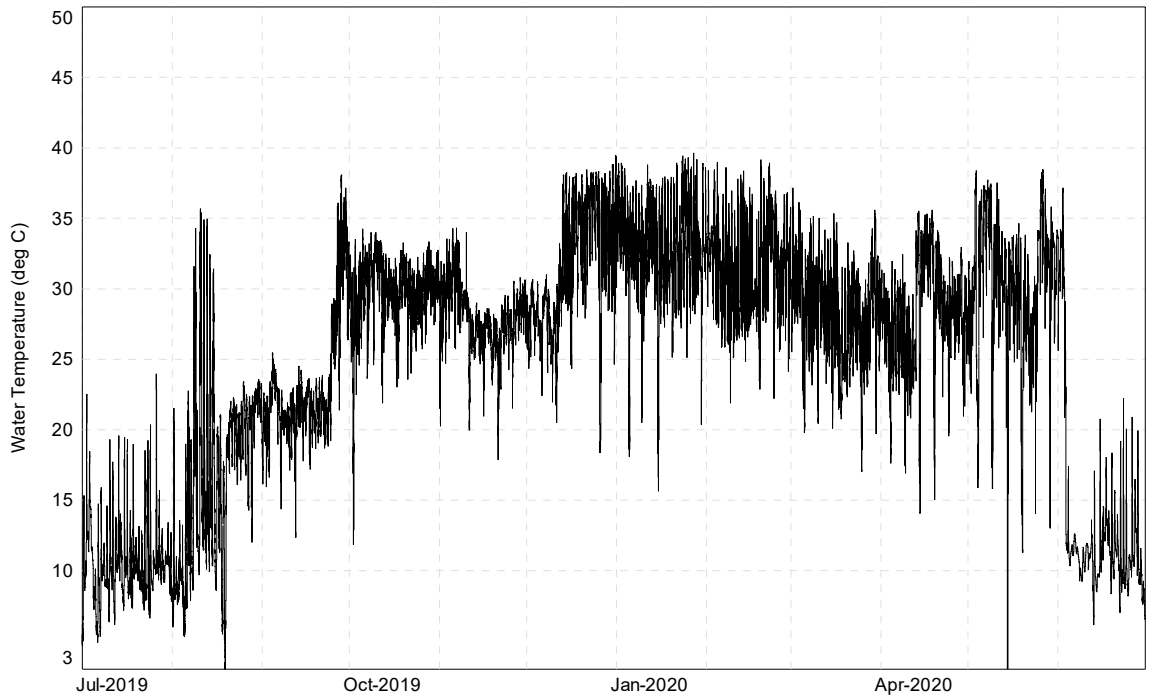

Figure 11 Temperature of the cooling water discharge permitted by consent 0919-3, 2019-2020

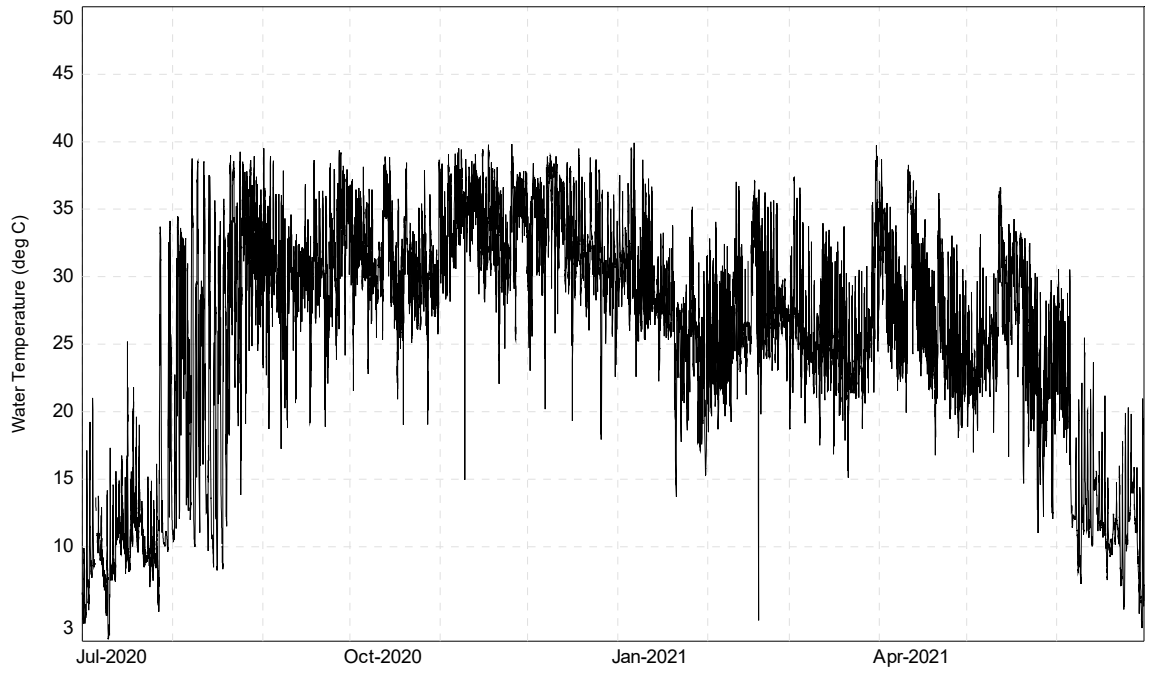

Figure 12 Temperature of the cooling water discharge permitted by consent 0919-3, 2020-2021

Further analysis and comparison of cooling tower and operational performance is illustrated in Figure 13 and Figure 14. Cumulatively during the year under review the cooling water discharge was at or above 35˚C for approximately 11 % of the time. This is in comparison to 7% of the time in 2019-20, 28% of the time in 2018-2019 prior to the operational changes made in November 2018, 1% of the time between December 2018 and the end of the 2018-2019 monitoring year and 35% of the time in the 2017-2018 year.

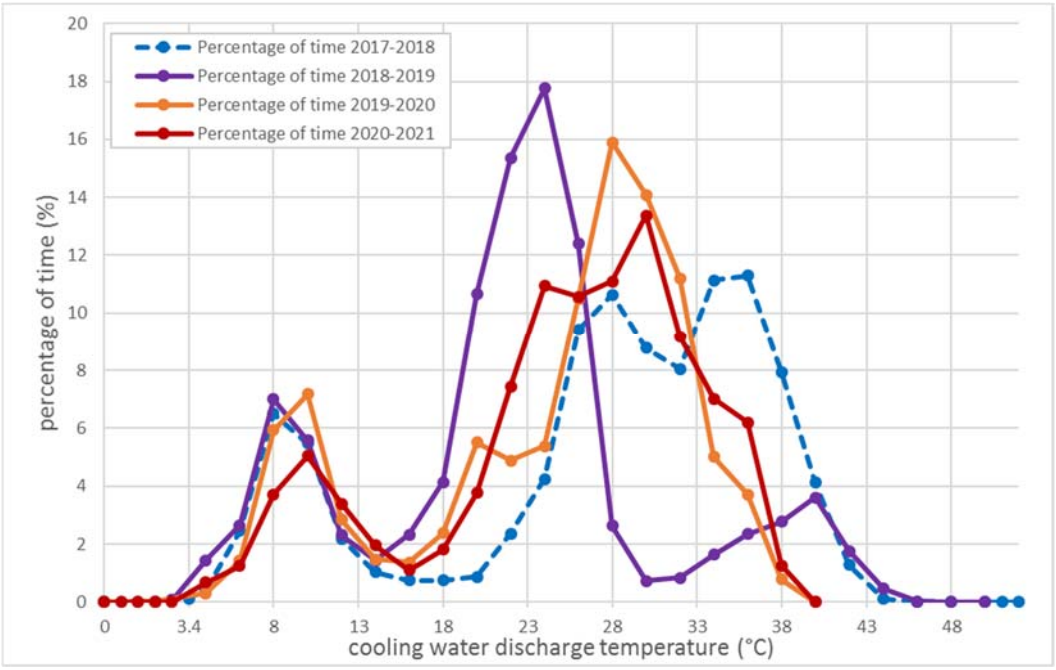

Figure 13 Cooling tower discharge temperature probability density during the 2017 to 2021 years from 1 July-30 June

During the period 1 December to 30 March, the time of year when typically the stream flow is low and the water temperature is higher, the cooling water temperature was at or above 33˚C for 16% of the time, and above 35˚C for 11% of the time. This in comparison to only 1.3% of the time above both 33 and 35˚C respectively during this period for the 2018-2019 year and 48% and 39% of the time respectively for this period in the 2017-2018 year. Whilst there was a significant reduction in the heat load on the receiving environment as a result of the initial improvements in operational management of the cooling tower in the 2018-2019 year, the reduction in heat load had been lessened by the further operational changes that were adopted in the 2019-2021 years, as illustrated in Figure 14.

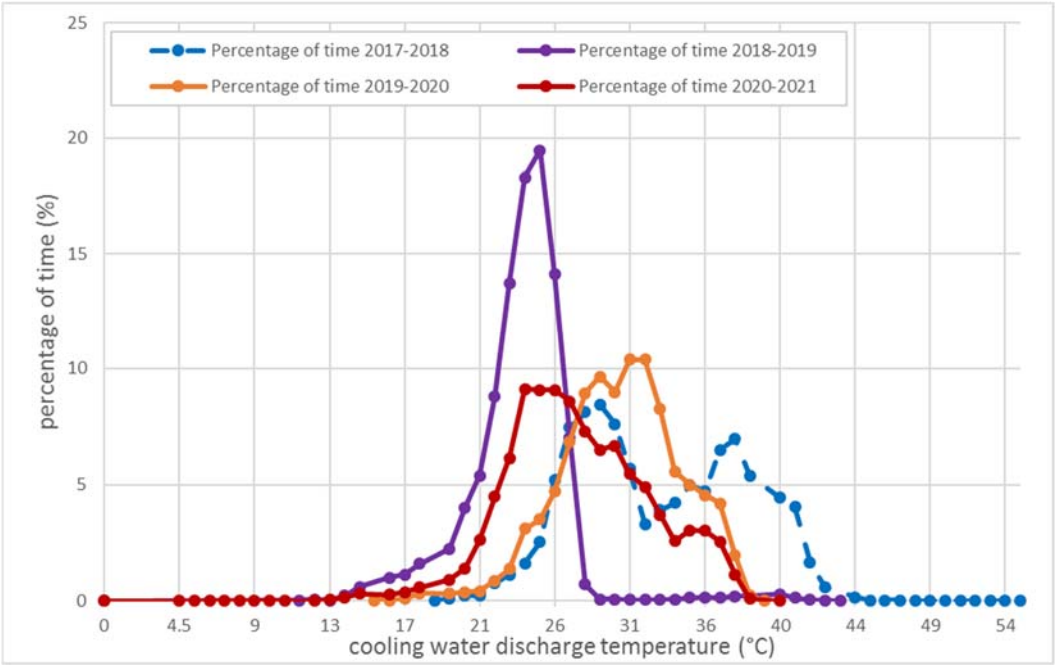

Figure 14 Cooling tower discharge temperature probability density during the 2017 to 2021 years, 1 December-31 March

The effects of these changes, as observed in the receiving waters, are discussed in Section 2.1.1.5.2.

2.1.1.5 Receiving water temperatures

The Company maintained continuous records of Kaupokonui Stream water temperatures (upstream of the spray coolant discharge zone and at the downstream end of the designated mixing zone), and water temperature exiting the cooling tower (discussed in section 2.1.1.4). Since 19 March 2014, the upstream and downstream temperature data have been sent directly to Council by telemetry on a daily basis. During the year under review, the data was 1 minute averaged data. As per the consent conditions, compliance will continue to be assessed based on 15 minute averages. The consent holder undertakes regular checking of the recording system to ensure that compliance is achieved in terms of continuity and accuracy of the record, particularly in relation to the 3˚C maximum stream temperature increase permitted by consent conditions, and a requirement for the temperature increase not to exceed 2˚C for more than 10% of the discharge period (on an annual basis).

Calibration was performed at monthly intervals by Company personnel, and checks were made by Council staff during monthly receiving water sampling surveys.

Historically, Council had been advised that the accuracy of the temperature probes was ± 0.1˚C, however, calibration records forwarded to Council for the 2018-2019 year showed off-sets of up to 0.5˚C that were not being corrected for.

From October 2018, the Company introduced a reduced tolerance for allowable deviations from the reference thermometer during verifications. The allowed deviation was reduced from ± 0.5 ˚C to ± 0.2 ˚C. Up until this point, based on the maximum permitted off-sets given in NEMS, there was potential for error up to ± 0.8˚C deviation at each monitoring location (± 0.5˚C, with an additional off-set of ± 0.3˚C allowed for due to errors on the thermometer used to perform the calibration), and a consequent potential error of up to ± 1.6˚C on any calculated temperature differentials overall. Following implementation of the lower deviation tolerance, the potential error was reduced to between ± 0.2˚C and ± 0.5˚C at each monitoring location and therefore a temperature differential accuracy of between ± 0.4˚C and ± 1.0˚C depending on the accuracy of the thermometer used to perform the calibration.

2.1.1.5.1 Parallel temperature monitoring

Where there are cooling water discharges to waterways, it is Council policy to have continuous water temperature monitoring in place to confirm compliance with consent conditions relating to permitted instream temperature changes. The majority of this monitoring is undertaken by the Council with the installation of one upstream site and at least one downstream site. In the case of the lactose plant, this temperature information is required by the Company, as it is used to control cooling water system operating parameters. The Company is responsible for all aspects of the monitoring of the receiving water temperatures immediately upstream and downstream of their site, with any maintenance, validations and calibrations carried out internally.

The data, including any requested calibration records, are provided to the Council. It is therefore considered that the accuracy of the data and consent compliance can be confirmed by periodic parallel temperature monitoring, rather than a full duplication of effort, as would be the case if Council were to undertake monitoring of a similar scale to that which is in place for other consent holders.

The Council's temperature logger was installed alongside the Company's temperature probe at the both the upstream and downstream monitoring sites between 14 April and 15 May 2021, with the comparisons shown in Figure 15 and Figure 16.

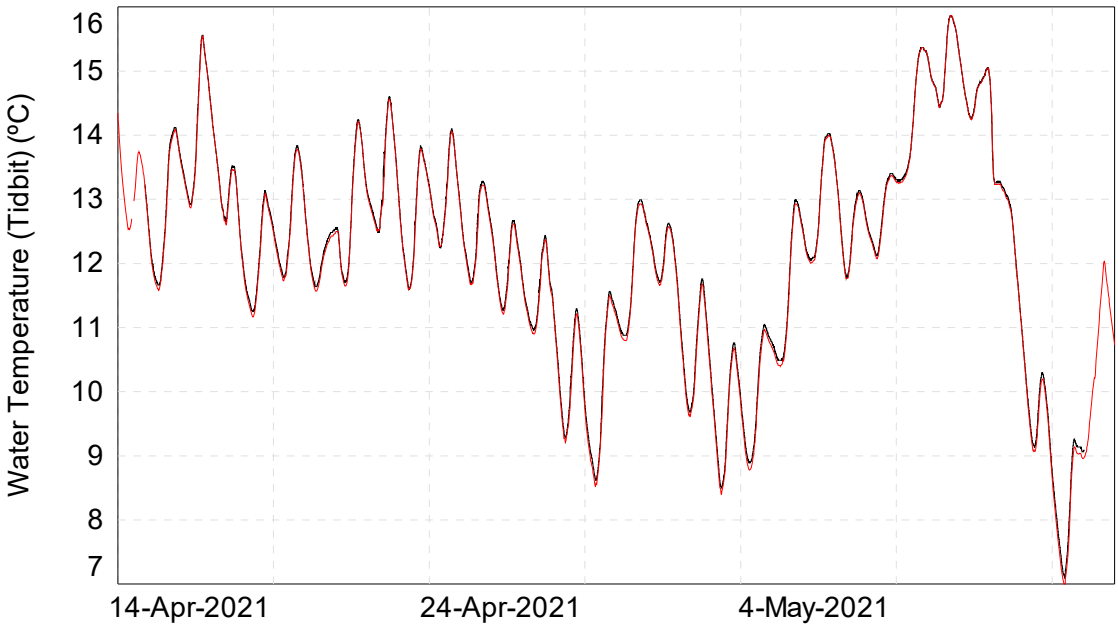

Figure 15 Parallel temperature monitoring upstream of the Company's site

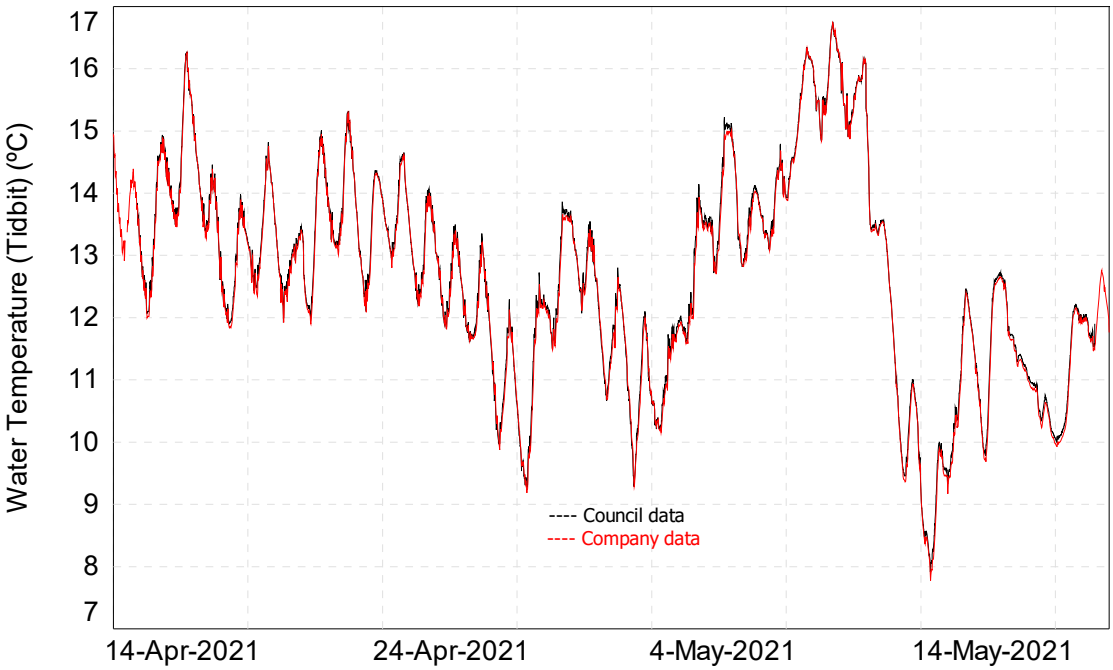

Figure 16 Parallel temperature monitoring downstream of the Company's spray cooling water discharge

Good agreement was observed at both monitoring sites, with the temperature difference being only approximately ± 0.1˚C at the upstream site and ± 0.2˚C at the downstream site.

2.1.1.5.2 Annual consent holder data

The temperature record over the 2020-2021 reporting period for the Kaupokonui Stream upstream and downstream of the lactose plant discharge is presented in Figure 17 and Figure 18. The change in temperature is given in Figure 19.

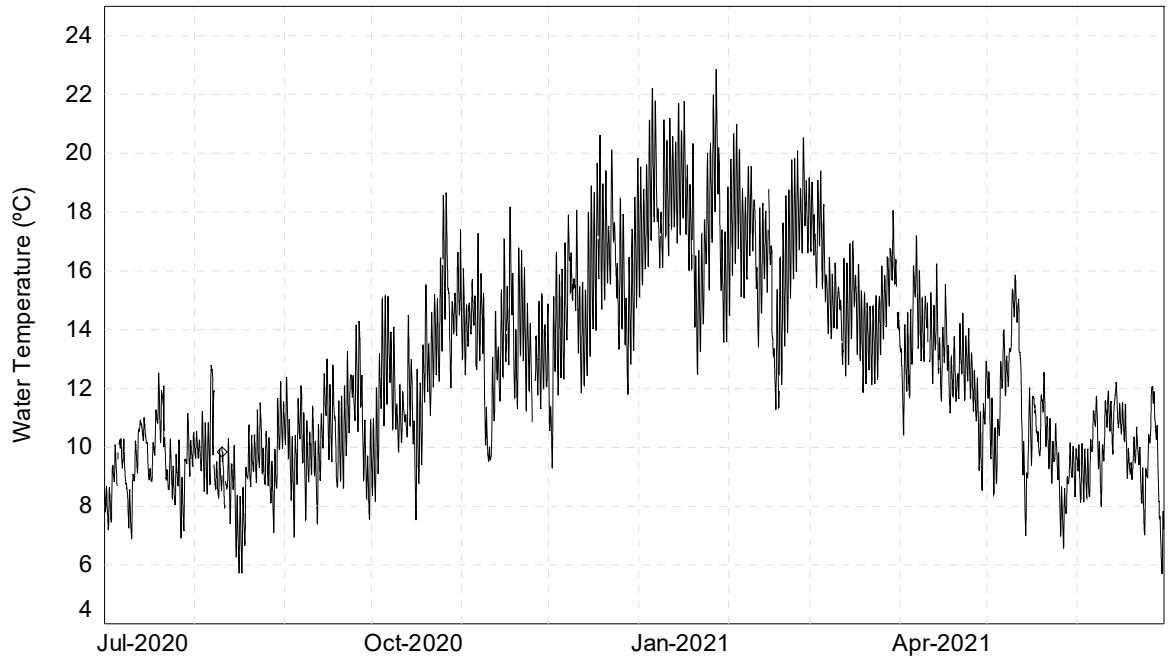

Figure 17 Water temperature (˚C) records for the Kaupokonui Stream upstream of the Lactose plant, electronic data

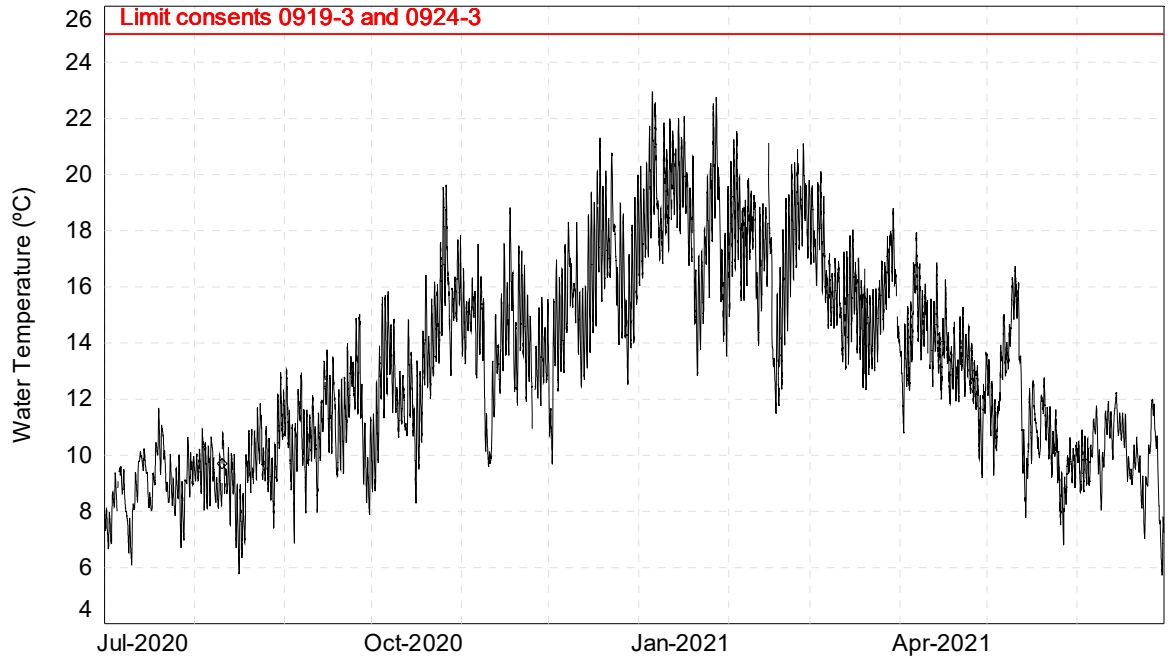

Figure 18 Water temperature (˚C) records for the Kaupokonui Stream downstream of the lactose plant, electronic data

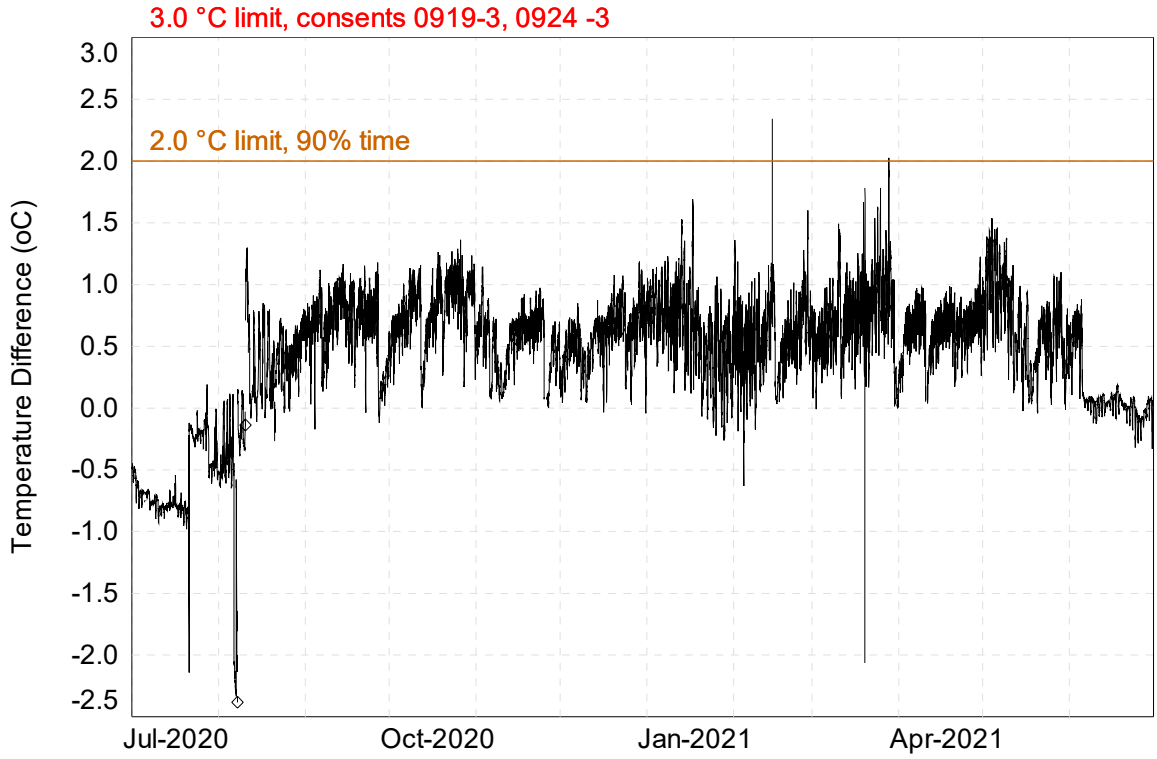

Figure 19 Kaupokonui Stream temperature change below the lactose plant, calculated from electronic data

A summary of the reported temperature change and maximum temperature data for 2020-2021 (15 minute data) is given in Table 7. On a monthly basis, the recorded percentage of time the change was below 0°C, above 2.0°C, 2.5°C and 3.0°C is given, together with the minimum and maximum reported change and the maximum downstream temperature.

Table 7 Summary of Fonterra Ltd's continuous water temperature records (˚C) from two monitoring probes in the Kaupokonui Stream

Month	Temperature change% Time*				Downstream temperature				
	<0˚C	>2˚C	>2.5˚C	>3˚C	Min reported change (d/s-u/s) (˚C)	Max reported change (d/s-u/s) (˚C)	Days in excess of 3˚C	Max downstream temp	Days in excess of 25˚C
Jul-20	98	0	0	0	-2.1	0.2	0	11.7	0
Aug-20	31	0	0	0	-2.4	1.3	0	13.0	0
Sep-20	0.02	0	0	0	-0.2	1.2	0	15.0	0
Oct-20	0	0	0	0	0.0	1.4	0	19.6	0
Nov-20	0	0	0	0	0.0	1.1	0	18.8	0
Dec-20	0.3	0	0	0	-0.04	1.2	0	21.3	0
Jan-21	4.8	0	0	0	-0.3	1.7	0	23.0	0
Feb-21	2.1	0.02	0	0	-0.6	2.3	0	21.5	0
Mar-21	0.04	0	0	0	-2.1	2.0	0	20.1	0
Apr-21	0	0	0	0	0.04	1.2	0	17.9	0

Month	Temperature change% Time*				Downstream temperature				
	<0˚C	>2˚C	>2.5˚C	>3˚C	Min reported change (d/s-u/s) (˚C)	Max reported change (d/s-u/s) (˚C)	Days in excess of 3˚C	Max downstream temp	Days in excess of 25˚C
May-21	0.1	0	0	0	-0.04	1.5	0	16.7	0
Jun-21	44	0	0	0	-0.3	0.9	0	12.3	0
Totals for 2020-2021*	13	0.01	0	0	-2.38	2.34	0	23.0	0

Note:* =% of actual record (3 days 19 hrs of missing record)

Condition 4(b) of consent 0919-3 requires that the discharge does not result in an increase of more than 3˚C at any time, and does not alter the temperature of the receiving water by more than 2°C for 90% of the time (on an annual basis). There is an alarm on the system that alerts staff if there is a high differential temperature recorded and periodic testing is performed to ensure that the alarm is functioning.

The Company operates a null switch, which is activated during periods when the temperature probes are pulled out of the water for protection during high flows, or during calibration. This reduces the number and duration of temperature spikes recorded (it should be noted that 0.1% exceedance during any one month's operations equates to a time period of approximately 1 hour).

There was one occasion when the reported temperature difference exceeded 2˚C. The Company reported that there had been a brief outage on the river temperature monitoring due to a damaged wire on 14 February 2021. The cooling tower was manually set to 100 % to avoid the possibility of a consent exceedance during the outage. The apparent temperature recorded that exceeded the 2˚C differential was one 15 minute average data point while the fault was repaired and before the probe was replaced in the water.

Therefore these consent limits were not exceeded during 2020-2021.

Condition 5 of consents 0919-3 requires that the discharge shall not raise the temperature of the receiving water above 25°C at the boundary of the mixing zone. Figure 18 shows that this condition was complied with during the year under review.

The data and summary provided in Figure 19 and Table 7 show that, although the temperature probes comply with the requirements of NEMS standard for the monitoring data, and significant improvements have been made to the calibration processes the Company employs, there still appears to be some occasional issues with the precision of the recording of the temperature differential between the upstream and downstream sites. During the year under review, the data reported indicated that there was a drop in stream temperature between the upstream and downstream sites for 13% of the time. This is in comparison to 11% of the time in 2019-20, 3% of the time in 2018-2019, 16% of the time in 2017-2018 and 23% of the time in the 2016-2017 year.

It is also noted that during the month of June in the year under review, 98% of the data provided for the upstream and downstream temperatures resulted in a negative temperature differential in comparison to 83% of the data in June 2020. In the 2019-2020 Annual Report it was noted that 81% of June 2020 temperature differentials were less than -0.5°C. This is due to the permitted calibration errors of the measuring devices, but continues to support the use of a 2°C temperature change limit on the consent for the majority of the time and the need for continuation of the parallel temperature monitoring. During the plant shutdown in July 2020, 66% of the month's data resulted in a negative temperature differential that was in the range -0.5°C to -1.0°C as shown in Figure 19.

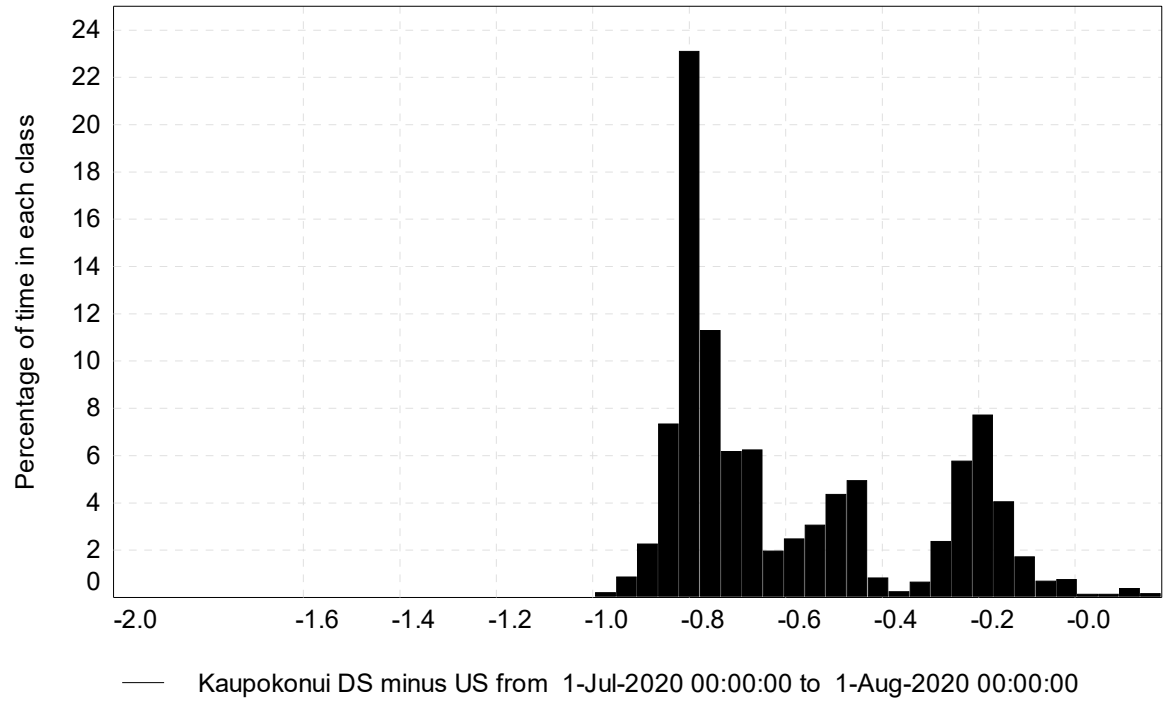

Figure 20 Probability distribution for the Kaupokonui instream temperature differential between the Company's upstream and downstream monitoring sites during July 2020

As discussed in Section 2.1.1.4 operational management of the cooling water discharge system was changed during the 2018-2019 year and again part way through the 2019-2020 year. The effects of these changes are illustrated in the comparison of the temperature differential probability density curves for the 2017-2018, 2018-2019 and 2019-2020 years, and 2020-2021 year shown in Figure 21. A summary of the operational changes and the notable observable effects are given in Table 8.

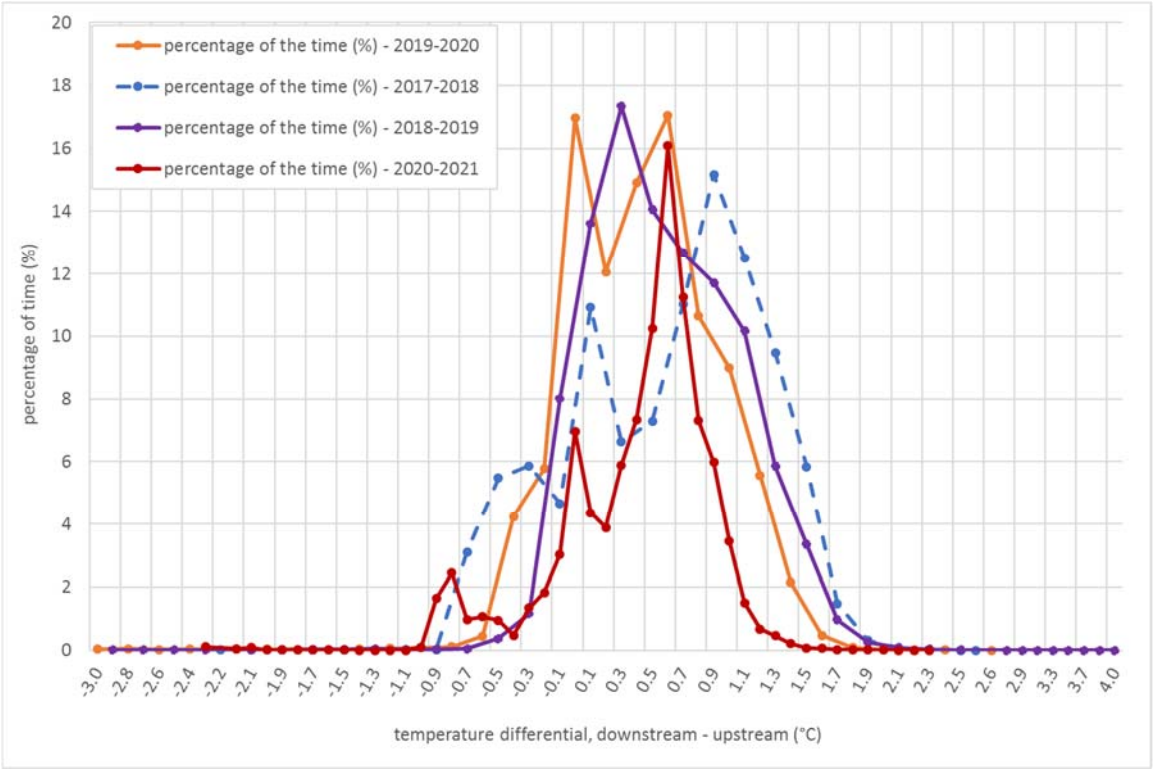

Figure 21 Instream temperature differential probability density during the 2017-2021 years from 1 July-30 June

Table 8 Summary of cooling water system operational changes and receiving water temperature related outcomes

Timeframe	Change in operational management of cooling tower and associated in-house monitoring	Observable effects on the instream temperature	Comments
2016-2017		Negative upstream-downstream temperature differentials reported for 23% of the electronic record. Maximum negative temp differential reported -1.5°C	Errors within limits permitted by NEMS standards, resulted in potential error of ± 1.6 ˚C on any calculated temperature differentials. Would need to be considered in relation to the temperature increase permitted on the reissued consent. Discussions commenced on options to improve precision.
2017-2018		Negative upstream-downstream temperature differentials reported for 17% of the electronic record. Maximum negative temp differential reported -2.2°C	Discussions on-going. Council monitoring programme to include period of parallel temperature monitoring for the 2018-2019 year
Oct 2018	Company introduced a reduced tolerance for allowable deviations from the reference thermometer during verifications from ± 0.5 ˚C to ± 0.2 ˚C.	A significant reduction in the amount of time that a negative temperature differential was recorded to only 3.2% of the electronic record.	Time lag identified in the control loop for the utilisation options available for running the cooling tower efficiently based on the upstream downstream temperature differentials to take effect
Nov 2018	Manual diversion of all flow from the cooling water flows to the cooling tower. Cooling tower operating at maximum cooling conditions at all times	A significant reduction in the most common instream temperature differential, from 0.9 to 0.3°C A significant reduction in the percentage of the time that the temperature differential is greater than 1.0°C	
2019-2020	Removal of cooling tower bypass line Addition of variable speed pump to control cooling tower residence time Operation of cooling tower fans based on river temperature differential	A significant change in the most common instream temperature differentials, with a bimodal pattern evident in the year under review. That is two most common instream temperature differentials of 0.0 and 0.6°C, both at 17% of the time A significant increase in the amount of time that a negative temperature differential is reported (11% of record). A further reduction in the amount of time the temperature differential is above 1.0°C	Due to permitted errors inherent in any temperature measurements, actual instream temperature differentials may be up to 1.0°C higher than reported measurement. Would need to be considered in relation to the temperature increase permitted by reissued consent.

Timeframe	Change in operational management of cooling tower and associated in-house monitoring	Observable effects on the instream temperature	Comments
2020-2021	No further operational changes	Most common instream (targeted) temperature differential 0.6°C at 16% of the time Further increase in the amount of time that a negative temperature differential is reported (-0.1 to -1.0°C for 13% of record). A further reduction in the amount of time the temperature differential is above 1.0°C	Due to permitted errors inherent in any temperature measurements, actual instream temperature differentials may be up to 1.0°C higher than reported measurement.. Would need to be considered in relation to the temperature increase permitted by reissued consent.

This demonstrates that the most effective option to minimise effects on the environment was running the cooling tower at maximum capacity, as was the case in the 2018-2019 year from November onwards. The reduction in the discharge temperatures would have resulted in a significant reduction in the effects occurring within the approximately 200 m discharge and mixing zone. An additional advantage is that it would improve the sustainability of the cooling water discharge system at times when the upstream receiving water temperature peaks during the summer months, whilst still ensuring compliance with the 25°C downstream temperature limit (peak upstream temperature recorded to date, 24.8°C on both 29 and 30 January 2018).

The operational management of the cooling tower in the 2019-2021 years would have resulted in an improvement in the effects occurring within the discharge spray zone when compared to the 2017-2018 year, but some of this improvement would have been lost when compared to the latter part of the 2018-2019 year.

2.1.1.6 Wastewater irrigation volumes

In relation to the Company's spray irrigation of wastewater onto land (that is, the exercise of 0922-3 and 0923-3) the Company supplied the Council with monitoring data relating to the daily volume of factory and dairy shed effluent (DSE) spray irrigated. This information is summarised in Table 9.

Table 9 Waste irrigation records supplied by Fonterra Ltd (volumes)

Month	Kapuni Farm 1							Farms 2 & 3						
	Factory			DSE			Total	Factory			DSE			Total
	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >2630	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >3834
		Av.	Max		Av.	Max.			Av.	Max.		Av.	Max.	
Jul 20	1	1	18.8	0	0	0	0	27	519	1,500	7	23	167	0
Aug 20	23	134	455	23	23	80	0	30	1,001	1,392	16	40	118	0
Sep 20	30	409	700	29	70	118	0	30	1,257	1,529	0	0	0	0
Oct 20	31	512	761	28	71	120	0	31	1,476	2,072	18	62	167	0
Nov 20	30	528	757	29	82	118	0	30	1,418	1,900	15	66	167	0
Dec 20	31	414	834	31	71	119	0	31	1,168	1,405	23	79	167	0

Month	Kapuni Farm 1							Farms 2 & 3						
	Factory			DSE			Total	Factory			DSE			Total
	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >2630	Days	Volume, m^3/d		Days	Volume, m^3/d		Days 2-day volume >3834
		Av.	Max		Av.	Max.			Av.	Max.		Av.	Max.	
Jan 21	28	361	764	28	50	120	0	31	1,162	1,645	29	112	167	0
Feb 21	28	431	851	26	63	116	0	28	1,189	1,804	22	110	167	0
Mar 21	31	386	718	31	63	118	0	31	1,305	1,595	8	34	167	0
Apr 21	28	334	602	28	59	116	0	30	1,193	1,698	12	64	167	0
Mar 21	30	326	764	28	39	78	0	30	1,009	1,625	17	56	167	0
Jun 21	1	67	554	0	10	96	0	27	243	1,143	7	40	167	0

Note: Average daily volume irrigated is calculated from days when irrigation occurred

The Company continued to irrigate a large volume of wastewater during the year under review. Consents 0922 and 0923 permit a maximum volume of 2,630 m^3 (Farm1) and 3,834 m^3 (Farms 2 and 3) of factory effluent and dairy effluent combined to be spray irrigated per two consecutive days, with a maximum daily volume for dairy shed effluent of 120 and 168 m^3, respectively. The data provided by the Company shows that all of these limits were complied with. The maximum volume irrigated on Farm 1 in any two consecutive days was a total of 2,227 m^3 and on Farms 2 and 3 it was total of 3,812 m^3. It is noted that during the early part of the year under review some steam condensate that could not be returned to Todd as a result of the return line failure was included in this wastewater irrigation.

With the exception of the winter shut down period that occurs in June and July each year, irrigation of factory effluent occurred almost daily during the monitoring year. A total factory effluent volume of 511,506 m^3 was irrigated during the 2020-2021 year, with a distribution between farms of 23%, 18% and 58% for Farm 1, Farm 2 and Farm 3, respectively. This was an increase of 4% from the volume of 493,611 m^3 irrigated in the 2019-2020 year. This follows an increase of 5% between the 2018-2019 and 2019-2020 years. The factory wastewater irrigation distribution between the farms during the year under review saw a reduction in the percentage of the factory wastewater applied to Farm 2 when compared to the previous year (24%, 20% and 56%).

Disposal of dairy shed effluent from the Farm 3 dairy shed to land via the factory effluent spray irrigation system was established in 2015-2016, ending the oxidation pond discharges to the Kaupokonui and Motumate Streams. During the year under review, Farm 3 irrigation commenced for the season on 7 July 2020 (although regular irrigation did not commence until early October). A total volume of 20,685m^3 was discharged on Farm 3 during the year, which was a 48% increase on the previous year. On Farm 1, where irrigation commenced on 4 August 2020, a total volume of 18,175 m^3 was discharged. This is a slight reduction in volume when compared to the 2019-2020 year volume of 19,229 m^3, which had been a 60% increase on the volume discharged in the 2018-2019 year.

2.1.1.7 Wastewater composition

Factory wastewater

The Company commenced monthly monitoring of factory wastewater composition in May 2007. This was done at the request of the Council in order to improve calculations of loadings on irrigation areas and to characterise variation in effluent quality. The Company increased the frequency to weekly grab sampling in July 2008. The plant wastewater is now automatically sampled by the Company at the filter on the line from

the plant wastewater tank. A grab sample is taken every five minutes when wastewater is being pumped to the farms. The composite of these grab samples is refrigerated and a weekly composite sample is sent to an outside laboratory (Industrial Chemistry Services Ltd) for analysis. In 2020-2021 the pH, organic strength, major mineral components, nutrients (including nitrogen species) and the metals copper and zinc were determined for 51 samples collected between 15 July 2020 and 30 June 2021. It is noted that the number of sample collected for analyses has been steadily increasing since the 2017-2018 year. The results are summarised in Table 10.

Table 10 Results of factory wastewater monitoring by Fonterra Ltd

Parameter	Unit	2020-2021		% change	2019-2020		% change	2018-2019	
		Median N = 51	Range		Median N = 49	Range		Median N=46	Range
pH	pH	4.5	3.8 - 7.4	2	4.4	4.0 - 8.0	0	4.4	3.8 - 7.4
Conductivity	µS/cm @25°C	1,496	228 - 2,580	-	-	-	-	-	-
Chemical oxygen demand	g/m^3	5,140	43 - 8,630	-3	5,300	82 - 9,480	-7	5,685	308 - 17,760
Biochemical oxygen demand	g/m^3	3,000	20 - 4,400	-6	3,200	30 - 4,800	7	3,000	140 - 6,000
Total Nitrogen	g/m^3N	99	8.9 - 167	-2	102	5.0 - 166	24	82	9.4 - 174
Nitrate	g/m^3N	62	0.1 - 139	2	61	0.8 - 130	3	59	0.13 - 149
Nitrite	g/m^3N	1.4	0.0 - 20	-42	2.4	0.01 - 30	100	1.2	0.01 - 13.5
Total Kjeldahl Nitrogen (TKN)	g/m^3N	36	0.8 - 104	44	25	1.0 - 96	67	15.0	1.4 -65.0
Calcium	g/m^3	162	12.0 - 276	-11	183	12 - 259	20	153	50 - 306
Calcium	meq/L	8.1	0.6 - 13.8	-	-	-	-	-	-
Magnesium	g/m^3	9.8	4.8 - 41	-18	12	4.9 - 46	0	12	5 - 97
Magnesium	meq/L	0.8	0.4 - 3.4	-	-	-	-	-	-
Sodium	g/m^3	104	15 - 228	-2	107	22 - 235	8	99	54 - 164
Sodium	meq/L	4.5	0.63 - 9.9	-	-	-	-	-	-
Potassium	g/m^3	40	13 - 110	-17	48	10 - 265	-13	55	12 - 150
Total Phosphorus	g/m^3P	59	0.7 - 161	-31	85	4.2 - 144	67	51	6 - 260
Chloride	g/m^3	60	14 - 234	-	-	-	-	-	-
Ash	g/m^3	902	77 - 1,883	-8	976	93 - 1,816	14	855	328 - 1,868
Copper	g/m^3	0.230	0.014 - 0.860	-15	0.270	0.042 - 0.850	-29	0.38	0.07 - 0.98
Zinc	g/m^3	0.340	0.029 - 0.750	3	0.330	0.028 - 0.770	-93	4.4	0.26 - 0.93
Sodium adsorption ratio		2.2	0.54 - 4.2	-27	3.0	0.8 - 5.9	4	2.9	1.9 - 5.4

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2018-2019, 2019-2020 and 2020-2021 monitoring years on the basis of median values, as shown in Table 10. Wastewater organic strength in 2020-2021, was, on the whole similar to or more concentrated when compared with the 2019-2020 year, with the changes being from -3% (a slight

reduction of chemical oxygen demand) to 44% (increasing Kjeldahl nitrogen). Although there was a 44% increase in the median Kjeldahl nitrogen, the total nitrogen median was very similar to the previous year. Although this is second consecutive increase in the median Kjeldahl nitrogen of the wastewater, it is still lower than the 2016-2017 median of 48 g/m^3. It is also noted that the total nitrogen concentration has continued to agree reasonably well with the sum of the individual nitrogen species in the 2016-2021 years, unlike the 2013-2015 seasons. Although the nitrite concentration has become more elevated at times in recent years, the highest concentrations found in any of the groundwater monitoring bores remained low (0.006 g/m^3), which is well below the long term drinking water standard of 0.2 g/m^3. The mineral concentrations in the year under review were similar to, or less than the previous year median. The median total phosphorus concentration had increased by 67% between the 2018-2019 and 2019-2020 years, but reduced again during the year under review. The sodium adsorption ratio was again elevated on occasion, though well within the safe range for soil stability.

The annual volume of factory wastewater produced since 2009-2010, together with the annual mass of factory nitrogen irrigated, is presented in Figure 22. With respect to the mass discharge rate of wastewater components, factory wastewater volume had generally changed little between the 2011-2012 and 2016-2017 years. Therefore, during this period, the estimated mass discharge rate of the wastewater components increased or reduced by about the same proportion as their respective concentrations. However, since the 2017-2018 year there has been much more variability in the annual volume discharged and/or the concentration of the components in the discharge. This has resulted in what was, in the 2017-2018 year, a maximum volume discharged, with a minimum total nitrogen mass discharge. A further reduction in the mass discharge rate of total nitrogen was achieved in the 2018-2019 year. However an additional 6,739 kg of nitrogen was discharged onto the farms during the irrigation of the factory wastewater in the 2019-2020 year and a further additional 6,433 kg of nitrogen in the 2020-2021 year. This change is as a result of increase Food Safety and Quality requirements that have resulted in the need for increased "cleaning in place" (CIP) of the factory equipment. The CIP chemical in use at the site is nitric acid.

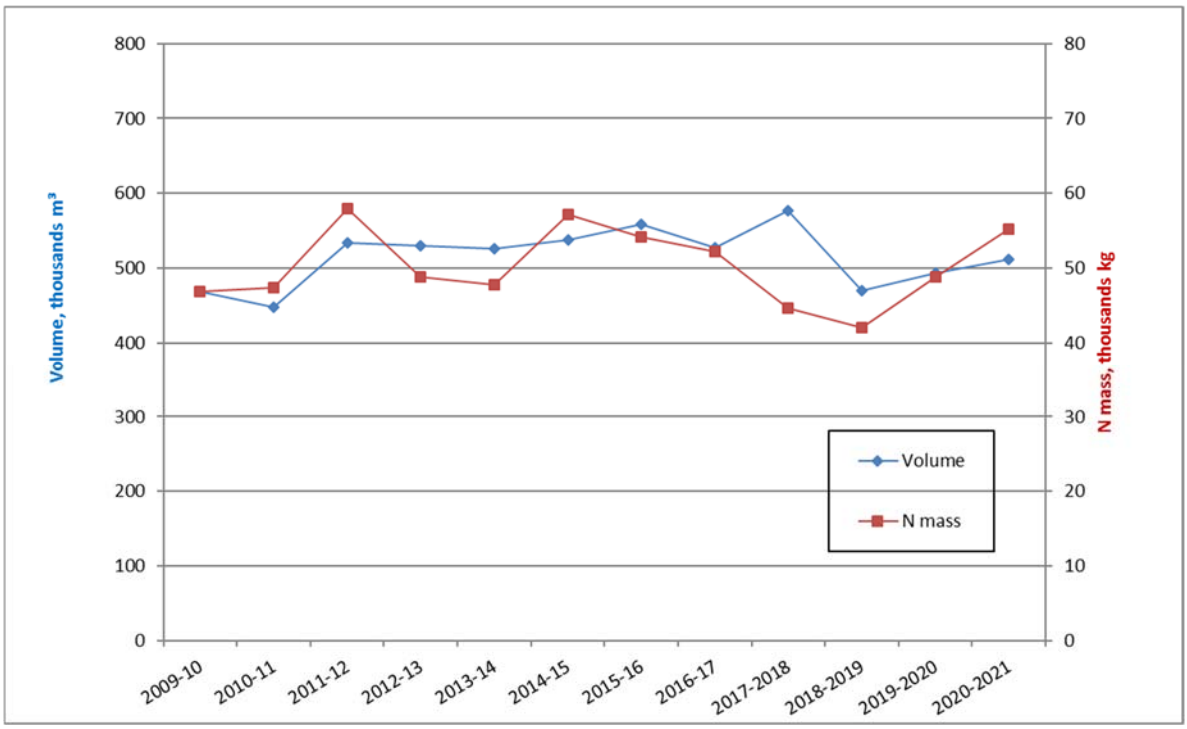

Figure 22 Annual volume of factory wastewater and estimated factory nitrogen mass irrigated, 2009-2021

Both the factory wastewater and dairy shed effluent (DSE) strengths vary through the season. A comparison of the relative strengths of these different wastewater streams is discussed following the DSE section.

Dairy shed effluent (DSE)

The Company began weekly analysis of DSE during the 2015-2016 season upon the commencement of spray irrigation of DSE to land, together with factory wastewater. Automatic solenoid samplers, located beside the storage pond pump at each farm, collect composite samples over 24 hours whenever DSE pumping occurs, with a weekly composite being analysed for each farm's DSE. The parameters determined are similar to those for the factory wastewater, with the exception that chemical oxygen demand (COD), copper and zinc are not determined. A total of 46 samples were taken between 14 August 2020 and 30 June 2021 for Kapuni Farm 1, and 37 samples were taken between 15 July 2020 and 30 June 2021 for Farms 2 and 3. The results are summarised in Table 11.

Table 11 Results of dairy shed effluent monitoring by Fonterra Ltd

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 46	Range	2019-2020 median (N=42)	Median N = 37	Range	2019-2020 median (N=31)
pH	pH	7.8	5.9 - 8.2	7.9	7.9	7.5 - 8.1	8.0
Biochemical oxygen demand	g/m^3	320	60 - 2,300	400	240	80 - 1480	280
Total Nitrogen	g/m^3N	163	54 - 212	153	97	50 - 219	127
Nitrate	g/m^3N	0.23	0.01 - 48	0.43	0.50	0.01 - 7.7	0.100
Nitrite	g/m^3N	0.20	0.02 - 7.8	0.10	0.20	0.00 - 0.90	0.030
Total Kjeldahl Nitrogen (TKN)	g/m^3N	159	49 - 212	153	96	49 - 218	126
Calcium	g/m^3	99	32 - 158	100	80	51 - 136	82
Magnesium	g/m^3	25	5 - 72	29	19	5 - 63	29
Sodium	g/m^3	72	26 - 113	86	49	28 - 138	67
Potassium	g/m^3	615	60 - 740	580	290	93 - 750	450
Total Phosphorus	g/m^3P	61	30 - 90	62	38	25 - 81	55
Ash	g/m^3	1,417	540 - 1,708	1,505	842	524 - 1,674	1,130

Comparison of contaminant loadings from the factory wastewater and DSE

The DSE has generally been found to have much lower organic (BOD compared to BOD and COD, Figure 24) and higher mineral strength than factory wastewater (for example potassium, Figure 30), and is slightly alkaline (Figure 25). During the 2018-2019 year it was found that the organic strength of the DSE from Farm 3 exceeded that of the factory wastewater through February and March due to a breakdown of the separator which allowed more solids through to the DSE irrigation pond. This trend has not repeated in the 2019-2021 years (Figure 24). In the 2018-2019 year it was found that the Farm 3 DSE had an oxygen demand, total nitrogen (Figure 26), calcium (Figure 29), potassium (Figure 30) and phosphorus concentrations (Figure 31) that were between two and three times higher than in the previous year. The elevated concentrations occurred during the period January to April. Again this has not reoccurred during the year under review. In the 2019-2021 years the effluent from Farm 1 has had higher median component concentrations than that of Farms 2 and 3, which is in contrast to the 2018-2019 year. The change is a result of both a substantial increase in the median strength of the Farm 1 effluent and a substantial reduction in the median strength of the Farm 3 effluent when compared to the 2018-2019 year. The reduction in the strength of the Farm 3 effluent is likely to be as a result of the separator functioning correctly since the

earlier breakdown. The median total nitrogen concentration in the Farms 3 effluent was 97 g/m³ (down from 127 g/m³ in 2019-2020), which was less that the Farm 1 effluent at 163 g/m³ (up from 153 g/m³ in 2019-2020). This is in comparison to the factory wastewater, which was at 99 g/m³ (similar to the 102 g/m³ in the 2019-2020 year). The predominant nitrogen species present in the dairy shed effluent are generally ammoniacal nitrogen and organically bound nitrogen, whereas the factory wastewater contains much higher concentrations of nitrate and nitrite nitrogen. The additional nitrogen load applied to the paddocks during the year under review from the Farm 1 and Farm 2 and 3 DSE was about 5,326 kg (compared to 5,072 kg in 2019-2020 and 4,352 kg in 2018-2019), continuing to be about 9% of the total nitrogen load.

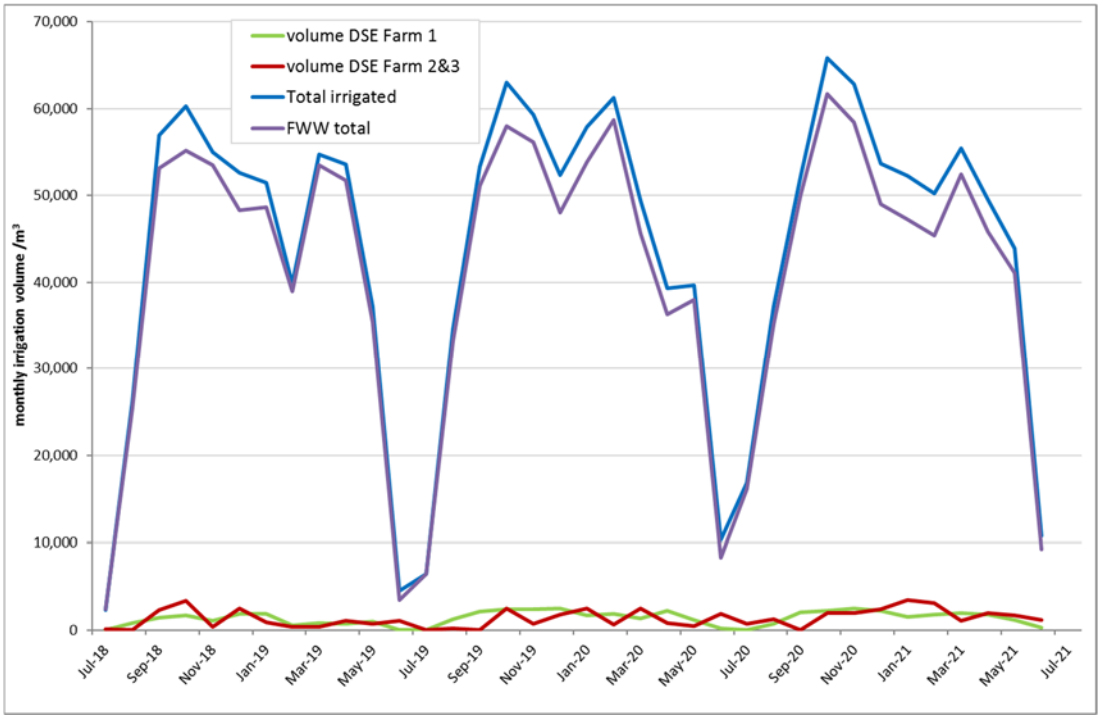

Figure 23 Relative irrigation volumes during the year under review, with previous two years for comparison

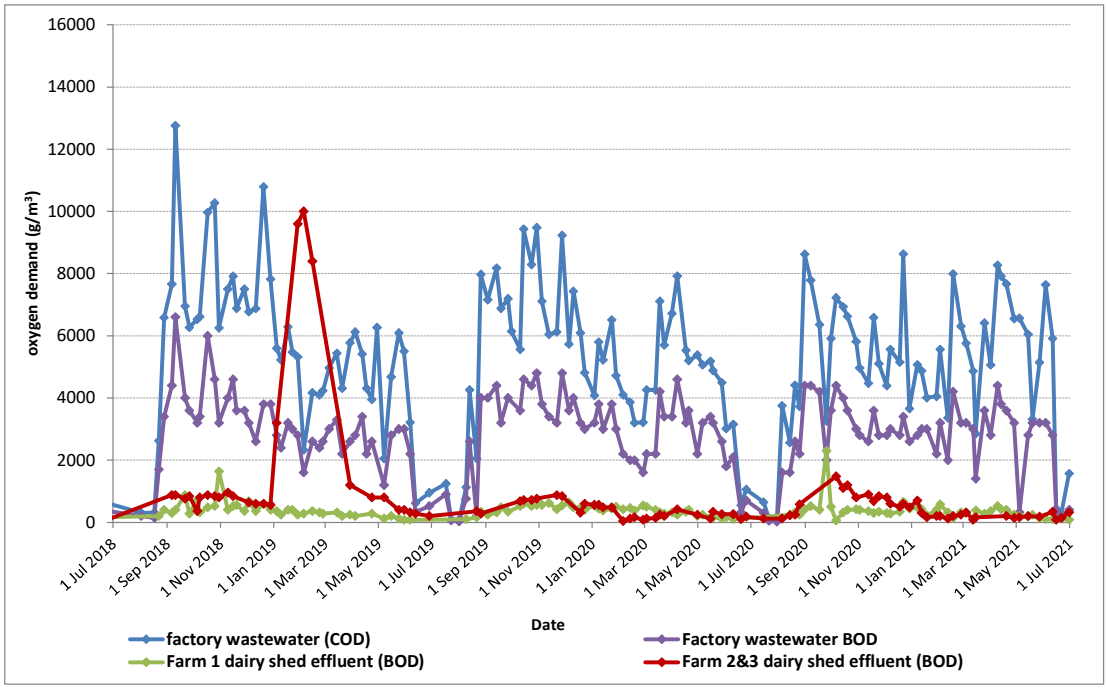

Figure 24 Oxygen demand of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

Figure 25 pH of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

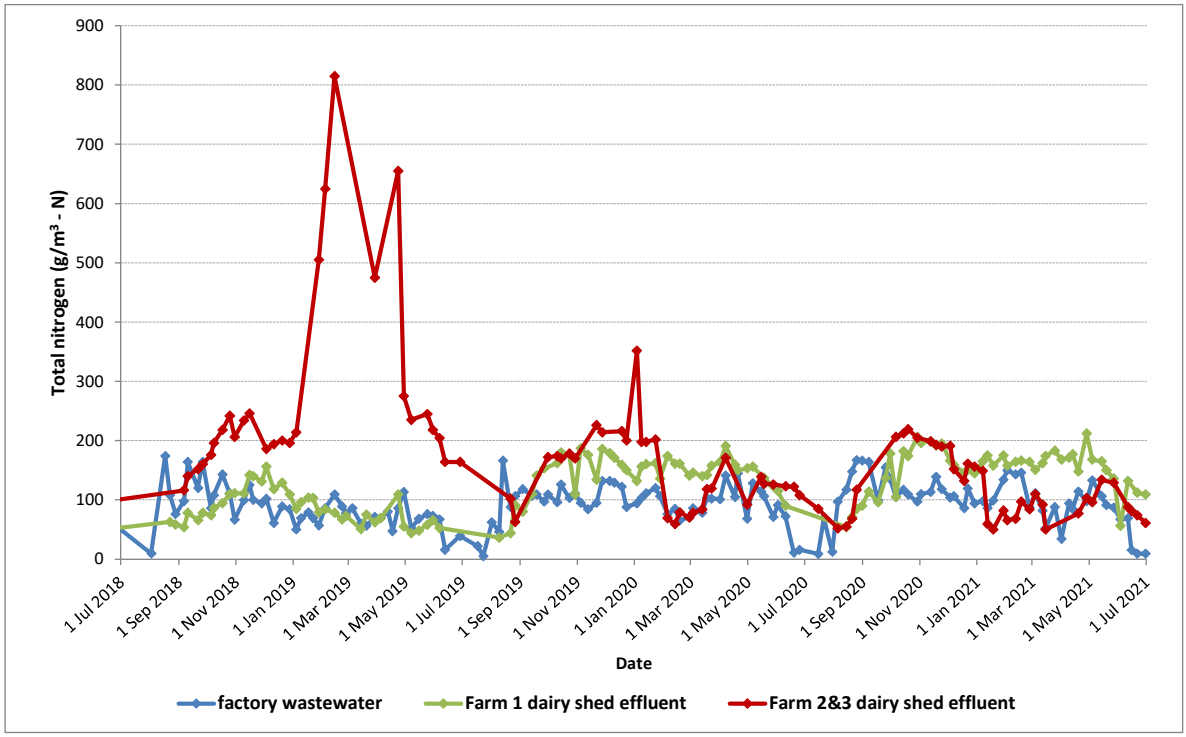

Figure 26 Nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

It is noted that during the last three years, the nitrite concentration of the Farm 3 DSE had reduced, and remained low for the 2018-2020 years. This parameter was elevated to varying degrees on occasion in both the Farm 1 DSE and Farm 3 DSE during the year under review. The nitrite concentration of the factory wastewater had been showing a progressive increase in nitrite concentration season on season when

comparing the 2017-2020 monitoring years. The concentrations had decreased somewhat during the year under review, but remained elevated when compared to the 2017-2018 year. (Figure 28).

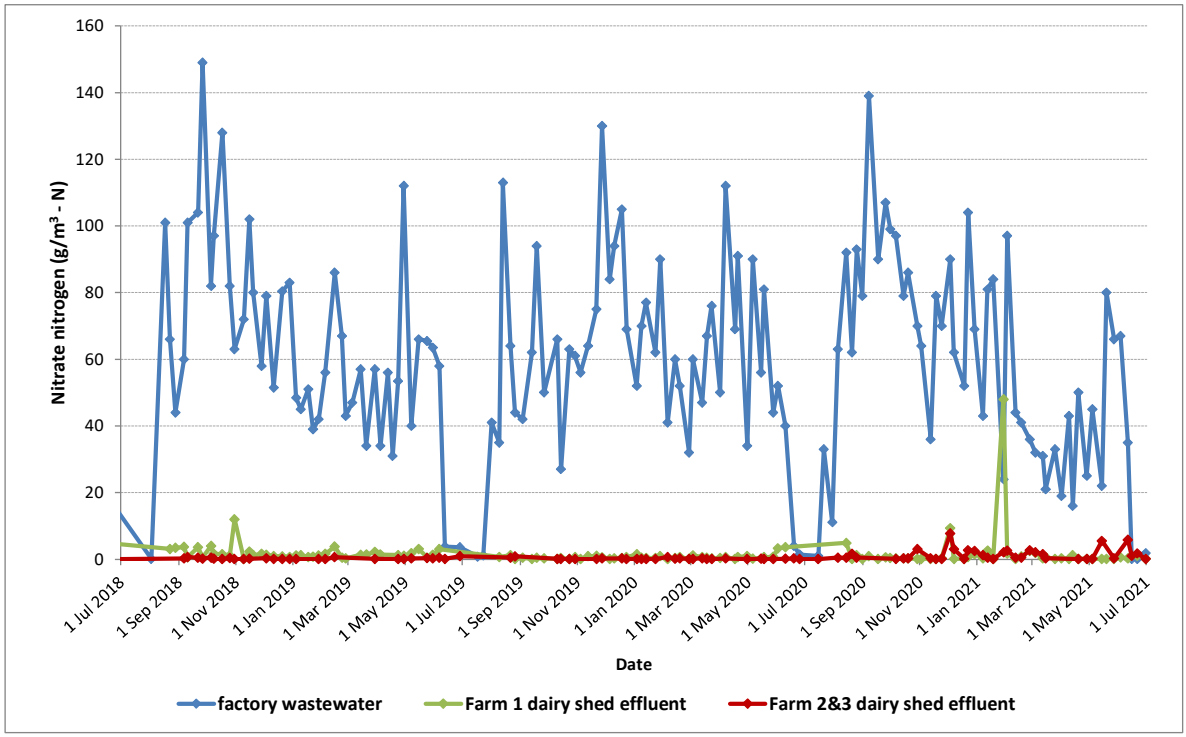

Figure 27 Nitrate nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

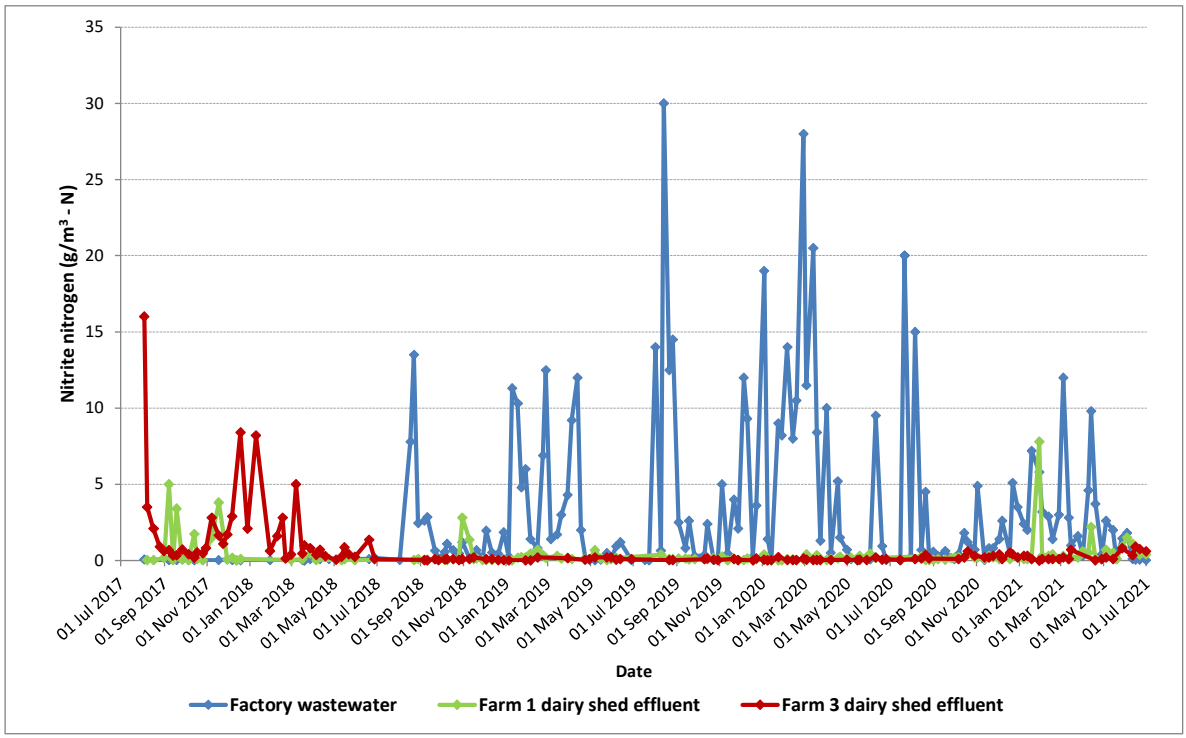

Figure 28 Nitrite nitrogen of the factory wastewater and dairy shed effluents during the year under review, with previous three years for comparison

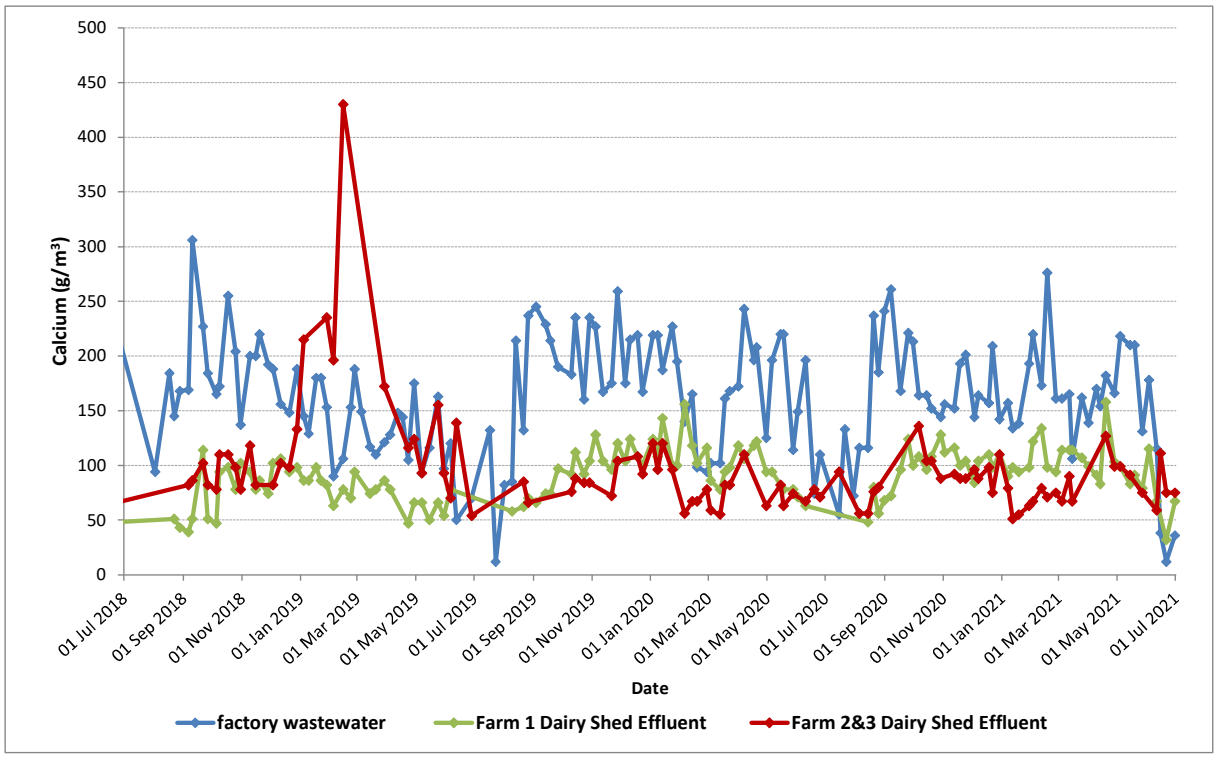

Figure 29 Calcium concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

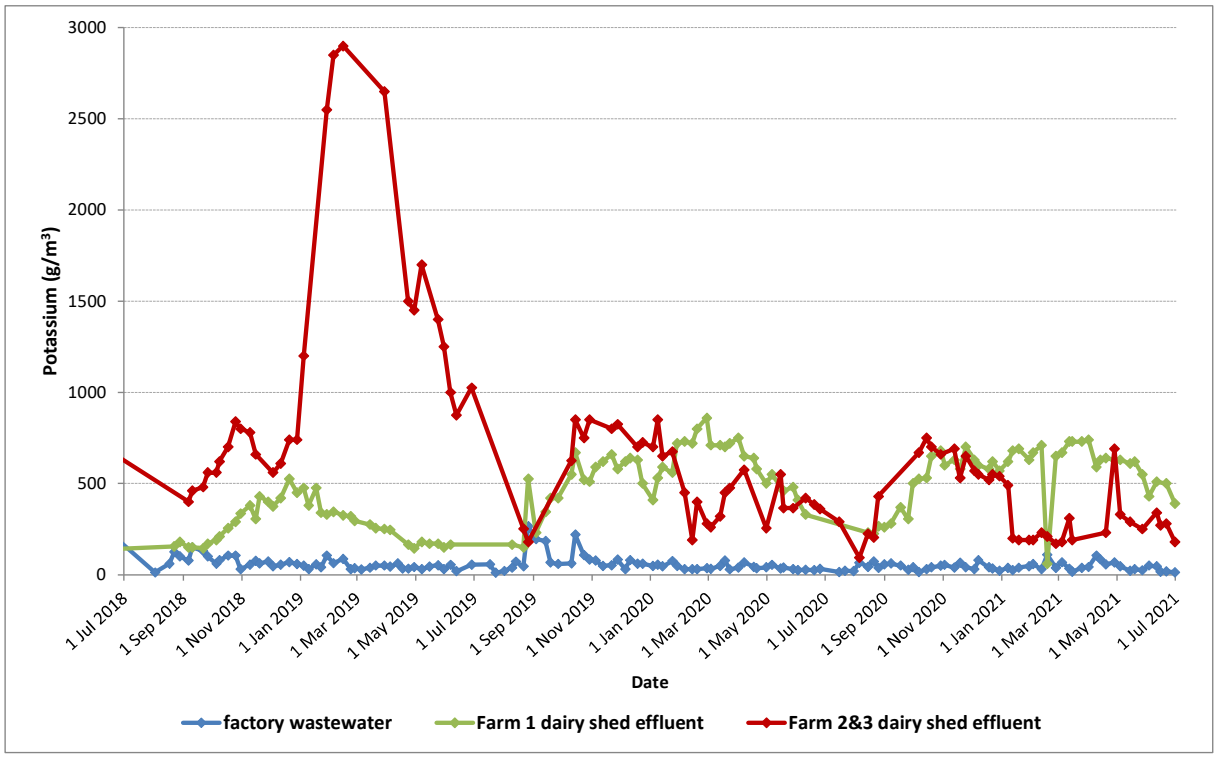

Figure 30 Potassium concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

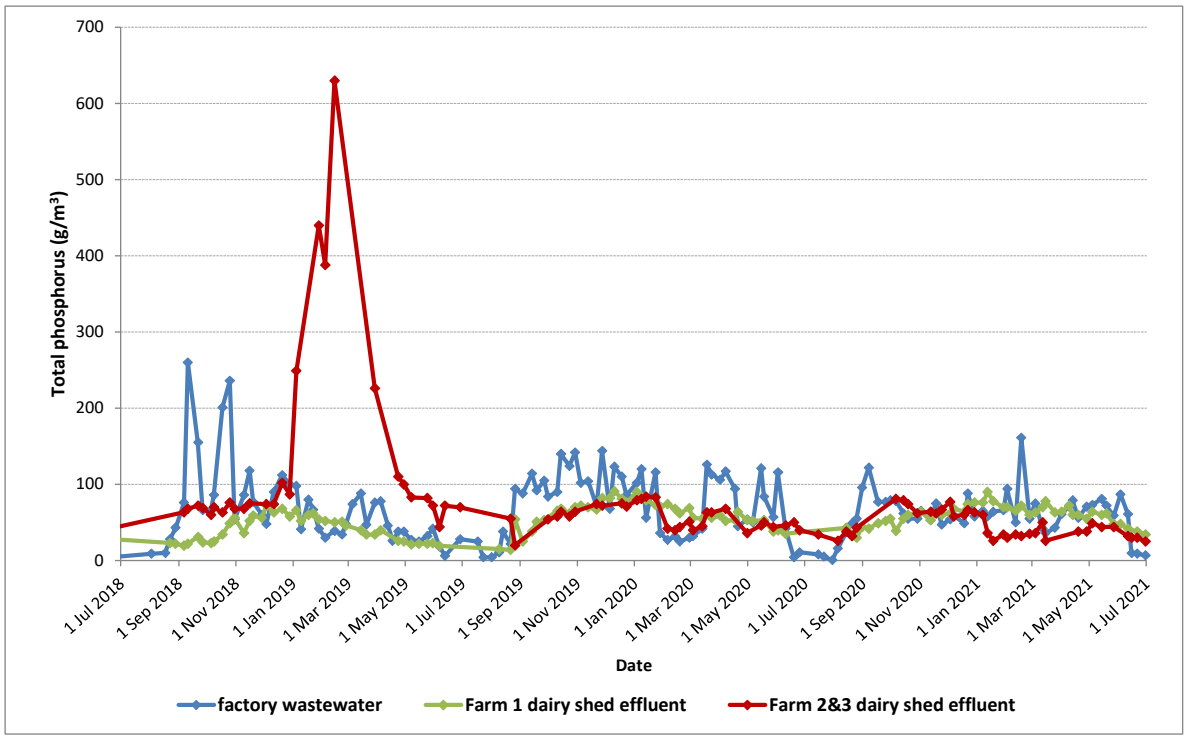

Figure 31 Phosphorus concentration of the factory wastewater and dairy shed effluents during the year under review, with previous two years for comparison

Total nitrogen and phosphorus application

The estimated monthly nitrogen and phosphorus loads irrigated onto the farms are shown in Figure 32 and Figure 34 respectively. These have been calculated based on the monthly irrigation volumes and the average monthly nitrogen and phosphorus concentrations for the three wastewater streams. A total of approximately 60,500 Kg of nitrogen and approximately 34,700 Kg of phosphorus were irrigated on to the farms in the 2020-2021 year. The maximum monthly mass of nitrogen irrigated onto the farms during the year under review was approximately 7,600 Kg in November 2020, with close to 7,500 Kg of nitrogen discharged in each of September, October and November. The maximum monthly mass of phosphorus irrigated during the year under review was approximately 4,500 Kg in September 2020. Figure 33 shows the total monthly rainfall totals and the mean daily soil moisture from the closest Council monitoring site, which is at the Glenn Road site. The Company operate a weather station located on Farm 3, and commenced providing the daily rainfall information to Council in November 2020. The monthly rainfall totals from this location are also shown in Figure 33. It is noted that the irrigation of the higher monthly masses of nitrogen and phosphorus are generally occurring at times of higher monthly rainfall and/or at times when the soil moisture is at or above the annual mean. Currently the Company's Whole Farm Management Plan states that the potential for the wastewater irrigation to discharge to the streams flowing through the farms during rainfall events is mitigated by avoiding irrigation on paddocks adjacent to water ways. The mitigation measures to counter the potential for adverse effects when soil moistures are high are to shorten the irrigation event or to take the paddock out of the irrigation rotation for a period of time. This may mean that the paddocks that have been affected in this way receive a higher irrigation volume during the dryer months of the year to balance this out. There are currently no formal methods used by the Company for measuring the soil moisture of the paddocks before or after irrigation events. This is assessed visually by the irrigation operators.

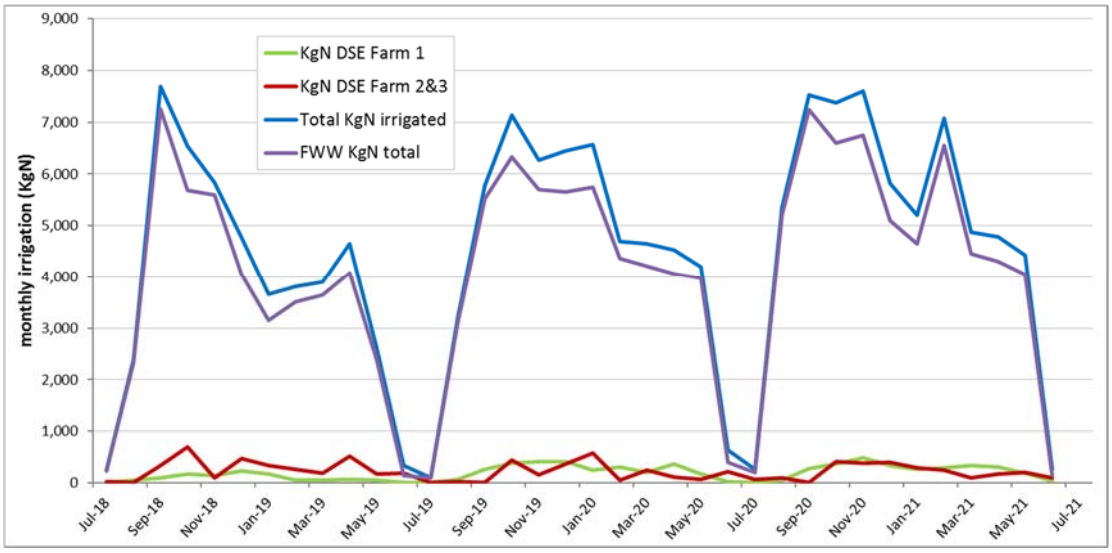

Figure 32 Estimated monthly mass of nitrogen irrigated

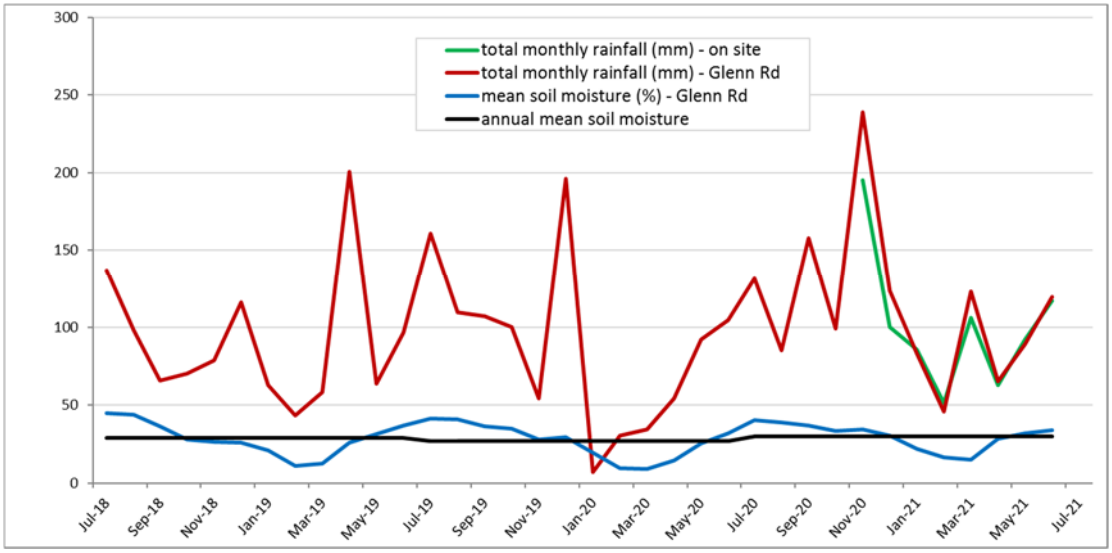

Figure 33 Monthly rainfall totals and median soil moistures

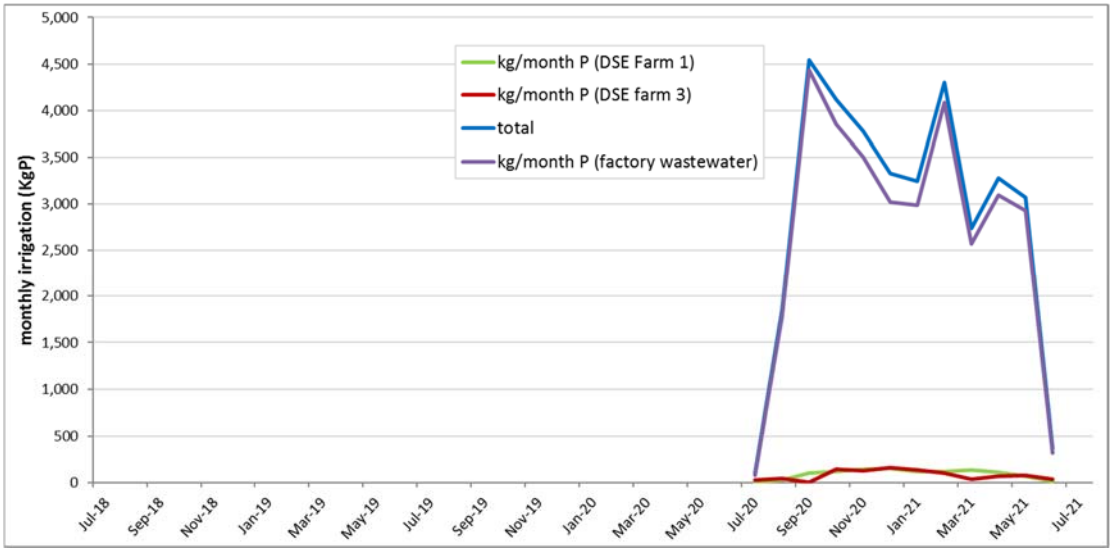

Figure 34 Estimated monthly mass of phosphorus irrigated

Interlaboratory comparison

Interlaboratory comparison exercises were carried out on 29 October 2020 and 16 February 2021. The samples collected were a split subsample of the weekly composite of the 24-hour composite samples taken of factory wastewater and farms DSE by the Company. The results are given in Table 12 and Table 13.

Table 12 Results of interlaboratory comparison on factory and dairy effluents, 29 October 2020

Parameter	Unit	Factory wastewater (IND005010)		Dairy shed effluent (Farm 1 – AG30890DP)		Dairy shed effluent (Farms 2 & 3 – AG04398DP)	
		Fonterra (ICS)	TRC	Fonterra (ICS)	TRC	Fonterra (ICS)	TRC
Sum of anions	meq/L	-	7.4	-	31	-	32
Sum of cations	meq/L	-	13.8	-	99	-	34
% Difference in Ion Balance	%	-	30	-	5.0	-	2.8
Alkalinity, total to pH 4.5	g/m³ $CaCO_3$	-	< 1.0	-	1,180	-	1,120
Biochemical oxygen demand (BOD)	g/m³	3,000	1,990	420	210	800	380
Calcium	g/m³	144	123	128	99	88	87
Chloride	g/m³	29	46	-	270	-	330
Chemical oxygen demand (COD)	g/m³	5,810	5,500	-	-	-	-
Conductivity, 25°C	mS/m	138	133.4	138	322	-	323
Potassium	g/m³	49	71	680	470	660	550
Potassium adsorption ratio	-	-	1	-	6	-	8
Magnesium	g/m³	<5	14	22	44	19	28
Sodium	g/m³	-	0.62	-	156	-	131
Ammoniacal nitrogen	g/m³N	97	106	68	66	87	87
Nitrate	g/m³N	70	80	0.1	< 0.10	3	< 0.10
Nitrite	g/m³N	0.7	0.17	0.2	< 0.10	0.3	< 0.10
Nitrate + nitrite	g/m³N	-	80	-	< 0.10	-	< 0.10
Oil and grease	g/m³	-	< 5	-	59	-	56
pH	pH	4.4	4.3	7.7	7.8	7.9	7.8
Sodium adsorption ratio		-	2.4	-	1.4	-	2.1
Suspended solids	g/m³	-	320	-	670	-	1,060
Total Kjeldahl Nitrogen (TKN)	g/m³N	26	37	206	210	202	185
Total Nitrogen	g/m³N	97	117	204	210	205	185
Total Phosphorus	g/m³P	55	55	62	62	62	61
Ash	g/m³	953	-	1,454	-	1,620	-
Copper	g/m³	0.47	-	-	-	-	-
Zinc	g/m³	0.42	-	-	-	-	-

Table 13 Results of interlaboratory comparison on factory and dairy effluents, 26 February 2021

Parameter	Unit	Factory wastewater		Dairy shed effluent (Farm 1)		Dairy shed effluent (Farms 2 & 3)	
		Fonterra (ICS)	TRC	Fonterra (ICS)	TRC	Fonterra (ICS)	TRC
Sum of anions	meq/L	-	6.1	-	32	-	15.4
Sum of cations	meq/L	-	14.5	-	34	-	17.8
% Difference in Ion Balance	%	-	40	-	2.4	-	7.2
Alkalinity, total to pH 4.5	g/m³ $CaCO_3$	-	< 1.0	-	1,110	-	550
Biochemical oxygen demand (BOD)	g/m³	3,200	3,000	320	80	240	35
Calcium	g/m³	161	152	94	78	75	50
Chloride	g/m³	70	62	-	320	-	147
Chemical oxygen demand (COD)	g/m³	6310	5600	-	-	-	-
Conductivity, 25°C	mS/m	136.7	135.3	-	344	-	170.6
Potassium	g/m³	37	71	650	570	170	260
Potassium adsorption ratio	-	-	0.9	-	8	-	5
Magnesium	g/m³	22	11.7	26	25	24	20
Sodium	g/m³	102	90	91	81	138	42
Ammoniacal nitrogen	g/m³N	-	2.5	-	134	-	73
Nitrate	g/m³N	36	56	2.5	< 0.10	2.7	< 0.10
Nitrite	g/m³N	3	1.49	0.1	< 0.10	<0.1	< 0.10
Nitrate + nitrite	g/m³N	-	57	-	< 0.10	-	< 0.10
Oil and grease	g/m³	-	8	-	26	-	21
pH	pH	4.6	4.4	7.9	7.9	8	8
Sodium adsorption ratio		-	1.9	-	2.1	-	1.3
Suspended solids	g/m³	-	380	-	400	-	3,800
Total Kjeldahl Nitrogen (TKN)	g/m³N	48	33	161	172	81	80
Total Nitrogen	g/m³N	87	90	164	172	84	80
Total Phosphorus	g/m³P	55	49	60	77	35	47
Ash	g/m³	871	-	1,651	-	803	-
Copper	g/m³	0.024	-	-	-	-	-
Zinc	g/m³	0.027	-	-	-	-	-

In the 2015-2016 year, agreement between laboratories was poor, apart from on pH, which led to a revision of the methods of sample compositing, splitting and identification. During the year under review, the only parameters that were found to have good agreement (within ± 5%) for all three effluent sources were pH in the October sampling and pH and total nitrogen in the February sampling. Getting good agreement for the

dairy shed effluents can be particularly problematic due to the nature of the waste. The first area of focus would be to ensure that the samples are split in an effective manner, which is difficult to achieve.

In terms of total nitrogen, there was underestimation of between 3 and 17%, in the total nitrogen results for the factory wastewater and Farm 1 dairy shed effluent, but a 5 to 10% overestimation of the total nitrogen results for the Farm 3 dairy shed effluent results reported by the Company.

The discrepancy between the sum of anions and sum of cations, and conductivity in the factory wastewater indicates the presence of other anions (potentially from organic acids) that have not been quantified in the parameters determined. It is recommended that the Company investigate the potential environmental significance of the presence of these unidentified anions in the irrigated wastewater. Council may request that the Company have the suspended solids concentration of their sample determined as an indicator of the effectiveness of the sample splitting.

2.1.1.8 Soil sampling

Soil sampling and analysis was commissioned by the Company in June 2021. The depth of soil sampled was 0-75 millimetres. The Farm 1 results are presented in Table 14, the Farm 2 results are presented in Table 15, and the Farm 3 results are presented in Table 16. A comparison of the total nitrogen content of the soils in the various paddocks sampled is shown in Figure 37 and a comparison of the Olsen phosphorus concentrations is shown in Figure 38. The paddock numbering for Farm 1 is shown in Figure 35 and Figure 36 shows the paddock numbering for Farms 2 and 3.

Table 14 Soil sampling results Farm 1, June 2021

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	CEC	Sodium	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	me/100g	%BS	mg/kg	%	%	
13	7.0	13	29	57	27	364	19	33	45	1.1	9	1.42	13.4	9.4
14	7.0	15	34	58	27	422	18	38	44	1.2	8	1.14	10.8	9.5
17	6.9	13	31	52	25	324	13	35	42	1.1	10	1.37	13.3	9.7
18	6.8	7	23	48	27	340	15	33	47	0.6	4	1.51	14.5	9.6
21	7.0	20	30	66	30	375	15	55	49	1.5	11	1.34	12.5	9.3
24	7.2	22	40	53	24	442	7	9.6	37	1.9	6	0.88	8.4	9.6
29 (control)	6.6	5	7	27	14	48	80	77	26	0.7	12	0.8	8.8	11.0
30	7.0	14	26	52	25	348	14	42	43	1.3	5	1.25	11.9	9.5

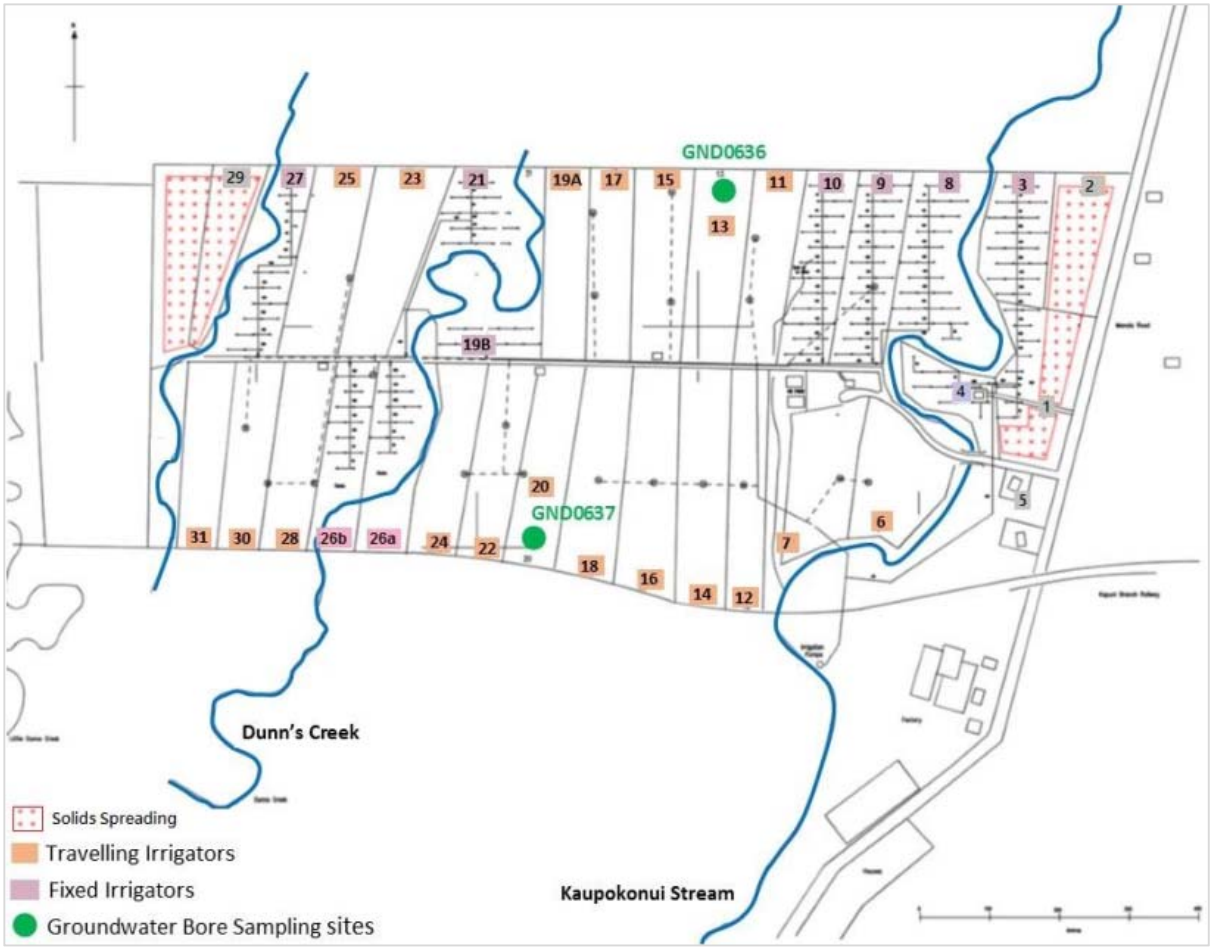

Figure 35 Paddock numbering, Farm 1

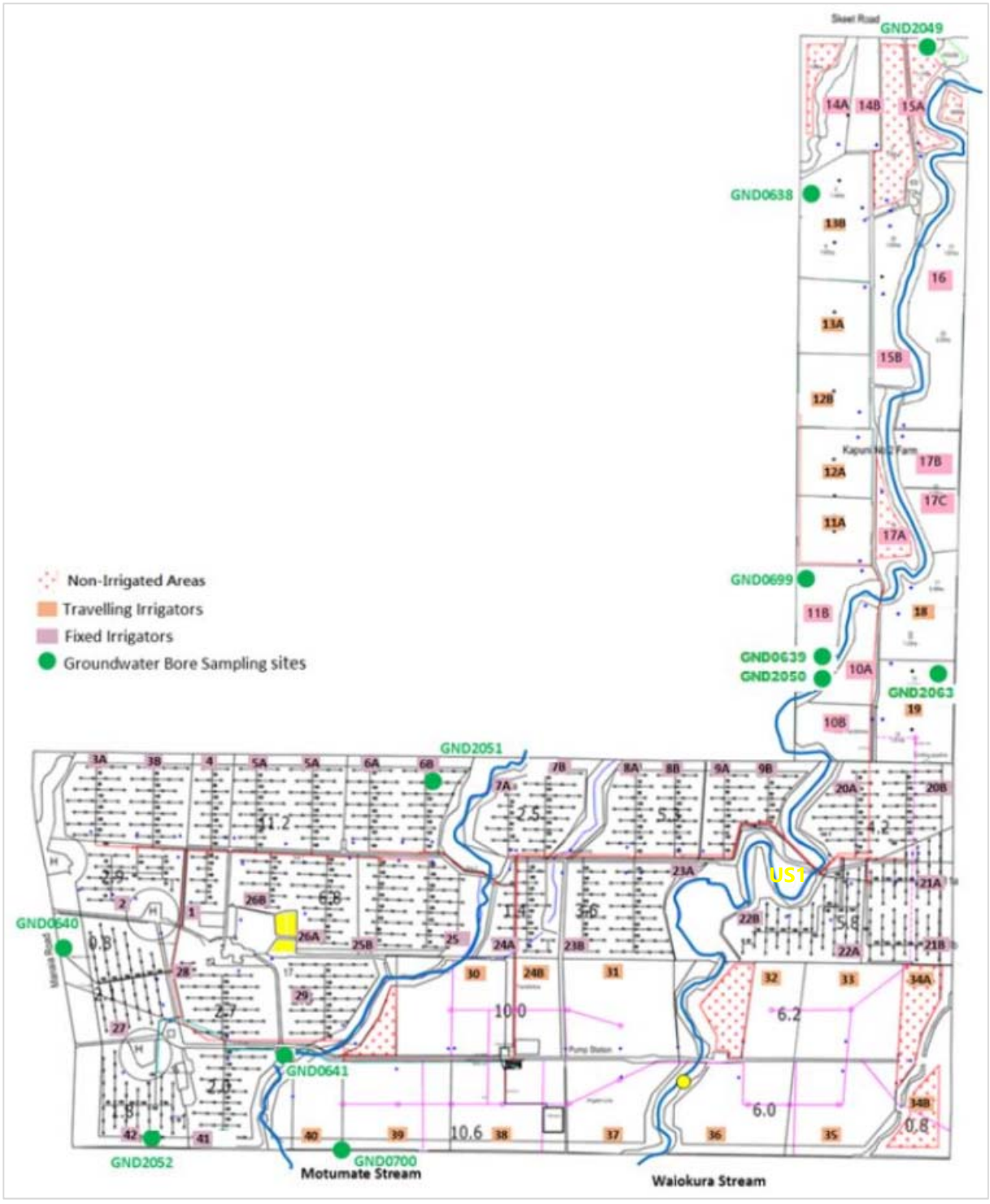

Figure 36 Paddock numbering, Farms 2 and 3

Table 15 Soil sampling results Farm 2, June 2021

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	CEC	Sodium	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	me/100g	%BS	mg/kg	%	%	
11A	7.1	27	38	48	28	387	5	37	45	0.98	11	1.39	13.6	9.7
12A	7.1	16	32	52	28	356	8	40	44	1.3	12	1.37	13.4	9.8
16A	7.1	27	38	57	30	426	9	33	47	0.95	10	1.48	13.8	9.3
17A (control)	6.3	9	18	52	14	135	12	73	30	1.0	10	0.99	9.7	9.8
17B	7.1	14	28	58	31	436	15	41	49	1.1	10	1.38	12.5	9.1
18	7.0	17	32	52	25	275	15	42	42	1.5	7	1.51	14.4	9.5

Table 16 Soil sampling results Farm 3, June 2021

Paddock Number	pH	Sodium	Potassium	Magnesium	Calcium	Olsen Phosphorus	Sulphate Sulphur	Anion Storage Capacity	CEC	Sodium	Extractable Organic Sulphur	Total Nitrogen	Total Carbon	C/N ratio
	pH	MAF	MAF	MAF	MAF	mg/L	mg/kg	%	me/100g	%BS	mg/kg	%	%	
4	7.1	16	31	59	24	315	8	65	37	1.4	13	1.08	10.6	9.1
21A	7.2	23	31	62	27	314	11	74	38	1.9	10	1.15	10.5	9.2
25A	7.2	23	30	63	27	334	10	66	39	1.9	9	1.17	10.3	9.0
31	7.0	15	28	58	28	340	13	52	44	1.2	11	1.17	11.9	8.8
US1 (control)	6.1	9	17	50	9	25	10	84	28	1.1	14	1.18	9.8	10.1
38	7.0	26	33	61	28	376	10	50	43	2	10	1.11	6.5	8.8
34B (control)	6.6	7	12	29	12	45	10	80	22	0.9	9	0.66	10.6	9.8

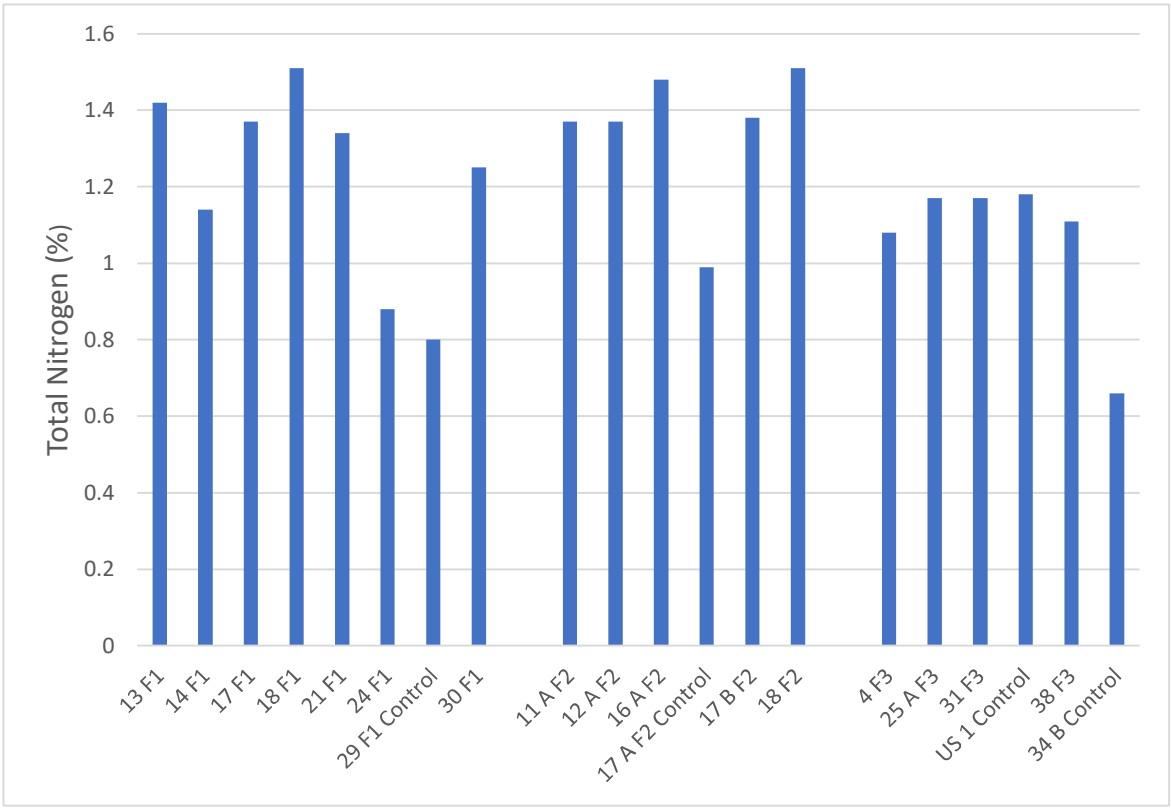

Figure 37 Total nitrogen concentration of soil samples taken from the Company's irrigation areas, June 2021

It can be seen that the nitrogen concentration of the soil is between 50 and 100% higher than the control paddocks. The Olsen phosphorus concentration is up to 15 times higher than the control.

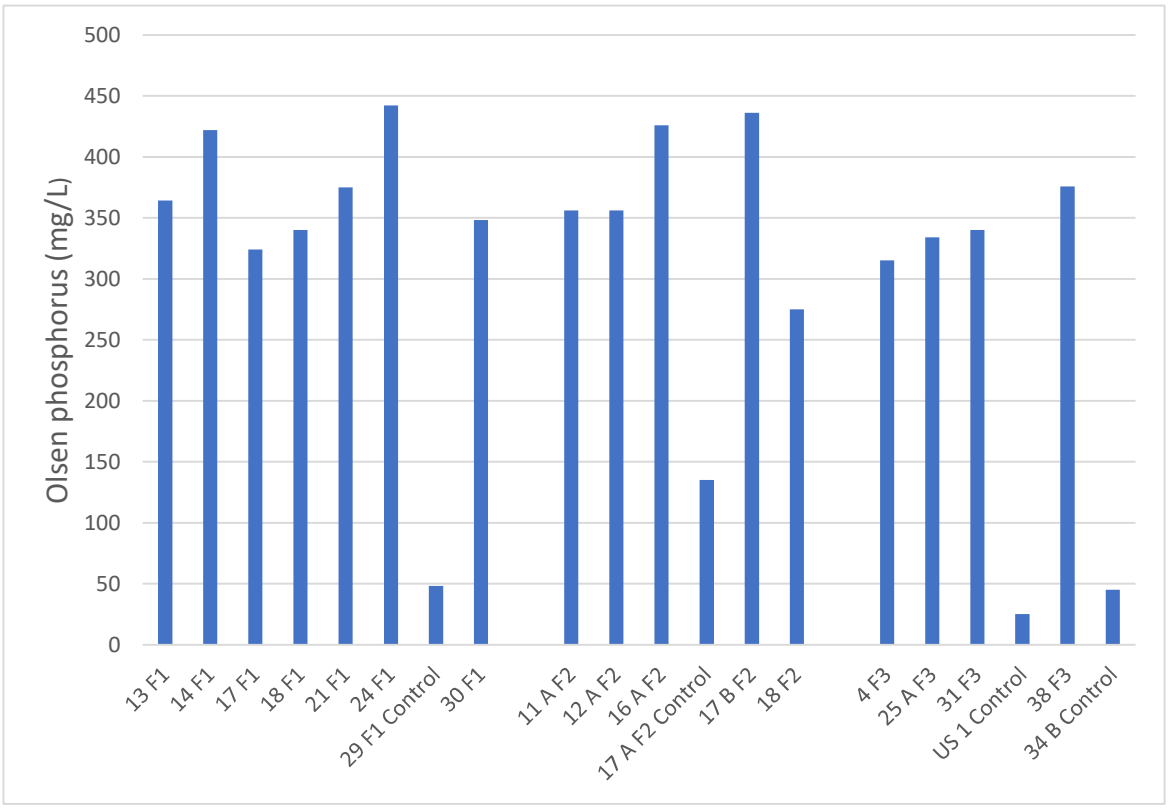

Figure 38 Olsen phosphorus of soil samples taken from the Company's irrigation areas, June 2021

2.1.2 Council monitoring

2.1.2.1 General inspections of factory premises

Twelve scheduled inspections of the premises, treatment system and Kaupokonui Stream were performed during the 2020-2021 period. A standard pattern was followed by the officer of the Council with all areas of discharges and potential spillage sites inspected. The inspections were made at approximately monthly intervals. Company staff met with the Council officer and provided an update on the Company's performance on each inspection occasion. The Company also communicates regularly with the Council regarding matters at the site that relate to their in-house monitoring, environmental performance and initiatives.

2.1.2.1.1 General site

The monthly inspections revealed no major problems with the general factory site. Generally the site was clean, tidy and orderly.

Improvements in the 2020-2021 year that were discussed at the site inspections or otherwise communicated to Council included:

- Continuation of the replacement of the wastewater PVC pipe crossings with stainless steel.
- Addition of a timer on the southern pond pump to wastewater (aids with management of irrigation volumes).
- Additional marking of stormwater drains.
- Improvements to the headworks of the groundwater monitoring bores.
- Improvements in the Company's tracking of the nitrogen loadings applied to the irrigation areas.

Projects planned for the 2021-2022 year included:

- Further investigation into water use on site, specifically the collection, treatment and re-use of suitable water discharges.
- Review of the riparian margins, and opportunities for further improvements.
- Continuation of the work programmes associated with the consent renewal applications.

A matter that arose during the 2020-2021 year were safety concerns with the line owned by Todd Energy that is used to return stream condensate to the Todd Energy site in August 2020. As a result the Company was informed that the line would need to be taken out of service and replaced.

The temporary solution put in place involved:

- Todd running a temporary 6" lay-flat hose made from reinforced rubber between the sites. This was well marked and considerable precautions have been taken to protect the line from damage
- Cooling the condensate sufficiently on site to allow for this to be used safely.
- Contingency to send condensate to the wastewater irrigation system to manage unplanned breakdowns with the chiller unit should they occur.

This system was utilised and monitored for the remainder of the year under review, with no issues found.

2.1.2.1.2 Intake from the Kaupokonui Stream

The monthly inspections showed that both the Company's weir and intake system worked well during the period under review. The intake screens were in place and cleaned regularly during the year under review. The water intake is also cleaned during the winter shut down each year and compliance with permitted activity Rule 53 of the Regional Freshwater Plan is checked. These cleaning activities were undertaken just before and again just after the year under review.

The fish pass installed by the Company under the guidance of the Council in March 2004, contained an adequate level of water and were unobstructed during all inspections. Trout were observed above the weir at the time of all but three of the inspections. An eel was also observed above the weir at the time of the May 2021 inspection. In December 2020, January 2021 and February 2021 a juvenile fish was sighted in the water intake. Although there are no intake fish protection requirements on the Company's current abstraction consent, the AEE supplied with the application for the replacement of the consent considered that the design of the fish intake was such that it was adequate to avoid effects. It is expected the standard conditions that ensure the intake is screened to avoid fish (in all stages of their life-cycle) entering the intake or being trapped against the screen will be included in the renewed consent.

2.1.2.1.3 Spray cooling water discharges to the Kaupokonui Stream

New cooling towers were constructed and commissioned in August and September 2015, designed to achieve an improved performance. Flow and temperature meters were installed on the inflow line to the towers, along with a temperature sensor on the outflow from the cooling tower that is used to provide the cooling water discharge temperature to Council. A flow meter had been placed on the line through which combined recovery condenser cooling water and stormwater was discharged directly to the stream under consent 0924-3. This was removed during the 2017-2018 year with the diversion of the cooling water to the cooling towers and stormwater to the northern stormwater pond. The installation of telemetry for the monitoring data from these meters had been delayed until December 2015, while landscaping around the towers was carried out. Accurate cooling water discharge flow monitoring commenced in September 2019.

Historically, there had been issues relating to missing data due to a third party server going off line temporarily, which then did not accept data until the link was reset. Alerts were put in place so that the link can be re-established by Fonterra staff in a more timely fashion. This has continued to work well during the year under review. The only remaining missing data tends to be when the probes have been removed during flood conditions, the null switch has been activated during calibrations, or rarely there are faults or electrical problems at the site. The missing data rate had been reduced to about 3% for the 2017-2019 years, and has been less than 1% for the 2019-2021 years.

Air actuated pressure regulating valves have been installed on the first nozzle of each discharge leg to ensure that all nozzles have a good spray discharge to maximise cooling. The Company is be able to open/close valves individually to ensure optimum spray discharge is achieved. The system was fully commissioned in December 2021.

During the year under review the cooling water discharge arms were in operation at all inspections between September 2020 and May 2021. It was found that the upstream versus downstream temperature difference was within the consented parameters. No issues were noted in relation to spray drift indicating that the well grown riparian vegetation continued to be effective at preventing spray drift of cooling water beyond the property boundary.

2.1.2.1.4 Other discharges to the Kaupokonui Stream

During October 2017 works to combine and relocate the IGL plant and factory extension stormwater pipes had occurred and for a period, the stormwater discharged via the new outfall without any treatment as the stormwater pond was yet to be completed, however a shut off valve had been installed and was functional during this period (Photo 1). All discharges from the norther area of the site occurred from this new combined outfall following this, with the first discharge from the northern pond logged by the Company as being 8 March 2018.

The Company actively manages discharges from the ponds and has the ability to divert the contents to the wastewater system, and/or to divert various parts of the stormwater catchment directly to the wastewater treatment system in the event that activities like site wash downs are occurring. Prior to discharge the quality of the water is assessed and checks are made to ensure that there are no visible effects occurring in

the stream during the discharge. The stormwater discharges, receiving water checks and quality assessment information is logged along with whether the pond has been discharged to the stream or to the effluent system for irrigation onto land at the farms. A copy of the log is provided to Council on a monthly basis and is available for checking at inspection

Photo 1 Northern stormwater pond, stop valves and outfall to the Kaupokonui Stream

In the 2018-2019 year it was noted that the groundwater discharge from the southern pond was to be addressed in near future by contractors following the finding that low flow rate discharges were occurring periodically from the southern pond outfall. It has subsequently been identified that there is some groundwater infiltration occurring into the discharge pipe. Discharges of this nature were noted to be occurring on occasion during the year under review. No adverse effects were found in the Kaupokonui Stream as a result of these discharges.

On a number of occasions it was found that the contents of the stormwater ponds were being used to cool the wastewater or were diverted due to quality issues identified during the assessment process, thereby reducing the number of discharges that occurred to the stream.

The Company began planning to plant low growing natives around both stormwater ponds to avoid the need to spray weeds, and also minimising the potential for overland flow of sediment and debris from the pine trees into the ponds during heavy rainfall events. Plans are still in place to plant shrubs around both stormwater ponds.

At each inspection it was noted that the stormwater catchments were clear of spills, the drains appeared clear of contaminants, and hazardous material storage was secure. It was also generally found that both of the stormwater ponds contained a small volumes of liquid which were free of visible hydrocarbons.

2.1.2.1.5 Water bore in the Kaupokonui Catchment

The Company ceased using its groundwater bore in mid-March 2013, when an upgrade of the York Chiller removed the need for additional cooling during periods of warmer temperatures in Kaupokonui Stream. Groundwater level in the bore was last measured on 25 September 2014, at 6.17 m below the top of the upstand. The Council was advised during the 2017-2018 year that the Company intended to decommission this bore and withdraw the application to renew this consent at some point. The withdrawal application was not received by Council during the year under review. However, it was noted at the inspection on 20 September 2019 that the bore had been closed in. No abstraction occurred during the year under review.

2.1.2.1.6 Discharges to the Motumate Stream

There is no longer any discharge of heat-elevated cooling water to the unnamed tributary of the Motumate Stream, previously used by the Kapuni School to heat its swimming pool. The school is now closed and no longer has a need for this service.

Bore water, when used, was also discharged back to the Motumate catchment via a tributary immediately opposite the factory across Manaia Road. The Council was advised by the Company that, as the groundwater cooling water system has not been utilised for a number of years, the Company also intend to withdraw the application to renew this consent at some point. No discharge occurred during the year under review.

2.1.2.1.7 Spray irrigation of wastewater

In general, the monthly inspections showed a good level of compliance in relation to the irrigation of wastewater.

Spray irrigation involves the use of both travelling irrigators and in-ground spray irrigators. Prior to mid-2007, approximately 95 ha was irrigated using travelling irrigators, while a further 25 ha was irrigated using in-ground irrigators. Works commenced in January 2007 on extension of the in-ground irrigation system, mainly on a parcel of land between Farm 2 and Farm 3 that had been purchased by the Company.

This extension increased the irrigated area during the 2007-2008 dairy season by 49 ha to 169 ha, of which 44 ha is reticulated with in-ground irrigators. During the year under review, the total area used for irrigation was 175 ha. The total area farmed is 244 ha.

No spray drift across streams was observed at the time of the monthly compliance monitoring inspections. Care is required while irrigating near watercourses particularly during wet and/or windy conditions. Spraying is not to occur within 20 m of the streambank of a watercourse (condition 6 of consent 0923). A weather station with telemetry to the pump station on Farms 2 and 3 was installed in August 2015, allowing faster response to changes in wind direction.

In previous monitoring periods some browning of grass, overland flow and minor ponding has been noted. Fonterra Research Centre was engaged to investigate the ponding/run-off issues. Subsequently, annual aeration was conducted for several years from the 2002-2003 monitoring period over a significant area of the Company's farms, which improved the capacity of these areas to receive and assimilate the irrigated wastewater. Testing undertaken in May 2010 indicated that aeration is no longer required, unless there are visible signs of ponding or damage to the pasture from pugging by stock. Some additional aeration was undertaken in February 2016, with aeration also undertaken in the 2018–2021 years.

On the whole, the general wastewater irrigation was found to be well managed. The pasture receiving irrigation appeared to be healthy, with no ponding, grass burn, or run-off observed during most of the inspections. Buffer distances were being adhered to at the time of all but one monthly inspection.

At the inspection on 19 November 2020 it was found that a travelling irrigator was located in paddock 39 (Farm 3) that was discharging wastewater as a test run and for tuning following previous maintenance work. The technician was pointing the spray arm in the direction of the adjacent farm race which caused a stream of wastewater to run down the race in the direction of the Motumate Stream and spray drift was occurring within 20 metres of the stream. The irrigation line was shut down as soon as the technician became aware of the runoff. The runoff was diverted into a paddock with a shovel and did not enter the stream. The irrigator was discharging for approximately 10 minutes. Condition 11(a) of consent 0923-3.3 was not being complied with at the time of inspection. As this was resolved immediately and a direct discharge to the stream was avoided, no further enforcement action was undertaken.

At the time of the groundwater sampling survey carried out on 7 April 2021 it was found that the some of the bores at the site were sitting in depressions, with dead grass in the lower ground around the bores. Photos were taken at GND0638. The Environmental Manager subsequently confirmed that the areas around the bores are sprayed, rather than it being as a result of ponding. Following the inspection the Company was advised that, although the most bores are located within a buffer zone, if ponding were to occur around the affected bores, there was the potential of a preferential flow path to groundwater along the soil/PVC

pipe interface. On the approach to site GND2063, which is located in paddock 19, it was found that there was an irrigator present in Paddock 18. No irrigation was occurring in this paddock at the time of inspection. There was evidence that run-off may have occurred from the paddock, but only for a short distance down the race. There was no evidence that the runoff extended to the stream. It was found that the irrigator was leaking and that there was a small amount of ponding underneath the irrigator and around a trough approximately 15 m away from the irrigator. The operator was contacted and he undertook to investigate. Prior to leaving site the Council officers were informed that the irrigation had ceased in that paddock at midnight, but that there was always residual pressure in the lines, and that a low flow rate discharge continued to occur until the pressure in the line had dropped. The operator advised that repairs had been undertaken to reduce the flow from the irrigator. The Environmental Manager subsequently advised that approval had been given to progressively replace all travelling irrigators with fixed in-ground sprinklers once the replacement consent(s) had been granted. In the meantime the Company was planning to have a pressure relief valve manufactured for installation at the hydrants, which would prevent the low flow rate discharges that occur from the travelling irrigators as the pressure in the line reduces following irrigation events. This has been found to work well, and there will be an on-going staged installation of these valve where required. The area around the trough would also be infilled to prevent potential ponding in this area during future irrigation events. On Farm 1 it appeared that the outer edge of the spray zone from one of the in ground irrigation spray nozzles may have been within 20 m of the bank of the Kaupokonui Stream. The Environmental Manager subsequently advised that this particular irrigator had been checked and confirmed as 39 m away from the stream bank, and as such was not likely to result in the edge of the spray zone being within 20 m of the bank. He also advised that all the other sprayers on both farms would be checked to confirm compliance with requirements.

During the year under review, work began on replacing PVC pipe crossings carrying the wastewater across the Kaupokonui, Waiokura and Motumate Streams following a risk assessment undertaken by the Company. The risk assessment of all stream crossings was prompted by the minor leakage that was discovered at the Farm 1 Kaupokonui Stream pipe crossing in the 2018-2019 year. At the end of the year under review, there was only one pipe left to replace. This was scheduled to be replaced during the winter shutdown pending an engineer confirming that the current bridge structure would support a stainless steel pipe. This was done.

2.1.2.1.8 Riparian planting

The riparian planting on the left bank of the Kaupokonui Stream adjacent to and downstream of the cooling sprays continues to provide secondary filtering of windblown spray cooling water drift as well as aesthetically benefiting the site. New planting was undertaken on the riverbank upstream of the factory in the 2001-2002 monitoring period. The gully areas in the vicinity of the Farm 1 cowshed to the downstream farm boundary, which were planted during the 1997 and 1998 winter periods, continued to be maintained during the 2019-2020 monitoring period. During the year, some small areas of the riparian planting were removed to allow access for the replacement of the PVC wastewater pipes over the stream during their replacement with lower risk stainless steel pipes. The extent of this was still to be assessed, but it would be minimised and replanted.

The Company has continued to invest in planting and fencing of waterways around the factory and Company farms. This also includes an annual (index linked) donation of $3,000 to the Taranaki Tree Trust in accordance with condition 10 (b) of consent 0919. The Taranaki Tree Trust was dissolved in 2016 after which time the donations were paid directly to the Council. To date, a total of approximately $79,240 had been donated under the requirements of consent 0919, with $4,721.58 (+GST) paid to the Council in the 2020-2021 year.

At the end of the 2020-2021 year, the Council had prepared 164 Riparian Management Plans (RMP's) fully or partially located in the Kaupokonui Stream catchment (an increase of four plans). Of these, 20 plans cover the 31 km of streambank that was originally identified as requiring improvement and met the criteria for

funding given in condition 10 of consent 0919-3 (that is, are located in the Kaupokonui Stream catchment above the Company's cooling water discharge). Both the plan numbers and streambank measurements are subject to change due to events such as a farms being split, improvements in mapping, reclassification of drains to streams, changes in riparian standards over time and the like.

Taking into account the riparian planting that was already existing at the time the plans were developed and changes such as those given above, the progress towards full implementation of the additional planting required is shown in Table 17 and is illustrated in Figure 39.

Subject to confirmation by audit, the riparian plantings recommended in the plans that had received funding to the end of June 2021 (nine plans) covered a total stream bank distance of 42 km, of which eight (89%) were 100% completed.

This compares to 29 plans covering a total of 33.3 km, of which five (17%) were 100% completed in the Kaupokonui Stream catchment downstream of the plant, and 164 plans covering a total of 777 km, of which 30 (18%) were 100% completed in the wider Kaupokonui parent catchment. The riparian planting progress for the Kaupokonui catchment as a whole is illustrated in Figure 40.

During the 2020-2021 year no farms received rebates under this scheme.

Table 17 Comparison of riparian plan progress in the Kaupokonui Stream catchment and Kaupokonui catchment (subject to confirmation by audit)

	Kaupokonui Stream				Kaupokonui Catchment total
	Upstream Fonterra	Plans that have received funding	Upstream of Fonterra no funding	Downstream Fonterra	
Total length of streambank, km	94.7	42	52.7	30.3	777
Additional recommended planting, km	33.6	15.2	18.4	16.8	358
Planting implemented, km	20.0	14.7	5.3	12.7	226
Planting percentage implemented,%	69.5	96.7	28.8	75.6	63.1
Fencing implemented, km	86.3	39.1	47.2	-	-
Percentage of steam bank fenced, %	91.1	93.0	89.5	-	-

It can be seen that the current data indicates that whilst there is still a moderate implementation rate of 63.1% in the catchment as a whole (up from 60.3% at June 2020), there has been a significant increase in the implementation rate upstream of the plant to 69.5% (up from 46% at June 2020). As would be expected, there is a higher implementation rate on those farms that have received funding, which have reached an implementation rate of 96.7% (up from 86.6% at June 2020), when compared to those that have not. The implementation rate for these plan holders was at 28.8% at June 2021 compared to 20% at June 2020.

It is important to note that, due to the fact that the Kaupokonui Stream catchment upstream of the plant has an extensive network of tributaries, there is a longer distance of stream bank above the plant than there is below it. There was also only half the amount of new planting originally recommended below the plant. This means any increases in the number of kilometres planted will have a much larger effect on the percentage completion downstream of the plant than it will upstream of the plant. Despite this, there were greater gains in the percentage implementation of the recommended planting upstream of the site during the year under review, up by 23.5%, than there were in the catchment downstream of the plant, up by 8.6%.

The data shows that progress also continues to be made with the riparian planting in the wider Kaupokonui catchment, although at a slower rate. This was up by 2.7%.

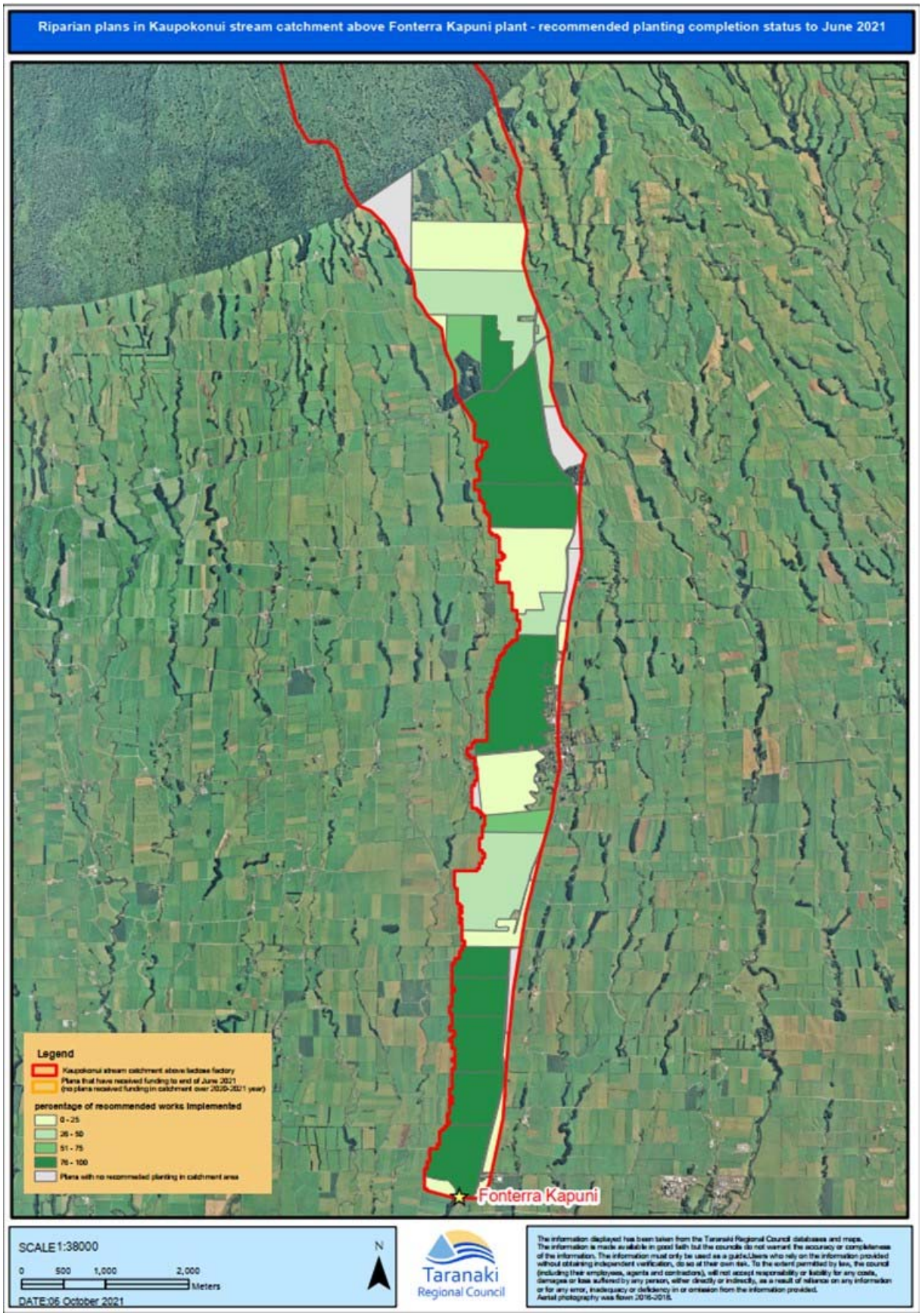

Figure 39 Riparian planting progress in the Kaupokonui Stream catchment above the lactose plant

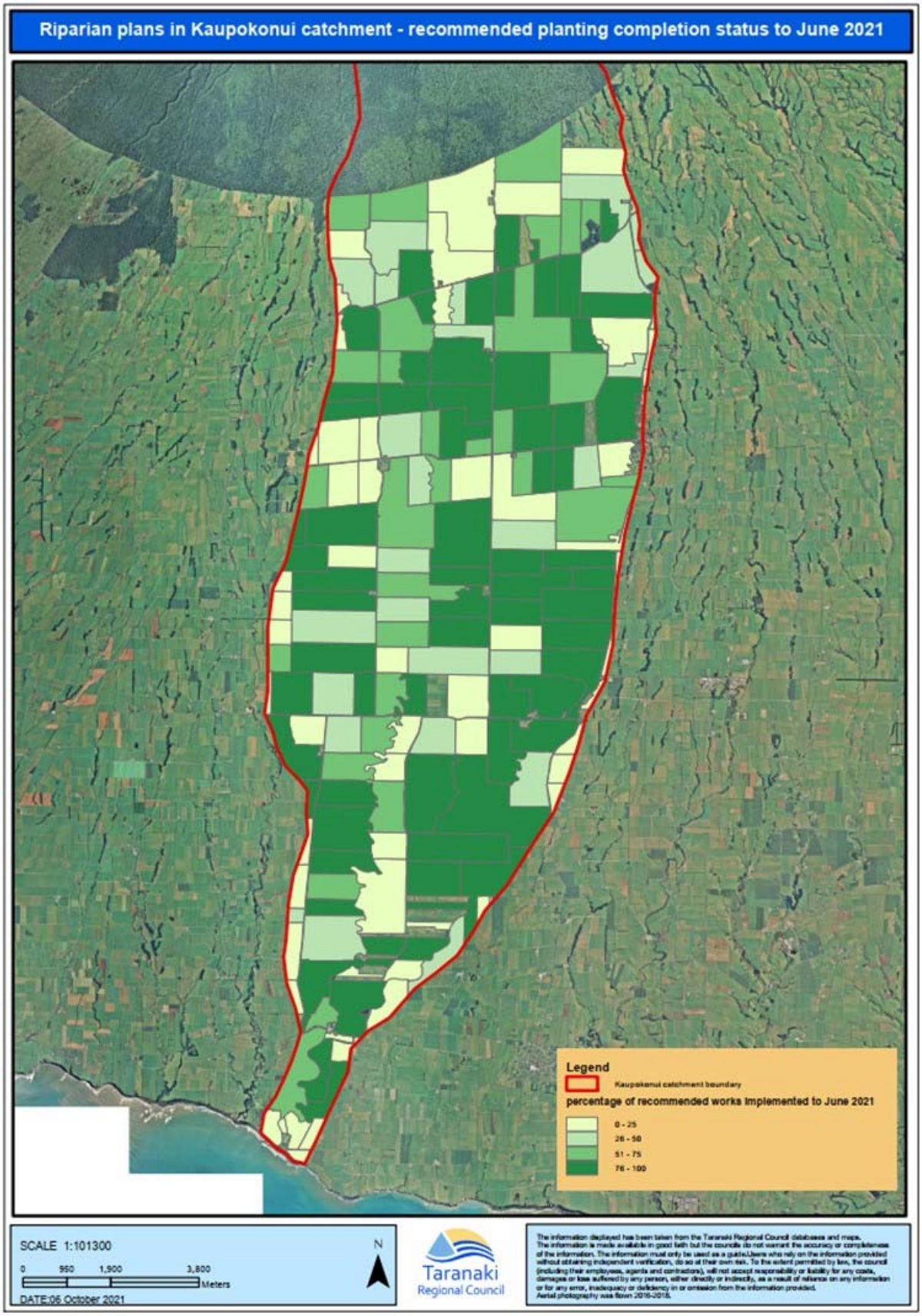

Figure 40 Riparian planting progress in the Kaupokonui Stream catchment

An example of riparian planting is given in Photo 2, taken along the Waiokura Stream on Farm 2, and about 1.1 km south of Skeet Road (Riparian Management Plan RMP1425). Groundwater monitoring bore GND2050 is situated down gradient of the fixed-in-place irrigators and up-gradient of the riparian plantings.

In a separate project initiated by the Company in September 2009, the Manaia Road boundaries of Farm 1 and Farm 3 were planted with native species for screening of the adjacent irrigation areas. A total of 2,142 plants were planted, over a total distance of 1,071 m, at a cost of $6,224. The roadside plantings provide visual screening and amenity value, protection of neighbours and road users from spray drift, and shelter for livestock and pasture. In addition, the Manaia Road boundary adjacent to the storm pond on the lactose plant site was planted in winter 2010. In November 2011, approximately 1,600 more plants were planted on the Manaia Road boundary of the Farm 1 run-off. Replanting was undertaken where a new crossing was installed over Waiokura Stream between Farm 2 and Farm 3 in June 2013. In June 2017, the Company purchased 4,000 native plants at a cost of $14,387. The Company supplied these to 11 upstream properties, all but one of which has a Riparian Management Plan. The Company also liaised with farmers regarding the planting. Additional fencing and planting was undertaken by the Company on Farm 3 during the 2018-2019 year, retiring some marginal farmland to a wetland.

All Fonterra plantings were maintained in the 2020-2021 year. Although some small sections needed to be removed to allow the replacement of the wastewater pipe crossings, the plantings were replaced as soon as possible following completion of the work.

Photo 2 Riparian plantings along Waiokura Stream, Farms 2 with fixed irrigators in operation

During the year under review the Council was informed that the Company was intending to remove some of the large pine trees on the stream bank next to the northern pond to prevent the possibility of them falling into the stream or onto the wastewater pipe crossing the stream. The trees would then be replaced

promptly with native trees. This was not progressed during the 2020-2021 year and was now expected to occur in 2021-2022.

2.1.2.1.9 Disposal of factory solid wastes

Solid wastes from annual cleaning of the waste effluent tank and lime silo had been disposed of by burial on Farms 2 and 3 during the winter maintenance shut-down for a number of years, ending in 2018. This activity was permitted under Rule 29 of the Regional Freshwater Plan, which covers the discharge of contaminants from industrial and trade wastes premises onto and into land subject to certain conditions, including minimum distance from water courses and water supply bores. A record was kept of the volumes discharged and of the burial site locations. The disposal sites are monitored during the routine monthly inspection of the farms by Council. Compliance with the conditions of the Rule has been found on each monitoring occasion.

During the 2016-2017 year a Trommel (solids separator) was installed on site to separate the solids (diatomaceous earth and activated carbon) out of the waste stream from the filtration of the whey permeate. Following this, the solids were separated in a contained skip bin containing a mesh screen, with the liquid portion being pumped out into the factory wastewater sump. Prior to the separation techniques, the solids were either accumulated in the wastewater tank or were irrigated onto land within the wastewater. In October of the 2016-2017 year the Company advised that the current carbon burial pit was to be filled in due to operational and health and safety constraints surrounding the regular on going presence and use of open pits on the farm. For a period from January 2018 the filtered material had been removed from the site by a composting/fertiliser company for use in their products. From August 2021, the solids were disposed of at an off-site location that holds a consent to accept this material for land stabilisation purposes.

Carbon from the wastewater tank continued to be buried on farm during the cleaning operations that occur during the shutdown period up to and including the winter 2018 shutdown. During the 2018-2019 year, the Company approached the Council for confirmation that shallow (between 25 and 50 mm) direct drilling of the waste into the pasture would still comply with Rule 29. Approval was given, and during the 2019 winter shutdown the waste was direct drilled into the paddock to the south of the southern stormwater pond on the corner of Manaia and Skeet Roads. This method and location of disposal was applied in the 2019-2021 years.

2.1.2.1.10 Bridges and culverts

At the time of the routine compliance monitoring inspections it was found that the bridges, culverts and pipelines across all stream were in good repair at the time of each inspection. The replacement of the PVC wastewater pipelines with lower risk stainless steel pipelines continued during the year under review.

2.1.3 Results of discharge monitoring

2.1.3.1 Physicochemical

2.1.3.1.1 Cooling water quality

Monthly sampling of the spray cooling water discharge (authorised by discharge permit 0919-3) involved the collection by the Company of one representative 24-hour composite sample of each waste, to be analysed by the Council. The results of these analyses for year under review are presented in Table 18 (STW002017). Conditions of this consent do not place limits on individual component concentrations in the discharge, but focus on the avoidance of effects in the receiving waters.

The cooling water previously discharge via the combined stormwater/cooling water pipe discharge (STW02018, permit 0924-3) was diverted to the cooling tower and the pipework was removed in February

2018. Prior to this, a composite sample was collected from the discharge from this system by the Company, which was analysed by the Council.

A summary of the historical results for both the cooling water discharge and combined stormwater/cooling water discharge are given in Table 19 for comparative purposes.

All ten samples collected during the year under review were composite samples, however there was one occasion on which there was no discharge and one occasion when a composite sample was not available at the time of inspection.

Table 18 Results of the analysis of spray cooling water discharge during the year under review (STW002017)

Date	BOD_5		Conductivity @ 25˚C	pH	Turbidity
	Total	Filtered			
	g/m^3	g/m^3	mS/m	pH	FNU
16 July 2020[a]	-	-	-	-	-
20 Aug 2020	0.7	<0.4	8.6	7.5	3.4
17 Sep 2020	0.6	0.5	11.3	7.5	0.68
15 Oct 2020	0.5	<0.4	9.0	7.5	0.42
19 Nov 2020	0.6	<0.4	10.3	7.4	0.44
22 Dec 2020	<0.4	<0.4	12.1	7.5	0.39
19 Jan 2021	<0.4	0.4	11.8	7.7	0.45
26 Feb 2021	0.8	<0.4	11.0	7.5	0.51
18 Mar 2021	<0.4	0.4	11.3	7.6	0.77
14 Apr 2021	<0.4	<0.4	8.8	7.5	0.44
20 May 2021	<0.4	<0.4	8.0	7.3	1.31
24 Jun 2021[b]	-	-	-	-	-
Range	<0.4 – 0.8	<0.4 – 0.5	8.0 – 12.1	7.3 – 7.6	0.39 – 3.4
Median	0.4	<0.4	10.7	7.5	0.48

a. Blockage in sample line due to cooling tower being switched off

b. Factory shut down - no discharge

Table 19 Summary of cooling water discharge quality from the Council surveys during the period March 1992 to June 2020

Waste	Spray cooling water (STW002017)				'Stormwater/cooling' water (STW002018 – to 15 Feb 2018)		
Parameter	Unit	No. of samples	Range	Median	No. of samples	Range	Median
BOD_5 (filtered)	g/m^3	261	<0.4 - 91	1.1	216	<0.5 - 1,100	1.4
BOD_5	g/m^3	206	<0.4 - 460	1.9	233	<0.5 - 1,100	2.5
Conductivity at 25˚C	mS/m	217	3.4 - 51.7	10.8	240	5.4 - 132	10.8

Waste	Spray cooling water (STW002017)				'Stormwater/cooling' water (STW002018 – to 15 Feb 2018)		
Parameter	Unit	No. of samples	Range	Median	No. of samples	Range	Median
Oil and grease	g/m	2	<0.5	<0.5	99	<0.5 - 4.3	<0.5
pH	pH	126	5.8 - 8.2	7.5	144	4.6 - 10.6	7.2
Turbidity	FNU[a]	11	0.28 - 2.9	0.48	-	- - -	-
Turbidity	NTU[b]	227	0.35 - 450	1.7	125	0.26 - 110	4.2

a. From July 2019

b. To June 2019

For the spray cooling water, there were no notable seasonal variations in the parameters monitored. The median total BOD has remained low (less than 1 g/m^3) for four successive years following the three consecutive years (2013-2014 to 2016-2017) over which it decreased significantly.

2.1.3.1.2 Stormwater quality

Discharges from stormwater pipe outlets to the stream were previously been sampled at four locations: from the northern (STW001062) and southern (STW002018) areas of the lactose plant, the IGL plant (STW001109), and the southern stormwater pond (STW002078), as shown in Figure 41.

The discharge from the previously combined stormwater/cooling water discharges have been addressed in section 2.1.3.1.1 above.

During 2017-2018, stormwater from the IGL plant, factory extension (STW001109), and the southern area outside the lactose plant itself (stormwater component of STW002018) was combined with the northern discharge (STW001062) for treatment in the northern stormwater pond. The discharge location for the northern stormwater pond outfall is STW002099.

Stormwater discharges from the containment ponds were found to be occurring very rarely at the time of inspection during the year under review.

2.1.3.1.2.1 Northern stormwater pond outfall

A sample was collected of the discharge from the northern stormwater pond outfall (site STW002099, Table 20) on two occasions during the period under review.

The limits prescribed by consent conditions for hydrocarbons, pH and suspended solids were complied with at the time of the sampling. The BOD was below both the guideline value given in the Regional Freshwater Plan (5.0 g/m^3) and the median of historical results.

Table 20 Results of the analysis of a grab sample of the northern stormwater pond during year under review (STW002099)

Date	BOD_5	Conductivity @ 25˚C	Oil and grease	pH	Suspended solids	Turbidity
	g/m^3	mS/m	g/m^3		g/m^3	FNU
4 Dec 2020	2.4	19.2	<4	6.5	<3	1.9
22 Apr 2020	2.1	3.4	<4	6.9	3	2.7
Consent limit	**-**	**-**	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	
2017-2020						
No of samples	8	8	8	8	8	8
Minimum	1.3	1.7	<0.5	6.0	2	0.91
Maximum	290	55.9	5	8.2	40	30
Median	5.1	8.1	4	6.8	12	5.3

2.1.3.1.2.2 Southern stormwater pond outfall

A sample was collected from the outlet of the stormwater pond (Site STW002078, Table 21 and Photo 3) on only one occasion during the year under review. This was sampled at a separate site visit as the pond was found to be at a low level and not discharging at the time of the monthly inspections. Sampling showed that the BOD continues to be slightly elevated in the stormwater from this area of the site and that the suspended solids concentration exceeded the limit on the consent.

Conductivity values at this site have been found to vary widely in the past, tending to be higher in winter when groundwater infiltration occurs. Two sources of groundwater infiltration to the stormwater lines were found by video camera and the lines were re-grouted in July 2009, but some infiltration continued. The sample collected during the year under review returned a low conductivity result.

Table 21 Results of the analysis of grab samples of the southern stormwater pond discharge during the year under review

Date	BOD_5	Conductivity @ 25˚C	Oil and grease	pH	Suspended solids	Turbidity
	g/m^3	mS/m	g/m^3		g/m^3	FNU
22 April 2021	25	5.1	8	6.7	**220**	86
Consent limit (0924-3)	**-**	**-**	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	
2008-2020^						
No of samples	34	43	38	42	39	3
Minimum	<0.5	3.0	<0.5	4.6	<2	7.5
Maximum	920	54.5	6	7.9	150	13.1
Median	1.5	40.6	<0.5	7.4	3	1.4

Although no upstream or downstream samples were taken at the time the high suspended solids discharge was occurring, it was noted that no deleterious effects from the discharge were visible in the receiving water

at the time the samples were obtained. There was also no evidence of sewage fungus at or below the discharge point.

Discharges to the stream from the lower outfall of the southern pond were stopped whilst further investigation was undertaken by the Company into the quality of the water entering the southern pond and other possible factors that may have contributed to the high suspended solids concentration. As part of this investigation, inspection of the southern pond bed by the Company when it was empty found there was a lot of sediment / silt in the base, likely due to the pond holding water for long periods of time. Inquiries were made in to mechanically cleaning the base of the pond. However, it was noted that the pond would need to be empty and dry for this to happen. It was also found that water quality entering the pond was a contributing factor. The Council was informed that the silt traps throughout the stormwater system are cleaned out annually. It was considered that these may have become overloaded and were potentially a cause of the lower quality water entering the pond. These were scheduled to be cleaned on 14 June but the Company requested to bring this forward if possible. Should an improvement result from these being cleaned, this would indicate that the annual cleaning frequency should be increased. It was also identified that the diversion system that was in place for use during roof washing had not been used.

Interim controls put in place were:

- The lower pond discharge to the river was removed from service, with only the upper discharge to be used, if at all.
- Until the silt traps had been cleaned all stormwater from the southern catchment was to be pumped to wastewater.

At the inspection undertaken on 25 June 2021 it was confirmed that the southern pond was only discharging from the upper discharge and the lower discharge had been removed from service whilst ongoing investigation continued into the quality of the stormwater in the pond.

Due to the short duration of the event, absence of environmental effects, the preventative actions taken and the thoroughness of the Company's investigation and follow-up plan, no enforcement action was considered necessary.

Photo 3 Outfall from the southern stormwater pond to Kaupokonui Stream (STW002078)

2.1.4 Receiving water (Kaupokonui Stream) quality

Sampling of the Kaupokonui Stream adjacent to the Company's factory and Farm 1's wastes irrigation area was performed by the Council on the monthly inspection visits. Three sites are located in the Kaupokonui Stream (Figure 41).

Table 22 Location of water quality sampling sites

Site code	Site	Location	Map reference, NZTM	
			Easting	Northing
KPK000655	Kaupokonui Stream	1 km upstream of rail bridge	1697963	5630770
KPK000660	Kaupokonui Stream	At water intake	1697644	5629758
KPK000679	Kaupokonui Stream	150 m downstream of spray cool discharge zone	1697607	5629399

Sampling was performed under varying flow conditions ranging from 0.81 m^3/s to approximately 3.47 m^3/s, as measured at Upper Glenn Road hydrometric station, 9.8 km downstream, where the median flow is 2.0 m^3/s, and mean annual low flow (MALF) is 0.73 m^3/s. The lowest flow conditions under which one of these stream surveys has been carried out is 0.52 m^3/s on 17 March 2020.

A record of flows (hydrograph) over the reporting period is presented in Figure 74. Samples were generally taken in the mornings. The results of this monitoring are summarised in Table 23 and a copy of the full results are available on request. Past Council sampling results from these sites are presented in summary form in for comparative purposes Table 24. It is noted that the Council moved to using a contract laboratory for analytical work in April 2018.

Table 23 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the year under review (N=12 samples)

Parameter	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Ammoniacal-N	g/m^3 N	<0.010 - 0.028	0.013	<0.01- 0.022	0.010	<0.01- 0.019	<0.01
Dissolved BOD_5	g/m^3	<0.4 - 0.5	<0.4	<0.4- 0.4	<0.4	<0.4- 0.4	<0.4
Total BOD_5	g/m^3	<0.4 - 1.1	<0.4	<0.4- 1.0	<0.4	<0.4- 0.9	<0.4
Conductivity@25°C	mS/m	6.9 - 11.2	9.6	7.1- 12.0	9.9	8.0- 12.2	11.6
Dissolved Reactive Phosphorus	g/m^3 P	<0.004 - 0.016	0.011	<0.004- 0.019	0.008	0.006- 0.015	0.009
Nitrate+Nitrite-N	g/m^3 N	0.25 - 0.77	0.45	0.29- 0.91	0.53	0.27- 0.90	0.54
pH	pH	7.1 - 7.8	7.5	6.8- 7.9	7.6	6.9- 8.0	7.6
Temperature	˚C	7.3 - 16.7	11.4	7.4- 16.5	11.3	7.6- 17.8	12.0
Total Kjeldahl Nitrogen	g/m^3	<0.10 - 0.16	0.11	<0.10- 0.19	<0.10	<0.10- 0.16	0.11
Total nitrogen	g/m^3	0.30 - 0.89	0.55	0.37- 0.98	0.63	0.45- 0.99	0.62
Turbidity	FNU	0.57 - 3.0	0.83	0.51- 3.6	0.75	0.45- 3.8	0.79
Free Ammonia	g/m^3	<0.01 - <0.01	<0.01	<0.01- <0.01	<0.01	<0.01- <0.01	<0.01

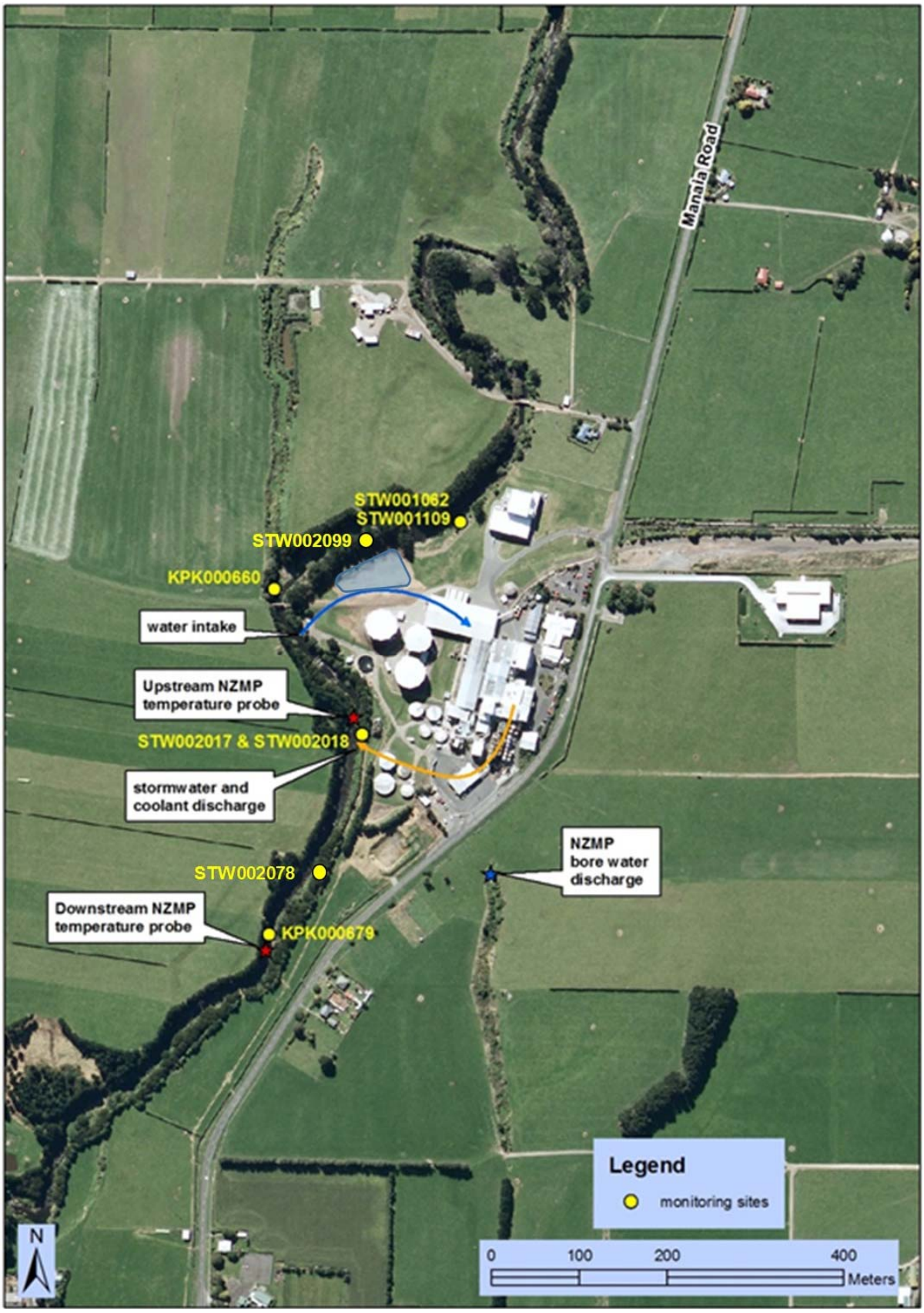

Figure 41 Section of Kaupokonui Stream for physicochemical monitoring in relation to Fonterra Ltd's waste discharges to water

Table 24 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2020

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Ammoniacal-N	g/m^3 N	248	<0.003 -0.869	0.022	260	0.003 - 0.147	0.017	248	<0.003 - 0.248	0.018
Dissolved BOD_5	g/m^3	258	<0.4 -2.0	0.5	242	<0.4 - 2.4	<0.5	260	<0.4 - 8.0	<0.5
Total BOD_5	g/m^3	258	<0.4 -8.3	0.6	261	<0.2 - 7.5	0.6	261	<0.4 - 8	0.7
Conductivity@25°C	mS/m	261	3.65 -12.3	10.0	269	3.65 - 13.0	10.6	263	3.54 - 14.6	10.8
Dissolved Reactive Phosphorus	g/m^3 P	72	0.003 -0.097	0.014	72	0.003 - 0.101	0.015	60	<0.003 - 0.103	0.017
Nitrate+Nitrite-N	g/m^3 N	129	0.06 -1.26	0.43	129	0.07 - 1.36	0.52	117	0.06 - 1.4	0.52
pH	pH	258	6.8 -8.5	7.7	267	6.6 - 9.0	7.7	247	6.9 - 8.6	7.7
Temperature	˚C	258	4.9 -19.1	12.0	276	5.1 - 19.5	12.3	250	5.2 - 21.7	13.5
Total Kjeldahl Nitrogen	g/m^3	22	<0.10 -0.46	0.12	22	<0.1 - 0.51	0.10	10	<0.1 - 0.52	0.17
Total nitrogen	g/m^3	22	0.35 -1.02	0.63	22	0.38 - 1.16	0.73	10	0.46 - 1.16	0.78
Turbidity	FNU	12	0.31 -55	0.72	12	0.33 - 60	0.74	12	0.28 - 50	0.90
Turbidity	NTU	248	0.39 -120	1.00	248	0.39 - 120	1.00	250	0.42 - 160	0.93
Free Ammonia	g/m^3	21	<0.01 -0.010	<0.01	33	<0.01 - 0.013	<0.01	21	<0.01 - 0.01	<0.01

The receiving water quality results indicated that there were minimal, if any, impacts measured in the Kaupokonui Stream at time of sampling as a result of the stormwater and cooling water discharges. There was also no sewage fungus noted over the monitoring period.

The biggest pH changes were on 20 May 2021. On this occasion the pH changed from 7.2 at site KPK000655 to 7.7 at KPK000660, and then back down to 7.1 at site KPK000679. There were no discharges from the stormwater ponds on this day and the cooling water composite sample had an acceptable pH of 7.3. After taking the reported analytical uncertainty of measurement into account for these samples, the pH change cannot be proven to be more than the ± 0.5 pH units that is considered to present a barrier to the passage of fish. There were also no significant adverse effects noted at the time of inspection. A pH change of this nature is unusual for the site. It is noted that possible sources of contaminants between site KPK000655 and KPK000660 include agricultural farmland, including Farm 1 on which wastewater irrigation occurs, and the tributary from Farm 1 that has a confluence with the Kaupokonui Stream just above KPK000660. Council will continue to monitor activities at the site and on the farms in question. It is noted that there was also a pH change of 0.5 pH units between sites KPK000660 and KPK000679 on 20 August 2020. There were no stormwater pond discharges occurring at the time of this survey and the cooling water composite sample was found to have an acceptable pH of 7.5 that would not have resulted in this pH decrease observed between these two monitoring sites.

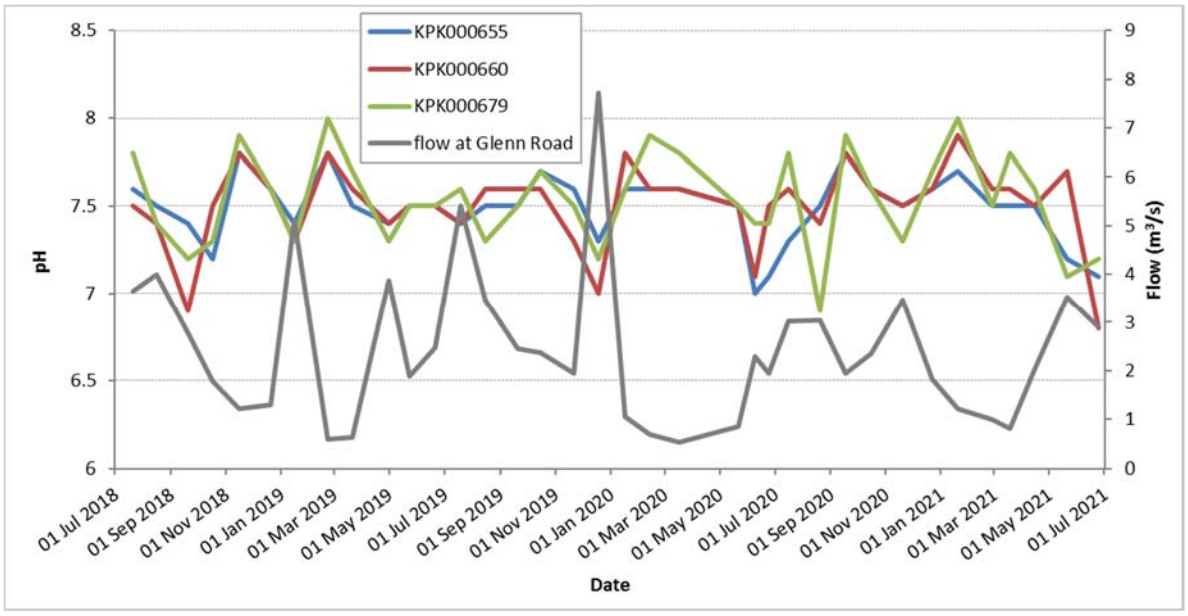

Figure 42 Downstream pH changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

The consent limit for the maximum concentration of filtered BOD in the river at the mixing zone periphery of 2 g/m^3 was complied with on all monitoring occasions.

The median of the ammoniacal nitrogen concentrations across the year under review was lower than the typical annual median. When detected, there was a decrease in the concentration of this parameter in a downstream direction, as one would expect where there are no additional ammoniacal nitrogen inputs.

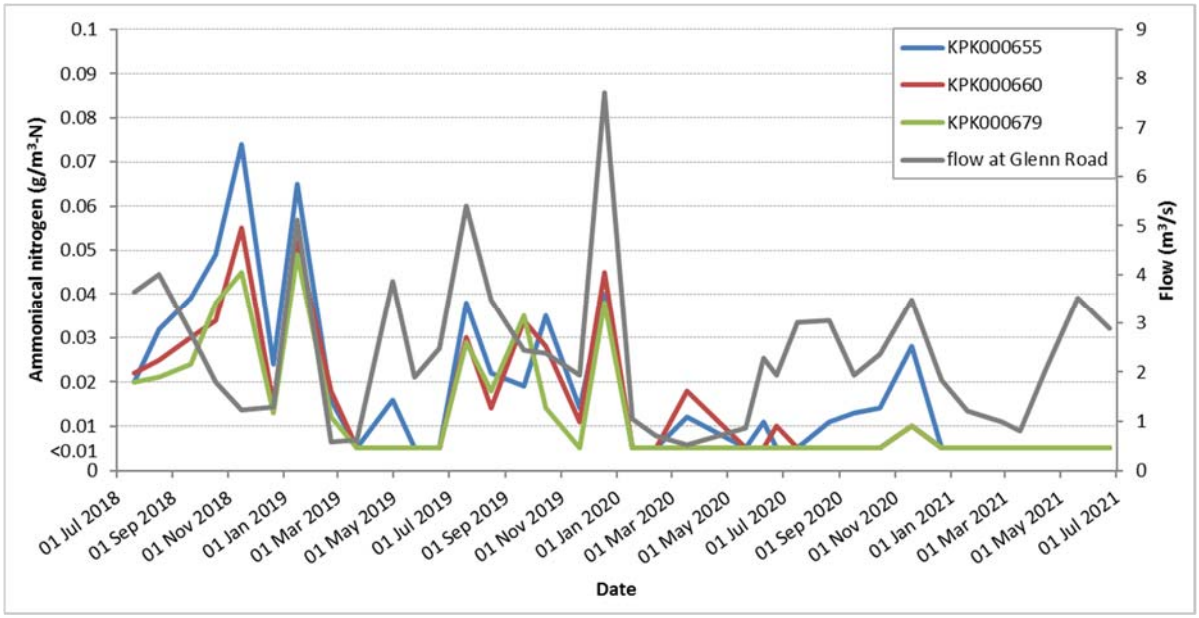

Figure 43 Downstream ammoniacal nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

Conductivity increased slightly in a downstream direction, with increases of up to 0.8 mS/cm observed between December 2020 and March 2021. This degree of change in the receiving water is not of environmental significance.

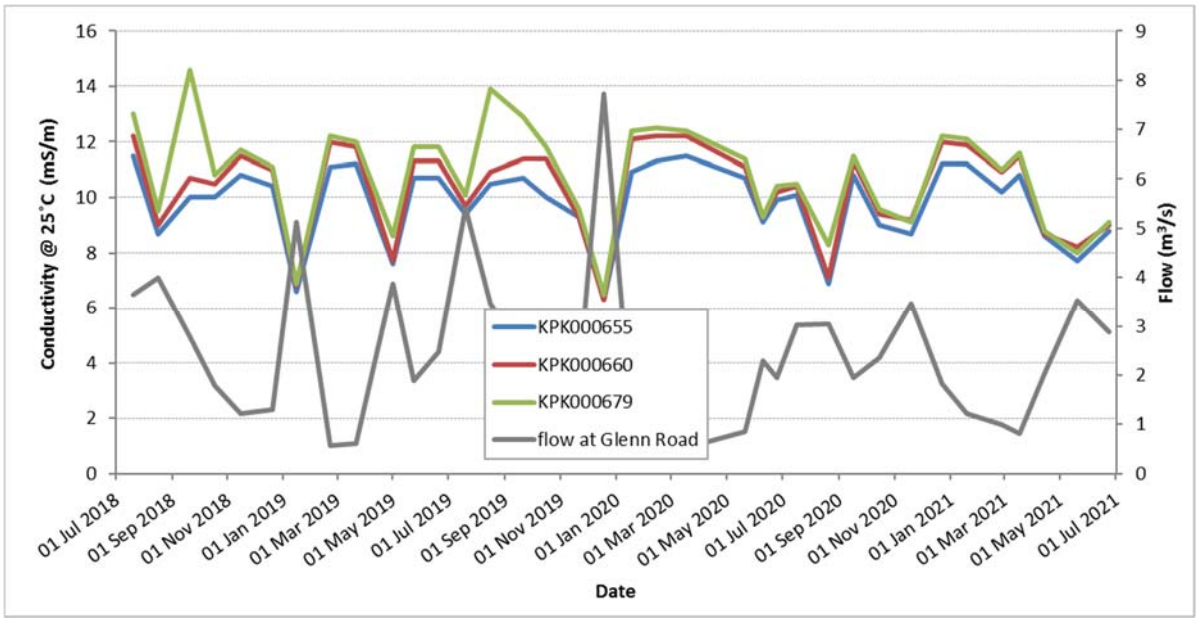

Figure 44 Downstream conductivity changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

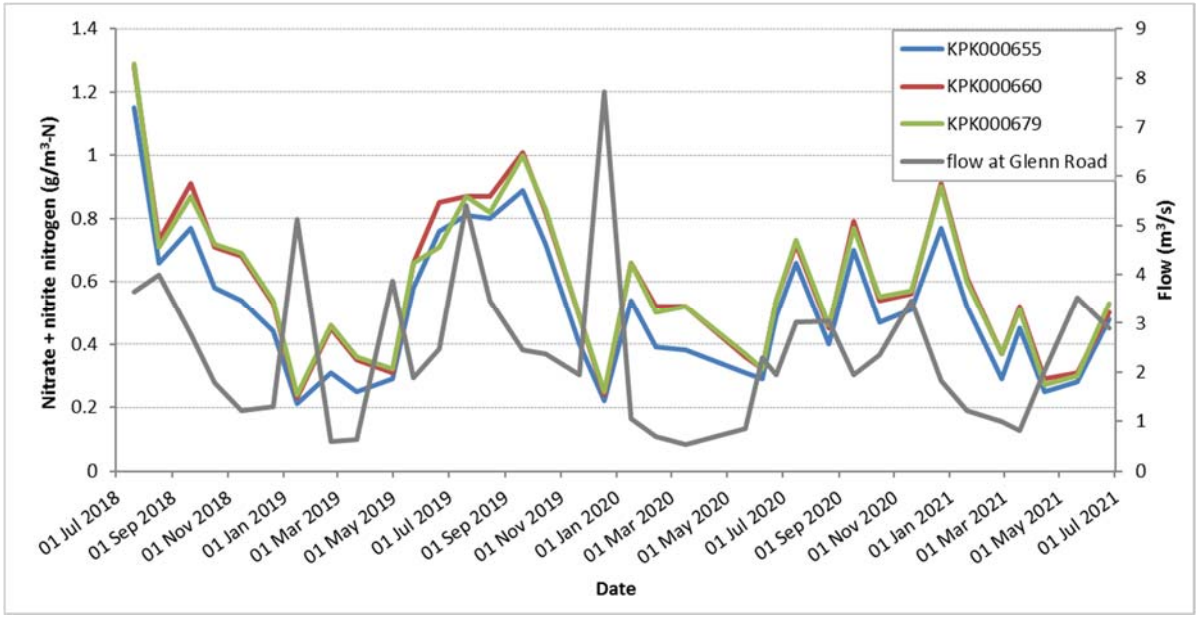

Figure 45 Downstream nitrate-nitrite nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

Nitrate-nitrite nitrogen increases slightly between the top site (KPK000655) and the site downstream of Farm 1 and the northern pond (KPK000660), whilst ammoniacal nitrogen is relatively low and generally decreases. The nitrate-nitrite nitrogen concentrations are well below the drinking water standards (11.3 g/m^3), and the National Policy Statement for Freshwater Management, Guide to Attributes (draft for comment)[3] (NPS) bottom line values of 9.8 g/m^3 (annual 95th percentile) and 6.9 g/m^3 (annual median).

[3] Ministry for the Environment. 2018*: A Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended 2017)*. Wellington: Ministry for the Environment.

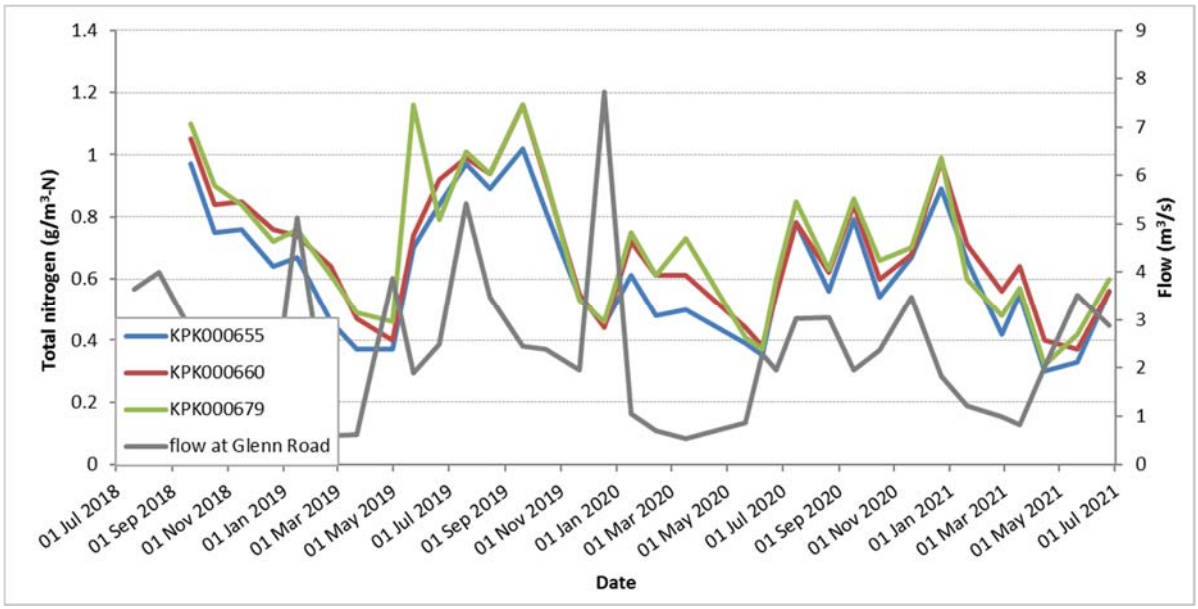

Figure 46 Downstream total nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

Total nitrogen was added to the analysis suite in September 2018 to help quantify relative influences of the instream oxidation of the reduced ammoniacal form of nitrogen and/or organic nitrogen inputs, compared to increased nitrates due to additional inorganic nitrogen inputs.

Total nitrogen generally follows similar trends to the nitrate-nitrite concentrations, which it did for the most part during the year under review. On 17 March 2020 it was found that there was an increase in total nitrogen between sites KPK000660 and KPK000679 that was not accounted for by an associated increase in nitrate-nitrite concentration. On this occasion the ammoniacal nitrogen also remained low, but there was an increase in the total Kjeldahl nitrogen (TKN). This would indicate the presence of organic nitrogen species during this dry and low flow condition survey. The results show that there was no similar findings during the surveys undertaken during the year under review.

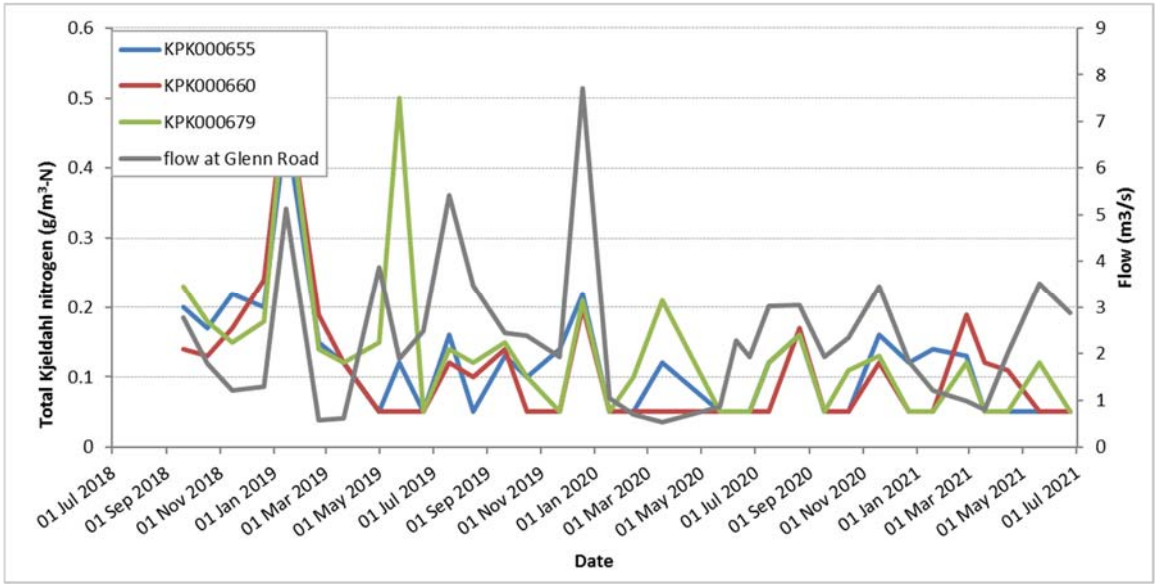

Figure 47 Downstream total Kjeldahl nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

All water temperature increases at the periphery of the mixing zone (150 m downstream of the spray system) were within the 3˚C rise permitted by consent conditions at the time of monitoring (Figure 48).

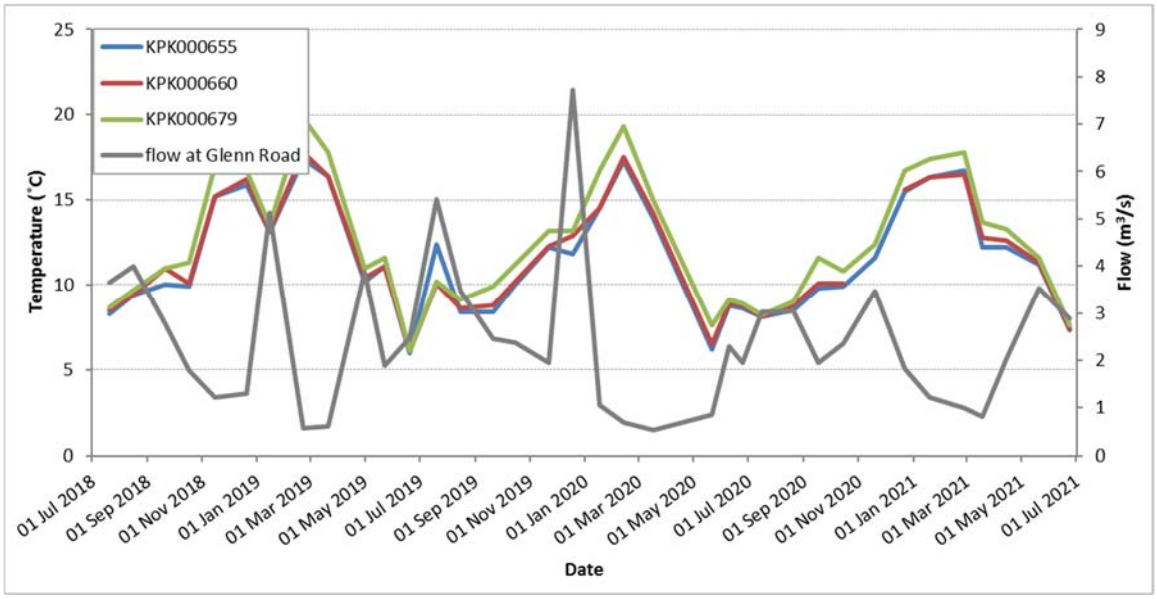

Figure 48 Downstream temperature changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

It is noted that, as expected, the larger temperature increases are observed at lower stream flows, particularly during the summer months, when there are also warmer air temperatures and higher humidities.

There were no significant changes in clarity, as indicated by turbidity measurements and field comments. Natural variation in clarity was observed, in relation to stream flow and rainfall.

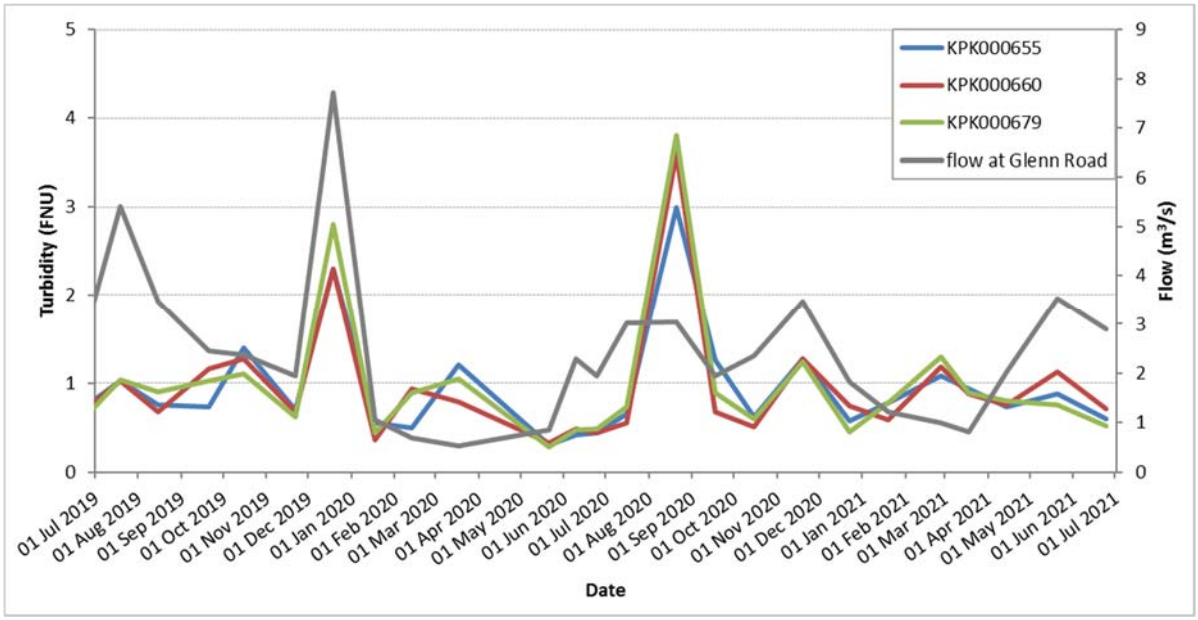

Figure 49 Downstream turbidity changes in the Kaupokonui Stream from the monthly stream surveys, with previous years for comparison

The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 25 year period prior to the 2020-2021 year (Table 24) and during this monitoring period (Table 23), shows that generally, apart from a single lapse in May 2007, there has been good water quality for the parameters measured under normal flow conditions.

2.1.5 Groundwater quality

Sampling of shallow groundwater bores was undertaken approximately every two months through the monitoring period by the Council. The monitoring frequency had been increased from bi-annual to monthly in 2006-2007 for a period of three years to gain a better understanding of the seasonal variation in groundwater quality, and was reduced to approximately every second month in 2009-2010. During the year under review up to 12 bores were sampled on the three wastewater spray irrigation farm properties, as described in Table 25 and depicted in Figure 50. One bore ('control') on each property is sited upslope of the irrigation area and at least another one or two bores ('impact') within or down-slope of each irrigation area.

Table 25 Description of the groundwater monitoring sites

Property	Bore	Designation	Site code	Depth m	Map reference, NZTM	
					Easting	Northing
Farm 1	North	Control	GND0636	6.5	1697543	5630420
	South	Impact	GND0637	6.5	1697238	5629857
Farm 2	North	Control (new)	GND2049	5.6	1698575	5628905
	West	Impact	GND0638	5.9	1698332	5628562
	South-west	Impact	GND0639	4.3	1698408	5627793
	South-west	Impact (new)	GND2050	7.0	1698397	5627747
	South-east	Impact	GND2063	7.0	1698397	5627747
Farm 3	North	Control (new)	GND2051	6.5	1697634	5627538
	West	Impact	GND0640	4.5	1696911	5627162
	Central	Impact	GND0641	3.4	1697367	5626969
	South-west	Impact (new)	GND2052	7.0	1697216	5626790
	South-east	Impact	GND0700	4.5	1697445	5626790

Relocation and replacement of the original 'impact' bores on Farm 2 and Farm 3 was performed in April 1998 (see TRC 98-73, Southern and No. 3 farms respectively), in consultation with the consent holder and following investigations into groundwater contours and flow directions at each of these farms' monitoring sites. During the year under review, the head works on all the bores were upgraded and the bores were redeveloped by air lifting. Bore GND0640 had been damaged by farming activities in 2007. During the bore maintenance works, this bore was located and returned to a serviceable condition, with monitoring recommencing in January 2021.

It is noted that originally, bore GND0640 was a control bore for Farm 3. However, following the expansion of this farm and the incorporation of the "No. 3 extension" (Figure 1) in 2008, this became an impact bore.

A summary of selected groundwater quality data previously collected by the Council from the farm bores is presented in Table 26 for comparison with data collected during the monitoring period under review. The bores shaded in Table 26 are those no longer monitored.

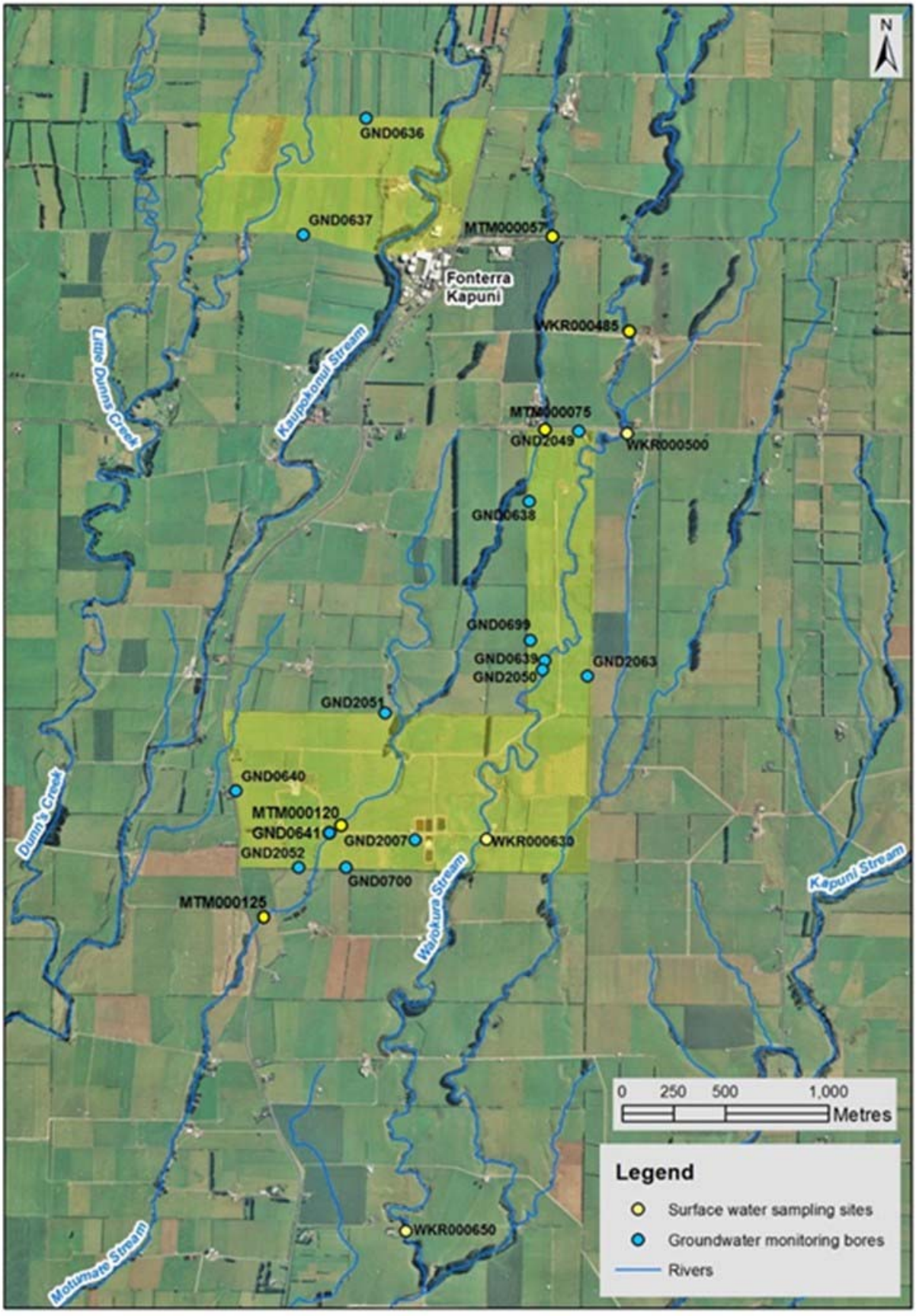

Figure 50 Groundwater monitoring bores, Motumate and Waiokura Stream sampling site locations on the three Company farms

Table 26 Summary of selected parameters from previous Council groundwater quality sampling performed during the period October 1991 to June 2020

Parameter		Level		pH		Conductivity @ 25˚C		Sodium		Nitrate/nitrite-N		COD*	
Unit		m		pH		mS/m		g/m³		g/m³N		g/m³	
Farm site	Bore	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)	N	Range (median)
Farm 1	Control GND0636	107	1.55-4.83 (2.90)	144	6.2-7.1 (6.5)	147	29.2 -63.8 (32.9)	97	12.0-56 (24.6)	147	3.7-24 (8.2)	86	<5-27 (6)
	Impact GND0637	106	2.77-6.15 (4.29)	143	6.1-7.8 (6.5)	139	37.6-91.1 (62.8)	94	40-179 (72.6)	143	1.5-33 (12.1)	82	<5-50 (6)
Farm 2	Control ('new') GND2049	78	1.73-3.80 (2.46)	79	6.2-7.2 (6.4)	79	21.4-51.8 (41.9)	37	26-38 (31)	79	1.6-27 (15.4)	43	<5-7 (<5)
	Impact ('central') GND0638	104	1.08-3.68 (2.51)	139	4.7-6.9 (6.5)	138	60.1-165 (81.5)	90	67-136 (87)	149	<0.01-49 (8.7)	84	<5-1600 (5)
	Impact ('original') GND0639	73	1.90-4.22 (2.86)	91	6.5-7.5 (6.9)	91	48.3-91.3 (71.1)	62	73-157 (117)	91	3.8-29 (10.7)	57	<5-57 (6)
	Impact ('new') GND2050	79	1.60-3.20 (2.58)	79	6.5-7.0 (6.8)	79	15.1-80.0 (62.5)	43	49-102 (64)	91	<0.01-13.3 (1.1)	43	<5-21 (6)
	Impact GND2063	76	1.55-5.22 (3.42)	76	6.3-6.9 (6.5)	76	27.9-54.3 (34.2)	42	35-59 (41)	76	0.4-18.6 (4.2)	39	<5-24 (5)
Farm 3	Control ('original') GND0640[a]	18	0.85-3.24 (1.99)	51	6.4-7.0 (6.8)	51	23.2-46.2 (28.6)	45	28-49 (29)	51	<0.01-3.4 (0.13)	42	4-30 (6)
	Control ('new") GND2051	79	1.86-4.46 (3.13)	79	6.3-7.2 (6.5)	79	28.1-67.5 (36.6)	43	214-37 (29)	79	0.03-30 (7.0)	43	<5-31 (5)
	Impact GND0640[b]	-	-	-	-	-	-	-	-	-	-	-	-
	Impact GND0641[c]	46	1.01–2.96 (1.73)	64	6.3-7.1 (6.5)	65	27.9-70.3 (61.5)	47	30-57 (47)	49	0.87-15.6 (9.3)	44	<5-54 (7)
	Impact ('original') GND0700	103	0.40-4.60 (2.17)	115	5.6-7.2 (6.7)	115	33.5-170 (66.8)	70	39-188 (81)	116	0.02-47 (7.0)	70	<5-33 (6)
	Impact ('new') GND2052	79	1.30-4.38 (2.47)	79	6.4-7.3 (6.6)	79	20.9-49.7 (37.5)	43	35-60 (44)	79	<0.01-12.9 (2.0)	43	<5-29 (<5)
	Impact ('deep') GND2007	0	-	48	6.7-8.0 (7.7)	48	35.8-39.0 (36.9)	26	35-39 (37)	48	<0.01-0.10 (<0.01)	23	<5-44 (10)

* COD filtered prior to 2006

a GND0640 monitoring from April 1992 to April 2007 (control prior to Farm 3 extension)

b GND0640 monitoring re-commenced January 2021 (impact post Farm 3 extension

c GND0641 not monitored between June 2013 and May 2018 due to a blockage that has now been cleared

The groundwater quality monitored at each farm is discussed below. Wastewater irrigation occurred on each farm throughout the monitoring period (see Section 2.1.1.5).

2.1.5.1 Farm 1 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 27. The full set of results is available upon request.

Table 27 Results of groundwater quality sampling on Farm 1

Waste		Control (GND0636)			Impact (GND0637)		
Parameter	**Unit**	**No.**	**Range**	**Median**	**No.**	**Range**	**Median**
Alkalinity Total	g/m^3 CO_3	3	36 - 49	41	3	81 - 114	101
Ammoniacal nitrogen	g/m^{3}N	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m^3	3	43 - 59	50	3	99 - 139	123
Calcium	g/m^3	3	16.8 - 23	18.4	3	16.1 - 16.3	16.2
COD	g/m^3	3	<6 - 6	<6	<6	<6 - <6	<6
Chloride	g/m^3	6	28 - 57	33	6	28 - 34	33
Conductivity @ 25'C	mS/cm	6	28.6 - 35.8	29.3	6	36.5 - 55.2	49.0
DRP	g/m^{3}P	3	0.006 - 0.024	0.017	3	0.016 - 0.092	0.017
Hardness Total	g/m^3 CO_3	3	68 - 92	76	3	65 - 79	66
Magnesium	g/m^3	3	6.2 - 8.6	7.2	3	5.8 - 9.4	6.3
Nitrite nitrogen	g/m^{3}N	3	<0.002 - <0.002	<0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m^{3}N	6	4.5 - 6.4	4.9	6	4.5 - 15.7	11.0
pH		6	6.5 - 7.0	6.7	6	6.7 - 7.1	6.9
Potassium	g/m^3	3	6.9 - 11.1	7.5	3	10.1 - 58	57
Sodium	g/m^3	3	21 - 28	24	3	41 - 48	44
Sulphate	g/m^3	3	22 - 23	22	3	27 - 46	40
Sum of Anions	meq/L	3	2.6 - 3.2	2.6	3	3.4 - 4.8	4.7
Sum of Cations	meq/L	3	2.6 - 3.2	2.7	3	3.6 - 4.9	4.7
Temperature	˚C	6	14.1 - 14.7	14.5	6	14.2 - 15.8	14.6
Total Kjeldahl nitrogen	g/m^{3}N	6	<0.1 - 0.21	0.12	6	0.14 - 0.37	0.21
Total nitrogen	g/m^{3}N	6	4.6 - 6.5	5.0	6	4.7 - 15.9	11.2
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.65 - 3.53	3.01	6	4.00 - 5.60	4.81

At the end of the 2016-2017 year it was considered that the water quality of the control bore GND0636 groundwater appeared to be improving slightly in terms of nitrate. Based on the 2017-2018 data, it appeared that this had stabilised somewhat, but this was followed by an increased median during the 2018-2019 year. During the 2019-2020 and 2020-2021 years the annual medians have again improved. It is noted that the nitrate concentrations in this bore have now remained below the drinking water standard for three consecutive years. It is noted that during this period the groundwater levels have shown a trend of decreasing groundwater level, though still retaining the expected variation due to seasonal changes. The combination of decreasing nitrate-nitrite concentration alongside decreasing groundwater levels is

consistent with the observation that heavy rainfall tends to flush more nitrate into the groundwater and/or that increases in groundwater levels tend to "collect" nitrates stored in the surface soils.

Water quality at the impact bore GND0637 was found to have higher ionic strength and showed a marked elevation in alkalinity, bicarbonate, median nitrate, potassium, sodium, sulphate and conductivity levels when compared to the control bore. There are also some large "seasonal variations" in the down gradient bore that are not present in the control bore (Figure 51 to Figure 53) These factors are consistent with the effect of leaching of wastewater from spray irrigation disposal to shallow groundwater.

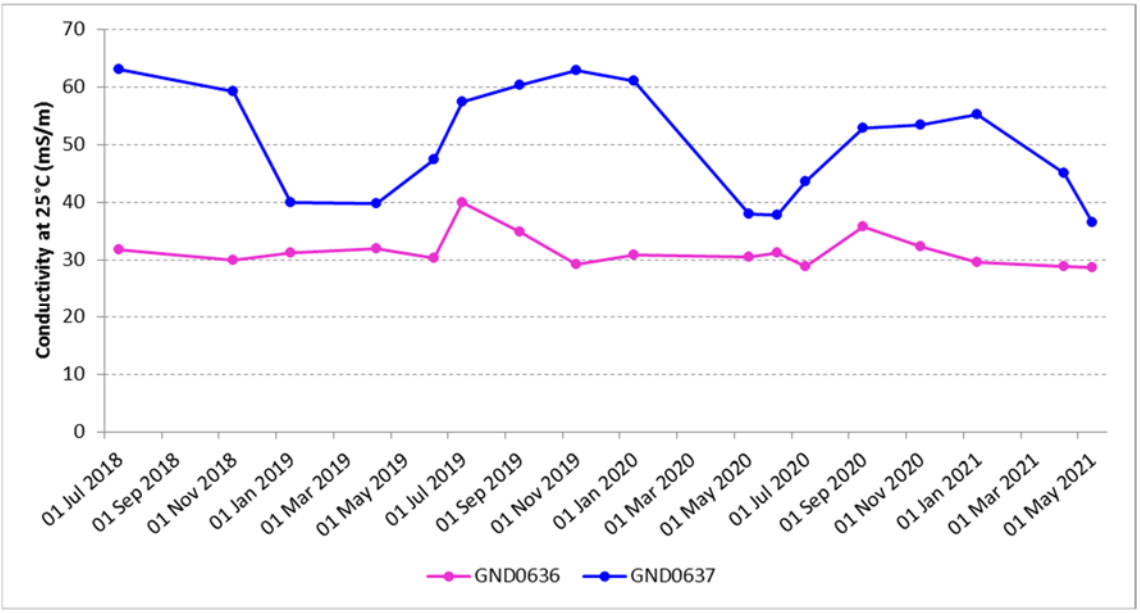

Figure 51 Three year trends in groundwater conductivity at Farm 1

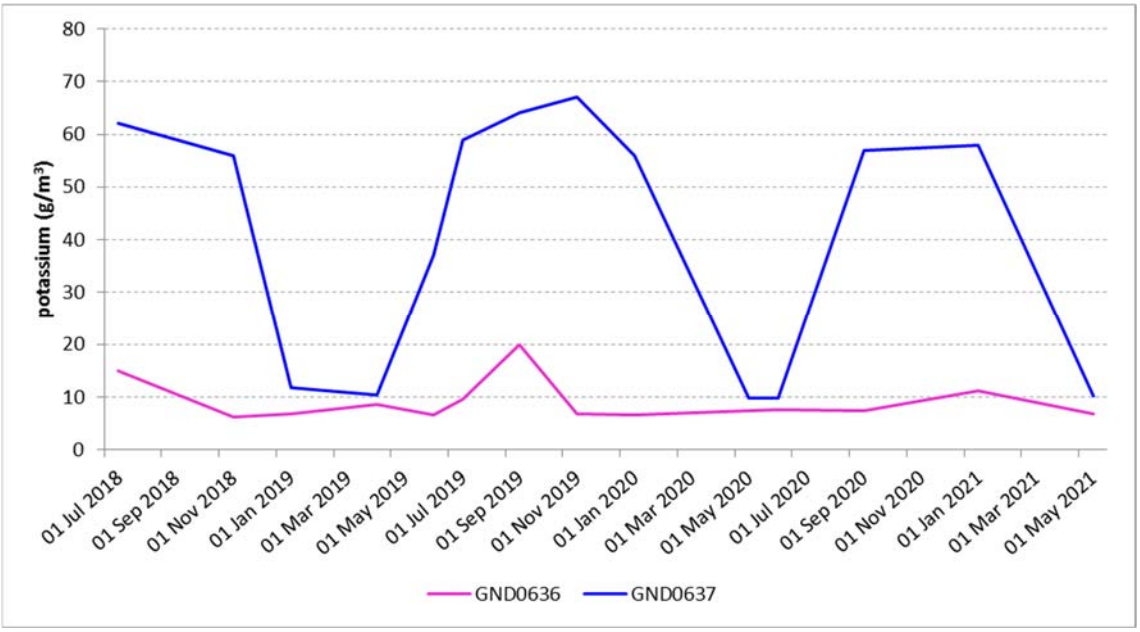

Figure 52 Three year trends in groundwater potassium at Farm 1

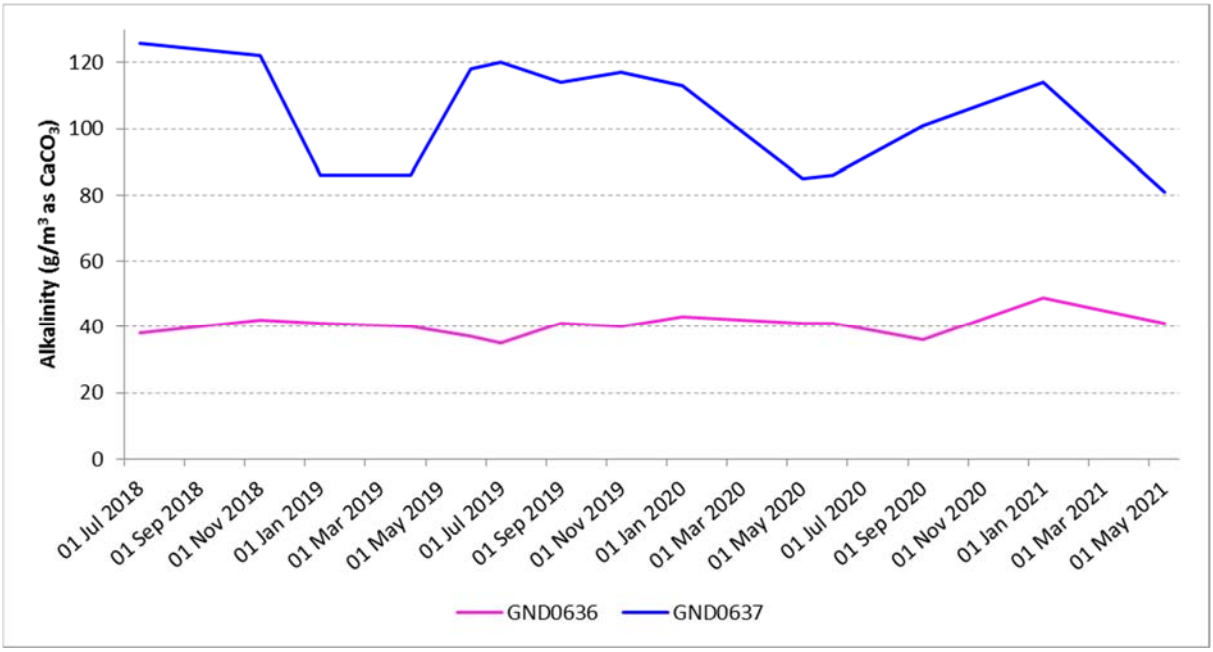

Figure 53 Three year trends in groundwater alkalinity at Farm 1

The sodium concentration again appears to be reducing overall, with all values recorded during the year under review being slightly below the historical median (refer to Figure 54 and Table 27). The COD of both bores was found to be low at each of the sampling surveys. For the most part, the nitrate concentration at the impact bore was significantly higher than at the control bore. Although the nitrate concentration was slightly lower at this site than the control bore on two of the monitoring occasions, this may be related to the lower groundwater levels at the time of year these samples were collected. It is also noted that the groundwater level in GND0637 is approximately 2 m lower than at GND0636. The median values for both sodium and nitrate in the 2020-2021 year, and for the historical data, are higher at the impact bore than at the control bore.

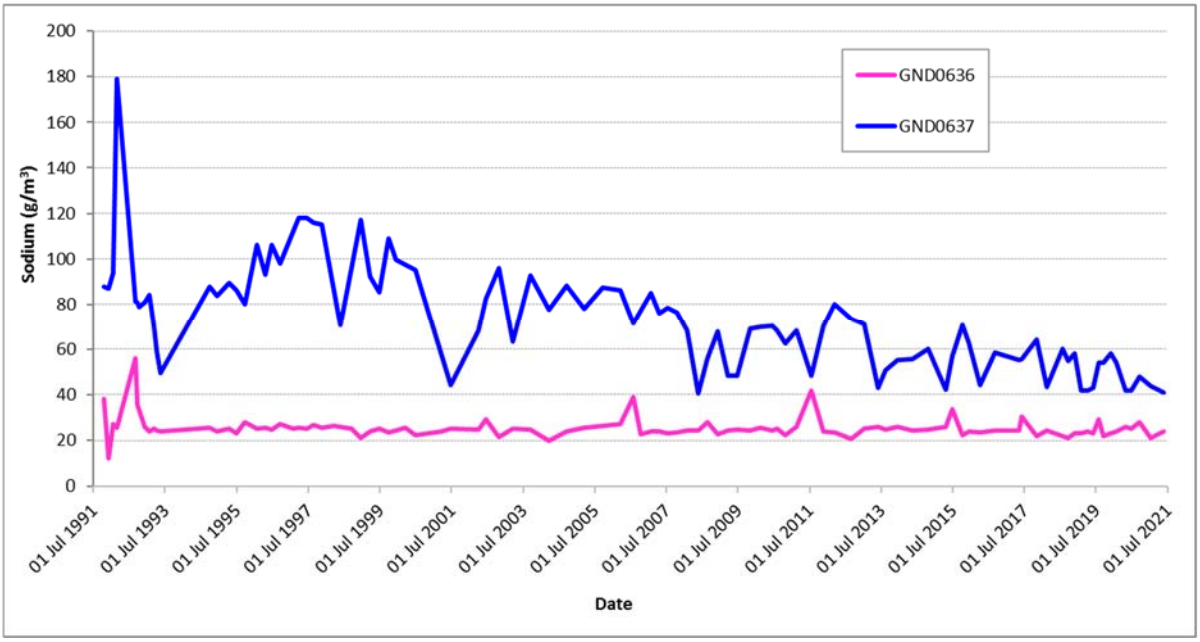

Figure 54 Long term trends in groundwater sodium concentration at Farm 1

Figure 55 compares the long term trends in groundwater nitrate-N levels at the impact bore with the control bore, 640 m up-gradient, on the northern boundary of the farm. In contrast to previous years, levels

of nitrate-N in the impact bore were much higher in spring and summer than they were in winter and spring, which is the usual trend observed. The three samples collected during this period were all above the drinking water standard (11.3 g/m^3), with the sample collected in November over 4 g/m^3 higher than the standard. It is noted that although still high, it was lower than the 22 g/m^3 maximum for the 2019-2020 year that was the highest concentration recorded in the impact bore since May 2012.

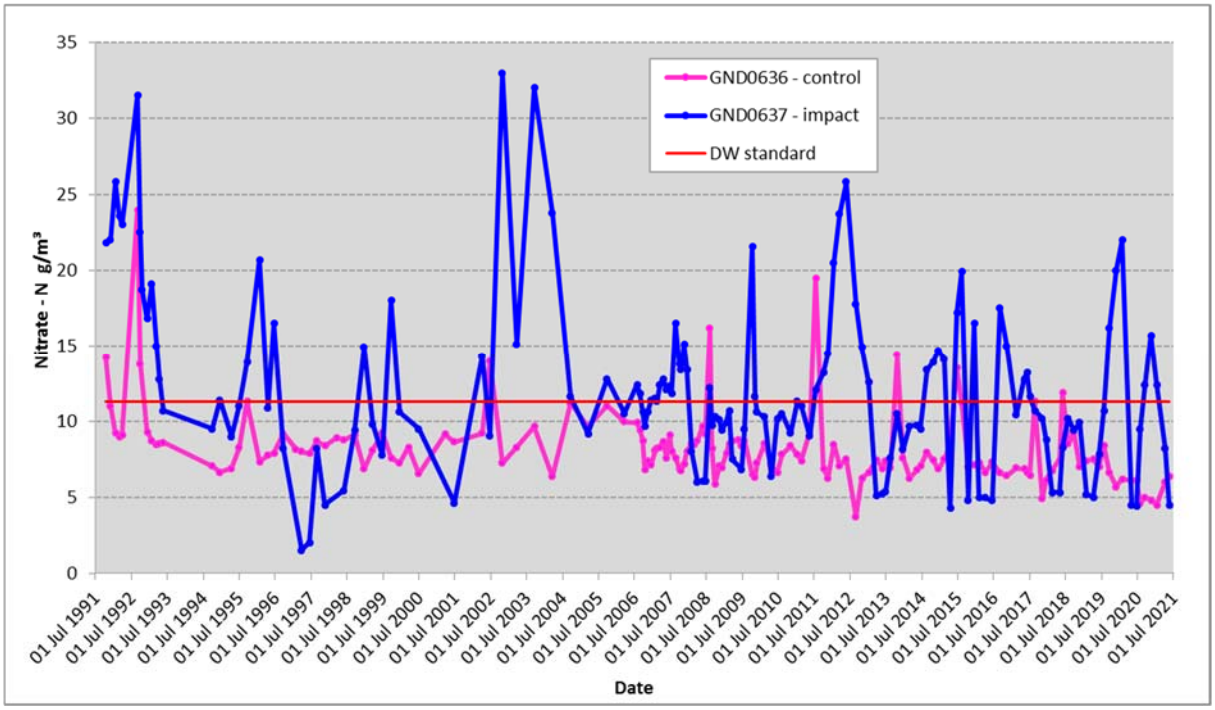

Figure 55 Long term trends in groundwater nitrate-N concentration at Farm 1

When looking at the changes in groundwater level and nitrate concentration at the time of the November 2019 and January 2020 surveys (Figure 56), it is likely that the effects of irrigation are evident in the impact bore. Although the groundwater levels at the two sites were showing consistent seasonal trends, the nitrate-N concentration was significantly higher on the down gradient farm boundary than at the control bore. Without onsite rainfall and time series paddock by paddock irrigation data, it is difficult to gauge whether the effects are related to periods of irrigation, rain related flushing, or a combination of these. It has been signalled to the Company that paddock by paddock irrigation records are likely to be required by the renewed discharge consent. The Company provided this information voluntarily for part of the 2020-2021 year and, following discussions on how this data could be managed effectively, began providing this information on a monthly basis from the start of the 2021-2022 year.

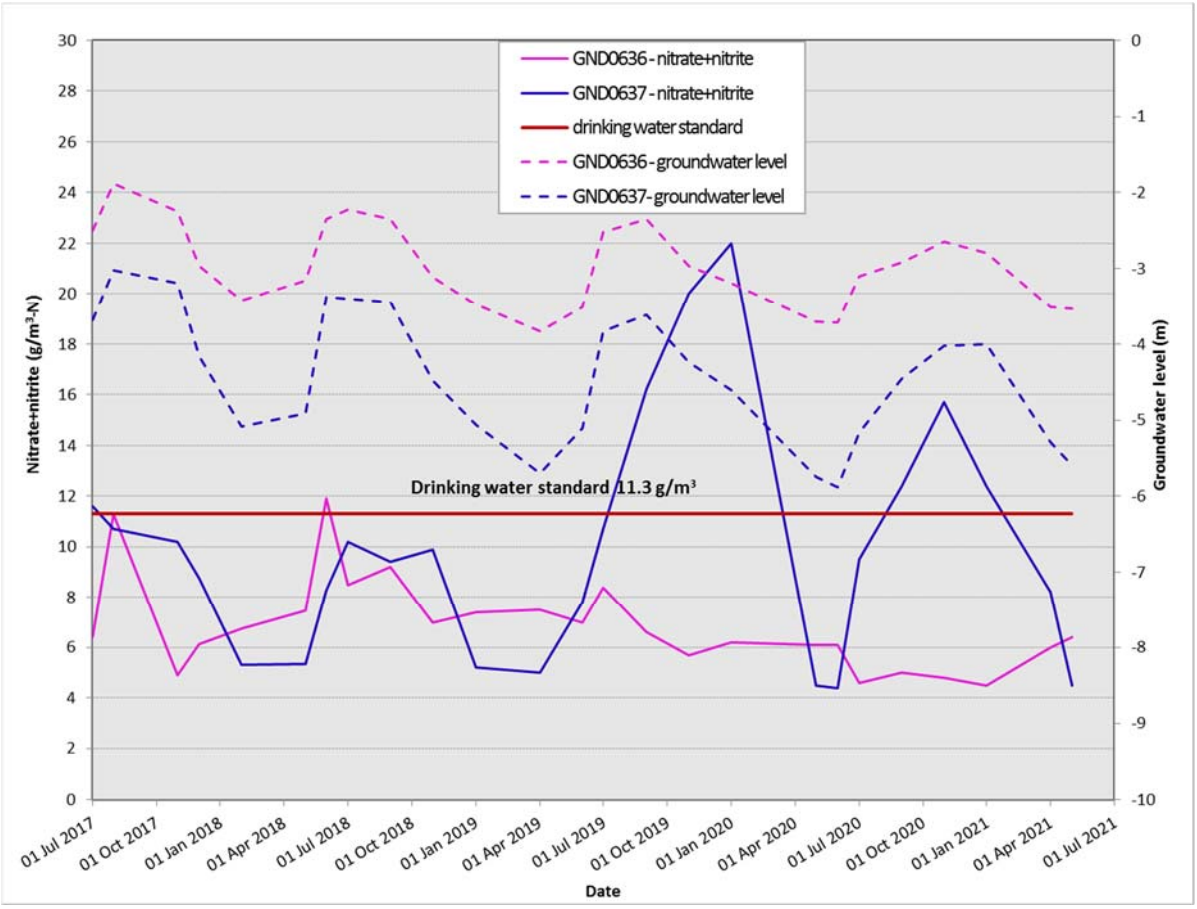

Figure 56 Farm 1 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.2 Farm 2 groundwater

The results of groundwater monitoring on this farm during the year under review are summarised in Table 28. The full set of results is available upon request. Site GND0639 could not be sampled in the May 2020 survey as the bore was dry.

The control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road (Figure 50). This replaced the original 'control' bore, GND0638, which is situated on the western boundary with about 350 m of irrigated paddocks up-gradient. This bore was affected by ponding of effluent in spring 2006 and possibly again in spring 2007. For this reason, following this discovery, the wastewater was irrigated only in summer in the paddock immediately up-gradient (number 13B). However, this paddock was subsequently aerated, with irrigation resuming. No further issues with ponding have been reported.

The impact monitoring bore, GND0699, some 670 m down-gradient due south of GND0638 collapsed in December 2006, following damage caused by farm activities. A replacement impact bore, GND2050, was installed above the Waiokura Stream in March 2008. This was the third impact bore drilled on Farm 2 west of the Waiokura Stream. Figure 57 compares the long term trends in groundwater nitrate-N levels at the newer impact bores (GND2063 and GND2050), the two longer standing impact bores (GND0639 and GND0699), and the original, but impacted control bore (GND0638) with the new control bore (GND2049).

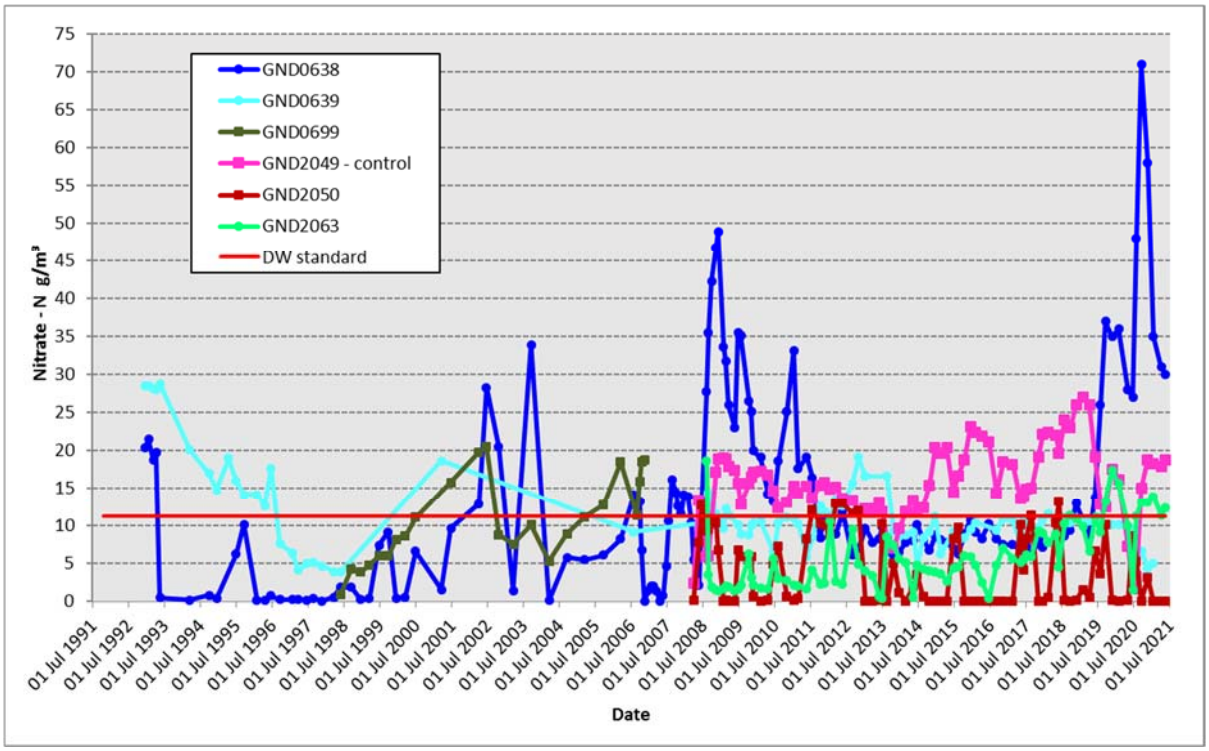

Figure 57 Long term trends in groundwater nitrate-N concentration at Farm 2

The control bore, GND2049, continued to show the influence of an unknown source in the first seven months of the monitoring period. The nitrate-N concentration in this bore ranged from 3.3 to 18.8 g/m^3 during the monitoring period, with an annual median of 18.1 g/m^3. This follows annual medians of 13.0 g/m^3 in 2013-2015, 25 g/m^3 in 2018-2019, and 12.7 g/m^3 in 2019-2020. Five of the six results obtained during the year under review were above the drinking water standard. The historical median of historical results to June 2020 remained the same as that for data to June 2019. This is following slight increases in the median of the historical data for the three consecutive years, with changing from 14.9 g/m^3 to 15.1 g/m^3 and then to 15.4 g/m^3. For the assessment of environmental effects to accompany the consent renewal application, the Company had been asked to investigate whether the nitrate being found in this bore originates from farming activities up-gradient across Skeet Road, from "mounding" of factory effluent applied down gradient, or by some other mechanism, noting that the nitrate level is often varying inversely with groundwater level. Although a theoretical analysis of the existing data was provided, there was no conclusive evidence supporting the conclusion that "upwelling" was the cause of the elevated nitrates at the control bore. It is likely that the renewed consent will require further work on this matter.

The conductivity, pH, sodium and chloride levels of the control bore were within the normal ranges found in adjacent farming areas. COD and ammonia were low, indicating little leaching of organics into this bore.

Table 28 Results of groundwater quality sampling on Farm 2

Parameter	Unit	Control (GND2049)			Impact (GND0638)			Impact (GND0639)			Impact (GND2050)			Impact (GND2063)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Alkalinity Total	g/m³ CO_3	3	46 - 55	51	3	112 - 165	165	2	152 - 171	161.5	3	179 - 184	183	3	40 - 43	41
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	0.1	4	<0.01 - <0.01	<0.01	6	<0.01 - 0.57	0.27	6	<0.01 - <0.01	<0.01
Bicarbonate @ 25'C	g/m³	3	56 - 67	63	3	136 - 200	200	2	186 - 210	198	3	220 - 220	220	3	49 - 3	49
Calcium	g/m³	3	21 - 30	25	3	61 - 115	115	2	14.2 - 14.4	14.3	3	30 - 33	31	3	11.6 - 3	11.6
COD	g/m³	6	<6 - <6	<6	6	<6 - 8	8	2	6 - 6	6	3	<6 - 7	<6	6	<6 - 9	<6
Chloride	g/m³	6	19.2 - 36	33.5	6	145 - 310	310	4	49 - 57	49.5	6	38 - 56	52.5	6	33 - 40	37
Conductivity @ 25'C	mS/cm	6	21.8 - 43.1	40.1	6	111 - 188	138	4	52.6 - 68.9	64.9	6	55.9 - 65.4	64.0	6	36.1 - 40.9	38.5
DRP	g/m³P	3	<0.004 - 0.009	0.008	3	0.005 - 0.009	0.009	2	0.026 - 0.031	0.029	3	<0.004 - 0.010	<0.004	3	0.012 - 0.02	0.012
Hardness Total	g/m³ CO_3	3	92 - 131	110	3	240 - 450	450	2	76 - 79	77.5	3	157 - 181	168	3	75 - 75	75
Magnesium	g/m³	3	9.8 - 13.3	11.4	3	22 - 40	40	2	9.9 - 10.4	10.2	3	19.9 - 24	22	3	10.2 - 11.2	11.1
Nitrite nitrogen	g/m³N	6	<0.002 - <0.002	<0.002	3	0.002 - <0.002	<0.002	2	<0.002 - <0.002	<0.002	6	<0.002 - 0.003	0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m³N	6	3.3 - 18.8	18.1	6	30 - 71	42	4	4.4 - 6.7	5.3	6	0.01 - 5.3	0.05	6	11.3 - 13.9	12.8
pH		6	6.4 - 6.6	6.5	6	6.5 - 6.8	6.6	4	6.8 - 7.0	6.9	6	6.8 - 7.4	7.0	6	6.3 - 6.7	6.6
Potassium	g/m³	3	5.4 - 7.5	6.6	3	68 - 103	75	2	27 - 27	27	3	13.7 - 27	14	3	7.8 - 12.1	11.6
Sodium	g/m³	3	24 - 32	26	3	91 - 120	96	2	92 - 92	92	3	54 - 60	58	3	38 - 43	39
Sulphate	g/m³	3	6.3 - 19.4	12.8	3	31 - 40	37	2	59 - 65	62	3	6.2 - 6.3	6.3	3	27 - 28	27
Sum of Anions	meq/L	3	2.9 - 3.9	3.6	3	10 - 16.6	10.8	2	6.4 - 6.5	6.45	3	6.1 - 6.6	6.4	3	3.3 - 3.5	3.4

Parameter	Unit	Control (GND2049)			Impact (GND0638)			Impact (GND0639)			Impact (GND2050)			Impact (GND2063)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Sum of Cations	meq/L	3	3 - 4.2	3.5	3	10.7 - 16.8	10.8	2	6.2 - 6.3	6.25	6	14.4 - 15.1	14.8	3	3.5 - 3.6	3.5
Temperature	˚C	6	13.9 - 14.2	15.0	6	14.4 - 15.2	14.6	4	14.0 - 14.5	14.5	6	0.15 - 0.71	0.34	6	14.3 - 15.4	14.6
Total Kjeldahl nitrogen	g/m^{3}N	6	<0.1 - 0.16	<0.1	6	<0.1 - 1.04	41.5	4	0.13 - 0.36	0.23	6	0.20 - 5.5	0.70	6	<0.1 - 0.29	0.27
Total nitrogen	g/m^{3}N	6	3.3 - 19.0	18.0	6	31 - 71	6.6	4	4.8 - 7.0	5.4	3	6.2 - 6.3	6.3	6	11.4 - 14.2	13.0
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	4	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	1.36 - 3.50	2.50	6	1.82 - 3.65	2.89	4	2.18 - 4.04	2.98	6	2.20 - 3.16	2.76	6	3.18 - 4.74	3.57

At the bore inside the irrigation area, GND0638, nitrate-N concentration had reduced from the peak of 49 g/m³ recorded during 2008-2009 down to 8 g/m³ in 2012. For the six years from June 2012 to June 2018 it had been fluctuating between 6 to 11 g/m³, remaining just below the drinking water standard of 11.3 g/m³. During the 2018-2019 year the fluctuations were more pronounced and higher than in the previous year with the range being 8.6 to 13.8 g/m³. The annual median of 9.4 g/m³ was also higher when compared to the previous two years (7.7 g/m³ in 2017-2018 and 7.5 g/m³ in 2016-2017). Only two nitrate-N results were recorded that exceeded the drinking water standard during that year. In the 2019-2020 year, the nitrate-N results were in the range 26 to 37 g/m³, with a further sharp increase in concentration found at the start of the 2020-2021 year. The Company was asked to investigate and undertake follow-up action as per condition 12 (a) of consent 0923 and section 9.7 of the Whole Farm Management Plan. The findings of the investigation and mitigation measures undertaken are discussed in Section 2.3. All results obtained during the year under review were between about two and a half to six times the drinking water standard. The nitrate-N concentration reached eight times the historical median for this monitoring location. The concentration of 71 g/m³ recorded in the September 2020 sample was a new maximum for this bore. Reductions were observed in the four samples collected on and after 17 November 2020, with the effects of the mitigating measures detected in the reducing nitrate-N concentrations.

The ionic strengths of the samples from this bore were significantly higher than both the other bores monitored in the year under review and at this bore in the 2018-2019 and 2019-2020 years. There were also differences between the sum of anions and sum of cations that was considered to potentially be as a result of the presence of an inorganic acid. Conductivity, sodium, potassium and chloride values were elevated, as might be expected underneath such a wastewater irrigation area, though COD and ammoniacal nitrogen levels were low. It is noted that the conductivity and chloride concentrations followed similar trends to the nitrate-N results (Figure 58, Figure 59 and Figure 62).

At the impact bore GND0639 it was found that the nitrate concentration varied from 5.0 to 9.5 g/m³ during the year under review, remaining below the drinking water standard. In contrast to the 2017-2018 year, there appeared to be little influence from changes in ground water levels in the 2018-2022 years (Figure 58). It is noted that this bore continues to exhibit higher sodium concentrations that in any of the other Farm 2 bores, with the exception of GND0638 (Figure 61).

Historically, it has been found that at the newer impact bore beside the Waiokura Stream, GND2050, nitrate-N concentration appears to fluctuate with groundwater level (Figure 58). Over the total record, the nitrate-N concentration is typically in the range 3 to 13 g/m³ during winter and spring, falling to <1 g/m³ in summer and autumn. Denitrification is a likely explanation, as ammonia concentration varies inversely with nitrate, reaching >0.5 g/m³N, while a low oxygen level (that is, conducive to denitrification) has been recorded. It is noted that the conductivity, sodium, potassium and chloride values continue to be elevated at GND2050 when compared to the control bore.

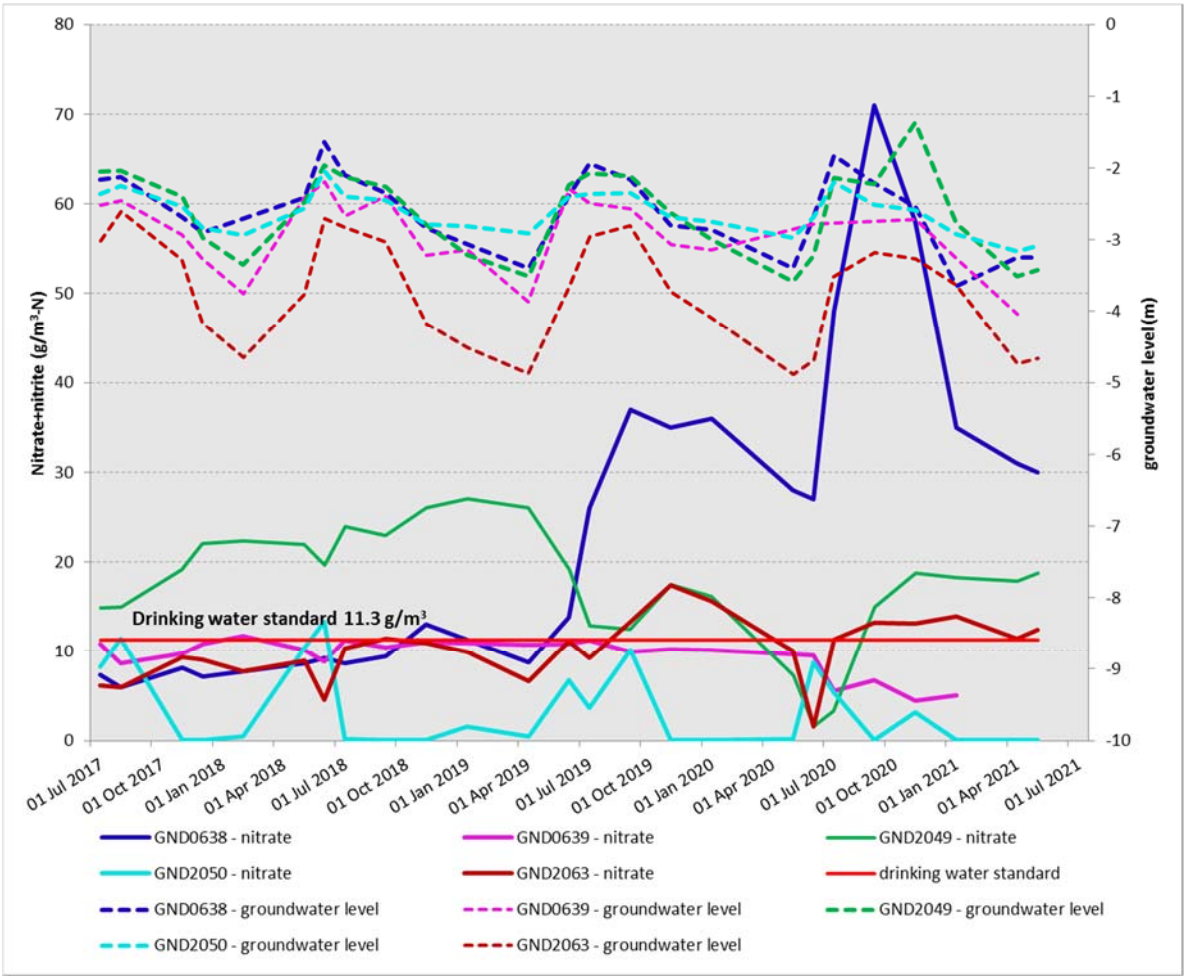

Figure 58 Farm 2 groundwater levels and nitrate + nitrite nitrogen concentrations and groundwater levels during the year under review

The relative concentrations of selected parameters, conductivity, pH, sodium, chloride and potassium, are shown in Figure 59 to Figure 63.

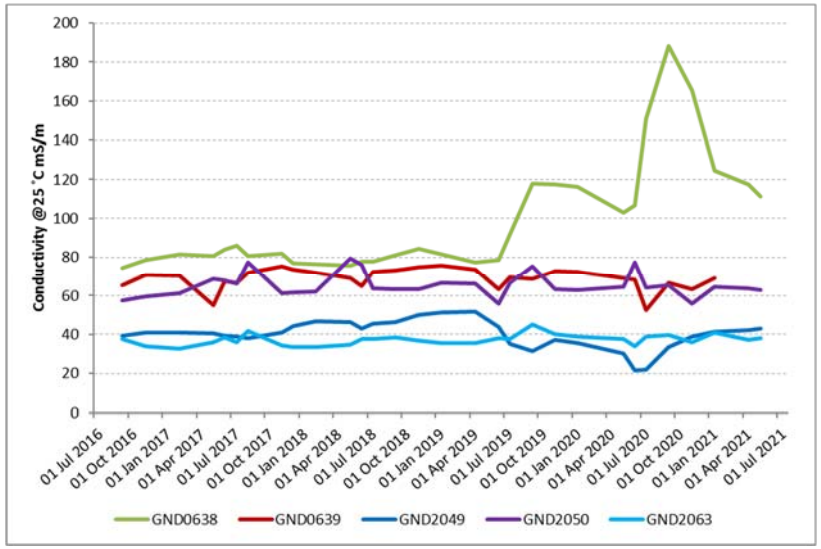

Figure 59 Groundwater conductivity at Farm 2 bores, June 2016 to date

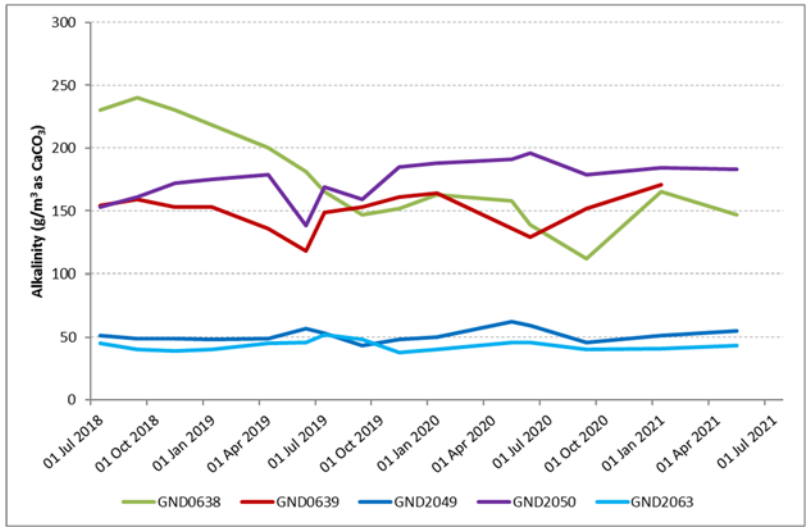

Figure 60 groundwater alkalinity at Farm 2 bores, June 2018 to date

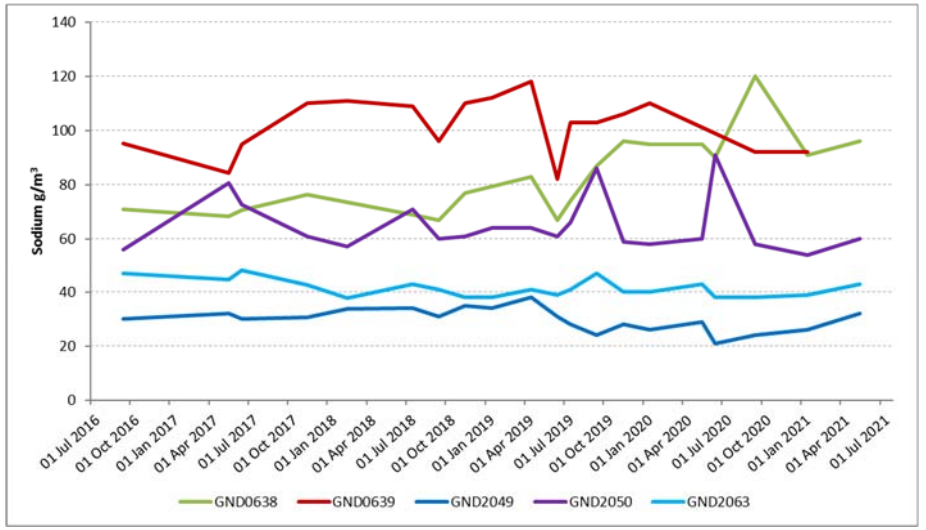

Figure 61 Groundwater sodium concentration at Farm 2, June 2016 to date

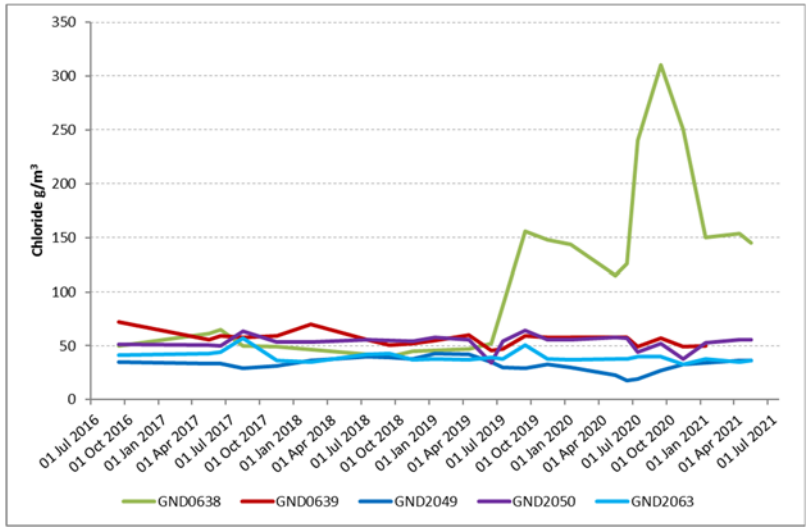

Figure 62 Groundwater chloride concentration at Farm 2 bores, June 2016 to date

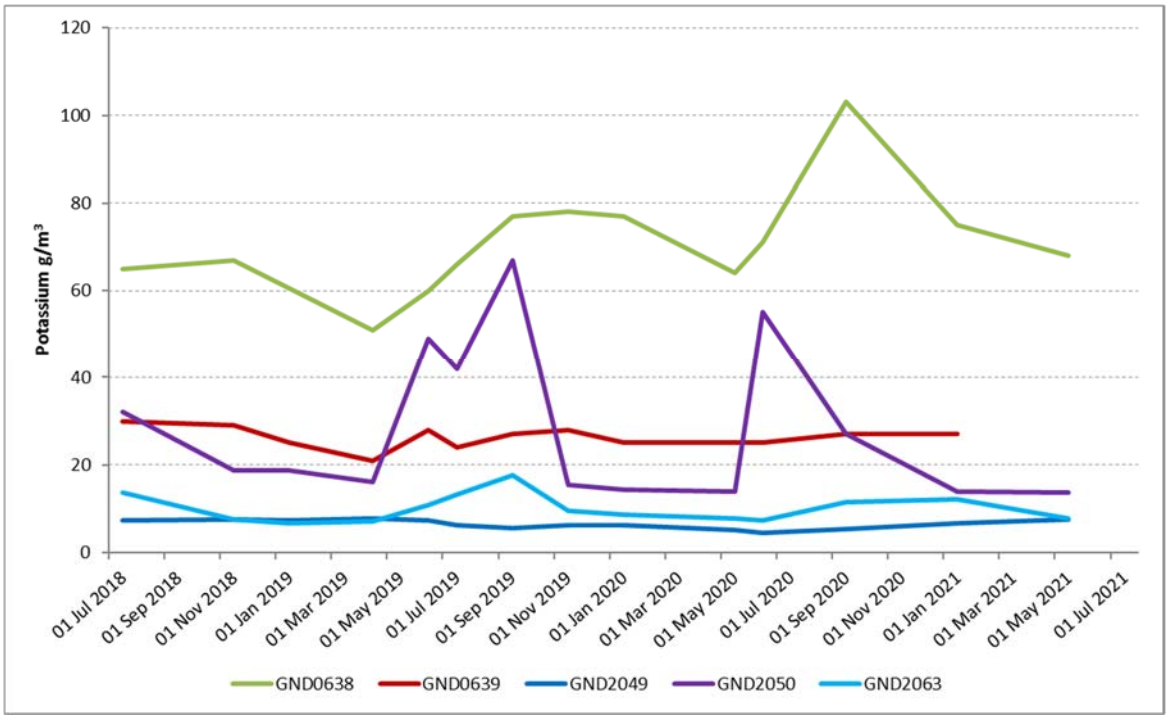

Figure 63 Groundwater potassium concentration at Farm 2 bores, June 2018 to date

2.1.5.3 Farm 3 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 29. The full set of results is available upon request.

The control bore for Farm 3, GND2051, was drilled in March 2008, on the northern boundary above Motumate Stream. This replaced the original control bore, GND0640, which was situated beside Manaia Road on the western boundary down-gradient of the extended farm area, and was damaged by farm activities in May 2007.

Another impact monitoring bore (GND2052) was also drilled in March 2008, on the southern boundary to the west of Motumate Stream, immediately down-gradient of recently installed fixed in-ground irrigators. The existing impact bore, GND0700, to the east of Motumate Stream, was maintained. An old impact monitoring bore, GND0641, situated between the main access track and Motumate Stream, which had at times been dry, was reinstated in the programme in August 2008. This was not able to be sampled for a number of years due to a bailer becoming stuck inside the bore in May 2013. Sampling access to this bore was re-instated and routine monitoring recommenced in July 2018.

Monitoring of the Motumate Stream, provisionally provided for in the programme to monitor potential effects from the discharge of cooling water, was also initiated in November 2018 to monitor for potential effects on the stream from irrigation activities given the extension in the irrigation area that had occurred after the increase in the area of Farm 3. This data is reported in Section 2.1.6.

Table 29 Results of groundwater quality sampling on Farm 3

Parameter	Unit	Control (GND2051)			Impact (GND0640)			Impact (GND0700)			Impact (GND0641)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Alkalinity Total	g/m³ CO_3	3	45 - 51	46	2	71 - 71.5	71.5	3	84 - 100	99	3	90 - 107	93	3	74 - 84	80
Ammoniacal nitrogen	g/m³N	6	<0.01 - <0.01	<0.01	4	0.33 - 0.48	0.40	6	<0.01 - 0.02	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - 0.38	0.18
Bicarbonate @ 25'C	g/m³	3	55 - 62	56	2	87 - 87	87	3	103 - 122	120	3	110 - 130	113	3	90 - 103	98
Calcium	g/m³	3	12.2 - 14.6	12.3	2	11.2 - 11.8	11.5	3	12.1 - 13.1	12.6	3	20 - 26	23	3	13.4 - 16	14.2
COD	g/m³	6	<6 - 8	<6	6	8 - 42	25	3	<6 - 8	6	3	10 - 32	20	6	<6 - 8	<6
Chloride	g/m³	6	28 - 50	33	2	46 - 46	46	6	57 - 80	67.5	5	58 - 77	68	6	46 - 48	47
Conductivity @ 25'C	mS/cm	6	29.8 - 47.8	31.8	4	30.2 - 31.9	30.8	6	39.6 - 63.4	45.5	5	53.8 - 64.9	61.8	6	34.1 - 43.0	35.3
DRP	g/m³P	3	0.008 - 0.018	0.012	4	0.004 - 0.005	0.005	3	0.016 - 0.024	0.023	3	<0.004 - 0.004	<0.004	3	0.025 - 0.055	0.051
Hardness Total	g/m³ CO_3	3	78 - 86	82	2	58 - 61	59.5	3	71 - 84	76	3	93 - 93	107	3	68 - 81	72
Magnesium	g/m³	3	11.5 - 12.6	11.9	2	7.3 - 7.5	7.4	3	9.8 - 12.8	10.4	3	10.1 - 10.1	11.9	3	8.5 - 9.9	8.9
Nitrite nitrogen	g/m³N	6	<0.002 - <0.002	<0.002	2	<0.002 - 0.006	0.004	3	<0.002 - <0.002	<0.002	6	<0.002 - 0.003	0.002	6	<0.002 - <0.002	<0.002
Nitrite+nitrate	g/m³N	6	2.3 - 18.4	6.0	4	0.01 - 0.33	0.019	6	0.43 - 5.5	2.7	5	6.7 - 8.9	7.7	6	0.033 - 3.8	0.166
pH		6	6.5 - 7.0	6.7	4	6.8 - 6.9	6.9	6	6.8 - 7.1	6.9	5	6.8 - 7.2	6.9	6	6.7 - 7.5	6.95
Potassium	g/m³	3	7.2 - 12.5	9.7	2	7.0 - 7.2	7.1	3	16 - 30	19.4	3	36 - 45	40	3	9.8 - 10.8	10.1
Sodium	g/m³	3	22 - 27	23	2	31 - 34	32.5	3	53 - 83	68	3	43 - 56	51	3	35 - 48	40
Sulphate	g/m³	3	31 - 37	33	2	2.8 - 3.1	3.0	3	9.2 - 32	27	3	35 - 48	40	3	11.4 - 49	17
Sum of Anions	meq/L	3	2.8 - 3	3	2	2.8 - 2.8	2.8	3	3.5 - 5	4.5	3	4.7 - 5.9	5.1	3	3.2 - 4.2	3.2

Parameter	Unit	Control (GND2051)			Impact (GND0640)			Impact (GND0700)			Impact (GND0641)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median	No.	Range	median
Sum of Cations	meq/L	3	2.7 - 3.1	2.9	2	2.7 - 2.9	2.8	3	4.1 - 6.1	5.0	3	4.6 - 5.9	5.4	3	3.2 - 4.0	3.5
Temperature	˚C	6	14.3 - 15.0	14.7	4	14.8 - 16.8	15.0	6	14.4 - 15.3	14.8	5	14.2 - 15.5	14.9	6	14.4 - 15.0	14.9
Total Kjeldahl nitrogen	g/m^{3}N	6	<0.1 - 0.20	0.14	4	0.41 - 1.33	1.05	6	0.13 - 0.57	0.19	5	0.22 - 1.38	0.49	6	0.14 - 0.36	0.32
Total nitrogen	g/m^{3}N	6	2.4 - 18.5	6.1	4	0.43 - 1.35	1.22	6	0.62 - 6.1	2.85	5	7.8 - 9.3	8.5	6	0.37 - 4.0	0.50
Un-ionised ammonia	g/m^3	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01	5	<0.01 - <0.01	<0.01	6	<0.01 - <0.01	<0.01
Water Level	m	6	2.92 - 4.2	3.6	4	2.05 - 4.4	2.76	6	1.65 - 2.97	2.23	5	1.51 - 2.91	1.87	6	1.97 - 3.70	2.88

The impact of wastewater irrigation upon the old impact bores (GND0700 and GND0641) was reflected in elevated sodium, chloride, conductivity and potassium levels (Figure 64, Figure 65, Figure 66, and Figure 67), with GND0641 appearing to potentially be showing a trend of increasing trend in chloride, conductivity and potassium.

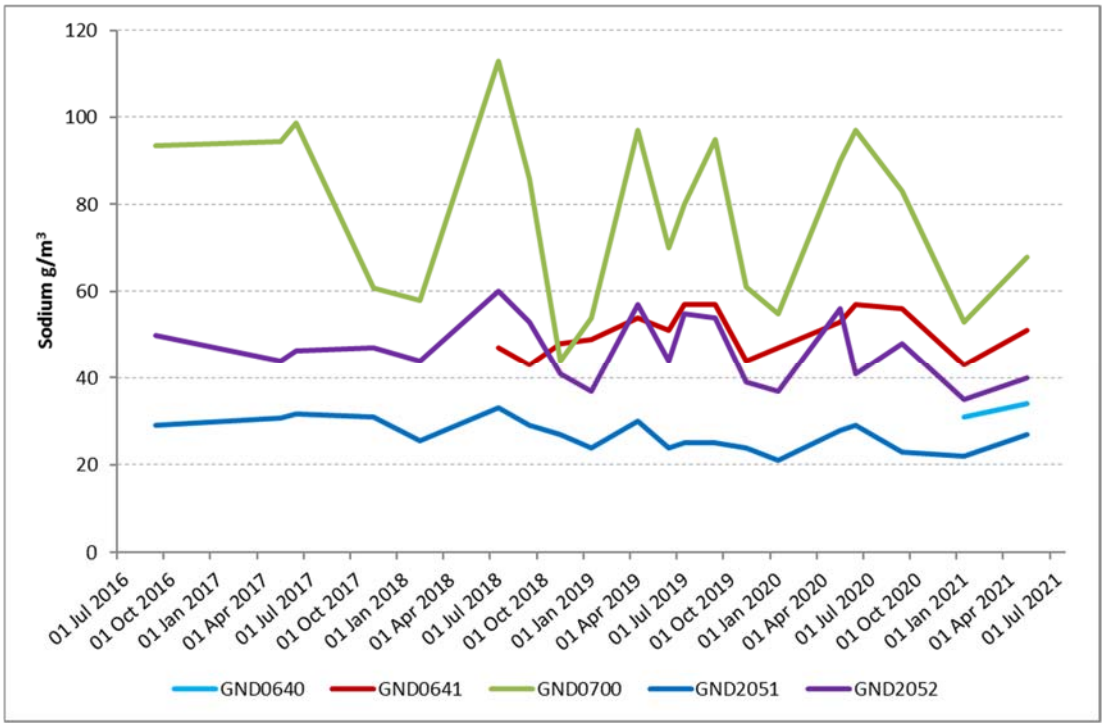

Figure 64 Groundwater sodium concentration at Farm 3 bores, June 2016 to date

It is noted that the chloride concentration and conductivity of the new control bore GND2051 had also been elevated at times, with this bore now showing an emerging decreasing trend in these parameters. Potassium was found to be elevated in this bore at the start of the 2019-2020 year. This returned to being at or below median during the year under review.

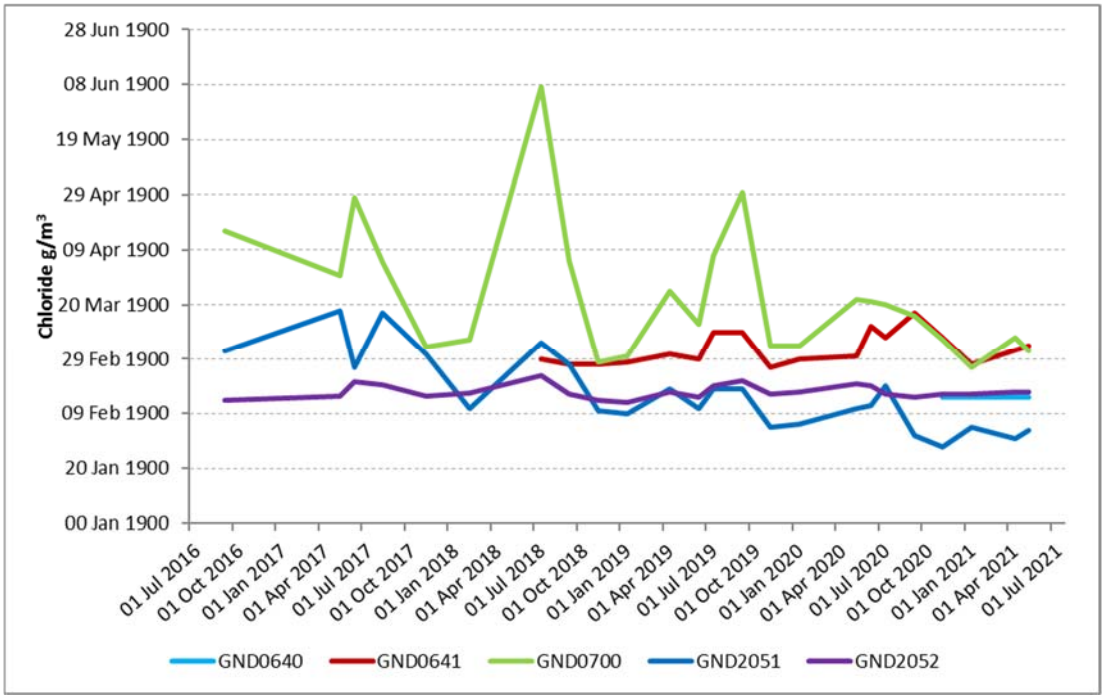

Figure 65 Groundwater chloride concentration at Farm 3 bores, June 2016 to date

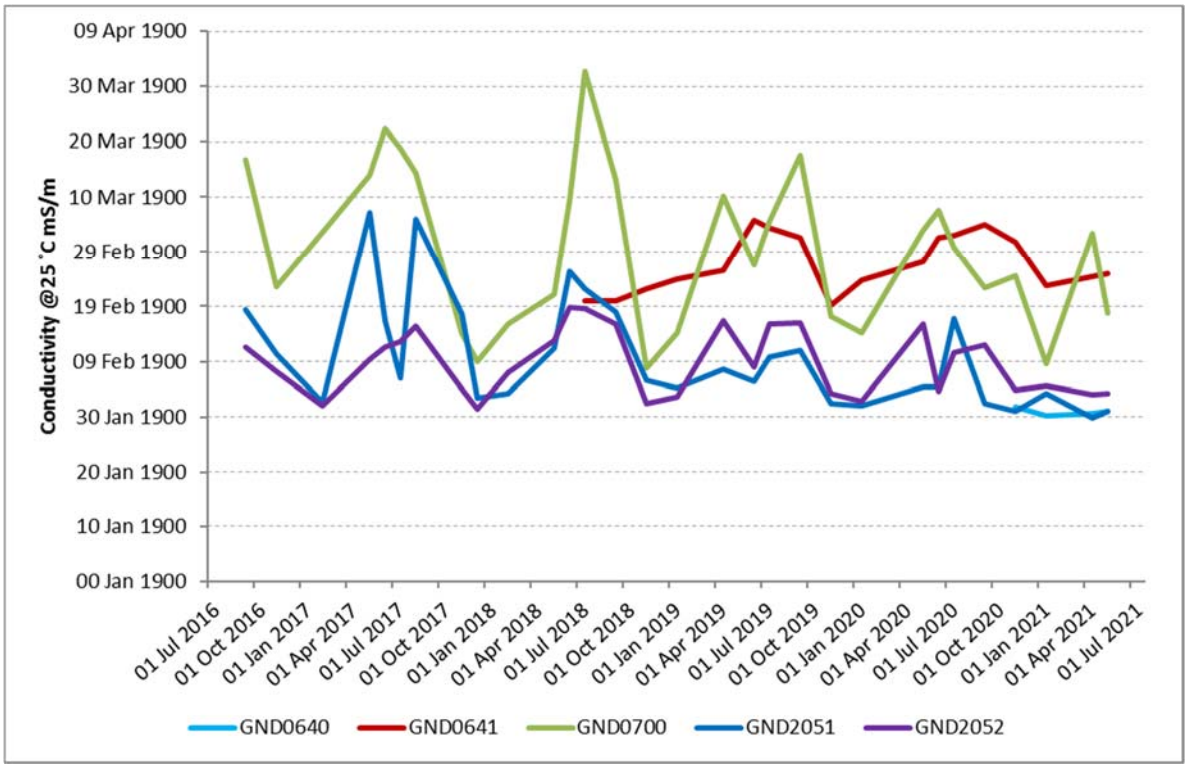

Figure 66 Groundwater conductivity at Farm 3 bores, June 2016 to date

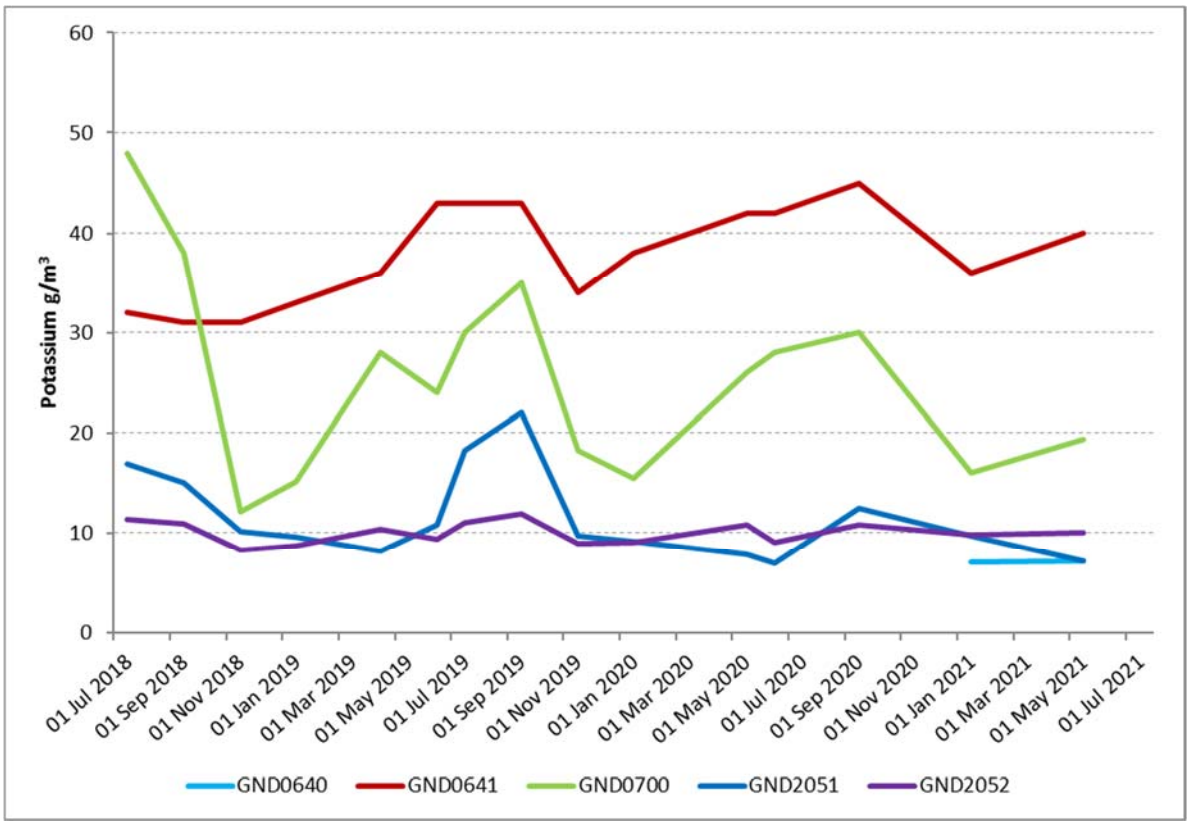

Figure 67 Groundwater potassium concentration at Farm 3 bores, June 2018 to date

Figure 68 compares trends in groundwater nitrate-N levels at the two current impact bores, GND2052 and GND0700, and the reinstated impact bore, GND0641 (between 2008-2013 and June 2018-July 2019), with the old and new control bores, GND0640 (until 2007) and GND2051.

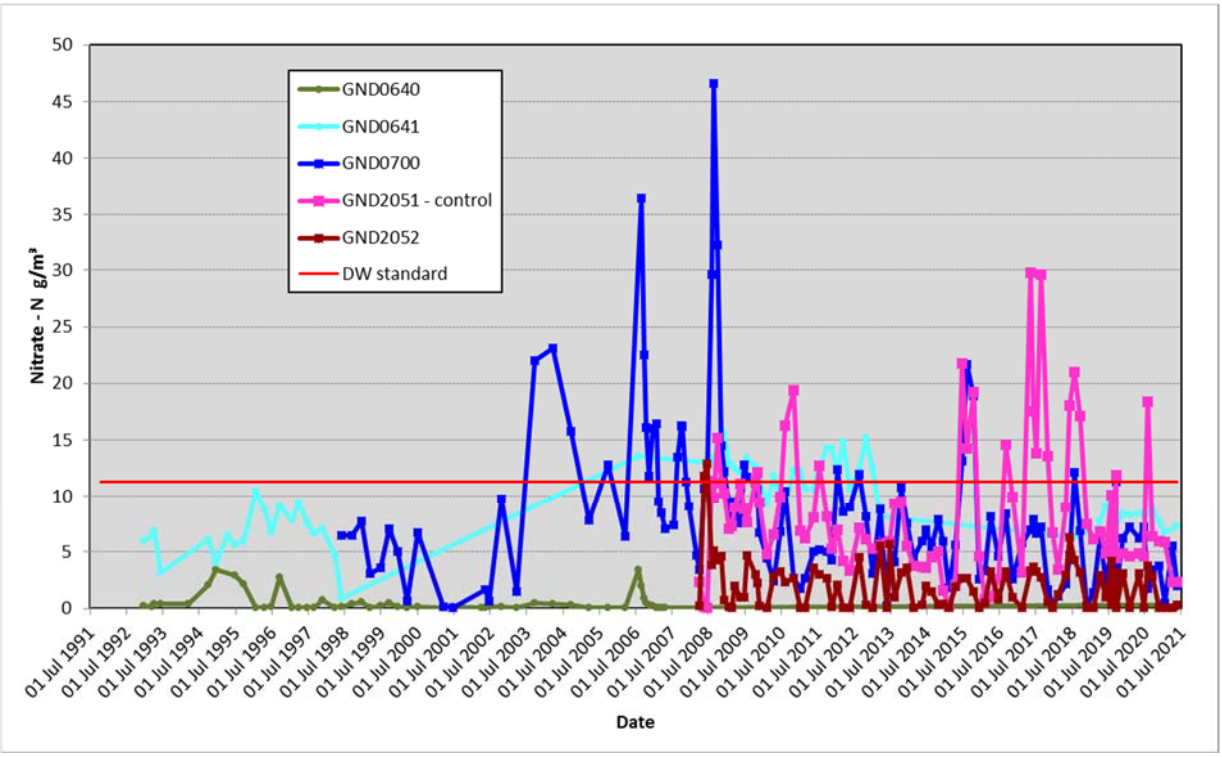

Figure 68 Trends in groundwater Nitrate N concentration at Farm 3

At the new control bore (GND2051), nitrate-N values were still elevated at times. There was marked increase in the nitrate-N in the sample collected on 27 July 2020. This coincided with a 2.2 metre increase in the groundwater level at this bore (Figure 69). As the groundwater levels receded, the nitrate-N concentrations decreased from the high of 18.4 g/m^3 to 2.3 g/m^3. The annual median of the samples collected during the year under review (6.0 g/m^3) was higher than that obtained for the 2018-2019 data (4.9 g/m^3), but continued to be below that obtained across the three preceding monitoring years during which time elevated annual medians were obtained (7.2 g/m^3 in 2018-2019, 13.6 g/m^3 in 2017-2018, 14.6 g/m^3 in 2016-2017 and 3.6 g/m^3 in 2015-2016).

Impact bore GND0700 generally yielded low levels of nitrate-N, with an annual median value of 2.7 g/m^3 for the year under review. The maximum concentration obtained was in this bore was 5.5 g/m^3, which was also in the July 2020 survey. In contrast to the groundwater level trend observed at the control site, at this site there had been a slight reduction in groundwater level at this site when compared to the previous survey.

For the third consecutive year the new impact bore GND2052 had a much lower median nitrate-N value (0.17 g/m^3) during the year under review when compared to the 2018-2019, 2017-2018 and 2016-2017 years (1.67 g/m^3, 2.71 g/m^3 and 6.94 g/m^3 respectively).

At the impact bore GND0640 that was re-instated in November 2020, the nitrate-N concentrations were low, with a median of 0.02 g/m^3. Although this is now an impact bore, the median of the four samples collected during the year under review was lower than the median of historical results collected between 1992 and 2007 (0.13 g/m^3), when this was a control bore for the southern section of Farm 3.

At the impact bore GND0641 that was re-instated in July 2018, the nitrate-N concentrations were elevated, however the annual median of 7.7 g/m^3 was lower than the historical median (9.3 g/m^3), with no results exceeding the drinking water standard.

Overall, the results showed that the impact bores were experiencing only minor effects and indicate generally good management of nitrogen application rates in the vicinity of these three bores. However, the nitrate-N results obtained for the new control bore (GND2051) indicate that the groundwater on the

northern boundary of Farm 3 may be experiencing similar effects to those seen at the Farm 2 control bore (GND2049). Again, for the assessment of environmental effects to accompany the consent renewal application, the Company was asked to investigate whether the nitrate comes from farming activities up-gradient, from "mounding" of factory effluent applied down (the ground surface) gradient, or by some other mechanism.

Historically, GND2049 and GND2051 tend to show elevations in chloride, conductivity, and to a lesser extent sodium, in the surveys in which elevations in nitrate-N occur. It is noted that the relative contaminant concentrations are different in the other impact bores. These findings highlight that this is a complex system, and the relative contaminant concentrations would depend on when irrigation was last undertaken in the vicinity of each of the bores, the component concentrations of the wastewater as these vary according to wastewater type and site activities, and the mobility of the various contaminants in the soil/groundwater.

Although a theoretical analysis of the existing data was provided, there was no conclusive evidence supporting the conclusion that "upwelling" was the cause of the elevated nitrates at the control bores. It is likely that the renewed consent will require further work on this matter.

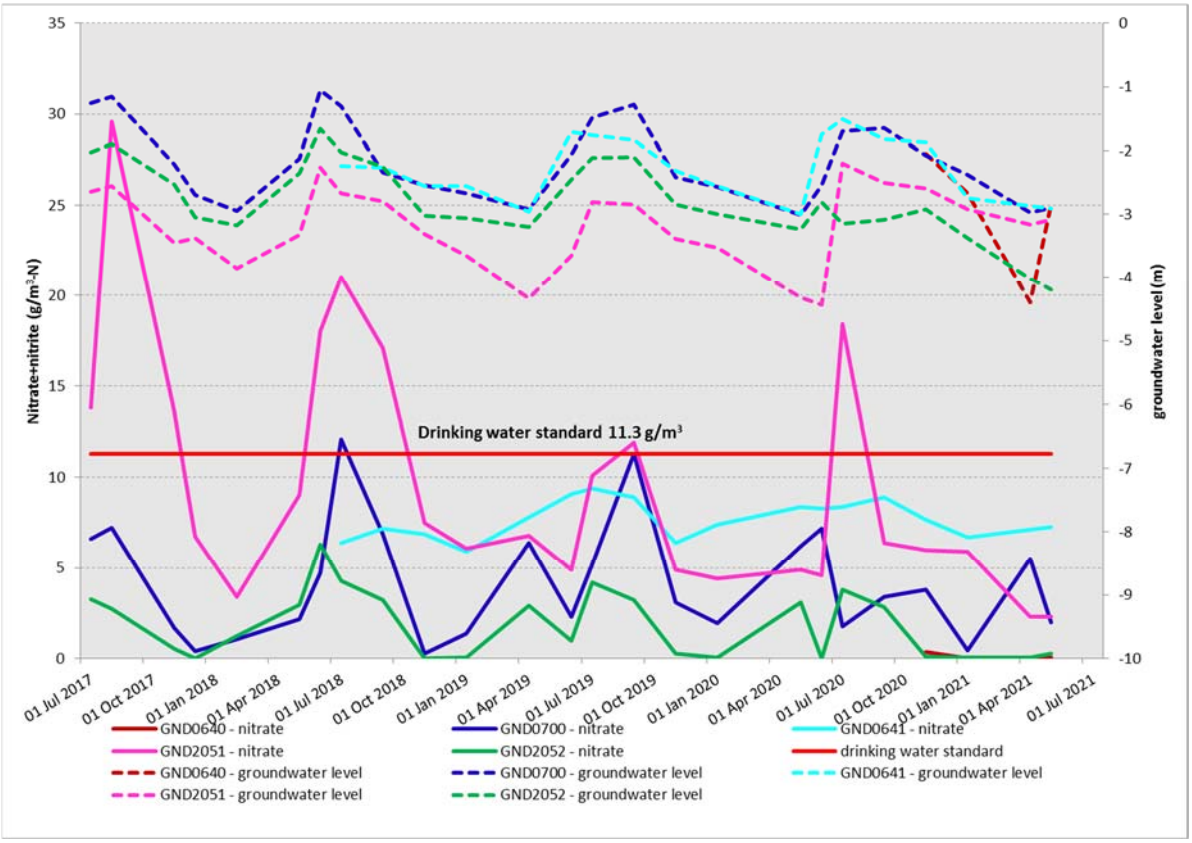

Figure 69 Farm 3 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.4 General

The use of all three farms for spray irrigation of wastewater has impacted on shallow groundwater to varying degrees, raising sodium and conductivity levels and altering nitrate levels.

The main parameter of concern is nitrate level, given the NZ Drinking Water Standard of 11.3 g/m^3 (as nitrate-N) has been exceeded frequently during this and previous monitoring periods. There are no known shallow groundwater water users in the immediate vicinity of the spray irrigation area, because of the availability and usage of the Waimate West Rural Water Supply Scheme. However, the Regional Freshwater Plan for Taranaki (2001) does provide for the taking and use of groundwater at a scale that would enable

reasonable farm use as a permitted activity. GWR Policy 4 of the Regional Policy Statement for Taranaki (2010) also states that groundwater quality will be maintained and enhanced by promoting land use practices that minimise, as far as practicable, the potential adverse effects on groundwater quality.

A summary of the groundwater nitrate monitoring results is given in Table 30. It is noted that during the year under review, the minimum, maximum and median values obtained for GND0638 increased to their highest levels since 2007-2008 year.

Table 30 Summary of groundwater nitrate concentrations at monitoring bores during the year under review

Property	Site code	Bore location	Designation	Number of samples	Nitrate & Nitrite-N, g/m^3	
					Range	Median
Farm 1	GND0636	North	Control	6	4.5 - 6.4	4.9
	GND0637	South	Impact	6	4.5 - **15.7**	11.0
Farm 2	GND2049	North	Control (new)	6	3.3 - **18.8**	**18.1**
	GND0638	West	Impact	6	**30 - 71**	**42**
	GND0639	South-west	Impact	4	4.4 - 6.7	5.3
	GND2050	South-west	Impact (new)	6	0.01 - 5.3	0.05
	GND2063	South-east	Impact	6	11.3 - **13.9**	**12.8**
Farm 3	GND2051	North	Control (new)	6	2.3 - **18.4**	6.0
	GND0640	West	Impact	4	0.01 0.33	0.019
	GND0641	Central	Impact	6	6.7 - 8.9	7.7
	GND2052	South-west	Impact (new)	6	0.033 - 3.8	0.166
	GND0700	South-east	Impact	6	0.43 - 5.5	2.7
New Zealand Drinking Water Standard					**11.3**	

In recognition of the potential for adverse effects on soil and groundwater quality, and in order to enable better combination of wastewater disposal and farming operations, the Company in 2006 purchased an additional 60 ha of land between Farm 2 and Farm 3, bringing the total farmed area to 244 ha. Consent 0923-3 was varied to provide for a planned 41% increase in spray irrigation area, from 120 to 169 ha (5 ha on original Farm 3). Work started in January 2007 on the extension, which comprised a 4.1 km pipeline from the factory to a storage and control facility on Farm 3, and the installation of fixed in-ground irrigators. The new system was commissioned in time for the 2007-2008 processing season.

The effect of the additional irrigation area on groundwater nitrate level was predicted, using the AgResearch Overseer model in combination with the water balance for the site. The annual average nitrogen loading used in the model was 523 kgN/ha/y (average over the previous 6 years, based on the November/December 2005 wastewater composition study) for the existing area. Assuming average rainfall of 1,200 mm, evapo-transpiration of 450 mm, and wastewater application of 383 mm, the drainage was estimated at 1,133 mm. The concentration of nitrate-N in the leaching water was predicted to be about 25 g/m^3. This value is similar to the levels that were found in some of the impact monitoring bores in previous monitoring periods. The introduction of the new farm was predicted to reduce the nitrogen load to about 371 kgN/ha/y. The concentration of percolate (leaching water) was predicted to reduce to 17 g/m^3, a factor of 39%.

It is noted that there has been a slight increase in the recognised areas irrigated on each of the farms of between 3 and 5 ha, increasing the total area irrigated from 164 to 175 ha across all three farms. This was as a result of more accurate mapping of the area.

In 2020-2021, a total metered volume of 511,506 m^3 of factory effluent was generated, which had a (time-based) average total nitrogen concentration of 99 g/m^3 (51 samples, range 8.9-167 g/m^3), giving an estimated total nitrogen mass of 55,238 kg. When applied to 175 ha, at an average depth of 292 mm, this amounted to an overall annual nitrogen application rate of 316 kg/ha. The calculated annual nitrogen application rates for Farm 1 (55 ha), Farm 2 (28 ha) and Farm 3 (92 ha) are 237, 356 and 350 kg/ha, respectively, assuming that the effluent has been evenly distributed across the available irrigation area on all three farms[4]. The average rate for Farms 2 and 3 was 353 kg/ha. It is noted that there was an increase in the estimated total mass of nitrogen applied to all three farms across the year under review when compared to the previous year. The increases were 10% on Farm 1, 4% on Farm 2, and 18% (4,833 kg) on Farm 3.

For dairy shed effluent, on Farm 1, a total metered volume of 18,175 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 151 g/m^3 (46 samples, range 54-163 g/m^3), giving a total mass of 2,910 kg (similar to the 2019-2020 total). When applied to 55 ha, at an average depth of 33 mm, this amounted to an overall annual nitrogen application rate of 53 kg/ha.

For dairy shed effluent, on Farm 3, a total metered volume of 20,685 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 117 g/m^3 (37 samples, range 50–219 g/m^3), giving a total mass of 2,416 kg. When applied to 120 ha, at an average depth of 22 mm, this amounted to an overall annual nitrogen application rate of 13 kg/ha.

The total mass of nitrogen from DSE irrigated was 5,326 kg in the 2020-2021 year, which was similar to the previous year. The factory wastewater annual nitrogen mass increased by 6,433 in the 2020-2021 year following an increase of 6,739 kg in the 2019-2020 year. During the year under review, the DSE total nitrogen again amounted to 9% of the nitrogen mass irrigated.

The averaged combined annual nitrogen loading rate for 2020-2021 from the irrigation of factory wastewater and DSE was 290 kg/ha on Farm 1 and 377 kg/ha on Farm 3, with the factory wastewater only annual loading rate on Farm 2 being 356 kg/ha. A comparison of the nitrogen application rates in recent years are given in Table 31.

Table 31 Farm nitrogen application rates

Monitoring year	Farm 1 nitrogen application rate (kg/ha/y)	Farms 2 and 3 nitrogen application rate (kg/ha/y)	Comments
2020-2021	290	366	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2019-2020	267	327	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2018-2019	221	286	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2017-2018	230	326	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3
2016-2017	288	379	Factory wastewater and DSE fully implemented at Farms 1, 2 & 3

[4] Preliminary paddock by paddock irrigation data provided during the year under review indicated that this may not be the case. This will reviewed in the 2021-2022 Annual Report following the consistent voluntary reporting of this information for the full year.

Monitoring year	Farm 1 nitrogen application rate (kg/ha/y)	Farms 2 and 3 nitrogen application rate (kg/ha/y)	Comments
2015-2016	283	353	Factory wastewater plus DSE (2 months only Farm 1) (9 months Farms 2 & 3)
2014-2015	270	382	Factory wastewater only, no DSE
2013-2014	259	309	Factory wastewater only, no DSE
2012-2013	244	321	Factory wastewater only, no DSE

In comparison, the respective loadings in 2014-2015 from factory wastewater alone were 270 and 382 kg/ha. Although the nitrogen loading rates had increased between that year and 2016-2017, there had been successive reductions in the loading rates on the farms during the 2017-2019 periods. During the 2019-2021 years, loading rates have returned to the higher rates reported in the 2014-2017 years.

This shows that the addition of the DSE has not significantly affected the nitrogen loadings and they are still considerably less than the average value of 523 kg/ha/y estimated for the period before the irrigation area was extended (2006-2007 processing season).

The calculated nitrogen mass and annual loadings need to be treated with caution as there can be significant discrepancies in the median wastewater and DSE analysis data between individual nitrogen species and total nitrogen (refer Table 10 and Table 11), along with relying on the assumption that the waste has been irrigated uniformly across all paddocks. In addition, there continued to be large variations in the total nitrogen concentrations of the wastewaters throughout the year under review.

Four additional groundwater monitoring bores were drilled in March 2008 to provide for the new irrigation area; to replace the two bores damaged during the 2006-2007 monitoring period; and to install a proper control for Farm 2. One of the damaged bores (GND0641) was repaired and made available for sampling again, which started again in January 2021.

On Farm 1 during the 2020-2021 year, it appears that, overall, the base nitrate levels under the irrigation areas have increased, with the annual median of the impact bore (GND0637) increasing from 8.6 in the 2018-2019 year to a concentration that is close to or above the 11.3 g/m^3 drinking water standard for the 2019-2021 years. As with the 2019-2020 year, during the year under review three of the nitrate-N concentrations in GND0637 were found to be above the drinking water standard. This is comparable with the long term monitoring data, with 47% of the total dataset for this bore above the standard. This is significantly higher than the 9% of the total dataset at the control bore that have been above the drinking water standard. At the control site (GND0636), again, none of the six samples collected during the year under review contained nitrate-N concentrations at or above the drinking water standard. For the second successive monitoring year there has been a decrease in the annual median nitrate-N concentration in the control bore, both of which have been lower than the historical median. During the year under review, the median value obtained for the impact bore was similar to the historical median for that site.

During the 2020-2021 year, the findings on Farm 2 indicate that whilst the nitrogen loadings may have been better managed in the south western area of the farm, this was not the case in other areas. During the year under review all samples from impact bore GND0638 were significantly higher than the drinking water standard, with the highest value being close to seven times the historical median. The potential causes of the increased nitrate-N concentrations in this bore were investigated by the Company, with the investigation findings and mitigating measures undertaken discussed in Section 2.3. It was also found that all six samples from impact bore GND2063 were at or above the drinking water standard. This may be attributable to uneven application of the nitrogen loadings across the farm and the increased overall annual

nitrogen loading on Farm 2 from the wastewater disposal activities during the year under review. This was 355 kg/ha during the year under review compared to 341 kg/ha in the 2019-2020 year and 241 kg/ha in the 2018-2019 year.

Concentrations at the control bore (GND2049) were elevated and generally above those found in the 2018-2019 year. Following a relatively low concentration of 3.3 g/m^3 found in the July 2020 sample, the concentration increase markedly along with successive increases in groundwater level between July and November 2020. It is noted that the nitrate-N concentration remained elevated and above the drinking water standard from September 2020 through to the end of the monitoring year, despite falling groundwater levels. In the 2019-2020 year it was found that there had been a decrease in the annual median, down to 12.7 g/m^3, following three years of consecutive increases in annual median (from 14.4 g/m^3 in 2016-2017 to 19.7 g/m^3 in 2017-2018 and then to 25.0 g/m^3 in the 2018-2019 year). During the year under review, the annual median returned to being at the higher level of 18.1 g/m^3.

On Farm 3, it had appeared that nitrate levels under the irrigation areas had decreased and were stabilising in response to the 2007-2008 increase in irrigated area. Again, during the year under review, it was found that the annual medians were for all the bores were similar to or lower than their respective historical medians. On a survey basis, it is noted that that the nitrate levels in the control bore (GND2051) have continued to show the occasional elevation that is above the drinking water standard of 11.3 g/m^3. During the year under review, this occurred on only one occasion, in July 2020, when there was also a significant increase in ground water level. The maximum value obtained (18.4 g/m^3) was higher than the 2019-2020 maximum, (11.9 g/m^3) but lower than the previous three years, which were in the range 21.0 g/m^3 to 29.8 g/m^3.

In the past, there have been spikes in groundwater nitrate concentrations that have occurred at most monitoring bores, both impact and control, that have coincided with recent heavy rainfall events and/or increased groundwater levels. The likely mechanism considered for these occurrences was the flushing of nitrate-N in the subsurface soils into the groundwater by the rainfall, combined with the groundwater "collecting" any subsurface nitrate-N in the soil as it rises. There were again spikes in nitrate level observed during the year under review and generally the bores with noticeable increases in nitrate-N concentrations were affected by increasing groundwater levels. This trend was observed at the Farm 1 impact bore, but not at the Farm 1 control bore. In previous year, there have been occasions on which further increases in the nitrate-N concentration have been observed as the groundwater levels reduced, indicating effects of the irrigation activities at this farm. All Farm 2 bores, with the exception of GND0639 (impact bore), demonstrated a trend of increasing (or reducing) nitrate-N concentrations that were consistent with increases or reductions in the groundwater level to varying degrees. GND0639 had relatively stable nitrate concentrations irrespective of changes in groundwater levels. Historically, GND2049 (control bore) has demonstrated nitrate-N concentrations that have varied inversely with groundwater levels, but this was not the case during the year under review. With the exception of GND0641, all Farm 3 bores had increases in the nitrate-N that coincided with the higher groundwater levels that were apparent in all of the bores in the winter survey. It is noted that the effects were again not quite as pronounced as in the 2016-2018 monitoring periods, however it is also noted that, for the most part, the changes in groundwater levels were also less pronounced and remained generally lower during the year under review. It is noted that the groundwater level in the Farm 3 control bore (GND2051) was found to have been above those recorded in the preceding three years, and recorded a nitrate-N concentration the was higher than the peak value from the previous year. These finding continue to be consistent with the above theory.

As discussed above, the results for the two relatively new control bores, at the upslope boundaries of Farm 2 and Farm 3, have continued to show significant elevations in groundwater nitrate-N levels in excess of the drinking water standard at times. This may be as a result of activities on adjacent farms, or of groundwater mounding that can occur as a result of an elevated localised hydraulic loading due to irrigation. As stated in the 2016-2020 annual reports, it had been signalled to the Company that the Assessment of Environmental

Effects (AEE) for the consent renewal would need to include paddock by paddock irrigation data, continuous groundwater level and rainfall data to support the investigation and reasoning for the elevated nitrate-N levels in the bores on the up gradient boundaries of Farms 2 and 3. This information was not provided in detail at the time of application, but the above continuous and daily data will be required by the replacement consents.

2.1.6 Motumate Stream surface water quality

In combination with groundwater monitoring, some spatial synoptic surface water monitoring was conducted at four sites on the Motumate Stream adjacent to and downstream of the Company's farms (Figure 50, Table 32). Three of these sites were previously monitored from November 2009 to April 2013, with approximately bi-monthly sampling recommencing in November 2017. A new site, MTM000057, was added further upstream in September 2018 due to the elevated level of contaminants observed in this stream and in the groundwater monitoring site at the control sites on the up gradient farm boundary.

These sites were originally chosen to monitor any possible effects on surface water from the discharge of groundwater used for cooling at the plant. The appropriateness of these locations may be re-evaluated to ensure that they are suited to the monitoring of potential effects in the stream from the spray irrigation of wastes on the Company's Farms 2 and 3, whilst also giving consideration to stream access. The results from the 2020-2021 monitoring period are presented in Table 33, and a summary of the monitoring previously performed is presented in Table 34.

Table 32 Description of the water quality monitoring sites in the Motumate Stream

Site	Site code	Description	Map reference, NZTM	
			Easting	Northing
1	MTM000057	Motumate Stream at railway line	1698475	5629820
2	MTM000075	Motumate Stream upstream of Skeet Road	1698445	5628959
3	MTM000120	Motumate Stream, Farm 3, Fonterra Kapuni	1697413	5626971
4	MTM000125	Motumate Stream at Hicks Road	1697046	5626558

The results for the 2020-2021 continue to show that the conductivity, sulphate, and dissolved magnesium measurements were generally similar at sites MTM000057 and MTM000075, with increases of varying degrees between this site and MTM000120. MTM000125 was generally similar to MTM000120 for these parameters (Table 33). Alkalinity, bicarbonate, chloride and sodium (Figure 70) were generally similar at sites MTM000057 and MTM000075, with increases of varying degrees between this site, followed by a further slight increase between MTM000120 and MTM000125.

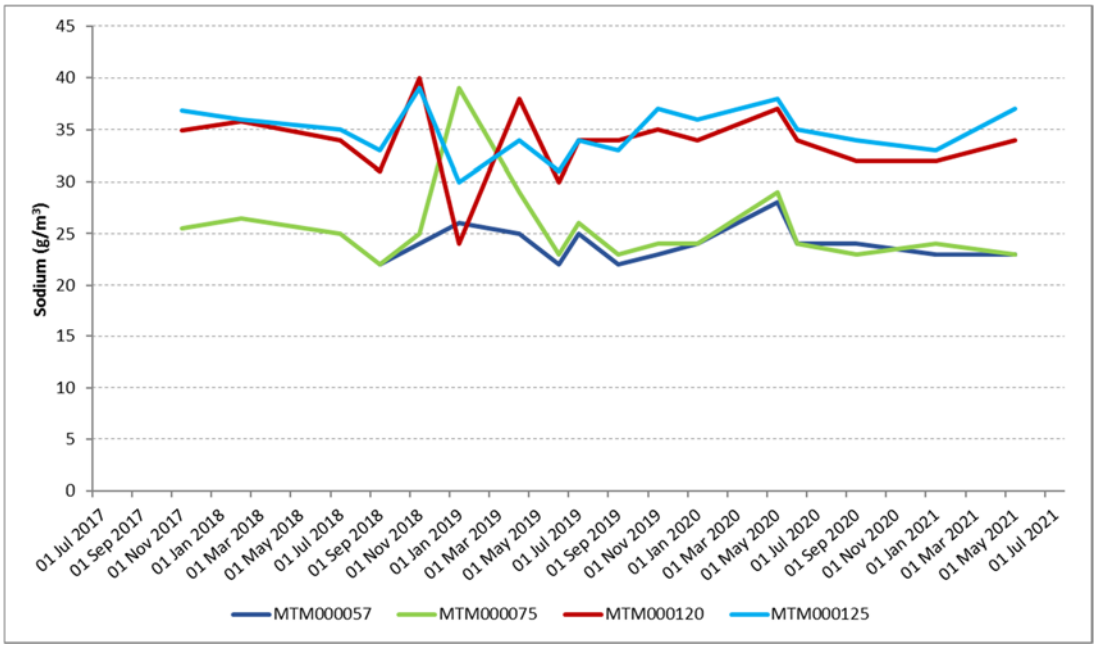

Figure 70 Sodium concentrations in the Motumate Stream 2017 to date.

None of the changes were such that they would be considered a significant adverse environmental effect.

The nitrate-N concentration continued to show a large seasonal variation (Figure 71), increasing from about 6 to 8 g/m^3 during times with higher groundwater level and/or soil moisture to 2 g/m^3 during times periods with lower groundwater level and/or soil moisture. This is a larger variation than was observed in the Waiokura Stream, which was in the range of approximately 2.1 to 3.8 g/m^3 (Table 37 and Figure 72). This is also in comparison to the NPS bottom line of 9.8 g/m^3 (annual 95th percentile). On all occasions the nitrate-N results increased between MTM000057 and MTM000075 and then generally decreased in a downstream direction. There were two surveys when the increase between sites MTM000057 and MTM000075 was small rather than the larger increase usually observed, although the nitrate/nitrite-N at these sites were still higher than at MTM000120 and MTM000125.

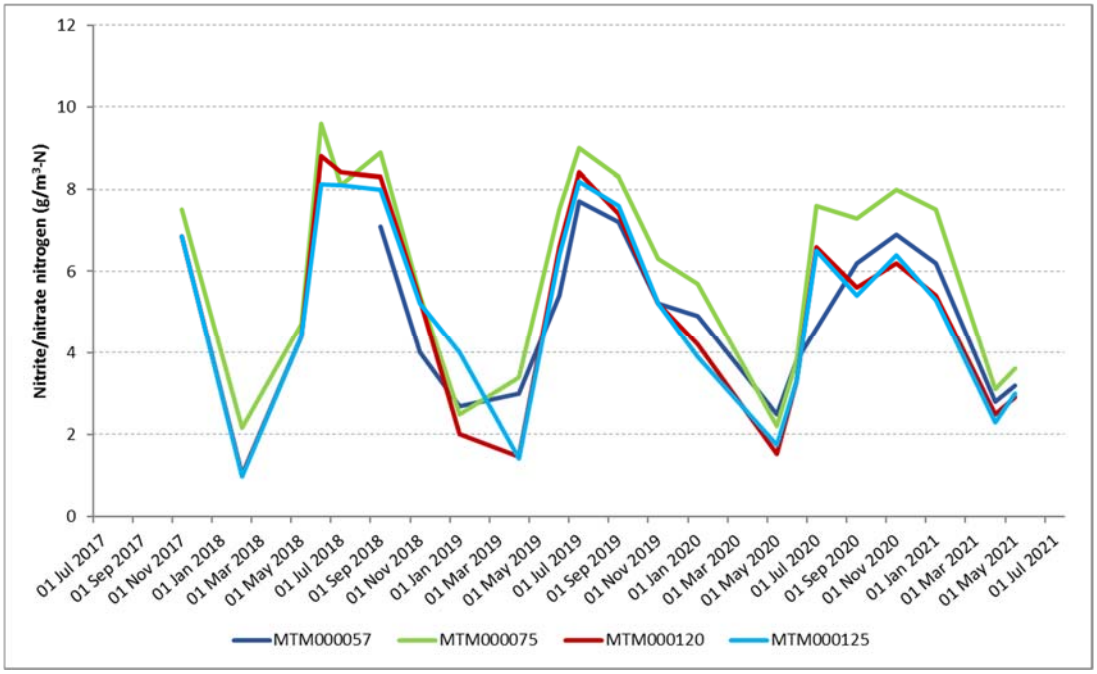

Figure 71 Nitrate/nitrite nitrogen concentrations in the Motumate Stream July 2017 to date

Continued monitoring will provide further information so that an assessment can be made regarding any possible environmental effects to surface water from the spray irrigation of wastewater on Farms 2 and 3, especially when paddock by paddock irrigation information is available. Total nitrogen was added to the analysis suite during the 2020-2021 year. Results obtained during the year under review showed that the total nitrogen concentration followed the same trends as the nitrate/nitrite-N concentration.

In terms of a comparison between the Motumate Stream and the Waiokura Stream it is noted that, in addition to the higher base nitrate-N concentrations, the conductivity and sodium were consistently higher in this water body during the year under review than in the Waiokura Stream. It is noted that there has been a shift in the range of nitrate-N concentrations observed in the Motumate Stream between monitoring undertaken in the 2009 to 2013 years (up to 5.9 g/m^3) and recent monitoring (up to 9.6 g/m^3).

In the 2018-2019 Annual Report it was proposed that if these higher levels continued in the 2019-2020 year, that consideration be given to re-establishing periodic biomonitoring in the Motumate Stream, and a recommendation to this effect was included in the report. As the high levels did continue, the stream habitat was evaluated. It was found that the habitat of the stream was such that biomonitoring results were likely to be influenced more by the habitat than any potential water quality issues through the irrigated area. Additionally it was likely that any effects from the high nitrates in the upper Motumate Stream would overshadow an effect potentially occurring through the irrigation area, if any were to be occurring.

Further investigations were initiated in the 2020-2021 year in order to identify whether there may be any unauthorised discharges occurring in the upper reaches of the catchment above the Fonterra Kapuni Farm 2 site in an attempt to identify the reasons for these elevated nitrates. Additional sampling was undertaken in December 2010. During these investigations found that the nitrate/nitrite-N concentration at the headwaters of the Motumate Stream was 2.3 g/m^3, which is similar to the concentration found in the Waiokura Stream. There were continued downstream increases in the nitrate/nitrite-N concentration, but no point source discharges were identified.

Table 33 Results of Motumate Stream quality sampling for the year under review

Parameter	Unit	MTM000057			MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	3	59 - 67	62	3	62 - 68	62	3	73 - 85	79	3	77 - 88	82
Ammoniacal nitrogen	g/m^3-N	5	0.012 - 0.044	0.019	6	0.020 - 0.055	0.030	6	0.021 - 0.080	0.035	6	0.028 - 0.135	0.050
Bicarbonate	g/m^3 at 25°C	3	71 - 81	76	3	75 - 83	76	3	89 - 103	96	3	93 - 107	100
Biochemical oxygen demand 5day	g O_2/m^3	5	0.5 - 0.7	1.0	6	0.5 - 2.0	1.0	6	0.5 - 1.4	1	6	0.5 - 1.2	1
Calcium	g/m^3	3	20 - 22	21.0	3	21 - 22	21.0	3	20 - 21	21.0	3	20 - 21	21.0
Chloride	g/m^3	5	32 - 38	35	6	32 - 42	36	6	39 - 45	41	6	40 - 45	42
Conductivity @ 25'C	mS/m	5	31.2 - 35.3	34.8	6	32.1 - 36.8	36.8	6	39.3 - 40.0	39.7	6	39.3 - 41.0	40.1
Dissolved reactive phosphorus	g/m^3-P	5	0.021 - 0.072	0.037	6	0.018 - 0.077	0.038	6	0.02 - 0.048	0.030	6	0.019 - 0.046	0.027
Hardness Total	g/m^3 as $CaCO_3$	3	84 - 89	87	3	87 - 91	88	3	91 - 93	93	3	89 - 95	92
Magnesium	g/m^3	3	8.0 - 8.4	8.4	3	8.5 - 8.8	8.7	3	9.7 - 9.9	9.8	3	9.3 - 10	9.8
Nitrite nitrogen	g/m^3-N	3	0.010 - 0.024	0.011	3	0.009 - 0.025	0.012	3	0.010 - 0.040	0.020	3	0.014 - 0.055	0.019
Nitrite/nitrate nitrogen	g/m^3-N	5	2.8 - 6.9	6.2	6	3.1 - 8.0	7.4	6	2.5 - 6.60	5.50	6	2.3 - 6.50	5.35
pH	pH Units	5	7.5 - 7.8	7.6	6	7.1 - 7.8	7.5	6	7.4 - 7.8	7.6	6	7.5 - 7.7	7.5
Potassium	g/m^3	3	14.5 - 16.1	15.0	3	14.5 - 16.0	15.5	3	13.9 - 17.5	15.7	3	14 - 18.8	16.1
Sodium	g/m^3	3	23 - 24	23	3	23 - 24	23	3	32 - 34	32	3	33 - 37	34
Sulphate	g/m^3	3	18 - 25	21	3	18 - 23	21	3	23 - 29	25.0	3	23 - 30	27.0
Sum of Anions	meq/L	3	2.9 - 3.2	3.1	3	3.0 - 3.3	3.2	3	3.5 - 3.7	3.5	3	3.6 - 3.8	3.7
Sum of Cations	meq/L	3	3.0 - 3.2	3.1	3	3.2 - 3.2	3.2	3	3.6 - 3.8	3.7	3	3.6 - 4	3.7
Temperature	°C	5	12.2 - 17.2	15.3	6	11.1 - 16.9	14.6	5	11.3 - 17.1	14.9	5	11.3 - 17.4	15.3
Total Kjeldahl nitrogen	g/m^3-N	5	0.29 0.58	0.40	6	0.36 0.75	0.40	6	0.34 0.72	0.5	6	0.33 0.75	0.4
Total nitrogen	g/m^3-N	5	3.3 7.3	6.5	6	3.8 8.3	7.9	6	3.1 6.9	5.95	6	2.8 6.9	5.85
Turbidity	FNU	5	5.6 - 13.6	8.8	6	4.6 - 15.1	10.4	6	7.2 - 23	9.3	6	2.8 - 18.9	9.15
Un-ionised ammonia	g/m^3	5	0.00016 - 0.0004	0.0002	6	0.00008 - 0.0005	0.000275	6	0.00017 - 0.0008	0.000335	6	0.00031 - 0.0011	0.00048

Table 34 Summary of Motumate Stream water quality data from the Council surveys during the period November 2009 to April 2013 and September 2018-June 2020

Parameter	Unit	MTM000057			MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	11	51 - 97	62	12	53 - 99	66	12	60 - 96	71	12	63 - 103	77
Ammoniacal nitrogen	g/m^3-N	11	0.016 - 0.330	0.022	22	<0.010 - 7.260	0.042	22	0.012 - 2.900	0.040	17	0.025 - 3.38	0.091
Bicarbonate	g/m^3 at 25°C	11	62 - 118	75	12	64 - 120	80	12	73 - 116	86	12	77 - 125	93
Biochemical oxygen demand 5day	g O_2/m^3	11	<0.4 - 10	0.8	28	<0.4 - 500	1.1	27	<0.4 - 13	1.5	16	0.7 - 3.2	1.2
Calcium	g/m^3	11	20 - 23	22.0	12	21 - 24	21.0	12	15 - 23	21.5	12	20 - 24	21.5
Chloride	g/m^3	11	32 - 47	36	12	33 - 51	37	12	28 - 52	44	12	40 - 50	46
Conductivity @ 25'C	mS/m	11	32.6 - 40.0	34.1	12	33.6 - 44.2	36.1	12	27.0 - 43.3	40.3	12	38.4 - 47.0	41.1
Dissolved reactive phosphorus	g/m^3-P	11	0.017 - 0.66	0.033	19	0.022 - 0.154	0.054	19	0.019 - 0.380	0.047	16	0.017 - 0.163	0.050
Hardness Total	g/m^3 as $CaCO_3$	11	81 - 98	90	12	87 - 98	92.0	12	64 - 105	97	12	90 - 108	97.0
Magnesium	g/m^3	11	7.4 - 10.2	9.0	12	8.0 - 10.7	9.3	12	6.5 - 11.4	10.5	12	9.0 - 12	10.6
Nitrate nitrogen	g/m^3-N	11	2.5 - 7.7	4.9	12	2.2 - 9.00	6.00	12	1.45 - 8.40	5.25	12	1.38 - 8.20	5.15
Nitrite nitrogen	g/m^3-N	11	0.005 - 0.048	0.014	12	0.008 - 0.164	0.010	12	0.008 - 0.044	0.014	12	0.013 - 0.131	0.020
Nitrite/nitrate nitrogen	g/m^3-N	11	2.5 - 7.70	4.9	25	0.95 - 9.60	5.4	25	1.02 - 8.80	4.65	16	0.98 - 8.20	5.2
pH	pH Units	11	7.2 - 7.7	7.60	28	7.4 - 7.8	7.5	27	7.1 - 8.0	7.5	17	7.3 - 7.7	7.5
Potassium	g/m^3	11	13.5 - 28	14.7	12	13.5 - 17.8	15.3	12	7.9 - 18.1	14.9	12	13.5 - 20	15.6
Sodium	g/m^3	11	22 - 28	24.0	21	21.9 - 39	25.3	21	24 - 40.8	34.0	14	30 - 39	35.0
Sulphate	g/m^3	11	17.3 - 26	19.4	12	17.1 - 26	20.5	12	10.1 - 32	25.5	12	16.4 - 33	26.0
Sum of Anions	meq/L	11	2.9 - 3.9	3.1	12	3.0 - 4.1	3.2	12	2.5 - 4.0	3.7	12	3.3 - 4.3	3.8
Sum of Cations	meq/L	11	2.9 - 3.8	3.2	12	3.1 - 4.1	3.3	12	2.5 - 4.3	3.8	12	3.5 - 4.4	3.9
Temperature	°C	11	10.1 - 19.0	13.1	27	1.2 - 19.9	13.3	27	10.7 - 19.7	14.0	17	11.4 - 20.0	14.2
Turbidity	NTU	11	5.8 - 92	8.1	21	4.0 - 100	10.1	20	4.2 - 36	10.6	16	3.0 - 18.3	8.3
Un-ionised ammonia	g/m^3	11	0.00008 - 0.0032	0.00023	18	0.0002 - 0.070	0.0004	18	0.00013 - 0.03407	0.00035	16	0.00021 - 0.0137	0.00086

2.1.7 Waiokura Stream surface water quality

Some spatial synoptic surface water monitoring was conducted at three sites on the Waiokura Stream adjacent to and downstream of the Company's farms (Figure 50, Table 35). This was carried out approximately bi-monthly.

Table 35 Description of the water quality monitoring sites in the Waiokura Stream

Site	Site code	Description	Map reference, NZTM	
			Easting	Northing
0	WKR000485	Waiokura Stream approx. 400 m u/s Skeet Road	1698819	5629373
1	WKR000500	Waiokura Stream at Skeet Road	1698807	5628892
2	WKR000630	Waiokura Stream 1.5 km, u/s of Hicks Road (~ 150m upstream of Farm 3's southern boundary)	1698126	5626926
3	WKR000650	Waiokura Stream at Hicks Road	1697735	5625026

These sites were chosen to monitor any possible effects on surface water from the spray irrigation of wastes on the Company's Farms 2 and 3. The results from the 2020-2021 monitoring period are presented in Table 37, and a summary of the monitoring previously performed is presented in Table 36.

Although the medians show little change between sites during the year under review (Table 37), the results for the 2020-2021 monitoring period again indicate subtle increases in most parameters, in particular conductivity and sodium, in the samples downstream of the control site (WKR000500) during each of the surveys. However, the changes observed are not significant enough to be considered an environmental effect. Nitrate nitrite-N concentration showed a seasonal fluctuation, varying from about 3.9 g/m^3 in winter/spring to 2.1 g/m^3 in autumn. This was again much less of a fluctuation than was observed in the 2016-2017 year (6.8 to 2.0 g/m^3). The median nitrate-N concentration for 2020-2021 at all three long established sites were similar to the respective long-term median values, as were the median sodium concentrations.

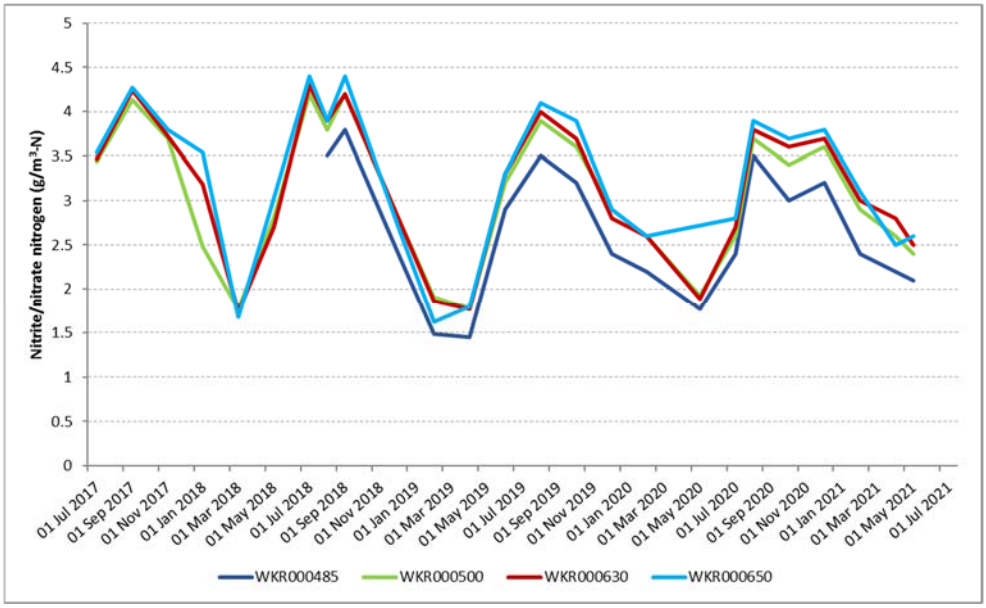

Figure 72 Nitrate/nitrite nitrogen concentrations in the Waiokura Stream July 2017 to date

Continued monitoring over future periods will provide further assessment of any possible environmental effects to surface water from the spray irrigation of wastewater on Farms 2 and 3, especially when paddock by paddock irrigation information is available.

Table 36 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2020

Parameter	Unit	WKR000485			WKR000500			WKR000630			WKR000650		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Alkalinity Total	g/m^3 as $CaCO_3$	11	44 - 67	55	11	44 - 66	55	11	47 - 68	56	10	48 - 70	57
Ammoniacal nitrogen	g/m^3-N	11	<0.010 - 0.400	0.014	12	<0.010 - 0.520	0.018	11	<0.010 - 0.110	0.012	10	<0.010 - 0.123	0.013
Bicarbonate	g/m^3 at 25°C	11	53 - 81	66	11	54 - 80	67	11	57 - 83	68	10	58 - 85	69
Biochemical oxygen demand 5day	g O_2/m^3	11	<2 - 3.0	2.0	19	0.5 - 12	2.0	18	0.7 - 3.3	2.0	17	0.5 - 3.4	2.0
Calcium	g/m^3	11	12.4 - 15.3	13.9	11	13 - 15.8	14.2	11	13.2 - 15.9	14.6	10	13.4 - 16	14.6
Chloride	g/m^3	11	23 - 28	24	12	23 - 29	25	11	25 - 30	26	10	26 - 29	28
Conductivity @ 25'C	mS/m	11	22.1 - 24.9	23.0	135	18.3 - 33.6	23	137	18.8 - 28.0	24.8	135	16.6 - 31.5	25.6
Dissolved reactive phosphorus	g/m^3-P	11	0.023 - 0.158	0.033	81	0.012 - 0.196	0.0	82	0.013 - 0.095	0.034	80	0.016 - 0.444	0032
Hardness Total	g/m^3 as $CaCO_3$	11	51 - 66	60	11	54 - 68	62.0	11	55 - 70	63.0	10	57 - 71	63.5
Magnesium	g/m^3	11	4.9 - 6.8	6.0	11	5.2 - 7.0	6.2	11	5.4 - 7.3	6.5	10	5.8 - 7.5	6.6
Nitrate nitrogen	g/m^3-N	11	1.44 - 3.7	2.4	11	1.77 - 4.20	2.90	11	1.76 - 4.20	2.80	10	1.61 - 4.40	3.10
Nitrite nitrogen	g/m^3-N	11	0.003 - 0.019	0.008	11	0.003 - 0.019	0.01	11	0.004 - 0.017	0.01	10	0.004 - 0.014	0.01
Nitrite/nitrate nitrogen	g/m^3-N	11	1.45 - 3.80	2.40	123	1.27 - 4.20	2.8	123	1.03 - 6.51	2.94	122	1.03 - 4.40	2.92
pH	pH Units	11	7.4 - 7.8	7.70	101	6.6 - 8.0	7.6	103	6.9 - 8.2	7.7	100	7.0 - 8.3	7.7
Potassium	g/m^3	11	5.3 - 9.8	6.0	11	5.4 - 10	6.1	11	5.8 - 10.2	6.8	10	6.0 - 9.0	6.9
Sodium	g/m^3	11	16.6 - 22.0	19.1	133	14.8 - 25.4	19.5	134	9.4 - 24.9	21.4	132	13.9 - 62.4	22.6
Sulphate	g/m^3	11	7.2 - 10.3	9.3	11	7.1 - 10.7	9.7	11	8.9 - 12.2	10.9	10	10.3 - 12.8	11.6
Sum of Anions	meq/L	11	2.0 - 2.3	2.1	11	2.1 - 2.4	2.2	11	2.2 - 2.4	2.3	10	2.2 - 2.6	2.4
Sum of Cations	meq/L	11	1.9 - 2.4	2.2	11	1.98 - 2.5	2.3	11	2.1 - 2.6	2.4	10	2.1 - 2.8	2.4
Temperature	°C	10	9.6 - 17.8	14.7	137	7.1 - 18.5	12.3	138	8.3 - 20.5	12.7	136	8.1 - 20.2	12.7
Turbidity	NTU	11	1.7 - 13.4	7.8	11	1.6 - 15.4	7.6	11	3.0 - 14.9	8.0	10	1.6 - 17.3	8.4
Un-ionised ammonia	g/m^3	11	0.00008 - 0.0037	0.00018	11	0.0001 - 0.0041	0.00024	11	0.00009 - 0.001	0.00019	10	0.00007 - 0.0029	0.00024

Table 37 Results of Waiokura Stream quality sampling for the year under review

Parameter	Unit	WKR000485			WKR000500			WKR000630			WKR000650		
		No.	Range	Median	No.	Range	Median	No.	Range	Median	No.	Range	median
Ammoniacal nitrogen	g/m^3-N	7	<0.010 - 0.021	<0.010	7	<0.010 - 0.024	0.014	7	<0.010 - <0.010	<0.010	7	<0.010 - 0.022	<0.010
Biochemical oxygen demand 5day	g O_2/m^3	7	<0.4 - 0.6	0.6	7	<0.4 - 0.9	0.4	7	<0.4 - 0.8	0.6	7	<0.4 - 1.4	0.8
Conductivity @ 25'C	mS/m	7	22.1 - 23.7	22.8	7	23.1 - 24.3	23.5	7	23.6 - 27.8	25.0	7	24.3 - 26.4	25.8
Dissolved reactive phosphorus	g/m^3-P	7	0.023 - 0.057	0.027	7	0.021 - 0.056	0.026	7	0.021 - 0.053	0.026	7	0.02 - 0.050	0.026
Nitrite/nitrate nitrogen	g/m^3-N	7	2.1 - 3.5	2.4	7	2.4 - 3.70	2.9	7	2.5 - 3.80	3.0	7	2.5 - 3.90	3.1
pH	pH Units	7	7.5 - 7.7	7.7	7	7.1 - 7.8	7.5	7	7.1 - 7.8	7.6	7	7.2 - 7.8	7.6
Sodium	g/m^3	7	17.8 - 20	19.2	7	18.3 - 21	19.8	7	20 - 23	21.0	7	21 - 24	22.0
Temperature	°C	7	9.8 - 16.7	11.7	7	9.9 - 16.2	11.7	7	10.1 - 16.7	12.2	7	10.0 - 16.9	11.7
Turbidity	NTU	7	4.3 - 9.6	9.1	7	4.6 - 9.4	6.4	7	4.5 - 10.5	7.8	7	4.1 - 10.7	5.1
Un-ionised ammonia	g/m^3	7	<0.00007 - 0.0002	<0.0001	7	<0.00005 - 0.0002	0.0001	7	<0.00002 - <0.0001	<0.0001	7	<0.00004 - 0.0002	0.0001

2.1.8 Biomonitoring

2.1.8.1 Fish passage temperature compliance in mixing zone

The Council installed and maintained two water temperature data loggers in the Kaupokonui Stream during the 1994-1995 monitoring period. These loggers were sited toward the left and right banks of the stream flow channel at the downstream periphery of the spray cooling water discharge zone. The purpose of these temperature recorders was to monitor compliance with Special Condition 8 of consent 0919-3 and 9 of consent 0924-3 which require that these discharges shall not give rise to a thermal barrier preventing the movement of fish species within the designated mixing zone of the wastes with the Kaupokonui Stream.

The presence of a significant water temperature differential across the stream within the spray discharge zone was established during the temperature surveys of March 1993, March 1994 and January 1995. These surveys recognised that only a gradual rise in water temperature occurred toward the true right bank of the stream during spray cooling water discharges, and that this gradual increase would not be expected to present a thermal barrier preventing fish passage through the spray discharge or 150 m mixing zone of the stream. The across-stream temperature differences measured at the periphery of the spray zone were 9.5˚C, 3.7˚C, and 2.1˚C at the time of the 1993, 1994 and 1995 surveys respectively, although variation in disposal systems, weather, stream flow conditions and factory production contributed to these differences in results.

In January 2011, the Council stopped monitoring temperature differential across the width of the stream, after continuous monitoring (at 15-minute intervals with very occasional disruption) since August 1993. The record is depicted in Figure 73. The monitoring ceased for two reasons. First, there was an unacceptable risk to the safety of the personnel who climbed down the stream bank and waded to the monitoring sites. Secondly, while temperature measurement along the length of the mixing zone was continued by the Company, at the time it was considered that transverse monitoring was no longer considered necessary, as disruption to fish passage was not expected to occur. This was based on the fact that significant periods of cooler water conditions had been demonstrated towards the right bank of the stream and there was gradual mixing of the cooling water discharges with the receiving water. The assumption was made that the fish would make use of the cooler flow corridor close to the true right bank.

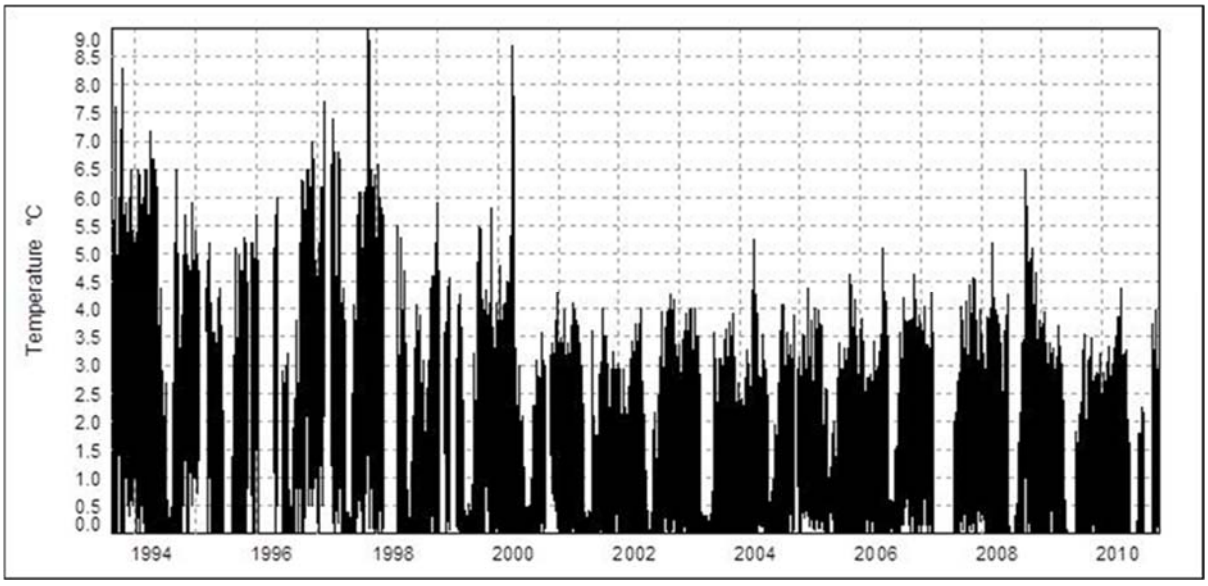

Figure 73 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Ltd spray cooling water discharge zone, 1993-2010

It was requested that the current temperature conditions within the mixing zone and the validity of this assumption be investigated by the Company during the preparation of the AEE for the renewal of the cooling water discharge consent.

Work was undertaken by the Company and a report was submitted as part of the application, however it was noted that the temperature monitoring was carried out prior to the cooling water discharge temperatures reaching their maximum. The instream temperature differentials through the spray discharge area and mixing zone were measured during a period of time when the upstream temperatures in the Kaupokonui Stream were in the range 17.8˚C to 18.1˚C and the cooling water discharge temperatures were in the range of 30˚C to 32˚C. Although the report states that the cooling water discharge temperature was maximised (within operational constraints) during the survey, monitoring of the cooling water discharge temperature shows that the peak temperatures resulting from the operational changes (approximately 40˚C) were not reached until after the monitoring within this reach of the stream had been completed. As a result, the report cannot be considered representative of the worst case that may be found under normal operating conditions.

After the cross stream temperature monitoring was ceased, a programme of (triennial) fish monitoring was instituted, to assess both the influence of the cooling water discharge on fish passage, and the effectiveness of the fish pass at the water abstraction weir about 100 metres upstream. The first fish monitoring survey was conducted in January 2014. A second survey was carried out in June 2017 and was undertaken again in the 2019-2020 year. The results of the 2019-2020 survey are discussed in section 2.1.8.4. The next survey has been rescheduled to the 2021-2022 year following the removal of the Glenn Road weir.

Kaupokonui Stream flow records for the monitoring period for the Glenn Road recording station are presented in Figure 74.

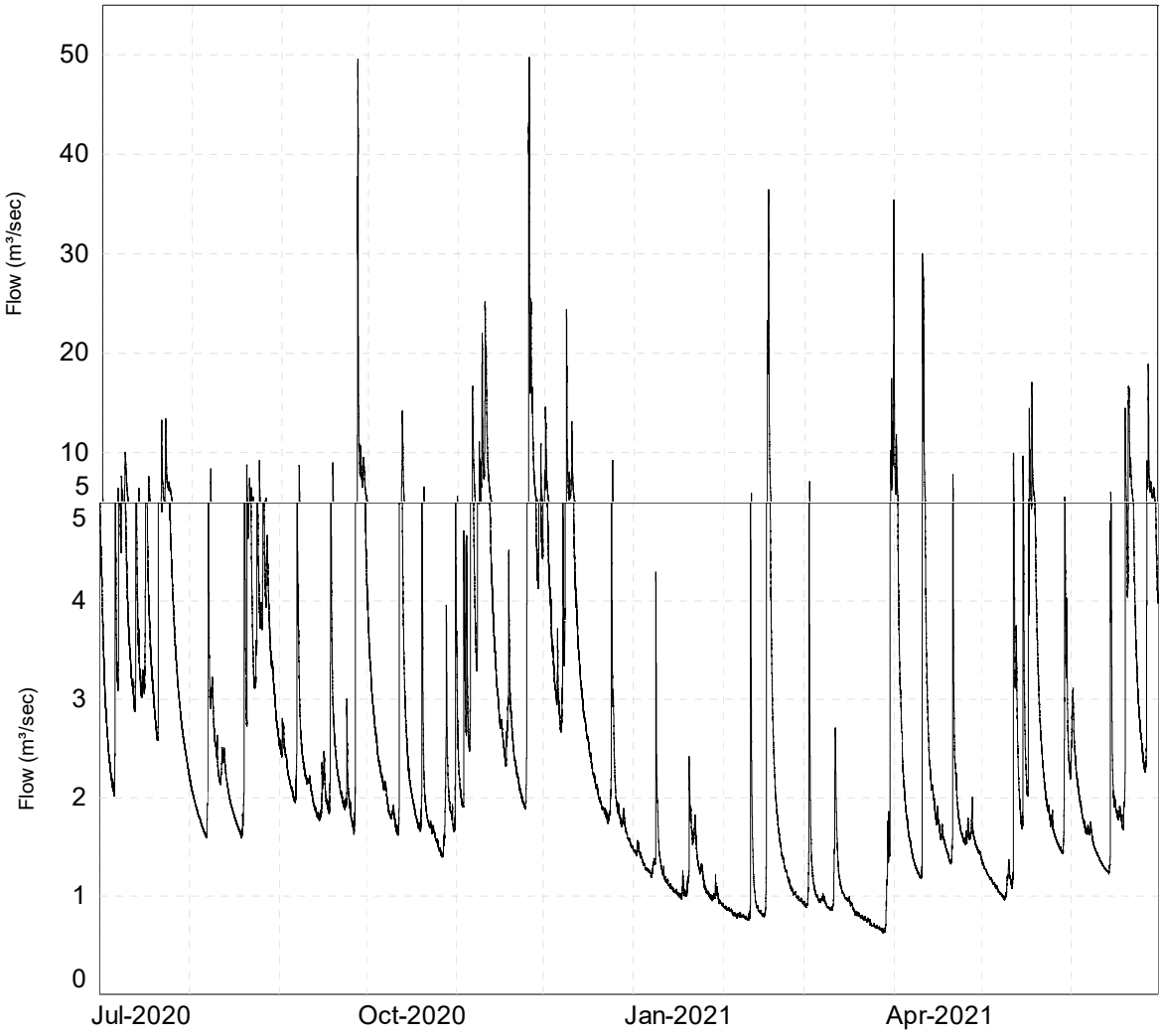

Figure 74 Kaupokonui Stream at Glenn Road flow record (m^3/s) for the year under review

2.1.8.2 Lower stream water temperatures

Two additional water temperature data loggers remained in place in the lower reaches of the Kaupokonui Stream for the duration of the year under review period to provide ambient stream temperature data over the 14 km reach downstream of the factory to the coast. These loggers are sited in the stream at Upper Glenn Road, about 9.8 km downstream of the lactose plant discharge, and above the tidal influence, approximately 1.4 km upstream of the stream mouth. The loggers were installed in July 1999, with the agreement of the Company, in response to concerns expressed by submitters to consents 0919-3 and 0924-3 to discharge cooling water from the lactose plant. The original location of the Upper Glenn Road monitoring site was at the Glenn Road weir. With planning underway to remove the Glenn Road weir, a new monitoring location was established that is approximately 500 metres upstream of the weir.

Water temperature records for these two sites are illustrated in Figure 75 and Figure 76.

A monthly summary of these data is included in Table 38.

Stream temperatures were relatively low during the year under review, with the maximum temperatures at Glenn Road and the beach being 25.5˚C and 24.0˚C on 27 January 2021. This is in comparison to temperatures of approximately 1˚C higher at each of these sites during both the 2018-2019 and 2019-2020 years.

On 27 January 2021 the temperature of the Kaupokonui Stream upstream of the Company's site peaked at 22.9˚C, with the temperature at the downstream mixing zone below the sprayers being 22.7˚C, that is, effectively unchanged. The discharge temperature from the cooling tower was approximately 26˚C at this time.

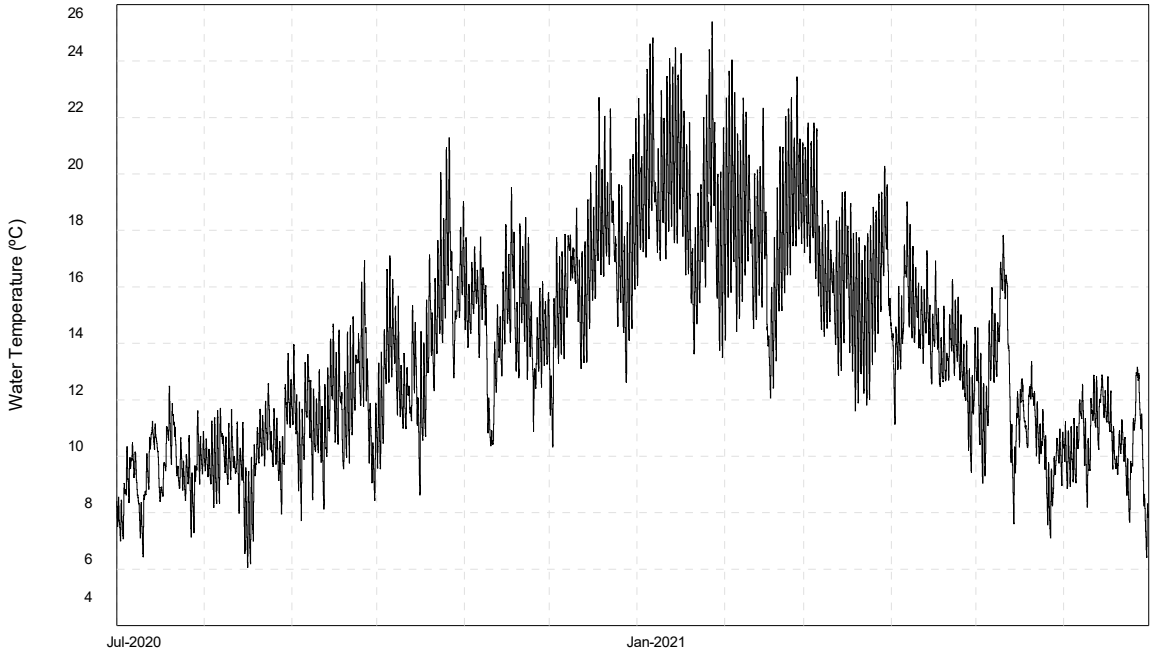

Figure 75 Water temperature (°C) records for the Kaupokonui Stream at Glenn Road during the year under review

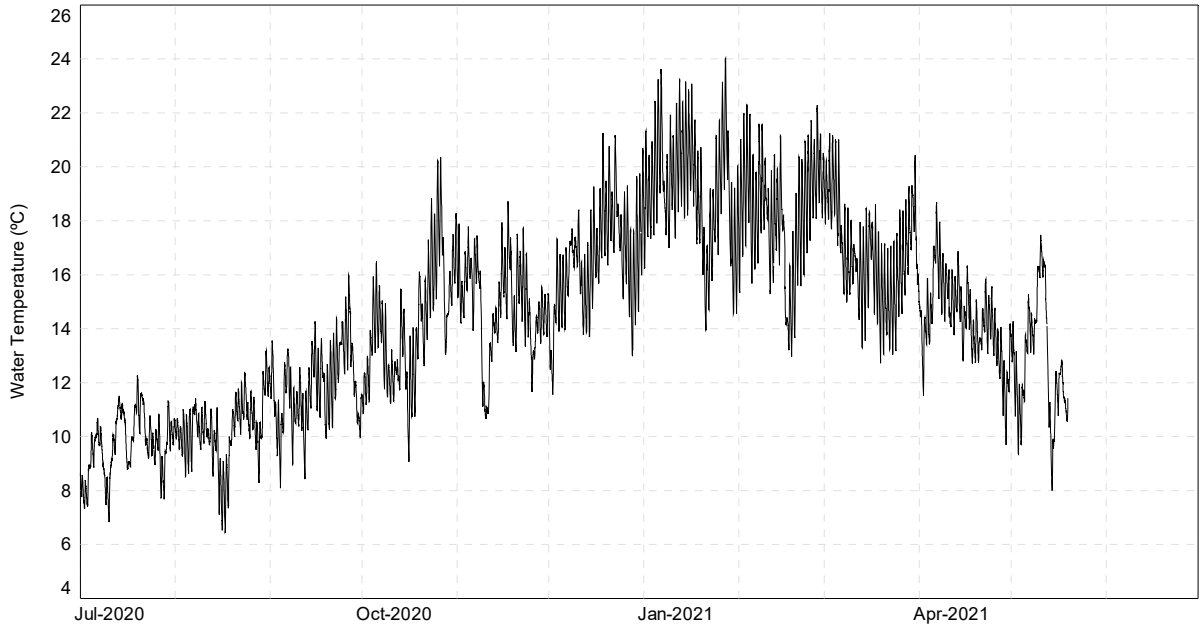

Figure 76 Water temperature (°C) records for the Kaupokonui Stream at beach during the year under review

Table 38 Monthly Kaupokonui Stream water temperature data for Glenn Road and the coast during the year under review

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
Jul 2020	6.4	9.4	12.5	6.8	9.7	12.3
Aug 2020	6.1	10.0	13.7	6.4	10.2	13.2
Sep 2020	7.7	11.7	17.0	8.1	11.9	16.0
Oct 2020	8.6	14.0	21.3	9.1	14.1	20.4
Nov 2020	10.4	14.7	19.5	10.7	14.8	18.7
Dec 2020	10.3	16.6	22.7	11.6	16.6	21.3
Jan 2021	13.5	19.2	25.4	13.9	19.2	24.0
Feb 2021	12.1	18.1	24.1	13.0	18.3	22.3
Mar 2021	11.6	16.5	21.8	12.7	16.7	21.3
Apr 2021	9.4	14.2	19.0	9.7	14.3	18.7
May 2021	7.1	11.7	17.8	-	-	-
Jun 2021	6.4	10.6	13.2	-	-	-

Key missing data due to loss of the logger

An analysis of the stream water temperature data for each site over the year under review indicated that 20˚C, above which trout start to become stressed, was exceeded for approximately 6% of the year at Glenn Road and 5% of the year near the mouth. Annual median water temperatures were 13.6˚C at Glenn Road and 14.5˚C near the mouth. During the warmer months of November to March, the temperatures exceeded 20˚C for approximately 14% of the time at Glenn Road and 11% of the time at the coast, which is a reduction in the amount of time at both sites when compared to the previous year.

The highest temperature recorded in the lower Kaupokonui River is 29.0°C, at Glenn Road on 9 January 1994 at 1500 NZST.

Instream temperatures continue to increase beyond the periphery of the mixing zone. It is not clear whether the increase in stream temperature due to the lactose plant's cooling water discharge introducing a step change that is cumulative, or whether stream temperatures below the lactose plant drop back to the upstream temperatures before natural heat fluxes take effect, and whether the reduction in flow due to the water consumption at the plant contributes to this in any way. This will be a matter for further investigation during the processing of the replacement consent applications.

2.1.8.3 Evaluation of fish passage

An assessment of the effectiveness of the fishpass on the Kaupokonui Stream weir at the Company's plant (Consent 0302-3) was performed by Council staff using night spotting techniques at six sites in the Kaupokonui Stream in April 1999. These results were reported in the 1998-1999 Annual Report by Council (TRC 1999), which contained a recommendation for further fish investigations in the Kaupokonui Stream upstream of the Company's weir. The purpose of the proposed investigations was to determine the upstream extent of red-finned bully migration within the stream. This information was required to determine whether or not passage for native fish needed to be specifically addressed in the design of a replacement fish pass. However, fish data recorded in the lower section of the Kaupokonui Stream in October 1999 demonstrated that passage for native fish needed to be given specific consideration in the design of a new fish pass.

In October 2000 the Council recorded torrentfish in the lower section of the Kaupokonui Stream. Torrentfish migrate up and down waterways several times throughout the year and have been recorded in Taranaki streams up to an altitude of 440 m. However, they are poor climbers and are not currently able to negotiate the hydrological control weir in the Kaupokonui Stream at Glenn Road, at an altitude of 50 m. With the construction of a new fish pass at this weir to enable the passage of torrentfish and other native species over the weir, torrentfish are expected to migrate upstream to the Company's site, at an altitude of 160 m.

In September 2000, Fish and Game Taranaki wrote to the Council recommending that a 'constructed stream' type fish pass be built over the Company's Kapuni weir, similar to the one recently built on Cold Creek for South Taranaki District Council. Such a pass would allow for the passage of both trout and native fish. A deep channel in the centre of the pass would allow for the passage of trout. Rough, shallow zones on the edge of the pass would allow for the passage of native fish. It was suggested that a local engineering firm develop a design, and that a recognised fish pass expert evaluate the design. The Council concurred with this proposal.

In December 2000, the Council's Freshwater Biologist met onsite with Company and Fish and Game Taranaki staff, and Mr Charles Mitchell, a fish pass consultant. The weir was visited and options for the fish pass to provide passage for native fish (targeting torrentfish), and trout were discussed.

A report dated May 2001 prepared by Charles Mitchell and Associates was forwarded to the Council. This report outlined two possible options for upgrading fish passage past the weir. In November 2001, the Company advised the Council of the proposed works to construct the fish pass. The Council advised that it was appropriate to undertake the works in accordance with the conditions of consent 4623, and that no change to the consent was required.

Construction of the fish pass was subsequently completed in late March 2004, and the pass was commissioned in early April 2004. Council and Fish and Game Taranaki assisted with the construction, particularly the placement of rocks within the pass. Visual inspections have indicated the pass is functioning well, and trout have been observed immediately upstream that may have used the pass. However, in November 2010, during a routine biomonitoring survey, it was noted that a cut-out had formed in the side of the lower section of the pass, through which a significant amount of the water flow was escaping. Repairs to the upper and central sections were made in May 2013. Further work on the bottom section was carried out in summer 2013-2014.

To interpret the results of a fish passage survey correctly, it is important to be aware of other barriers to fish passage downstream of the site being surveyed. Located downstream of the Kapuni Lactose factory, there is a weir known locally as the Glenn Road weir. This weir is an orphaned structure which presents a significant barrier to the passage of most fish, but is considered to have some historical significance, and therefore it has been allowed to persist. Only the best climbing species have been able to negotiate the Glenn Road weir. As a result, it is extremely unlikely that swimming species, such as common smelt, inanga, and torrentfish are able to reach the Kaupokonui Stream near the lactose factory. Climbing species are also adversely effected by this structure as was seen in 2020 when 100+ adult lamprey were found dead surrounding the structure after failing to navigate the weir. This means that the Kapuni Lactose weir fish pass has never properly been assessed for provision of passage for swimming species as well as the full natural extent in terms of abundance for climbing species. The Glenn Road weir is consented to be removed from the stream with works beginning when conditions are favourable. It is anticipated that this is likely to be during the summer of 2021.

After the removal of the Glenn Road weir, the weir at Kapuni Lactose will become the first known barrier to fish passage in the catchment, although there may be some natural barriers or behavioural restrictions that could influence fish species reaching the Kapuni Lactose weir. Therefore, it is imperative the fish pass is assessed and maintained at a high standard to ensure swimming and climbing species have access to the catchment upstream of the Kapuni Lactose weir. Because most swimming species have likely been excluded

from the catchment since the installation of the Glen Road weir, it is expected that the fish community of the entire Kaupokonui catchment upstream of the Glen Road weir will drastically (but not immediately) change upon removal of the weir. This means that swimming species, other than trout, may attempt to navigate the Kapuni Lactose weir, likely for the first time in many decades. This will require a more comprehensive assessment of the weir's fish pass.

A visual inspection of the weir during the March 2020 survey noted that there were areas of improvement that needed to be undertaken to ensure a higher proportion of successful fish passage attempts is achieved across all species. However, further improvements are also likely to be needed following the removal of the weir to accommodate swimming species that were not previously able to reach the Company's weir. It is considered appropriate that any remedial work is delayed until the Glen Road weir has been removed and passage is reassessed in 2021-2022 (and potentially the following year) so that premature remedial actions are not made, and it can be ensured that any modifications address issues for different fish communities.

At the time of the routine compliance monitoring inspections trout were observed above the weir on nine of the 12 monitoring occasions. An eel was also observed above the weir at the time of the May 2021 inspection. In December 2020, January 2021 and February 2021 a juvenile fish was sighted in the water intake.

2.1.8.4 Fish survey

Fish surveys were scheduled to take place every third year. A survey was carried out in March 2020, with the next survey scheduled for the 2022-2023. However, due to potential issues found with the weir and fish passage, and the removal of the Glenn Road in the 2020-2021 year, the monitoring schedule was revised. A discussion of the actual and potential issues identified during the March 2020 survey, and the reasons for the revised monitoring schedule are presented below, along with relevant activities that occurred during the year under review.

A four-site fish survey was undertaken in the Kaupokonui Stream on 13 and 17 March 2020, in order to determine whether the activities of the Kapuni Lactose factory had had any impact on the fish communities of this stream. The fish communities were surveyed using the electric fishing technique, with all fish identified where possible, counted, and lengths estimated. The sites monitored are described in Table 39 and shown in Figure 77.

Table 39 Location and description of fish monitoring sites in relation to the Kapuni Lactose factory

Site	Site code	Site description	Grid reference	Distance to coast (km)	Approximate Altitude (m)
1	KPK000652	4.3 km upstream of intake weir	E1698130 N5632654	19.68	170
2	KPK000666	Between intake weir and cooling water discharge	E1697744 N5629658	15.5	160
3	KPK000677	Downstream of cooling water discharge	E1697644 N5629458	15.3	160
4	KPK000685	Skeet Rd	E1697221 N5628986	14.51	150

The two main activities that could potentially impact on the fish communities are the discharge of cooling water to the Kaupokonui Stream and the water intake weir, located just upstream of the cooling water discharge. In addition, it should be noted that at the time of this survey, some kilometres downstream of the factory is an orphaned structure, the Glenn Road weir, which did not have adequate fish passage provision.

Upstream of the Kapuni Lactose weir, longfin and shortfin eels were recorded, indicating that the Company's weir is not posing a significant barrier to fish passage for these climbing species. The weir has yet to be assessed for all swimming species such as inanga, smelt, and torrent fish due to the presence of the Glenn Road weir. While redfin bully was not recorded at site one, it has been recorded in the past above the weir. Lack of detection of the redfin bully during the March 2020 survey was likely due to low abundance rather than there being a complete barrier to fish passage for the species presented by the Kapuni Lactose weir.

While the fish pass is clearly navigable by the species present (climbers) in this area of the stream, there will likely need to be some improvement to the weir to allow easy fish passage to swimming species, and perhaps some improvement to increase the utilisation of the ramp by climbing species. It was noted that the weir has a large amount of attractant flow that could lead fish to the base of the weir which may result in the delay or failure of upstream passage. This could eventually lead to predation or mortality by movement to land as has been observed at a number of other similar structures. The face of the weir is not conducive to fish passage due to an overhanging perch and sharp edges.

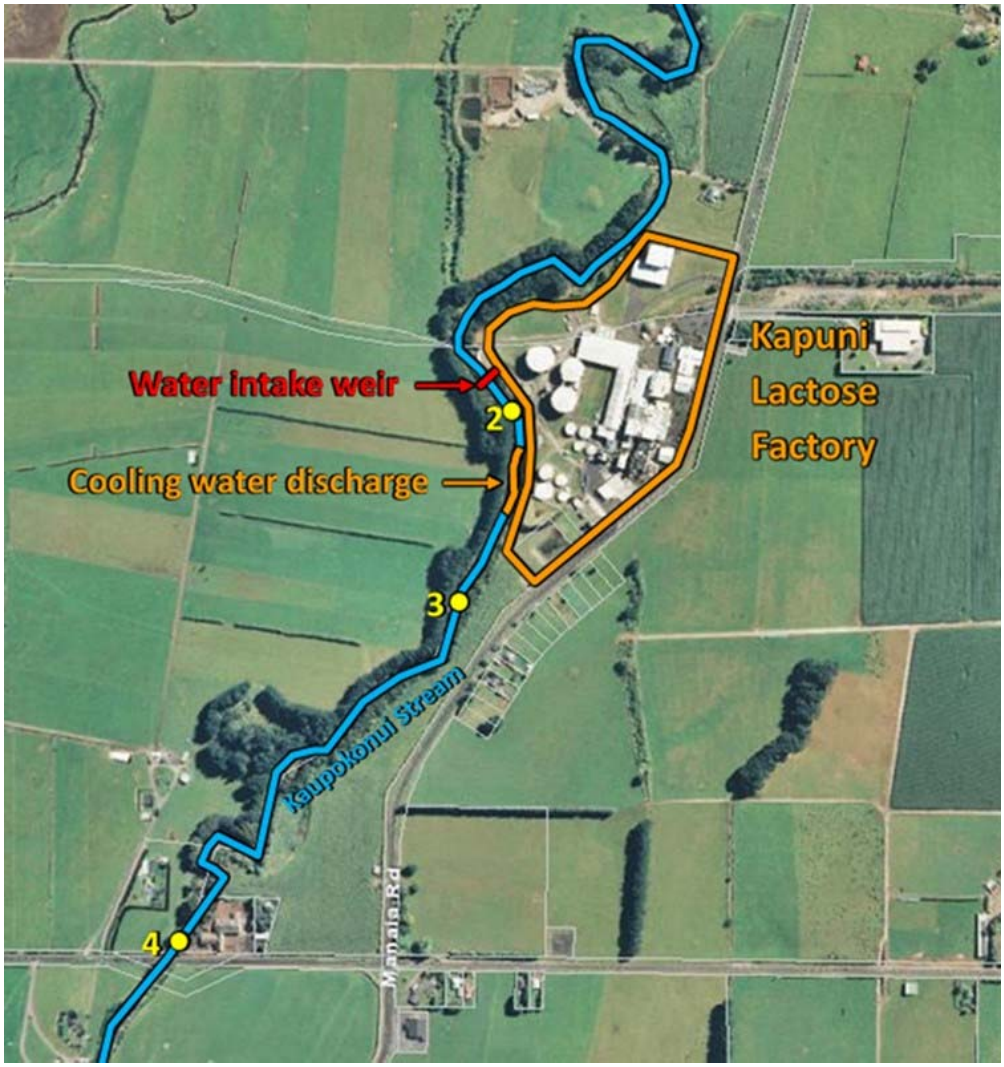

Figure 77 Fish monitoring sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory. Site 1 is located approximately 4.3 km upstream of the weir.

Additionally, the weir was found to be leaching from the underside and true right side of the weir, which may further encourage fish to linger at the base of the weir. The fish pass is somewhat shallow, which would prove challenging to navigate for larger fish. The top of the fish pass is unprotected and will prove difficult for smaller fish exiting the fish pass to avoid predation. Large trout were observed loitering at the top of the

fish pass, suggesting that it may be a frequent feeding spot which has been seen to occur at a number of similar structures. Addition of some form of exit cover, such as boulders, would aid smaller fish in avoiding predation while exiting the fish pass.

Overall, these surveys results appear to show that the activities of the Kapuni Lactose factory were not significantly adversely affected the fish communities of the Kaupokonui Stream at the time of the survey. However, it is expected that complete passage is not being provided for due to the reasons outlined earlier, and that, in general, these survey results are unlikely to effectively portray these issues due inherent limitations in the survey methodologies. As the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, the diversity and abundance of fish in this stretch of stream will likely improve. A more comprehensive assessment of the weir and thermal effects of the cooling operation will be required as the stream values increase. It is worthwhile delaying any remedial works until further information can be collected with respect to the changing fish community from the removal of the weir, which would be used to inform remediation options. However, it is also important to recognise that there is a possibility of potentially significant effects through the lack of fish passage and thermal effects, so any remediation required may need to be undertaken promptly to ensure continued consent compliance.

The Glenn Road weir was successfully removed in February 2021. Following the removal of the weir, Environmental DNA (eDNA) monitoring was undertaken in an attempt to assess the effectiveness of removing the barrier on the upstream fish communities. Sampling upstream of the Glenn Road weir indicated that inanga and torrentfish were now present, showing that the enhancement project was successful. It is now expected that these new species, and perhaps higher abundances of other species already present upstream of the Glenn Road weir, would begin to penetrate further up into the catchment and that they may eventually reach the Fonterra weir.

2.1.8.5 Macroinvertebrate surveys

Macroinvertebrate surveys were carried out in the Kaupokonui Stream in relation to the Fonterra Kapuni farm and factory to examine the effects of discharges to the stream and to land in the vicinity of the stream on 2 November 2020 and 1 February 2021. The Waiokura Stream sampling was expanded to include three site at the time of the February 2021 survey, as per the recommendations of the 2019-2020 Annual Report. Macroinvertebrates were identified and number of different types of taxa counted (taxa richness), macroinvertebrate community index (MCI) and semi-quantitative macroinvertebrate community index (SQMCI) scores were calculated for each site. The sites monitored are described in Table 40 and shown in Figure 78. Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The report summaries are provided below. Copies of the full reports are available from the Council upon request.

Table 40 Biomonitoring sites in the Kaupokonui and Waiokura streams sampled in relation to Fonterra Kapuni

River	Site number	Site code	Grid reference (NZTM)	Location
Kaupokonui Stream	3b	KPK000655	E1697963 N5630770	1 km u/s of railway bridge
	4	KPK000660	E1697613 N5629791	Railway, above factory
	5	KPK000679	E1697607 N5629399	160 m below cooling water discharge zone
	6	KPK000685	E1697221 N5628986	Skeet Road
	7	KPK000880	E1693026 N5622705	Glenn Road

River	Site number	Site code	Grid reference (NZTM)	Location
Waiokura Stream	U	WKR000500	E1698807 N5628892	Skeet Road
	I	WKR000640	E1697979 N5626757	Immediately D/S Fonterra Farm 3 boundary
	D	WKR000650	E1697735 N5625026	At Hicks (Thomas) Road

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_s$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored and enable the overall health of the macroinvertebrate communities to be determined.

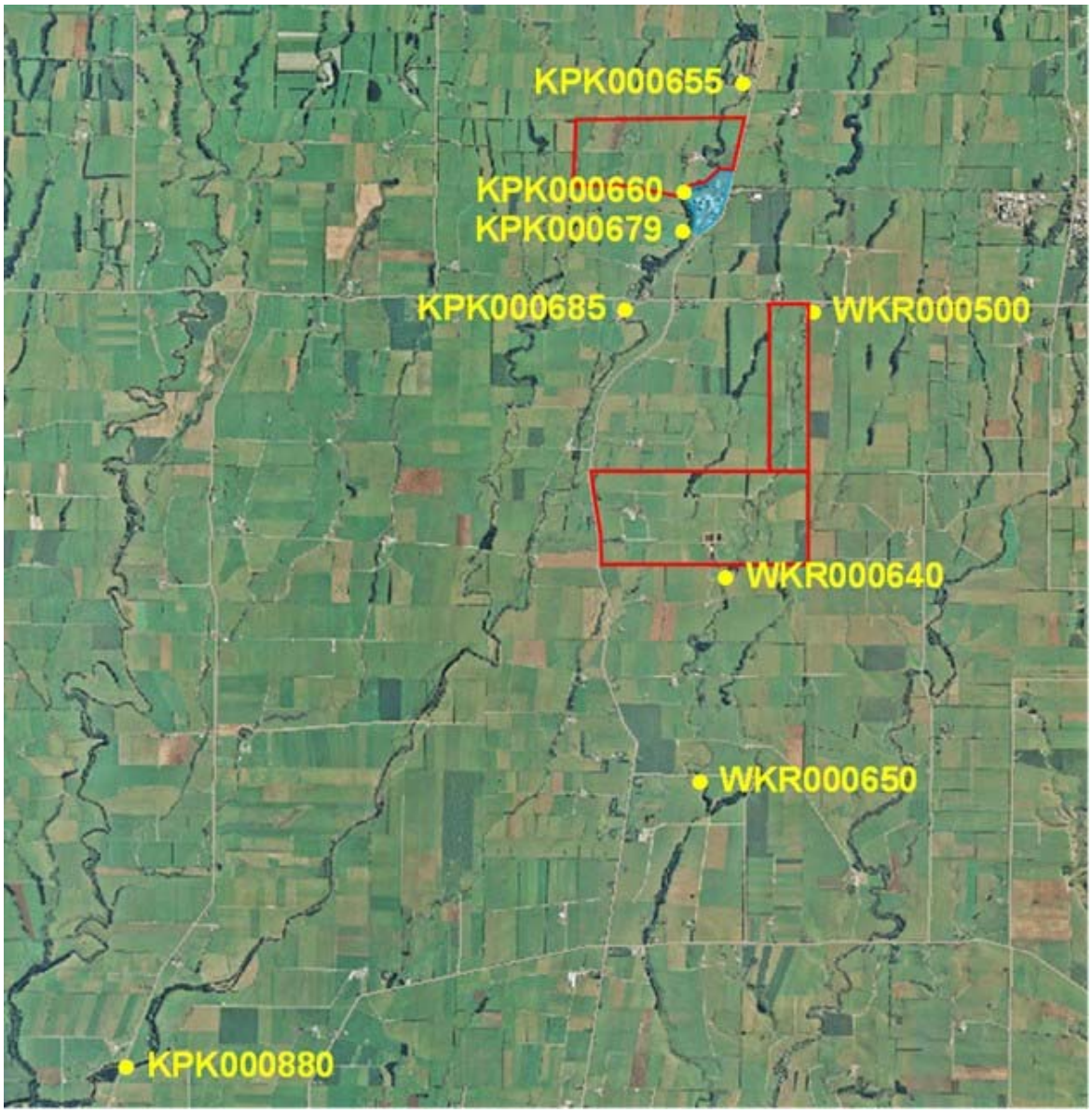

Figure 78 Biomonitoring sites in the Kaupokonui River sampled in relation to the Company's factory discharges

2 November 2020

In this November 2020 survey, the five sampling sites supported taxa richness of between 18 and 24 taxa. This range was slightly larger than recorded in the preceding survey. At individual sites taxa richness differed from the preceding survey by between a decrease of two taxa (site 6) and an increase of eight taxa (site 3b). These results were all equal to or lower than the sites respective medians since 1998, by up to seven taxa (site 4). This is demonstrated in Figure 79. Taxa richness in the current survey was similar at sites 3b and 5, while the remaining sites all recorded a lower richness of 18 taxa.

MCI scores ranged from 103 to 128 units in the current survey, indicating 'very good' to 'good' macroinvertebrate community health throughout the surveyed reach. As is typical, MCI scores overall showed a decrease in a downstream direction. The upstream site, 3b, recorded a MCI score of 128, which was significantly higher than the preceding survey result and the median score for this site; and was the highest score recorded at this site to date. This score was also significantly higher than the scores recorded at sites 4- 7, which had no significant differences between these sites. Site 4 had a score significantly lower than the preceding result, while site 6 recorded a score significantly higher than the preceding survey. Scores at both sites were similar to the respective median scores since 1998. In contrast, site 7 recorded a score similar to the preceding survey but significantly higher than the site's median score since 1998. SQMCI scores ranged from 4.4 to 5.9, with scores being similar at sites 3b, 4, 5, and 7. Site 6 had a score significantly lower than any other site in this survey.

In some previous surveys, a decline in macroinvertebrate community health has been noted between sites 3b and 4, which may be attributable to the discharge of treated dairy shed effluent to an inflowing tributary a short distance upstream of site 4. This deterioration was again recorded in the current survey, with a significant change in MCI score, and a decrease in taxa richness of six taxa between these two sites. However, it should be noted that the decrease in MCI score can be attributed to a higher than usual MCI score at site 3b.

Site 5 historically has had a lowered median MCI score, with some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in more recent years had found no sign of the heterotrophic growths (mats of filamentous bacteria and protozoa) recorded by several surveys at this site in the 1980s and early 1990s. However, an extensive outbreak of heterotrophic growths occurred in this reach of the river during the autumn-winter months of 2007. Heterotrophic growths were found on the substrate by the late summer survey of 2008, coincident with the deterioration in the macroinvertebrate community at this site at that time. In the spring 2010 survey bacterial growths were again recorded, although there was no significant deterioration in the macroinvertebrate community. At that time subtle impacts on the macroinvertebrate community, such as the appearance of the bloodworm midge (*Chironomus*), suggested that the degree of impact was potentially approaching a 'tipping point' after which deterioration in the macroinvertebrate community was more likely, provided the poor quality discharge continued. In spring 2014, the survey again recorded the presence of heterotrophic growths, but in that case, there was no obvious impact on the macroinvertebrate communities. This indicated that a poor quality cooling water discharge had been occurring, but that it was not resulting in the same degree of deterioration in water quality as the discharges that occurred in the early 1990s. The current survey did not record any heterotrophic growths, and recorded similar MCI and SQMCI scores at this site compared to site 4 above the discharge, indicating that the cooling water discharges had not caused any recent impacts on the macroinvertebrate communities at this site.

Site 7 recorded the lowest MCI score but the highest SQMCI score in the current survey. The MCI score was not significantly different from site 6 while the SQMCI score was a significant 1.5 units higher than at site 6. It is fairly typical to record a marked decline in macroinvertebrate community health between these two sites owing in part to the influence of the Dunns Creek tributary, which joins the river between the two sites, and also to the large distance between the two sites. Progressive downstream deterioration is often

observed in ringplain rivers and streams. Occasionally, there had been little difference, due to site 6 showing impacts from the cooling water discharge. However, in the current survey, there was little difference despite no significant evidence of cooling water discharge influencing the macroinvertebrate community at site 6.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and that the communities were largely in average condition, with the exception of the MCI score at site 3b. Community composition showed similarities between all sites. The current survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge. Further, the trend of improvement in communities adjacent to the factory observed in more recent years has continued to be recorded by this survey.

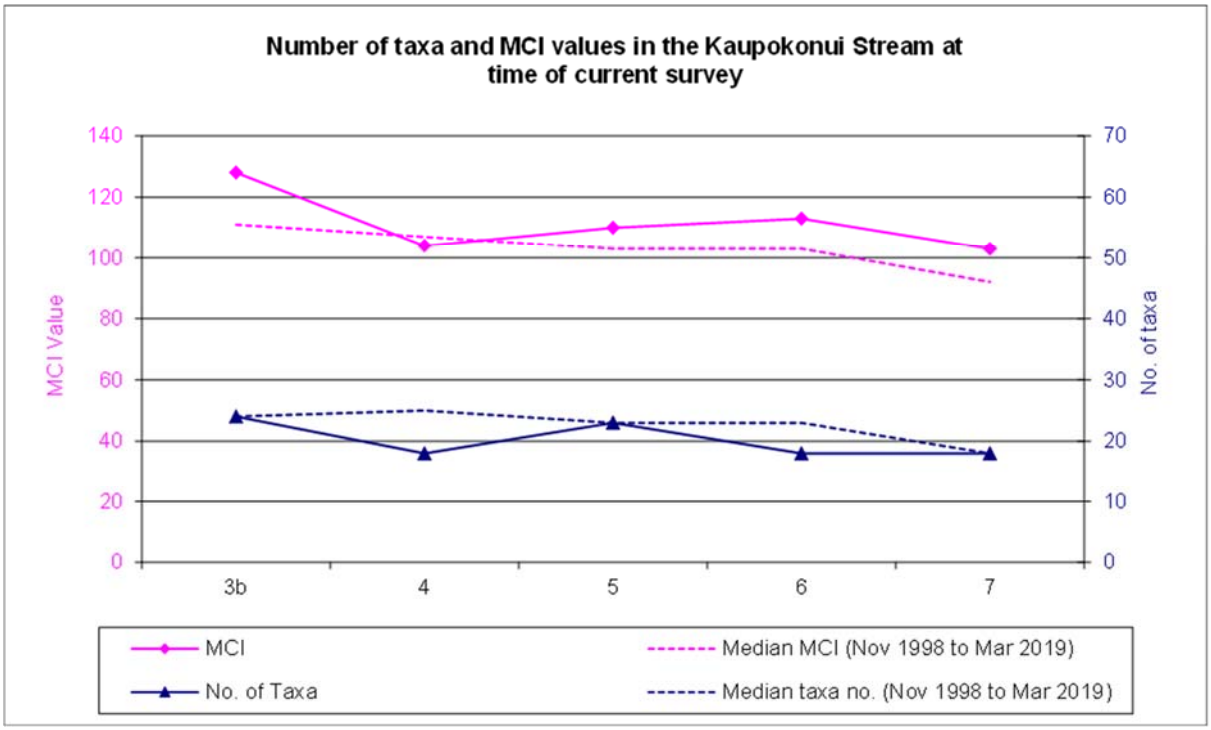

Figure 79 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to March 2019)

1 February 2021

Kaupokonui River

In this February 2021 survey, the five sampling sites in the Kaupokonui Stream supported taxa richness of between 18 and 25 taxa. Richness was similar at sites 3b and 4, while sites 5, 6 and 7 supported slightly lower richness. Compared to the preceding survey, the richness at individual sites was similar (sites 3b, 6 and 7), slightly lower at site 5, and six taxa higher at site 4. The richness was within three taxa of the median richness since 1998 at all sites.

MCI scores ranged from 91 to 106 units in the current survey, indicating 'good' macroinvertebrate community health throughout the upper reaches surveyed, and 'fair' macroinvertebrate community health at the lower site. Overall, and as is typical, MCI scores decreased in a downstream direction (Figure 80). Sites 3b and 4 had significantly higher MCI scores than site 7, while there were no other significant differences between sites.

SQMCI scores ranged from 2.7 to 5.1, with similar scores recorded at sites 3b, 4, 5 and 6; while site 7 recorded a score a significant 1.8 to 2.4 units lower than these sites. Sites 4 and 7 had scores significantly lower than the sites historic medians, while the remaining sites scores did not significantly differ from the

historic medians. Based on SQMCI scores, sites 3b, 4 and 6 were classified as having 'fair macroinvertebrate community health, site 5 was classified as 'good' and site 7 was classified as 'very poor'.

In some previous surveys, a decline in macroinvertebrate community health has been noted between sites 3b and 4, which may be attributable to the discharge of treated dairy shed effluent to an inflowing tributary a short distance upstream of site 4. No such deterioration was recorded in the current survey, with no significant changes in taxa richness or SQMCI and an increase in MCI scores between these two sites.

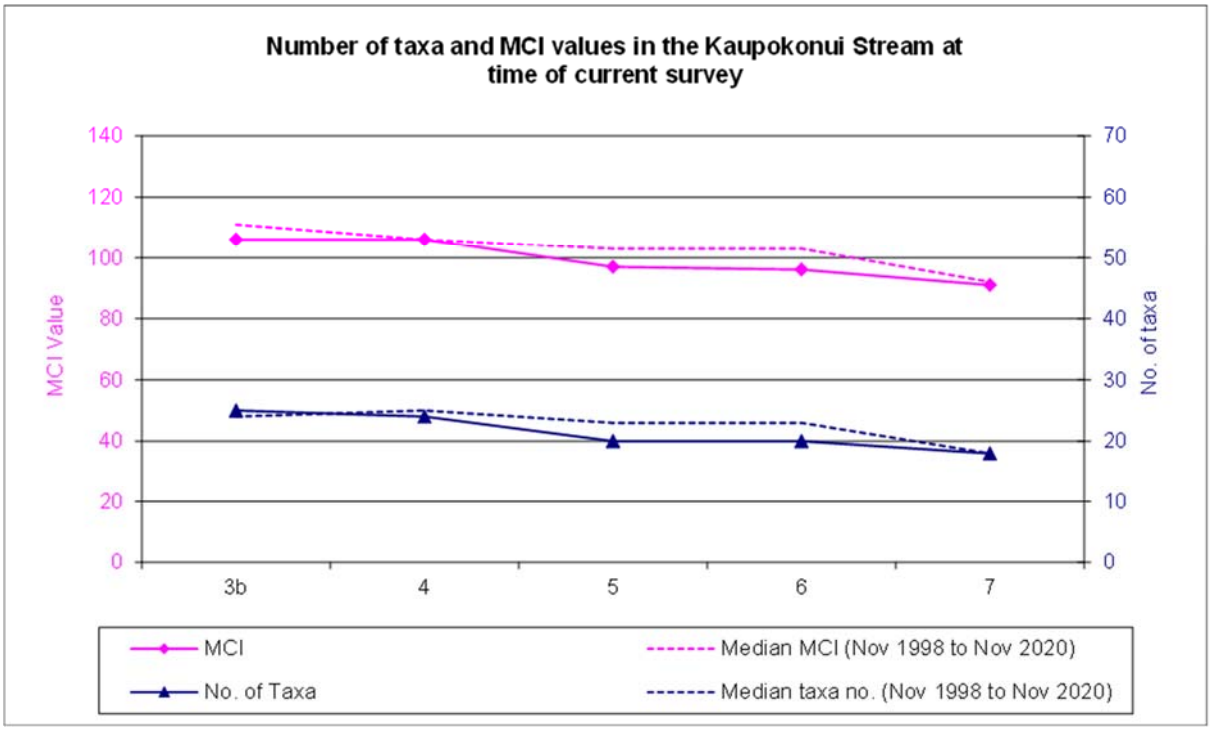

Figure 80 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to November 2020)

At site no heterotrophic growths were recorded in the current survey. Macroinvertebrate indices in the current survey were mixed, with taxa richness and MCI scores being slightly lower than the upstream sites, and the SQMCI scores being slightly higher. Therefore the current survey provided no evidence that there was any change in the macroinvertebrate communities as a result of the cooling water discharge.

Site 7 recorded the lowest result for all three invertebrate metrics in the current survey. The MCI score was a non-significant five units lower than at site 6, while the SQMCI score was a significant 1.9 units lower than at site 6. There was a two taxon decrease in richness between sites 6 and 7. It is fairly typical to record a marked decline in macroinvertebrate community health between these two sites owing in part to the influence of the Dunns Creek tributary, which joins the river between the two sites, and also to the large distance between the two sites. Often progressive downstream deterioration is observed in ringplain rivers and streams. Occasionally, there had been little difference, due to site 6 showing impacts from the cooling water discharge. However, in the current survey, the macroinvertebrate communities showed a lesser difference in taxa richness and MCI score between site 6 and 7 than has typically been observed, but a greater difference in SQMCI score.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities of the Kaupokonui Stream, and that the communities were largely in average condition. The current survey did not record the presence of heterotrophic growths, supporting a lack of impacts from the cooling water discharge.

For the 2020-2021 year, it is proposed that any the influence that maybe occurring in Dunn's Creeks as a result of the irrigation to land on Farm 1 be monitored directly by the inclusion of two new monitoring sites that are on the upstream and downstream boundaries of Farm 1. With the introduction of these sites in Dunns Creek and the acknowledged distance between the Kaupokonui Stream monitoring sites KPK000685 and KPK000880, it is proposed that any continued monitoring of the lower site is undertaken as part of the Council's State of the Environment monitoring work.

Waiokura Stream

The Waiokura Stream recorded moderate taxa richness of 16 taxa at sites U and I, and 19 taxa at site D. These numbers were slightly lower (by up to six taxa) than the historic medians for the sites U and D, and up to three taxa fewer than the previous summer survey at these two sites. MCI scores of 104, 106 and 86 units were recorded at sites U, I and D respectively. The scores categorised sites U and I as having 'good' and site D as having ' fair' macroinvertebrate community health. These scores were not significantly different from historic medians, or from the previous summer survey results for either site U or D. SQMCI scores of 6.1, 5.9 and 5.6 were recorded at the three sites, showing a slight decrease in a downstream direction. These scores were not significantly different from the preceding summer survey result at either site or the historical medians for sites U and D.

Taxa richness in the Waiokura Stream was lower than has been typical when compared to previous surveys at these two sites, with the richness at site U the lowest recorded richness to date for that site. The stream exhibited a greater than usual deterioration in MCI score, with a significant 18 unit decrease between the two sites. The SQMCI scores also indicated that there was some deterioration in a downstream direction although differences in this metric between sites were not significant.

Often the difference between sites U and D in the Waiokura Stream is largely attributable to the distance between the sites (approximately six kilometres), and the marked habitat differences between sites (especially the predominance of macrophytes at site D), rather than to any effects of the application of wastes to land from the Fonterra factory. Given the large distance between the two sites there has been insufficient evidence either to conclude that the change between sites is related to impacts caused by wastewater irrigation to land, or to rule this out as a cause of the observed deterioration.

In this survey, site I was introduced immediately downstream of the irrigation area to help ascertain whether the differences between sites U and D relate to habitat differences, wastewater irrigation to land, other land uses in the intervening catchment area, or a combination of these factors. The results of this survey show little difference between sites U and I, and a significant decrease in only MCI score between sites I and D. It is recommended that sites I and D are retained in the surveys of the Waiokura Stream scheduled for 2021-2022 to allow a consistent comparison with previous survey results.

Overall, there is no evidence supporting that the impacts of wastewater irrigation to land are causing deterioration in the macroinvertebrate communities of the Waiokura Stream. Furthermore, given the results recorded in this initial survey at site I, it appears that the deterioration typically observed between sites U and D is most likely to result from the marked habitat differences between the sites as well as other land use influences on the stream over the six kilometre distance between sites. However, given that only one survey has been carried out at site I, it is recommended that both sites I and D are surveyed for a minimum of five samples to ensure consistency and allow comparison with previous surveys. Should results and habitat remain similar at sites I and U for a minimum of five samples, consideration should be given to removing site D from the monitoring programme.

2.2 Air

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the 2020-2021 monitoring period. These inspections are an important part of the monitoring programme,

and are incorporated as part of the monthly inspections and water sampling, allowing for discussion of air discharge management issues.

From an air emissions perspective, the plant appeared to be well managed and well maintained, with a high standard of housekeeping observed at the time of each inspection. During each inspection a survey of the site boundary and the surrounding neighbourhood was carried out for odours and lactose powder fallout. No evidence of any lactose powder fallout was found during any of these surveys. No objectionable odours or visible emissions were noted beyond the site boundary during any of the inspections, with only on-site odours noted on occasion during inspections. On 20 August it was noted that there was a typical "sweet" wastewater odour localised around the wastewater tank, but this odour was not noticeable at the site boundary.

2.2.1 Emission monitoring

A wet scrubber system was commissioned by the Company in October 1998. The wet scrubber system links the exhaust streams from the flash drier (pre-drier) stack and the refined fluid bed drier, with this emission source then referred to as the flash drier. Continuous particulate meters have also been installed by the Company to give a real time indication of the powder emissions from each drier. These meters are indicators only, but do provide a warning to operators that the discharge levels have increased, enabling this to be responded to.

Table 41 is included for comparison of results prior to the installation of the wet scrubber system.

Table 41 Summary of the refined and pre-drier emission testing results prior to the installation of the wet scrubber (October 1998)

Stack	Date	Emission (mg/m^3)
Refined drier	26 November 1997	515
Refined drier	10 December 1997	215
Pre-drier	8 December 1999	158
Refined drier	21 January 1998	567

Isokinetic stack sampling and analysis of the exhaust from the flash drier stack for particulates was conducted on 21 September 2018 by CRL Energy, using USEPA method 17. During the year under review, there was again a slight change in the methodology of the emissions monitoring. In the 2019-2020 year the determination was an average of three tests performed over a period of about 60 minutes for the Flash drier and the small drier, but 50 minutes for the North and South Supertab. From the 2018-2019 year to date, the determination returned to being an average result from three tests each conducted over approximately 60 minute periods, rather than the one approximately 60 minute period used during the 2017-2018 year. Again, no information was included in the report regarding the production rate at the time the test was undertaken. The current consent does not contain any conditions specifying the methodology and reporting requirements for the stack testing required to confirm compliance with particulate emission rate limit. This will be addressed in the replacement consent.

The result is presented in Table 42 below, along with previous averaged CRL and Council results since 1998.

Table 42 Summary of isokinetic stack analysis of the flash drier (pre-drier) for 1998-2021

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Emission (mg/dsm^3)*	Comments
5 November 1998	-	-	<10	No visible emissions noticed
25 February 1999	-	-	<10	No visible emissions noticed

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Emission (mg/dsm^3)*	Comments
4 May 1999	-	-	<10	No visible emissions noticed
9 May 2000	-	-	<10	No visible emissions noticed
27 October 2000	-	-	<10	No visible emissions noticed
30 November 2000	-	-	21	No visible emissions noticed
29 November 2001	-	-	<10	No visible emissions noticed
21 January 2009	-	-	58	
6 February 2010	-	-	53	
20 January 2011	-	-	18	Mass emission rate 0.7 kg/hr
11 January 2012	-	-	67	Mass emission rate 3.0 kg/hr
9 January 2013	-	-	27	Mass emission rate 1.3 kg/hr
11 December 2013	-	-	18	Mass emission rate 0.9 kg/hr
17 December 2014	-	-	23	Mass emission rate 1.2 kg/hr
11 November 2015	-	-	18	Mass emission rate 0.9 kg/hr
21 September 2016	5.4	44891	17	Mass emission rate 0.8 kg/hr
25 October 2017	Not provided	46229	17.1	Mass emission rate 0.8 kg/hr
21 September 2018	Not provided	44408 to 45407	1.2	Mass emission rate 1.2 kg/hr
29 October 2019	Not provided	43305 to 44457	30	Mass emission rate 1.3 kg/hr
30 October 2020	Not provided	42383 to 45956	29	Mass emission rate 1.3 kg/hr

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas

The emission monitoring performed after the installation and commissioning of the wet scrubber system clearly shows the success of the wet scrubber in abating powder emissions from the refined drier and pre-drier at the lactose plant. In view of the consistently low particulate emissions, Council in 2002 stopped emission monitoring but continued the ambient deposition monitoring and inspections. The Company instituted its own emission testing in 2009, as part of product loss monitoring.

The consent limit for emissions from the wet scrubber system is 125 mg/m^3 of gas, adjusted to 0˚C, 1 atmosphere pressure and calculated as dry gas. Prior to the consent renewal (7 April 2000) the discharge limit was 250 mg/m^3 of gas, adjusted to 0˚C, 1 atmosphere pressure and calculated as dry gas.

The results obtained in October 2020 were again well below consent limits.

The Company commenced voluntary particulate emissions monitoring of the other three emission sources on site in 2016. The results are presented in Table 43, Table 44 and Table 45. There are currently no consent limits on these sources, however the renewed consent will contain particulate emissions limits for each of these stacks. Two of the three average particulate emission rates during the year under review were below the 125 mg/m^3 limit that applies to the flash drier.

Table 43 Summary of isokinetic stack analysis of small drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	2.5	26428	66	1.8
25 October 2017[b]	Not provided	23478	70.3	1.65
21 September 2018[c]	Not provided	22992 to 23635	104	2.4
29 October 2019[c]	Not provided	23054 to 24397	56	1.3
30 October 2020	Not provided	24598 to 24851	55	1.35

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas
a average of three test results using USEPA method 201A
b single test result using USEPA method 17
c average of three test results using USEPA method 17

Table 44 Summary of isokinetic stack analysis of the supertab north drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	0.629[d]	18863	93	1.7
25 October 2017[b]	Not provided	20616	24.7	0.50
21 September 2018[c]	Not provided	20553 to 23635	87	1.9
29 October 2019[c]	Not provided	17447 to 18851	110	2.0
29 October 2020	Not provided	16858 to 18156	130	2.25

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas
a average of three test results using USEPA method 201A
b single test result using USEPA method 17
c average of three test results using USEPA method 17
d tested in combination with supertab south drier

Table 45 Summary of isokinetic stack analysis of the supertab south drier, commenced in 2016

Date	Production rate (t/hr)	Stack emission rate (dsm^3/hr)	Particulate emission (mg/dsm^3)*	Particulate emission rate (kg/hr)
21 September 2016[a]	0.629[d]	21831	138	3.0
25 October 2017[b]	Not provided	20208	47.4	0.98
21 September 2018[c]	Not provided	22527 to 22927	90	2.0
29 October 2019[c]	Not provided	14204 to 14813	65	0.9
29 October 2020	Not provided	18841 to 21122	113	2.26

Key * mg/dsm^3 = milligrams per cubic meter of gas, at 0˚C, 1 atmosphere pressure and calculated as a dry gas
a average of three test results using USEPA method 201A
b single test result using USEPA method 17
c average of three test results using USEPA method 17
d tested in combination with supertab north drier

2.2.2 Deposition gauging

Many industries emit dust from various sources during operational periods. In order to assess the effects of the emitted dust, industries have been monitored using deposition gauges.

Deposition gauges are basically buckets elevated on a stand to about 1.6 m. The buckets contain deionised water to ensure that any dust that settles out of the air is not re-suspended by wind. A copper sulphate solution at a concentration of 5 g/L acts as a preservative to prevent growth of algae and bacteria.

In the year under review, gauges were deployed at five sampling sites around the lactose plant for a period of approximately five weeks during summer. The contents of the gauges were analysed for COD (chemical oxygen demand). The COD results are compared with the theoretical value for lactose powder and a "total deposited powder" (TDP) value is calculated.

The descriptions and locations of the five air deposition monitoring sites are provided in Table 46 and Figure 81.

The Council guideline value for total particulate deposited to cause nuisance is 130 mg/m^2/ day, but the Council does not have a specific guideline value for lactose powder deposited. The lactose deposition survey determines deposition due to lactose powder only, not total deposition.

Guideline values used by the Council for dust deposition are 4 g/m^2/30 days or 130 mg/ m^2/day deposited matter. Consideration is given to the location of the industry and the sensitivity of the surrounding community when assessing results against these values.

The deposition gauge results for the deployment period in the year under review are compared with previous results since 1997 in Figure 82 and Table 47.

Prior to the commissioning of the wet scrubber in October 1998, deposition rates of up to 1,300 milligrams per square metre were reported from surveys carried out surrounding the lactose factory site. There has been a significant reduction in deposition since the wet scrubber began operating. This is consistent with the decrease in stack emission concentrations measured (see section 2.2.2).

Table 46 Description of the Fonterra Ltd air deposition sample sites

Site number	Description
AIR002301	east of plant, across Manaia Road adjacent to the plant
AIR002302	east of plant, opposite the tanker bay
AIR002303	south of plant
AIR002304	west of plant
AIR002305	south west of plant

A review of the monitoring data from the nearest wind monitoring station (Taungatara at Eltham Rd) indicated that it was likely that winds were predominantly from the E and SE (approximately 42 % of the time) during the gauge deployment. Northerly and north westerly components were present for approximately 30 % of the time.

The lactose deposition rates recorded were above their respective historical medians at AIR002301, AIR002302, and AIR002303, but substantially below the historical media at site AIR002305. It appears that there is an emerging trend of increasing lactose deposition rates at sites AIR002301, AIR002302, and AIR002303 (Figure 82), which is supported by increasing 5 year rolling medians for these monitoring locations.

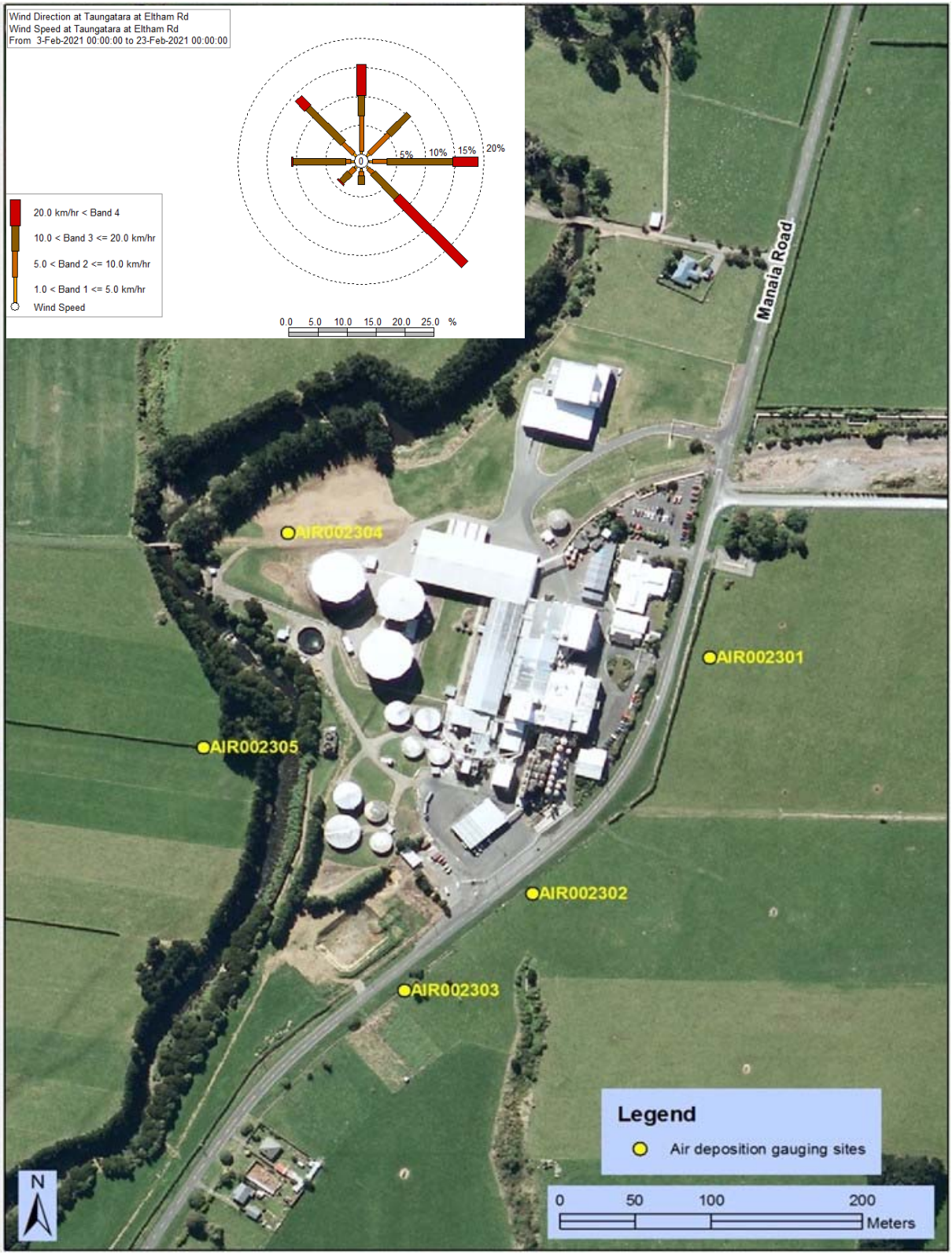

Figure 81 Location of air deposition gauging sites

The deposition rates obtained during the periods under review were elevated above the guideline value at only one site (AIR002301). This site is located on the opposite side of Manaia Road and was downwind of the site discharges to air for only 10.8 % of the gauging period. The monitoring locations that were downwind of the site for the greater part of the monitoring period had the lowest deposited lactose results (AIR002304 and AIR002305). This indicates that the elevated deposited lactose rate at AIR0002301 was as a

result of a short lived event. It is noted that there were no complaints received regarding particulate deposition during the deployment period of the gauges, and the deposition rate is not limited by the Company's consent.

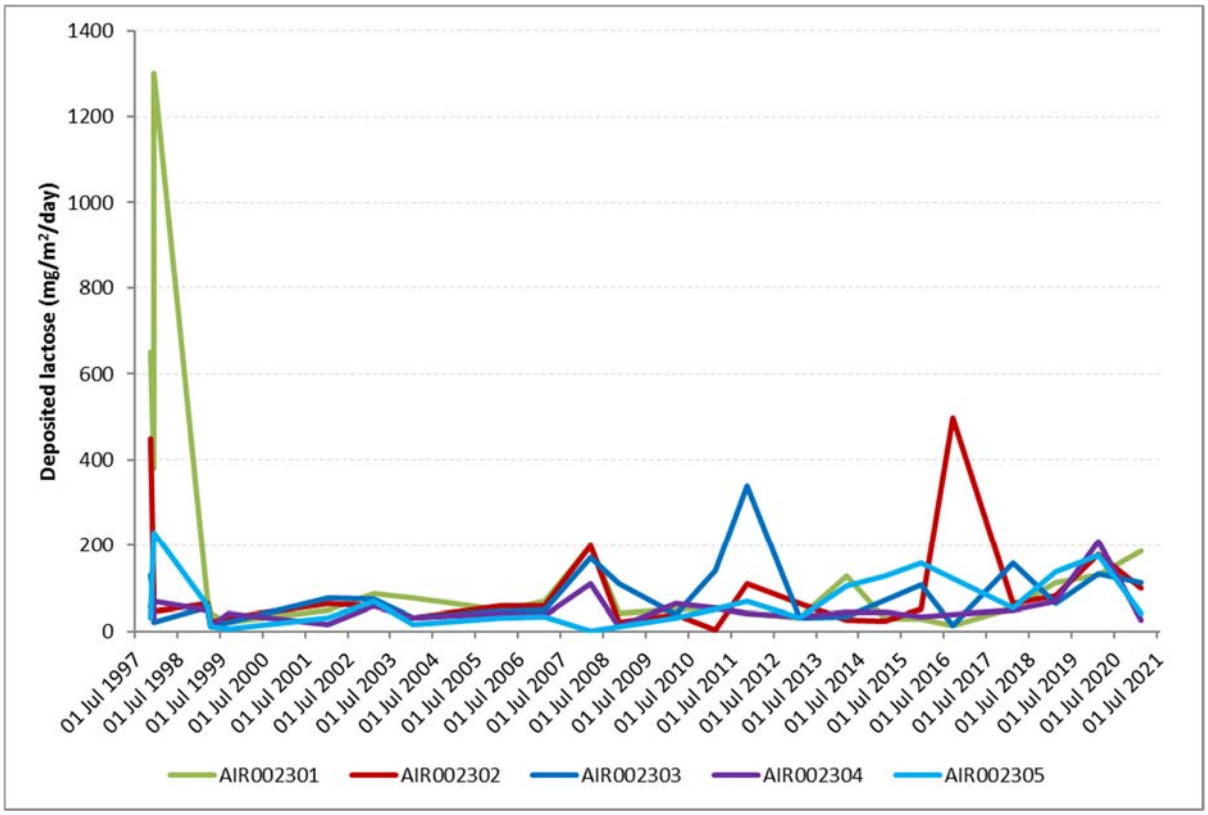

Figure 82 Deposition gauge results from 1997 to date

Table 47 Deposition gauge results from 1997 to date

Period	Number of days	Deposited lactose mg/m²/day				
		AIR002301	AIR002302	AIR002303	AIR002304	AIR002305
10 Nov to 24 Nov 1997	14	**650**	**450**	**130**	59	30
24 Nov to 9 Dec 1997	15	**380**	83	53	30	-
9 Dec to 22 Dec 1997	13	**1300**	46	20	68	**230**
4 Mar to 18 Mar 1999	14	71	63	56	50	60
12 Apr to 26 Apr 1999	14	40	20	<20	<20	<20
9 Sep to 29 Sep 1999	20	20	30	-	40	<10
9 Jan to 24 Jan 2002	16	50	63	78	<30	30
21 Jan to 3 Feb 2003	13	86	60	75	60	69
14 Jan to 29 Jan 2004	15	76	30	30	30	<30
11 Apr to 10 May 2005	29	-	-	-	-	-
10 Jan to 1 Feb 2006	22	50	59	47	40	30
11 Jan to 13 Feb 2007	33	70	59	49	37	34
15 Feb to 14 Mar 2008	28	**200**	**200**	**170**	110	-

Period	Number of days	Deposited lactose mg/m^2/day				
		AIR002301	AIR002302	AIR002303	AIR002304	AIR002305
20 Oct to 10 Nov 2008	21	40	20	110	<20	<20
12 Feb to 9 March 2010	25	52	38	39	63	30
25 Jan to 15 Feb 2011	21	21	<8	140	54	51
29 Sep to 17 Oct 2011	18	40	110	**340**	40	70
28 Jan to 15 Feb 2013	18	30	64	30	33	30
20 Feb to 17 Mar 2014	25	127	27	33	44	105
28 Jan to 18 Feb 2015	21	28	24	-	45	127
24 Nov to 15 Dec 2015	21	29	51	109	32	**159**
6 Sep to 27 Sep 2016	21	12	**498**	13	*	*
11 Jan to 2 Feb 2018	22	53	63	**158**	48	53
21 Jan to 26 Feb 2019	36	112	82	65	69	**139**
27 Jan to 17 Feb 2020	21	130	**178**	**134**	**210**	**176**
3 Feb to 23 Feb 2021	20	**187**	100	112	25	42
Historical median	-	*54*	*60*	*61*	*44*	*43*

* gauge contents contaminated by bird/bird droppings

2.3 Incidents, investigations, and interventions

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the Company. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach, that in the first instance avoids issues occurring, is favoured.

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified individual/organisation is indeed the source of the incident (or that the allegation cannot be proven).

Table 48 below sets out details of any incidents recorded, additional investigations, or interventions required by the Council in relation to the Company's activities during the 2020-2021 period. It also includes matters that commenced and were reported on in previous monitoring periods, only where additional activity by the Council continued during the monitoring period under review. This table presents details of all events that required further investigation or intervention regardless of whether these were found to be compliant or not.

Table 48 Incidents, investigations, and interventions summary table

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
4 Aug 2020	During routine monitoring it was found that there had been a significant increase in the nitrate-nitrite nitrogen concentration in bore GND0638. The Company was asked to investigate as per their Irrigation Management Plan	Y	N	Investigation found that in addition to routine application of wastewater, extra fertiliser had been applied to paddocks around the bore in the 2017-2018 and 2018-2019 seasons prior to them being used to grow maize. Proliq had been spread on the top half of the paddock in October 2018. Mitigating measures undertaken to allow nitrate-nitrite nitrogen concentration to reduce: 1. No PROLIQ to be spread on paddocks 13B, 14 A/B and 15 A 2. No fertiliser to be applied on paddocks 13B, 14 A/B and 15 A 3. No maize to be planted on paddocks 13B, 14 A/B and 15 A 4. Reduce irrigation of wastewater on paddock 13B and 14 A/B to reduce load by ~30% 5. Continue current monitoring schedule and review progress in 6 and 12 months
19 Nov 2020	During routine monitoring it was found that irrigation run-off and spray drift was occurring within 20m of the Motumate Stream for approximately 10 minutes	N	N	The irrigation line was shut down as soon as the technician became aware of the runoff. The runoff was diverted into a paddock with a shovel and did not enter the stream. The irrigator had been running for only approximately 10 minutes
7 Apr 2021	During routine groundwater sampling it was found that an irrigator was leaking and that there was a small amount of ponding underneath the irrigator and around a trough approximately 15m away from the irrigator	N	N	The irrigation operator took steps immediately to repair the leak on the irrigator feed pipe. The Council was advised that approval had been given for the progressive replacement of all travelling irrigators with fixed in-ground sprinklers once the replacement consent(s) had been granted. In the meantime the Company was planning to have a pressure relief valve manufactured for installation at the hydrants, which would prevent the low flow rate discharges that occur from the travelling irrigators as the pressure in the line reduces following irrigation events. The area around the trough would also be infilled to prevent potential ponding in this area during future irrigation events

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
22Apr 2021	During routine monitoring it was found that the results for the southern pond discharge did not comply with the suspended solids limit on the consent	N	N	Company under took investigation. Lower discharge point taken out of service until the pond could be cleared of accumulated sediment and onsite silt traps could be cleaned out
27 May 2021	Self-notification was received regarding a wastewater pipe leak on the corner of Skeet and Manaia Road, Kapuni	N	Letter of explanation requested	Investigation found evidence of some wastewater ponding, which was contained to the immediate area. The wastewater discharge did not enter any surface waterbody. The Fonterra Kapuni site was advised by South Taranaki District Council of a potential wastewater line breach the previous evening. The Fonterra shift manager investigated and confirmed it was wastewater from the site and immediately shut down the transfer of wastewater from the site to irrigation Farm 3. A letter of explanation was received and accepted. The site has investigated the practicality of systemic replacement of site formed bends in the existing pipeline as these can be subject to damage during installation. This will be completed during the 2022 winter shutdown, if not completed earlier

3 Discussion

3.1 Discussion of plant performance

Generally the onsite management and operation of the Kapuni lactose plant site was undertaken in a satisfactory manner. Continual liaison between the Company's staff and the Council has contributed to this performance. A number of improvements were made at the site during the year under review, including improvements in the tracking of nitrogen loadings applied to irrigation areas and a continuation of the programme to replace all of the PVC pipe crossings conveying wastewater over streams with stainless steel pipes.

Contingency planning is in place in the form of the Site Stormwater Management Plan. It is a requirement of the consent that the plan is reviewed and updated (if required) annually. The latest plan on record at the Council was issued in April 2021. A Spray Irrigation Plan is required by consents 0922-3.2 and 0923-3. The consent requires that this is updated annually with the updated plan to be provided to Council by 1 July each year. Council has been informed that the irrigation practices at the site have not changed substantially, but the irrigation management plan was updated to a whole farm management plan in June 2019 that covers the irrigation management and the farm management practices to ensure that the operation of these two activities is well integrated. The latest plan on record at the Council was issued in March 2021.

Data were collected by the Company and forwarded to the Council regarding the abstraction of water from the Kaupokonui Stream, temperature of the Kaupokonui Stream above and below the discharge of cooling wastes, cooling water discharge rates and temperatures, stormwater pond discharge records, and volume and composition of effluent sprayed to pasture on the two farms. Daily volumes, temperature maxima, and stormwater discharges were reported monthly. Historically, this was all provided in the form of monthly reports, with the upstream and downstream temperatures being provided electronically on a daily basis and irrigation waste composition records forwarded annually upon request. More recently the flow data for the abstraction and cooling water discharge and the cooling water discharge temperature has been provided to Council in the form of electronic data, that were initially also provided on a daily basis. This data is now provided every two hours. This change was made because there is an upstream consent that requires the consent holder to cease abstraction when the temperature of the Kaupokonui Stream, at the monitoring site operated by the Company upstream of their spray cooling water discharge, reaches 22°C. More frequent provision of the Company's monitoring data enables better adherence to this requirement, which was included in the consent at Fonterra's request as an affected party.

The Company's data collection and provision was satisfactory during the year under review. The improved accuracy and precision of the various datasets were maintained and gaps in the data were minimal. Parallel temperature monitoring in the Kaupokonui Stream found very little difference between the data collected by the Company and by the Council. Compliance with consent conditions was demonstrated for abstraction rates, stream temperatures and wastewater/effluent irrigation volumes.

It is noted that there has been a general trend of decreasing abstraction since the 2021-2013 year. This is evident in terms of maximum daily abstraction and annual volume taken. The maximum daily abstraction was 60% of the permitted daily take, with the maximum abstraction rate being only 64% of the maximum permitted take for 99% of the time.

A comparison of the abstraction and discharge data, indicates minimal water usage (within the ± 10 % accuracy of the two measuring devices used to determine this differential), though the water losses through evaporation and spray drift at the spray discharge booms is not accounted for here.

The main cooling system was replaced in August 2015. There is a continuously monitored system (conductivity) on the crystallising condensers, which will enable detection of contaminants for informing the discharge to the cooling water system and stream and/or diversion to wastewater irrigation. The Company's

operation of the cooling tower and associated systems during the year under review resulted in monthly median temperatures in the range of 25-28˚C and monthly maximums in the range 30-40˚C. The cooling water discharge was at or above 35˚C for 11 % of the year and at or above 33˚C for 16% of the time during the times of lower stream flows. Council monitoring found that the cooling water discharge complied with the contaminant concentrations limited by the consent.

Across the whole season, the median measured strength of wastewater irrigated onto land increased for nitrogen species for the third successive year. There was again also less consistency in the strength of the wastewater when compared to the 2017-2018 year. Although there was a relatively minor increase in the wastewater volume irrigated in the year under review when compared to the previous year, there was an increase in the estimated total mass of nitrogen calculated on a kilogramme per hectare per year basis. There had been a trend of decreasing estimated nitrogen loading on the farms as a result of the irrigation activities between the 2013-2014 and 2018-2019 years. This was followed by two years where successive increases have been estimated. In the 2020-2021 year, there was an estimated 13,172 kg more nitrogen applied to the paddocks in the factory wastewater irrigated when compared to the 2018-2019 year. Disposal of DSE to land via the factory effluent spray irrigation system was established in 2015-2016, ending the oxidation pond discharges to the Kaupokonui Stream tributary and Motumate Stream. This is in line with Council's policy of promoting discharges of DSE to land. The calculated estimate for the nitrogen application rate of the DSE amounted to approximately 9% of the total mass of nitrogen irrigated. It is also noted that there continues to be high nitrogen (and phosphorus) loads applied to the paddocks during months with high total rainfall and above mean soil moistures.

In general, soil composition data for the year under review showed elevated nitrogen and Olsen phosphorus concentrations in irrigated paddock when compared to the control paddocks.

The stormwater system to contain and control stormwater from the southern catchment of the factory site, designed to capture a 1 in 100 year flood volume, has provided additional security for the area where road tankers operate and process materials are stored. A similar system (northern pond) was put in place for the remainder of the site during the 2017-2018 year. On the whole, these continued to be well managed during the year under review, with samples being, for the most part, compliant with consent conditions. There was one exceedance of the suspended solids limit found in the southern stormwater pond discharge sample collected during the year under review.

Riparian planting was maintained on the factory site. The financial contributions were paid for the 2020-2021 year.

There were a total of five matters arising where additional investigations, or interventions were required by the Council in relation to the Company's activities during the 2020-2021 period. During routine monitoring it was found that there had been a significant increase in the nitrate-nitrite nitrogen concentration in bore GND0638. There was no breach of consent conditions, however the Company was asked to investigate as per their Irrigation Management Plan. This was done. Mitigating measure were put in place and, although still elevated, reductions in the nitrogen concentration of the bore were found in subsequent sampling surveys. There were two unauthorised discharges of wastewater to land found during routine monitoring. In one case run-off and spray drift was occurring within 20m of the Motumate Stream for approximately 10 minutes. The irrigation line was shut down as soon as the technician became aware of the runoff, and potential discharge to the stream was avoided. In the second case a leak at the connection of the irrigation pipe to the travelling irrigator several hours after the irrigation event had finished resulted in a low flow discharge and minor ponding. This was fixed during the inspection and a pressure relief valve was subsequently manufactured for installation at the hydrants so that the residual pressure in the line following an irrigation event does not result in a residual discharge from the travelling irrigators following the irrigation events. There was the one exceedance of the suspended solids limit found in the southern stormwater pond discharge sample. The Company carried out a thorough investigation and undertook

actions to prevent a reoccurrence. Self-notification was received regarding a wastewater pipe leak on the corner of Skeet and Manaia Road, Kapuni. The Company had been notified of the leak by the South Taranaki District Council. The wastewater transfer from the site Farm 3 was shut down immediately. There was no discharge to surface water. The Company undertook to replace any site formed bends in the existing wastewater pipelines as these can be subject to damage during installation. This will be completed during the 2022 winter shutdown, if not completed earlier

3.2 Environmental effects of exercise of consents

When looking at the water allocation of the Kaupokonui Stream, Council had made the assumption that the water take was approximately 30% consumptive. In the AEE, based on water balance calculations, Fonterra estimated that approximately 10% of the water take was consumptive. Following the resolution of the issues that affected the cooling water discharge rates provided for the 2016-2019 years, it was found that the data being supplied meet the agreed standards both in terms of completeness and accuracy of ± 5% from September 2019. As a result, a better estimate of the consumptive nature of the water take, and potential effects on the stream could be assessed from a water allocation perspective. However, it is noted that this would account only for the consumptive use within the factory and losses from the cooling tower, and would not account for the losses from evaporation and spray drift at the cooling water discharge booms. Data recorded across the year under review indicated that there was little, if any, consumptive use outside the ± 10% cumulative measurement error of the metering devices.

Inspections and sampling did not find any adverse effects in the receiving waters during the monitoring period, and there was good compliance with discharge permit conditions.

Temperature data supplied by the Company showed that the ambient temperature of the receiving water during the monitoring period was not increased by more than the amounts prescribed on consents 0919-3 and 0921-3, that is, by less than 2˚C for 90% of the time with an upper limit of 3˚C. With the improvement in the measurement error of the Company's instream monitoring that were implemented in the 2018-2019 year, there was improved confidence in the accuracy and precision of the data provided. This has been maintained during the year under review. In the 2017-2018 year, due to the measurement error of the temperature probes, temperature reductions were measured for approximately 16% of the time, with a maximum temperature drop of 2.2˚C reported to Council, resulting in a reduction in the tolerance applied during the Company's calibration of the temperature sensors. In the 2018-2019 year temperature reductions of between 0.01 and 0.9˚C were recorded for only 3% of the time. During the year under review, a negative temperature differential of up to 1.0°C was reported for 13% of the record. This indicates that the actual instream temperature differentials may be up to 1.0°C higher than measurement reported by the Company due to permitted measurement errors and means that this needs to be considered in relation to the temperature increase permitted by reissued consent.

During the year under review, operation of the cooling tower and associated systems resulted in the reported increase in temperature below the cooling water discharge being well below the consented limit, being at or below 1.0˚C for 93% of the time, with the temperature differential most commonly being between 0.5 and 0.6˚C (16% of the time).

In terms of the potential effects within the relatively long 200 m cooling water discharge mixing zone, there is the potential for there to be elevated temperatures that could present a barrier to fish passage. Based on historical monitoring, the assumption has been made that fish would make use of a cooler flow corridor close to the true right bank in order to negotiate this stretch of the stream. It was requested that the current temperature conditions within the mixing zone and the validity of this assumption be investigated by the Company during the preparation of the AEE for the renewal of the cooling water discharge consent. Although work was undertaken in February 2018, the temperature measurements within the mixing zone were not conducted during worst case conditions within normal operational parameters as cooling water

discharges were in the range of 30˚C to 32˚C. From November 2018 to the end of that monitoring year, the Company manually diverted all cooling water through the cooling tower and ran the cooling tower at the maximum cooling capacity. Monitoring from 1 December to 30 June 2019 that this reduced the cooling water discharge temperature (15 minute average) to below 29˚C for 99% of the time. In comparison, the more energy efficient operation of the cooling tower and associated systems that was in place during the year under review (outlined in Table 6) in the cooling water discharge temperature (15 minute average) being above 29˚C for 34% of the time and above 32˚C for 20% of the time during December to June inclusive. The lower cooling water discharge temperatures achieved whilst the cooling tower system operated in a way that achieved the maximum cooling capacity would also have resulted in a significant reduction in the temperature effects occurring within the relatively long approximately 200 m mixing zone. However, the cooling water discharge temperatures during the year under review were higher than those prevailing at the time the investigations of the temperature conditions within the mixing zone were undertaken for the AEE for the consent replacement.

The cooling water discharge consent also prohibits temperatures in excess of 25˚C downstream of the plant as a result of the cooling water discharges. This limit was complied with.

Five matters arose during the year under review where additional investigations, or interventions were required by the Council in relation to the Company's activities during the 2020-2021 period. In the first case, localised contamination was found at one of the 12 bores monitoring during the year under review, in which nitrogen concentrations were detected in GND0638 that were in excess of the previous maximum at this monitoring location. This did not contravene conditions of the consent, but the matter was investigated and mitigation measures were put in place as required by the management plan. This is discussed further below, along with other effects on the groundwater in the vicinity of the farms where the wastewater and dairy shed effluent are discharged. The other four matters were non-compliance with consent conditions or rules in the Regional Freshwater Plan, however no significant effects were found as a result of these non-compliances.

Effects on the groundwater in the vicinity of the farms were varied, but most showed an adverse impact on both mineral and organic component levels. This was previously addressed through extension of the irrigation disposal system and by more intensive wastewater and groundwater monitoring. The monitoring results show that, since 2011-2012, total volume of factory wastewater irrigated had remained relatively stable, although there was an increase in volume in the 2017-2018 year and a decreased volume during the year under review. There was a reduction in total nitrogen loading in 2012-2013, which increased back to the previous levels in 2014-2015, possibly as the result of a change in cleaning procedures. Since that year, there had been successive declines in the total nitrogen loading each year, up to and including the 2018-2019 year. During the 2019-2020 and year under review, there were higher nitrogen loads applied to the paddocks than in the 2017-2019 years. The estimated nitrogen application rates increased by about 14% on Farm 1 and 20% on Farms 2 and 3 in 2019-2020 and a further 10% on Farm 1, 4% on Farm 2, and 18% on Farm 3 during the year under review. There was only one bore (GND0638) that was consistently above the drinking water standard for nitrate-N, and a further two bores having an annual median above the standard, one of which was the control bore at the northern boundary of Farm 2 (GND2049). The reason for the reasonably consistent elevation in this control bore and the occasional elevation in the control bore for Farm 3 (GND2051) is still to be fully investigated. The Farm 1 impact bore returned an annual median that was just below the drinking water standard, but more than double the annual median of the control bore. The Farm 2 impact bores where nitrate-N was at or above all of the samples collected during the year under review were one of the sites near the Motumate Stream (GND0638) and the site on the eastern boundary (GND2063). Site GND0638 returned a result that was a new maximum for this site. As discussed in Section 2.1.5.4, there are no known shallow groundwater water users in the immediate vicinity of the spray irrigation area, because of the availability and usage of the Waimate West Rural Water Supply Scheme. However, the Regional Freshwater Plan for Taranaki (2001) does provide for the taking and use of groundwater at a scale

that would enable reasonable farm use as a permitted activity. GWR Policy 4 of the Regional Freshwater Plan for Taranaki (2010) also states that groundwater quality will be maintained and enhanced by promoting land use practices that minimise, as far as practicable, the potential adverse effects on groundwater quality. In the 2019-2020 Annual Report it was stated that consideration should therefore be given to changes that could be made to the management of the wastewater irrigation management to reduce the nitrate concentration, initially, at least in the bores that are on the boundary of the site, or are close to waterways. During the year under review the Company tracking of the nitrogen loadings applied to the irrigation areas from all sources. The Company also investigated and implemented mitigation measures to address the localised contamination in GND0638 as per consent conditions and the Company's Whole Farm Management Plan. The investigation found that additional nitrogen had been applied to the paddocks in the vicinity of this bore during the 2017-2019 years in the form of fertilizer and Proliq. The outcome of this was that the Company would ensure that the application of fertilizer and Proliq was avoided on paddocks 13B, 14 A/B and 15 A and that the wastewater irrigation load to these paddocks would be reduced by approximately 30%. The effects of these controls was to be reviewed in 6 month and 12 months from the date of the investigation report. Council monitoring showed that the nitrate-N concentration had more than halved to approximately 30 g/m^3 by the end of the year under review.

Biological surveys found no significant adverse effects on the stream communities of Kaupokonui Stream in relation to the discharges from the factory site and the presence of the weir, or in the Motumate and Waiokura Streams in relation to land irrigation.

Following the March 2020 fish survey and associated evaluation of the fish passage, overall, it was considered that the activities of the Kapuni Lactose factory were not having a significant adverse effect on the fish communities of the Kaupokonui Stream. However, due to fugitive attractant flows and a lack of a deeper channel catering to larger fish, it is likely that there was currently incomplete passage provision, but that would be challenging to confirm in practice. It was noted that additional issues may arise due the changes in the downstream environment when the Glenn Road weir was removed. At this time, it was predicted that the full range of swimming species, that will be able to access this part of the stream following the removal of the Glenn Road weir, may not be able to negotiate the Company's weir in sufficient numbers. As this is because the fish passage was designed and constructed to cater only to those fish that could successfully navigate the Glenn Road weir, it was considered that the extent to which this is true would need to be evaluated post weir removal. On this basis it was recommended that this evaluation be allowed to occur prior to assessing the full extent of the improvements and/or modifications that will be needed to the weir and fish passage to provide for the range of species required. However, as stated in the fish survey report, it is important to recognise that there is a possibility of potentially significant effects through the lack of fish passage and thermal effects within the cooling water mixing zone, so any remediation required may need to be undertaken promptly to ensure continued consent compliance. During site inspections in the year under review, trout, an eel and juvenile fish (species not determined) were observed upstream of the weir. eDNA monitoring was undertaken in the Kaupokonui Stream to evaluate the effectiveness of the removal of the Glenn Road weir. This monitoring indicated that inanga and torrentfish were now present above where the Glenn Road weir had been situated. As a result the scheduling of the fish surveys under this programme has been revised to include an electric fishing survey and two spotlighting surveys in the 2021-2022 year.

Macroinvertebrate monitoring of the Kaupokonui Stream during spring 2020 and summer 2021 did not show any significant adverse effect of the cooling or stormwater discharges to the stream on streambed communities. However, it was noted in the report that the site furthest downstream typically records the poorest macroinvertebrate communities, which was again the case in the surveys during the year under review. This has been attributed in part to the influence of the Dunns Creek tributary, which joins the stream above this site, and also to the large distance between the two relevant sites. In the 2019-2020 year it was considered that the biomonitoring sites used to monitoring the Company's activities (Farm 1 irrigations as

well as the activities at the factory site) that may influence macroinvertebrate communities in Dunns Creek and therefore the Kaupokonui Stream should be re-evaluated. This was done and it is now proposed that the influence that maybe occurring in Dunn's Creeks as a result of the irrigation to land on Farm 1 be monitored directly by the inclusion of two new monitoring sites that are on the upstream and downstream boundaries of Farm 1. With the introduction of these sites in Dunns Creek and the acknowledged distance between the Kaupokonui Stream monitoring sites KPK000685 and KPK000880, it is proposed that any continued monitoring of the lower site is undertaken as part of the Council's State of the Environment monitoring work. A recommendation to this effect is attached to this report.

In the Waiokura Stream taxa richness was lower than has been typical when compared to previous surveys at the upstream site (U) and the downstream site (D), with the richness at site U the lowest recorded richness to date for that site. The stream exhibited a greater than usual deterioration in MCI score, with a significant 18 unit decrease between the two sites. The SQMCI scores also indicated that there was some deterioration in a downstream direction although differences in this metric between sites were not significant. Often the difference between sites in the Waiokura Stream has been largely attributed to the distance between the sites (approximately six kilometres), and the marked habitat differences between sites (with predominant macrophytes noted at the downstream site), rather than to any effects of the application of wastes to land from the Fonterra factory. This can be supported by subtle changes observed in the macroinvertebrate community composition between the sites, which largely were associated with differences in habitat (principally an increase in macrophytes at the downstream site). It has previously been concluded that overall, and given the large distance between the two sites, there is insufficient evidence to conclude that any observed deterioration in the Waiokura Stream is related to the impacts of wastewater irrigation within the Waiokura catchment. However, on the basis of the available data, this cannot be ruled out either. In the 2019-2020 Annual Report it was therefore recommended that if the deterioration occurring at the downstream site is continued in the next scheduled survey, then increasing the monitoring frequency in the Waiokura Stream to spring and summer macroinvertebrate surveys should be considered. Furthermore, the sampling sites should also be re-evaluated in terms of what intermediate site(s) are also required. During the year under review an additional site was included in the scheduled Waiokura Stream survey so that, in the first instance, it might be possible to ascertain whether the differences between sites U and D relate to habitat differences, wastewater irrigation to land, other land uses in the intervening catchment area, or a combination of these factors. This intermediate site (I) was located immediately downstream of the Farm 3 site boundary. The results of this survey showed little difference between sites U and I, and a significant decrease in only MCI score between sites I and D. Overall, during this survey, there was no evidence indicating the impacts of wastewater irrigation to land are causing deterioration in the macroinvertebrate communities of the Waiokura Stream. Furthermore, given the results recorded in this initial survey at site I, it appears that the deterioration typically observed between sites U and D is most likely to result from the marked habitat differences between the sites as well as other land use influences on the stream over the six kilometre distance between sites. However, given that only one survey has been carried out at site I, it is recommended that both sites I and D are surveyed for a minimum of five samples to ensure consistency and allow comparison with previous surveys. Should results and habitat remain similar at sites I and U for a minimum of five samples, consideration should be given to removing site D from the monitoring programme

With respect to the Company's discharges to air, the results of the emissions monitoring undertaken on the flash dryer was again well below consent limit of 125 mg/dsm^3 that applies to this discharge only. The Company voluntarily monitors the particulate emissions from the other three stacks. Two of the three average particulate emission rates during the year under review were below the 125 mg/dsm^3 limit that applies to the flash dryer, with the supertab north dryer emission rate being slightly above this at 130 mg/dsm^3. The lactose deposition rates recorded were above their respective historical medians at AIR002301, AIR002302, and AIR002303, but substantially below the historical media at site AIR002305. It appears that there is an emerging trend of increasing lactose deposition rates at sites AIR002301,

AIR002302, and AIR002303, which is supported by increasing 5 year rolling medians for these monitoring locations. The deposition rate exceeded the guideline value only at site AIR0002301, which was downwind of the site discharges to air for only 10.8 % of the gauging period, indicating that this was as a result of a short lived event. It must be borne in mind that this is a guideline only and the particulate deposition rate is not limited by the Company's consent. No complaints were received by Council in relation to deposited particulates and inspections found no evidence of depositions. No odours were noted off site during the year under review.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 49 to Table 65.

Table 49 Summary of performance for Consent 0302-3

Purpose: ***To take and use up to 19,500 m³ /day (225 L/s) of water from the Kaupokonui Stream for cooling and general purposes associated with lactose manufacturing***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Undertake ecological monitoring	Biomonitoring surveys	Yes
2. Record daily rates of abstraction	Records received from the Company	Yes
3. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 50 Summary of performance for Consent 0919-3

Purpose: ***To discharge up to 19,500 m³/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Physicochemical and ecological monitoring of wastes and stream	Collection of samples and review of Company supplied data	Yes
2. Prohibited effects on receiving water	Site inspections, collection of samples, biological surveys	Yes
3. Limits on BOD level in receiving water	Collection of samples	Yes
4. Limits on temperature increase of receiving water	Temperature information supplied by the Company	Yes
5. Limit on downstream temperature of receiving water	Temperature data supplied by the Company and parallel temperature monitoring	Yes
6. Continuous monitoring of temperature of receiving water required	Temperature information supplied by the Company	Yes
7. Review of conditions 4 and 5	No further provision for review	N/A

Purpose: *To discharge up to 19,500 m^3/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
8. No thermal barrier or growths as a result of discharge within the mixing zone	Temperature information, site inspections	Yes
9. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes
10. Maintenance of riparian zone and annual donation to Taranaki Tree Trust	Site inspections. Review of contributions paid to Council	Yes
11. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 51 Summary of performance for agreed monitoring additional to consent 0919-3

Purpose: *Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014*		
Agreed monitoring	**Means of monitoring during period under review**	**Agreed monitoring standards met**
1. Installation and maintenance of a tamper-proof recording device measuring cooling water discharge rate and flow to accuracy of ± 5% by 31 August 2015	Issues resolved September 2019. Review of Company provided data	Yes
2. Installation and maintenance of a tamper proof data logger recording cooling water discharge rate and flow at 15 minute intervals (NZST) by 31 August 2015	Issues resolved September 2019. Review of Company provided data	Yes
3. Provision document from qualified person certifying installation and maintenance is as per manufacturers' instructions, and is operating to an accuracy of ± 5% within 30 days, and at Council's request	As found and after re-installation calibration data and certification will be required to meet the intent of this agreed monitoring standard. . Review of Company provided data	Yes
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy	Inspection and review of Company provided data	Yes

Purpose: *Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014*		
Agreed monitoring	**Means of monitoring during period under review**	**Agreed monitoring standards met**
5. By 31 August 2015, agreed measurements to be transmitted to Council to maintain a real time record in a format suitable for auditing and registering "zero" when no discharge occurring	Issues resolved September 2019. Review of Company provided data	Yes
Overall assessment of consent compliance and environmental performance in respect of this agreement		**High**
Overall assessment of administrative performance in respect of this agreement		**High**

N/A = not applicable

Table 52 Summary of performance for Consent 0920-3

Purpose: *To take up to 700 m^3/day from a bore in the Kaupokonui catchment for factory cooling water using plate heat exchangers*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Records of abstractions kept and supplied to Council	Records received – consent not exercised during monitoring period	Yes
2. Access to bore to be provided		Yes
3. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 53 Summary of performance for Consent 0921-3

Purpose: *To discharge up to 850 m^3/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effects discharge must not have on receiving water below mixing zone	Site inspections – consent not exercised during monitoring period	N/A
2. Consent holder to monitor daily volume, temperature of discharge	Consent not exercised during monitoring period	N/A
3. Review of consent conditions	No further provision for review	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

Table 54 Summary of performance for Consent 0922-3.2

Purpose: ***To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Maintenance of effluent spray irrigation plan, with specific matters to be covered in plan	Whole farm plan provided dated March 2021	Yes
2. Limit on maximum two day volumes	Records received	Yes
3. Consent exercised in accordance with procedures set out in effluent spray irrigation plan	Site and farm inspections	Yes
4. Provision for initiation of spray irrigation plan review, with plan reviewed plan by 1 July each year or upon two months' notice by Council	Plan reviewed and updated March 2021	Yes
5. Operation of spray irrigation plan, staff training	Site and farm inspections	Yes
6. No direct discharges of effluent into any watercourse	Farm inspections	Yes
7. No ponding	Farm inspections	Yes
8. 20 m 'buffer zone' to watercourse	Farm inspections	Yes
9. Records available to Council on request of effluent produced, volume irrigated, area and hours pumped	Records viewed at inspection. Volumes irrigated daily provided to Council	Yes
10. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 55 Summary of performance for Consent 0923-3.3

Purpose: ***To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt BPO to prevent or minimise adverse effects	Site and farm inspections, review of Company data, receiving environment monitoring	New maximum nitrate-N recorded for GND0638
2. Maintenance of effluent spray irrigation plan	Plan reviewed and updated March 2021	Yes

Purpose: *To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
3. Limit on maximum two day volumes	Records received	Yes
4. Consent exercised in accordance with procedures set out in plan	Site and farm inspections	Yes
5. Provision for initiation of spray irrigation plan review, with plan reviewed plan by 1 July each year and upon two months' notice by Council	Plan reviewed and updated March 2021	Yes
6. Operation of system in accordance with plan. Staff training	Site and farm inspections	Wastewater ponding from leaking connection to travelling irrigator found on one occasion
7. No offensive or objectionable odour	Farm inspections	Yes
8. No spray drift beyond boundaries	Farm inspections	Yes
9. No direct discharge to watercourses	Farm inspections	Yes
10. No ponding	Farm inspections	Yes
11. Spray 'buffer zone' limits	Farm inspections	Spray drift exceeded buffer zones at one inspection
12. Remediation in case of contamination of groundwater or roof water supply	Review of monitoring data and liaison with Company. Remedial actions put in place re: nitrate-N in GND0638	Contaminant concentrations decreased. Further reduction desirable
13. Installation and maintenance of monitoring bores	Farm inspections	Yes
14. Records provided to Council of effluent produced, volume irrigated, area and hours pumped	Records received	Yes
15. Change of consent conditions	Not sought	N/A
16. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Improvement required**
Overall assessment of administrative performance in respect of this consent		**Improvement required**

N/A = not applicable

Table 56 Summary of performance for Consent 0924-3

Purpose: *To discharge up to 1,440 m^3/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to undertake physicochemical and ecological monitoring	Consent holder and Council sampling. Old pipeline decommissioned and subsequently removed	Yes
2. Effects discharge must not have on receiving water below mixing zone	Site inspections	Yes
3. BOD of receiving water not to rise above 2 g/m^3	Samples collected	Yes
4. Temperature of receiving water not altered by more 2°C for 90% of time and not rise by more than 3°C	Consent holder data	Yes
5. Temperature of receiving water shall not increase above 25 degrees at the periphery of the mixing zone	Council data logger information, temperature information supplied by the Company. Parallel temperature monitoring	Yes
6. Consent holder to constantly monitor the temperature of the receiving waters	Consent holder maintains temperature probes instream, data forwarded to Council	Yes, with minor loss of record
7. Review of consent in June 2001 to evaluate performance of cooling system		N/A
8. Limits upon levels of contaminants in discharge	Sample collection	Suspended solids limit exceeded on one occasion in southern stormwater
9. Discharge not to create barrier for fish, or undesirable growths within the mixing zone	Site inspections	Yes
10. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes
11. Maintenance of contingency plan. Review and update (if required) annually	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes
12. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

*The consent specifies an average daily limit- ie a composite sample

N/A = not applicable

Table 57 Summary of performance for Consent 4032-5

Purpose: *To discharge emissions to the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt BPO to prevent or minimise emissions	Site inspections	Yes
2. Consent holder to fulfil obligations under the RMA	Site inspections	Yes
3. Limits of particulate from wet scrubber	Stack testing in October 2020	Yes
4. No alterations to plant or processes without prior consultation with Council	Site inspections	Yes
5. Discharge not to result in dangerous levels of airborne contaminants at or beyond the boundary	Not monitored during period under review	N/A
6. Discharge not to result in offensive or objectionable dust or odour at or beyond boundary	Site inspections	Yes
7. Change or cancellation of conditions		N/A
8. Discharge not to result in noxious or toxic levels of airborne contaminants at or beyond boundary	Not monitored during period under review	N/A
9. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 58 Summary of performance for Consent 4604-2

Purpose: *To discharge up to 280 L/s of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effects which must not arise below the 50 m mixing zone	Site inspections, samples, biomonitoring	Yes
2. Limits on oil & grease, pH and suspended solids in discharge	Sample collection	Yes
3. Contingency planning	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes

Purpose: *To discharge up to 280 L/s of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 59 Summary of performance for Consent 4623-3

Purpose: *To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. States consent is for on-going use of existing structure. Changes to the structure may need further authorisation under RMA	Inspection. No changes found	N/A
2. Structure to be maintained so it is safe and functions effectively	Inspection. Minor fugitive flows found at the weir. To be addressed along with any fish pass improvements that may be needed following the removal of the Glenn Road weir	Yes
3. Required prior notice of commencement of maintenance work	Inspection, no works found or notified during the period under review	N/A
4. The weir shall not restrict the passage of fish	Inspection and fish survey	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 60 Summary of performance for Consent 6423-1

Purpose: *To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Contingency planning	Review of Council records. Contained in Stormwater Management Plan. Latest plan on record April 2021	Yes
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental impacts	Site inspections	Yes

Purpose: *To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Limits on pH, suspended solids and hydrocarbons in the discharge	Sample collection	Yes
5. Effects which must not arise below the 50 mixing zone	Site inspections, stream sample collection, biomonitoring	Yes
6. Lapse of consent		N/A
7. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 61 Summary of performance of Consent 6948-1

Purpose: *To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option on adverse effects	Inspection by Council	Yes
2. Exercise in accordance with application	Inspection by Council	Yes
3. Notification prior to installation		N/A
4. Best practicable option to minimise contaminant discharge	Inspection by Council	Yes
5. Minimise disturbance of riverbed	Inspection by Council	Yes
6. Works resulting in downstream discolouration to be undertaken between November and April	Inspection by Council	Yes
7. Reinstatement of structure when no longer required		N/A
8. Lapse of consent		N/A
9. Review of consent conditions	No further opportunities for review	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 62 Summary of performance of Consent 9546-1

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to commencement of works	Liaison with Council. Work last undertaken June 2013	N/A
2. Culverts dimensions defined		N/A
3. Maximum depth of fill over culverts		N/A
4. Shaping of stream banks		N/A
5. Placement of rock rip-rap on upstream and downstream batters		N/A
6. Gradient of rock rip-rap in condition 5		N/A
7. Thickness of rock rip-rap on fill batters		N/A
8. Gradient of rock rip-rap in condition 7		N/A
9. Separation of concrete work from stream		N/A
10. Minimum period for curing of concrete in channel		N/A
11. No instream works between 1 June and 31 October	No maintenance undertaken during review period	N/A
12. Streambed disturbance minimised and reinstated		N/A
13. Fish passage not to be restricted	Inspection by Council	Yes
14. Pipes invert depth set		N/A
15. Gradient of culvert pipes not to exceed that of natural stream bed		N/A
16. Minimisation and mitigation of sediment discharged to stream	No maintenance undertaken during review period	N/A
17. Earthworks stabilisation to be as soon as practicable		N/A
18. Prevention of blockage and erosion responsibility of consent holder	Inspection by Council. No erosion or scour occurring	Yes
19. Procedure on discovery of archaeological remains		N/A

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
20. Removal of structure when no longer required		N/A
21. Lapse of consent on 20 June 2018 if not exercised	Consent exercised	N/A
22. Optional review provision for environmental effects	Next review date available 1 June 2023	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 63 Summary of performance of Consent 10215-1

Purpose: *To discharge solid farm dairy effluent onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effluent and farm dairy definition		N/A
2. Maximum volume of discharge		N/A
3. Notification upon volume exceedance	Check of Council records. No notifications received	N/A
4. Best practicable option on adverse effects	No disposals observed at inspection but no evidence of effects found	N/A
5. Diversion of stormwater		N/A
6. Maintenance of buffer distances	No disposals observed at inspection	N/A
7. Limit on Nitrogen application rate	Not assessed	N/A
8. Keeping of records	Not assessed	N/A
9. Actions following unauthorised discharge	No effects observed at inspection	N/A
10. Optional review provision for environmental effects	Next review date available 1 June 2023	N/A
11. Optional review provision for Regional Plan		N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

Table 64 Summary of performance of Consent 10232-1

Purpose: *To discharge pond sludge from farm dairy effluent onto and into land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Effluent and farm dairy definition		N/A
2. Maximum volume of discharge	Checking of records. No information provided to Council	N/A
3. Notification upon volume exceedance	Checking of records. No information provided to Council	N/A
4. Best practicable option on adverse effects	No disposals observed at inspection	N/A
5. Diversion of stormwater	Assessment by Council Officers	Yes
6. Maintenance of buffer distances	No disposals observed at inspection	N/A
7. Limit on Nitrogen application rate	Not assessed	N/A
8. Keeping of records	Not assessed	N/A
9. Actions following unauthorised discharge	Check of Council records for notifications received by Council. No notifications received	N/A
10. Optional review provision for environmental effects	Next review date available 1 June 2023	N/A
11. Optional review provision for Regional Plan		N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 65 Summary of performance of Consent 10412-1

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Specifies culvert dimensions		N/A
2. Specifies depth of fill over		N/A
3. Notification required 2 days prior to commencement of works	Checking of records and observation at inspection. Works not started	N/A
4. Prohibits work on under water stream bed between 1 May and 31 October		N/A

Purpose: *To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. All practicable steps to be taken to minimise streambed disturbance and effects, including specified measures		N/A
6. Gives rock riprap requirements including dimensions, batter and rock grading		N/A
7. Prohibits the restriction of fish passage		N/A
8. Specifies culvert invert		N/A
9. Specifies culvert gradient requirements		N/A
10. Specifies requirements for upstream and downstream stream banks		N/A
11. Specifies culvert maintenance requirements		N/A
12. Notification requirements if archaeological remains are found		N/A
13. Consent lases 31 March 2022 if not given effect to		N/A
14. Provisions for review of consent conditions	Next review opportunity June 2023	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

During the year, the Company generally demonstrated a high level of environmental and high level of administrative performance with the resource consents as defined in Section 1.1.4. However, an improvement is required in the management of the Company's activities in relation to the discharge of wastewater to land on Farms 2 and 3. There were four matters that arose during the year under review that related to the Company's management of the discharges of waste to land on Farms 2 and 3. There were two non-compliances relating to fugitive discharges from the wastewater conveyance systems and one that related to a non-compliance with the 20 m buffer zone from stream banks required during spray irrigation. These matters were addressed promptly and there were no adverse environmental effects associated with these non-compliances. The remaining matter related elevated concentrations of nitrate-N in one of the groundwater monitoring bores, with a new maximum for this monitoring location occurring during the year under review that was over six times the New Zealand drinking water standard. Although the mitigation measures employed during the year under review resulted in the contaminant concentration reducing by approximately one half, further improvement was still required in the groundwater quality in the vicinity of this bore. At the time of writing this report the nitrate-N concentration had reduced to 14.0 g/m^3.

3.4 Recommendations from the 2019-2020 Annual Report

In the 2019-2020 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of consented activities at the Company's Kapuni site in the 2020-2021 year, be amended from that undertaken in the 2019-2020 year by the inclusion of total nitrogen and ammoniacal nitrogen in the analysis suite for the groundwater monitoring survey.
2. THAT, due to the elevated nitrates in the upper catchment of the Motumate Stream, the re-establishment of periodic biomonitoring in the Motumate Stream be re-evaluated only after this issue has been investigated and resolved.
3. THAT, based on the findings of the biomonitoring surveys undertaken during the year under review, the locations of the biomonitoring sites be re-evaluated with the inclusion of up to three additional Waiokura biomonitoring sites during the 2020-2021 year.
4. THAT the Waiokura Stream biomonitoring surveys are undertaken in both spring and summer in the 2021-2022 if the deterioration occurring at the downstream site continues in the 2020-2021 survey.
5. THAT the biomonitoring sites used to monitoring the Company's activities that may influence macroinvertebrate communities in Dunns Creek and the Kaupokonui Stream be re-evaluated in the 2020-2021 year.
6. THAT consultation occur between the Council and the consent holder during the 2020-2021 year to establish what improvements may need to be made to the weir to rectify identified issues, and what improvements need to be made to the fish passage to address both the current potential issues and those likely to occur following the removal of the Glenn Road weir.
7. THAT provision be made in the 2021-2022 monitoring programme for the work required to re-evaluate the effectiveness of the fish pass following the removal of the Glenn Road weir.
8. THAT should there be issues with environmental or administrative performance in 2020-2021, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
9. THAT the Company investigate the reason for the elevated nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores.
10. THAT the Company investigate the environmental significance of the discrepancy between the sum of anions and sum of cations in the irrigated wastewater.

Recommendations 1, 3, and 4 were implemented, with one site added to the Waiokura Stream biomonitoring site survey. Recommendations 2 and 5 were accepted. Recommendations 6 and 7 were affected by a slightly delayed removal of the Glenn Road weir and therefore are on-going matters for the 2021-2022 year. Recommendation 8 did not require implementation. In relation to recommendation 9, a report has previously been provide detailing a theoretical explanation for these elevated levels, however the Council considered that the matter still needs to be further investigated. No information was received from Fonterra regarding investigations contained in recommendations 9 and 10 during the year under review.

3.5 Alterations to monitoring programmes for 2021-2022

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and

- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2021-2022, the monitoring be amended.

The inspection findings over the last several years have identified that there are few issues noted at the factory site (or in the Kaupokonui Stream samples) during the monthly site visits. It is therefore proposed that in the 2021-2022 year the frequency of these inspections be reduced with six inspections to be undertaken across the year. It is also proposed that provision be made for additional inspections to be undertaken should issues arise that require additional monitoring following the reduction in scheduled inspections. Issues arising during the year under review were predominantly related to the wastewater irrigation activities. Therefore alongside this proposed reduction in monitoring of the factory site, an increased focus be placed on observations at the time of the groundwater sampling on the farms and data provision requirements relating to the discharges of waste to land on the farms.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2021-2022, a change is made to the activities taking place, or a change is made to any of the consents in place for those activities.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at the Company's Kapuni site in the 2021-2022 year, be amended from that undertaken in the 2020-2021 year by a reduction in the number of site inspections and Kaupokonui Stream samples to six per year with provision for additional inspections should these be required.
2. THAT paddock by paddock discharge to land information be requested from the Company from the start of the 2021-2022 year.
3. THAT macroinvertebrate monitoring sites be introduced in Dunns Creek from the 2021-2022 year onwards to monitor potential impacts of the Company's irrigation of wastewater to land on Farm 1.
4. THAT monitoring of potential barriers to fish passage as a result of the Company's activities following the removal of the Glenn Road weir be carried out by the inclusion of an electric fishing survey and two spotlighting surveys in the 2021-2022 year.
5. THAT consultation occur between the Council and the consent holder during the 2021-2022 year to establish what improvements may need to be made to the weir to rectify identified issues, and what improvements need to be made to the fish passage to address both the current potential issues and those likely to occur following the removal of the Glenn Road weir.
6. THAT should there be issues with environmental or administrative performance in 2021-2022, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
7. THAT the Company investigate the reason for the elevated nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores.
8. THAT the Company investigate the environmental significance of the discrepancy between the sum of anions and sum of cations in the irrigated wastewater.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
Cl	Chloride.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 25˚C and expressed in mS/m or µS/cm.
DSE	Dairy shed effluent.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Ha	Hectare. A unit of land area.
IGL	Inhalation grade lactose.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
K	Potassium.
kg/ha/y	Kilograms per hectare per year.
kg/hr	Kilograms per hour.
L/s	Litres per second.
m^3	Cubic metres, a measure of volume.
MALF	Mean annual low flow. A statistic that describes the average amount of water in a river during times of low flow.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
Mg	Magnesium.

mg/dsm^3	Milligrams per cubic meter as measured at (or converted to) 0˚C and 1 atmosphere of pressure.
$mg/m^2/day$	Milligrams per square meter per day.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
Na	Sodium.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia.
NO_2	Nitrite, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of the environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and including all subsequent amendments.
SAR	Sodium adsorption ratio is a ratio of the concentration of sodium ions to the concentration of calcium plus magnesium ions. It is used to assess the likelihood that the amount of sodium present in irrigation water will cause permeability problems. An SAR greater than 10 to 15 can cause permeability problems in some soil types.
SIMP	Spray irrigation management plan.
SS	Suspended solids.
Temp	Temperature, measured in ˚C (degrees Celsius).
t/hr	Tonnes per hour.
TKN	Total Kjeldahl Nitrogen. A measure of the total concentration of organic nitrogen and ammonia, normally expressed in terms of the mass of nitrogen (N).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

For further information on analytical methods, contact a Science Services Manager.

Bibliography and references

Aston, T and Zillwood, B., 2009, *Particulate Emission Report Wet Scrubber*. CPL 09-31701.

Aurecon, 2019. *Kapuni Manufacturing Site Assessment of Environmental Effects, Revision 1*. Tauranga: Aurecon

Blakemore, KS, 2019a, *Biomonitoring of sites in the Kaupokonui River in relation to the Fonterra Kapuni farm and factory, October 2018*. TRC report KB076.

Blakemore, KS, 2019b, *Biomonitoring of sites in the Kaupokonui River and the Waiokura Stream in relation to the Fonterra Kapuni farm and factory, March 2019*. TRC report KB078.

Blakemore, KS, 2020a, *Biomonitoring of the Kaupokonui Stream in relation to the Fonterra Kapuni farm and factory, November 2019*. TRC report KB087.

Blakemore, KS, 2020b, *Biomonitoring of the Kaupokonui Stream and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, February 2020*. TRC report KB093.

Deegan, P and Clements, K, 2020, *Fish survey in the Kaupokonui Stream in relation to the Fonterra Kapuni lactose factory and weir, March 2020*. TRC report KC025.

Fowles, CR, 1993, *A water temperature survey of the Kaupokonui River to provide an assessment of a mixing zone and documentation of the effects of two cooling water discharges from the Lactose Company of New Zealand Ltd, 3 March 1993*. Taranaki Regional Council Internal Memorandum.

Fowles, CR, 1994, *A water temperature survey of the Kaupokonui River to provide an assessment of the mixing zone and documentation of the effects of the two re-positioned cooling water discharges from the Lactose Company of New Zealand Ltd, 29 March 1994*. Taranaki Regional Council Internal Memorandum.

Fowles, CR, 1995, *Water temperature survey of the Kaupokonui River, 23 January 1995*. Taranaki Regional Council Internal Memorandum.

Kingett, Mitchell & Associates, 1993, *Environmental effects on the Kaupokonui River, of the proposed modifications to the Kapuni Factory*. Report prepared for the Lactose Company of NZ Ltd.

Ministry of Health. 2018. *Drinking-water Standards for New Zealand 2005 (revised 2018)*. Wellington: Ministry of Health.

Ministry for the Environment, 2010, *Resource Management (Measurement and Reporting of Water Takes) Regulations 2010*. Ministry for the Environment, 8 pp.

Ministry for the Environment. 2018. *Best Practice Guidelines for Compliance, Monitoring and Enforcement under the Resource Management Act 1991*. Wellington: Ministry for the Environment.

Ministry for the Environment, 2018: *A Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended in 2017)*. Wellington: Ministry for the Environment.

Ministry for the Environment, 2020: *The National Policy Statement for Freshwater Management*. Wellington: Ministry for the Environment.

New Zealand Government, 2020 *Resource Management (National Environmental Standards for Freshwater) Regulations 2020*. Wellington

National Environmental Monitoring Standards (NEMS) Steering Group, *National Environmental Monitoring Standard - Water Temperature Measurement, Processing and Archiving of Water Temperature Data*, April 2017.

Taranaki Catchment Board, 1989, *Lactose Company of New Zealand – Water Rights Compliance Monitoring Programme Annual Report 1988/89*. Technical Report 89-18, Taranaki Catchment Board, Stratford.

Taranaki Regional Council, 1990, *Kaupokonui River Catchment Water Management Plan,* Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1990, *Lactose Company of New Zealand – Water Rights Compliance Monitoring Programme Annual Report 1989/90*. Technical Report 90-41, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1991, *Lactose Company of New Zealand Report 1990/91*. Technical Report 91-42, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1992, *Lactose Company of New Zealand: Compliance Monitoring Programme Annual Report 1991/92*. Technical Report 92-18, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1993, *Lactose Company of New Zealand: Monitoring Programme Annual Report 1992/93*. Technical Report 93-26, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1994, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1993/94*. Technical Report 94-26, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1995, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1994/95*. Technical Report 95-57, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1996, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1995/96*. Technical Report 96-23, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1997, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1996/97*. Technical Report 97-57, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1998, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1997/98*. Technical Report 98-57, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 1999, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1998-1999*. Technical Report 99-52, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2000, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 1999-2000*. Technical Report 2000-46, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2001, *Lactose Company of New Zealand: Air and Water Monitoring Programme Annual Report 2000-2001*. Technical Report 2001-41, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2003, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2001-2002*. Technical Report 2002-79, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2003, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2002-2003*. Technical Report 2003-38, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2004, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2003-2004*. Technical Report 2004-64, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2005, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2004-2005*. Technical Report 2005-107, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2006, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2005-2006*. Technical Report 2006-24, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2007, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2006-2007*. Technical Report 2007-107, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2008, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2007-2008*. Technical Report 2008-106, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2009, *Fonterra Kapuni Air and Water Monitoring Programme Annual Report 2008-2009*. Technical Report 2009-41, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2010, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2009-2010*. Technical Report 2010-86, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2012, *Fonterra Kapuni Stream Air and Water Monitoring Programme Biennial Report 2010-2012*. Technical Report 2012-81, Taranaki Regional Council, Stratford

Taranaki Regional Council, 2013, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2012-2013*. Technical Report 2013-106, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2015, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2013-2015*. Technical Report 2015-111, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2016, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2015-2016*. Technical Report 2016-52, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2018, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2016-2017*. Technical Report 2017-92, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2019, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2017-2018*. Technical Report 2018-96, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2020, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 2018-2019*. Technical Report 2019-51, Taranaki Regional Council, Stratford.

Taranaki Regional Council, 2021, *Fonterra Kapuni Stream Air and Water Monitoring Programme Annual Report 20198-20209*. Technical Report 2020-63, Taranaki Regional Council, Stratford.

Appendix I

Resource consents held by Fonterra Limited

(For a copy of the signed resource consent
please contact the TRC Consents department)

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To take and use up to 19,500 cubic metres/day [225 litres/second] of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing
Expiry Date:	1 June 2019
Site Location:	Kaupokonui Stream, Manaia Road, Kapuni Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697840E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such ecological monitoring associated with the abstraction of water from the Kaupokonui Stream as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That the consent holder shall operate and maintain a measuring device capable of accurately recording daily rates of abstraction and shall measure, record and make such records available to the Chief Executive, Taranaki Regional Council, on a monthly basis.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To discharge up to 19,500 cubic metres/day of cooling water from a lactose manufacturing plant via an outfall, cooling tower and/or spray system into the Kaupokonui Stream
Expiry Date:	1 June 2019
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the cooling water wastes, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to all or any of the following effects in the receiving water:

(a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(b) any conspicuous change in the colour or visual clarity;
(c) any emission of objectionable odour;
(d) the rendering of fresh water unsuitable for consumption by farm animals;
(e) any significant adverse effects on aquatic life, habitats, or ecology;
(f) any visible bacterial and/or fungal growths in the receiving water.

3. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not raise the average daily GFC (glass fibre) filtered five day biochemical oxygen demand of the receiving water above 2 gm^{-3} when measured at a site 150 metres downstream of the periphery of the spray discharge zone.

4. That the discharge (in conjunction with any discharges pertaining to the same site) shall not:

   a) alter the ambient temperature of the receiving water by more than 2 degrees Celsius for 90% of the time that the discharge is occurring on an annual basis; and

   b) alter the ambient temperature of the receiving water by more than 3 degrees Celsius at all times;

   when measured simultaneously immediately upstream and 150 metres downstream of the periphery of the spray discharge zone.

5. That the discharge shall not increase the temperature of the receiving water above 25 degrees Celsius at the periphery of the mixing zone defined in condition 2.

6. That the consent holder shall continuously monitor the temperature of the receiving waters in compliance with conditions 4 and 5, and forward the results of this monitoring to the Chief Executive, Taranaki Regional Council, at monthly intervals.

7. That the Taranaki Regional Council may review conditions 4 and 5 of this consent in June 2001, for the purpose of evaluating the performance of the cooling system in achieving compliance with these conditions.

8. That within the designated mixing zone, and including those waters of the Kaupokonui Stream directly receiving the cooling water discharge, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to:

   a) a thermal barrier preventing the movement of fish species; and/or
   b) any visible bacterial and/or fungal slime growths.

9. That no anti-corrosion agents, biocides, anti-flocculants or other chemicals shall be added to the cooling water without the written permission of the Chief Executive, Taranaki Regional Council.

10. That by the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by:

    a) the maintenance of existing riparian planting; and

    b) by donating annually to the Taranaki Tree Trust $3,000 (goods and services tax exclusive) for the purpose of providing long term riparian management in the Kaupokonui Stream catchment above the discharge. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.

11. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice or review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To take up to 700 cubic metres/day of water from a bore in the Kaupokonui catchment for factory cooling water using plate heat exchangers
Expiry Date:	1 June 2017
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629660N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall operate, to the satisfaction of the Chief Executive, Taranaki Regional Council, a measuring device capable of recording groundwater levels and daily and continuous rates of abstraction and shall make records available to the Chief Executive, Taranaki Regional Council.

2. That the consent holder shall allow the Taranaki Regional Council, its employees or agents, access to the bore at all reasonable times, for the purpose of inspecting the bore and/or taking samples of water or other material for analytical purposes.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To discharge up to 850 cubic metres/day of cooling water from plate heat exchangers and plant cooling system into an unnamed tributary of the Motumate Stream at two different locations
Expiry Date:	1 June 2017
Site Location:	Manaia Road Kapuni
Legal Description:	Pt Sec 14 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697930E-5629670N
Catchment:	Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That beyond a reasonable mixing zone extending to the confluence of the unnamed tributary and the Motumate Stream, the discharges shall not give rise to all or any of the following effects in the receiving water:

(i) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(ii) any conspicuous change in the colour or visual clarity;
(iii) any emission of objectionable odour;
(iv) the rendering of freshwater unsuitable for consumption by farm animals, and;
(v) any significant adverse effects on aquatic life, habitats, or ecology.

2. That the consent holder shall monitor the daily volume and temperature of the discharge, to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall make such records available to the Chief Executive, Taranaki Regional Council, on a monthly basis.

3. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date (Change):	15 July 2015
Commencement Date (Change):	15 July 2015 (Granted Date: 9 June 1999)

Conditions of Consent

Consent Granted:	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land
Expiry Date:	1 June 2019
Site Location:	893-911 Manaia Road, Kapuni
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697240E-5630126N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

    i) the administration, monitoring and supervision of this consent; and
    ii) charges authorised by regulations.

Special conditions

1. The consent holder shall maintain an effluent spray irrigation management plan, to the satisfaction of the Chief Executive, Taranaki Regional Council, which shall address the following matters:

    a) control of effluent application rate;
    b) monitoring of the effluent (physicochemical);
    c) monitoring of groundwater beneath the irrigated area (physicochemical);
    d) monitoring of drainage water downslope of the irrigated area (physicochemical);
    e) monitoring of the Kaupokonui Stream (physicochemical and biological);
    f) livestock management;
    g) irrigator maintenance and rotation;
    h) farm management and operator training;
    i) contingency events;
    j) the dairy industry guidelines;
    k) riparian planting and management; and
    l) the inclusion of dairy effluent.

2. The maximum volume of discharge shall not exceed 2,630 cubic metres over two consecutive days, including a maximum 120 cubic metres per day of dairy effluent.

3. The consent shall be exercised in accordance with the procedures set out in the effluent spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the effluent spray irrigation management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the effluent spray irrigation management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

4. The spray irrigation management plan described in special condition 1 of this consent shall be subject to review upon two months' notice by either the consent holder or the Taranaki Regional Council. Further, the consent holder shall review the spray irrigation management plan annually and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 1 July each year.

5. The consent holder shall ensure that:

   a) the operation of the spray irrigation system shall be carried out at all times in accordance with the requirements of the effluent spray irrigation management plan required in special condition 1 or subsequent version of that document which does not lessen environmental protection standards;

   b) all relevant site staff are to be regularly trained on the content and implementation of the effluent spray irrigation management plan, the maximum period between training sessions being 12 months. Relevant new staff are to be trained on recruitment and the training record made available to the Chief Executive, Taranaki Regional Council, upon request; and

   c) all relevant site staff are advised immediately of any revision or additions to the effluent spray irrigation management plan.

6. There shall be no direct discharge of effluent into any watercourse.

7. The spray irrigation system shall not be operated in a manner that causes ponding.

8. From the edge of the spray zone there shall be at least 20 metres to the bank of any watercourse.

9. The consent holder shall monitor and record on a daily basis the volume of effluent produced, the volume of effluent spray irrigated, the area spray irrigated and the hours the irrigation pumps are working; and shall make such records, together with groundwater monitoring data, available to the Chief Executive, Taranaki Regional Council, upon request.

10. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004 and/or June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 July 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date (Change):	15 July 2015
Commencement Date (Change):	15 July 2015 (Granted Date: 9 June 1999)

Conditions of Consent

Consent Granted:	To discharge combined dairy effluent and factory wastewater (evaporator condensate, washings, processing wastes and stormwater) from a lactose manufacturing plant by spray irrigation onto and into land
Expiry Date:	1 June 2019
Site Location:	560A & 586 Manaia Road & 1319 Skeet Road, Kapuni
Legal Description:	Lot 2 DP 5897 Lots 1 & 2 6039 Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697811E-5627168N
Catchment:	Waiokura Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

    i) the administration, monitoring and supervision of this consent; and
    ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The consent holder shall maintain an effluent spray irrigation management plan, to the satisfaction of the Chief Executive, Taranaki Regional Council, which shall address the following matters:

    a) control of effluent application rate and duration;
    b) application frequency
    c) designated application areas;
    d) prevention of runoff and ponding
    e) monitoring of the effluent (physicochemical);
    f) monitoring of groundwater beneath the irrigated area (physicochemical);
    g) monitoring of drainage water downslope of the irrigated area (physicochemical);
    h) monitoring of the Waiokura and Motumate Streams (physicochemical and biological);
    i) monitoring of soils and herbage (physicochemical);
    j) minimisation and control of odour effects offsite;
    k) livestock management;
    l) soil and herbage management;
    m) irrigator maintenance and rotation;
    n) farm management and operator training;
    o) contingency events;
    p) reporting monitoring data;
    q) notification to the council of non-compliance with conditions of this consent;
    r) the dairy industry guidelines;
    s) riparian planting and management; and
    t) the inclusion of dairy effluent.

3. The maximum volume of discharge shall not exceed 3,834 cubic metres over two consecutive days, including a maximum 168 cubic metres per day of dairy effluent.

4. The consent shall be exercised in accordance with the procedures set out in the effluent spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the effluent spray irrigation management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the effluent spray irrigation management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

5. The spray irrigation management plan described in special condition 2 of this consent shall be subject to review upon two months' notice by either the consent holder or the Taranaki Regional Council. Further, the consent holder shall review the spray irrigation management plan annually and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 1 July each year.

6. The consent holder shall ensure that:

   a) the operation of the spray irrigation system shall be carried out at all times in accordance with the requirements of the effluent spray irrigation management plan required in special condition 2 or subsequent version of that document which does not lessen environmental protection standards;

   b) all relevant site staff are to be regularly trained on the content and implementation of the effluent spray irrigation management plan, the maximum period between training sessions being 12 months. Relevant new staff are to be trained on recruitment and the training record made available to the Chief Executive, Taranaki Regional Council, upon request; and

   c) all relevant site staff are advised immediately of any revision or additions to the effluent spray irrigation management plan.

7. There shall be no offensive or objectionable odour as a result of the exercise of this consent at or beyond the boundary of the property or properties on which spray irrigation is occurring.

8. There shall be no spray drift as a result of the exercise of this consent at or beyond the boundary of the property or properties on which spray irrigation is occurring.

9. There shall be no direct discharge of any type of effluent into any watercourse.

10. The spray irrigation system shall not be operated in a manner that causes ponding.

11. The edge of the spray zone shall be at least:

   (a) 20 metres from the bank of any watercourse;
   (b) 10 metres from any property boundary, except as detailed in c);
   (c) 20 metres from the boundary with the property described as Lot 1 DP3601, Blk XV, Kaupokonui SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance.

12. Should monitoring of the discharge under conditions 13 and 14 indicate, in the opinion of the Chief Executive, Taranaki Regional Council, contamination of local groundwater or a water supply from the roof of a dwelling house as a result of the exercise of this consent the consent holder shall:

    (a) undertake appropriate remedial action as soon as practicable as described in the wastewater irrigation management plan prepared under condition 2, or other such action reasonably required by the Chief Executive, Taranaki Regional Council;

    (b) shall review the wastewater irrigation management plan and incorporate such reasonable modifications as are considered necessary by the Chief Executive, Taranaki Regional Council; and

    (c) where water supplies are significantly affected immediately provide alternative supplies as reasonably required by the Chief Executive, Taranaki Regional Council.

13. The consent holder shall site, install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge.

14. The consent holder shall monitor and record on a daily basis the volume of effluent produced, the volume of effluent spray irrigated, the area spray irrigated and the hours the irrigation pumps are working; and shall make such records, together with groundwater monitoring data, available to the Chief Executive, Taranaki Regional Council, upon request.

15. The consent holder may apply to the Taranaki Regional Council for a change or cancellation of the conditions of this consent, in accordance with section 127(1)(a) of the Resource Management Act 1991, to take into account of operational requirements, the results of monitoring, or irrigation scheme expansion.

16. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 July 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	9 June 1999
Commencement Date:	9 June 1999

Conditions of Consent

Consent Granted:	To discharge up to 1,440 cubic metres/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream
Expiry Date:	1 June 2019
Site Location:	Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629560N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, in conjunction with the Taranaki Regional Council, undertake such physicochemical and ecological monitoring of the stormwater and cooling water discharges, and the receiving waters (Kaupokonui Stream) as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

2. That allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to all or any of the following effects in the receiving water:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

b) any conspicuous change in the colour or visual clarity;

c) any emission of objectionable odour;

d) the rendering of fresh water unsuitable for consumption by farm animals;

e) any significant adverse effects on aquatic life, habitats, or ecology;

f) any visible biological and/or fungal growths in the receiving water.

3. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not raise the average daily GFC (glass fibre) filtered five day biochemical oxygen demand (BOD(5)) of the receiving water above 2 gm^{-3} when measured at a site 150 metres downstream of the periphery of the spray discharge zone.

4. That the discharge (in conjunction with any other discharges pertaining to the same site) shall not:

   a) alter the ambient temperature of the receiving water by more than 2 degrees Celsius for 90% of the time that the discharge is occurring on an annual basis; and

   b) alter the ambient temperature of the receiving water by more than 3 degrees Celsius at all times;

   when measured simultaneously immediately upstream and 150 metres downstream of the periphery of the spray discharge zone.

5. That the discharge shall not increase the temperature of the receiving water above 25 degrees Celsius at the periphery of the mixing zone defined in condition 2.

6. That the consent holder shall continuously monitor the temperature of the receiving waters in compliance with conditions 4 and 5, and forward the results of this monitoring to the Chief Executive, Taranaki Regional Council, at monthly intervals.

7. That the Taranaki Regional Council may review conditions 4 and 5 of this consent in June 2001, for the purpose of evaluating the performance of the cooling system in achieving compliance with these conditions.

8. That the discharge shall comply with the following limits at all times:

a)	oil and grease (Freon extractable)	<15 gm^{-3}
b)	pH (within the range)	6.0 - 8.5
c)	suspended solids	<100 gm^{-3}

9. That within the designated mixing zone, and including those waters of the Kaupokonui Stream directly receiving the discharge (in conjunction with any other discharges pertaining to the same site) shall not give rise to:

   i) a barrier preventing the movement of fish species and/or;
   ii) any visible bacterial and/or fungal slime growths.

10. That no anti-corrosion agents, biocides, anti-flocculants or other chemicals shall be added to the cooling water without the written permission of the Chief Executive, Taranaki Regional Council.

11. That the consent holder shall maintain a contingency plan, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent, and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. This contingency plan shall be reviewed and updated (if necessary) on an annual basis.

12. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004, June 2009 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date (Change):	2 June 2004
Commencement Date (Change):	2 June 2004 (Granted Date: 17 April 2000)

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant
Expiry Date:	1 June 2019
Site Location:	Manaia Road, Kapuni
Legal Description:	Pt Lot 1 DP 6157 Lots 1-9 DP 6588 Lot 1 DP 9769 Blk XV Kaupokonui SD Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697840E-5629860N

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any emissions of particulate matter during loading, processing, unloading, packaging, drying, transport or any other site operation.

2. Nothing in these conditions shall remove from the consent holder the obligations, liabilities, duties and/or responsibilities specified in section 17 of the Resource Management Act 1991 or any other part of the Act.

3. The particulate from the wet scrubber system, which treats the exhaust streams from the pre-drier stack and the refined fluid bed drier, shall not exceed 125 milligrams per cubic metre of air, adjusted to 0 degrees Celsius, 1 atmosphere pressure and calculated as a dry gas.

4. No alteration shall be made to plant or process which may substantially change the nature or quality of contaminants emitted without prior consultation with the Chief Executive, Taranaki Regional Council.

5. The discharge shall not result in dangerous levels of airborne contaminants at or beyond the boundary of the property, including but not limited to any risk of fire or explosion.

6. The discharge shall not result in offensive or objectionable dust or odour at or beyond the boundary of the property.

7. The consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent in accordance with section 127(1)(a) of the Resource Management Act 1991 to take account of operational requirements or the results of monitoring.

8. The discharge shall not result in noxious or toxic levels of airborne contaminants at or beyond the boundary of the property.

9. Subject to the provisions of this condition, the Taranaki Regional Council may in June 2004 and/or June 2009 and/or June 2014, serve notice that it intends to review any condition of the resource consent, in accordance with section 128(1)(a) of the Resource Management Act 1991, for the purpose of:

   a) dealing with any significant adverse effect on the environment arising from the exercise of this consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; or

   b) further specifying the best practicable option to remove or reduce any adverse effect on the environment caused by any discharge to air; or

   c) to add limits on discharge or ambient concentration of any contaminant or contaminants.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To discharge up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream
Expiry Date:	1 June 2017
Site Location:	Factory Extension Site, Manaia Road Kapuni
Legal Description:	Lot 1 DP 6157 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697740E-5629860N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That allowing for a reasonable mixing zone of 50 metres extending downstream of the discharge point, the discharge shall not give rise to all or any of the following effects in the receiving water:

(i) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(ii) any conspicuous change in the colour or visual clarity;
(iii) any emission of objectionable odour;
(iv) the rendering of fresh water unsuitable for consumption by farm animals; and
(v) any significant adverse effects on aquatic life, habitats or ecology.

2. That the discharge shall not exceed the following parameters:

(i)	oil and grease	<15 g/m^3
(ii)	pH [within the range]	6.0 - 8.5
(iii)	suspended solids	100 gm^3

3. That prior to the exercise of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

4. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	14 December 2017
Commencement Date:	14 December 2017

Conditions of Consent

Consent Granted:	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes
Expiry Date:	1 June 2019
Site Location:	879 Manaia Road, Kapuni
Grid Reference (NZTM)	1697665E-5629707N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. This consent authorises the ongoing use of the weir existing at the time the application for this consent was lodged, and as described in the application. Any change to the nature or scale of the structure may therefore need to be authorised by a formal process in accordance with the Resource Management Act, 1991.

2. The consent holder shall maintain the structure in a safe and sound condition such that it continues to function effectively.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to commencement of maintenance work that involves disturbance of, or deposition to the stream bed, or discharges to water. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

4. The weir shall not restrict the passage of fish.

Signed at Stratford on 14 December 2017

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	13 July 2004
Commencement Date:	13 July 2004

Conditions of Consent

Consent Granted:	To discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui Stream
Expiry Date:	1 June 2017
Site Location:	Manaia Road, Kapuni
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697810E-5629840N
Catchment:	Kaupokonui

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. Prior to the exercise of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

2. The exercise of this consent shall be conducted in general accordance with the information submitted in support of application 3198, and to ensure that the conditions of this consent are met at all times. In the case of any contradiction between the documentation submitted in support of application 3198 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on any water body.

4. The following concentrations shall not be exceeded in the discharge:

Component	**Concentration**
pH (range)	6.5 - 8.5
suspended solids	100 gm^{-3}
total recoverable hydrocarbons [infrared spectroscopic technique]	15 gm^{-3}

This condition shall apply prior to the entry of the stormwater into the Kaupokonui Stream at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

5. After allowing for reasonable mixing, within a mixing zone extending 50 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the Kaupokonui Stream:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission of objectionable odour;
   d) the rendering of fresh water unsuitable for consumption by farm animals;
   e) any significant adverse effects on aquatic life.

6. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2005 and/or June 2011, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	18 September 2006
Commencement Date:	18 September 2006

Conditions of Consent

Consent Granted:	To erect, place, maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purposes of conveying irrigation wastewater
Expiry Date:	01 June 2023
Review Date(s):	June 2017
Site Location:	Skeet and Manaia Roads, Kapuni
Legal Description:	Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD, Lots 1 & 2 DP 6039 Blk III Waimate SD, Lot 2 DP 5897 Pt Secs 25 & 26 Blk III Waimate SD
Grid Reference (NZTM)	1697950E-5627960N
Catchment:	Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4339. In the case of any contradiction between the documentation submitted in support of application 4339 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent.

4. The consent holder shall adopt the best practicable option to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. Any disturbance of parts of the river bed covered by water and/or any maintenance works which may result in downstream discolouration of water shall be undertaken only between 1 November and 30 April except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

7. The structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

8. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

9. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Co-operative Group Limited P O Box 444 HAWERA
Consent Granted Date:	23 May 2007

Conditions of Consent

Consent Granted:	To erect, place and maintain a stone lined bank on the left bank of Dunns Creek for erosion control purpose at or about GR: P20:072-919
Expiry Date:	1 June 2023
Review Date(s):	June 2011, June 2017
Site Location:	901 Manaia Road, Kapuni – Fonterra Kapuni No 1 Farm
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD
Catchment:	Kaupokonui
Tributary:	Dunns Creek

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4650. In the case of any contradiction between the documentation submitted in support of application 4650 and the conditions of this consent, the conditions of this consent shall prevail.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least seven days prior to the exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.

3. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

4. Except with the written agreement of the Chief Executive, Taranaki Regional Council, the structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

5. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

6. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 23 May 2007

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 424 Hawera 4640
Decision Date:	18 April 2013
Commencement Date:	18 April 2013

Conditions of Consent

Consent Granted:	To install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation
Expiry Date:	1 June 2029
Review Date(s):	June 2017, June 2023
Site Location:	586 Manaia Road, Kapuni
Legal Description:	Lot 1 DP 6039 Blk III Waimate SD (Site of structure)
Grid Reference (NZTM)	1698317E-5627432N
Catchment:	Waiokura

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 2 working days prior to the commencement of work. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

2. Installation shall include two culvert pipes with a diameter no less than 1.35 metres, and a total length no greater than 17.5 metres.

3. The fill over the top of the twin culvert pipes shall be no deeper than 3 metres.

4. The stream banks shall be shaped both upstream and downstream of the twin culvert to form a gradual transition between the existing channel width and the twin culvert.

5. The consent holder shall ensure that rock rip rap armouring is placed on the reshaped channel batters and the streambed, for at least 5 metres, both upstream and downstream of the culvert.

6. The rock rip rap required by condition 5 shall be placed at a slope no steeper than 1.5 horizontal to 1 vertical, and shall have the following grading:

    - 100% less than 800 mm diameter
    - 50% greater than 600 mm diameter
    - 90% greater than 350 mm diameter

7. The consent holder shall ensure that a layer of rock rip rap, at least 500 mm thick, is placed on the batters of the fill embankment.

8. The rock rip rap required by condition 7 shall be placed at a slope no steeper than 1.5 horizontal to 1 vertical, and shall have the following grading:

    - 100% less than 450 mm diameter
    - 50% greater than 300 mm diameter
    - 90% greater than 310 mm diameter

9. Any concrete work carried out in the river bed shall be completely separated from running water, by a temporary coffer-dam and/or diversion using sand bags or some other form of contained of fill.

10. The consent holder shall ensure that any concrete placed in the channel is not exposed to flowing water for a period of 48 hours after it has been placed.

11. No instream works shall take place between 1 June and 31 October inclusive.

12. The consent holder shall ensure that the area and volume of stream bed disturbance is, as far as practicable, minimised and any areas that are disturbed are, as far as practicable, reinstated.

13. The culvert shall not obstruct fish passage.

14. The invert of each culvert pipe shall be set 300 mm below the natural streambed.

15. The gradient of each culvert pipe shall be no steeper than the natural gradient of the stream bed at the site.

16. The consent holder shall take all reasonable steps to:

    a. minimise the amount of sediment discharged to the stream;
    b. minimise the amount of sediment that becomes suspended in the stream; and
    c. mitigate the effects of any sediment in the stream.

    Undertaking work in accordance with *Guidelines for Earthworks in the Taranaki region,* by the Taranaki Regional Council, will achieve compliance with this condition.

17. All earthwork areas shall be stabilised as soon as is practicable immediately following completion of soil disturbance activities.

    Note: For the purpose of this condition "stabilised" in relation to any site or area means inherently resistant to erosion or rendered resistant, such as by using indurated rock or by the application of basecourse, colluvium, grassing, mulch, or another method to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council and as specified in Taranaki Regional Council's Guidelines for Earthworks in the Taranaki Region, 2006. Where seeding or grassing is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once, on reasonable visual inspection by an Investigating Officer, Taranaki Regional Council, an 80% vegetative cover has been established.

18. The works shall remain the responsibility of the consent holder and be maintained so that:

    a. it does not become blocked and at all times allows the free flow of water through it;
    b. any erosion, scour or instability of the stream bed or banks that is attributable to the works carried out as part of this consent is remedied by the consent holder.

19. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

20. Except with the written agreement of the Chief Executive, Taranaki Regional Council, the culvert shall be removed and the area reinstated, if and when it is no longer required. A further resource consent may be required to authorise the removal of the structure, and the consent holder is advised to seek advice from the Council on this matter.

21. This consent shall lapse on 30 June 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

22. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2017 and/or June 2023, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	5 February 2016
Commencement Date:	5 February 2016

Conditions of Consent

Consent Granted:	To discharge solid farm dairy effluent onto and into land
Expiry Date:	1 June 2041
Review Date(s):	June 2023, June 2029, June 2035 and in accordance with special condition 11
Site Location:	1291 Skeet Road; 560 A & B, 586 and 594 Manaia Road, Kapuni (Kapuni Farms)
Legal Description:	Lot 2 DP 5897 Lot 2 DP 6039 Blk III Waimate SD, Lot 6 DP 2903 Lot 3 DP 3601 Blk XV Kaupokonui SD (Discharge source & site)
Grid Reference (NZTM)	1698545E–5626837N; 1698551E–5627075N 1698184E–5627034N; 1697499E–5626999N 1698510E–5627964N; 1698564E–5628854N
Catchment:	Waiokura Motumate

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent authorises the discharge of pond sludge from farm dairy effluent onto land. For the purposes of this consent:

   a) Farm dairy includes every area of the dairy cow milking process and includes covered and uncovered areas where cows reside for longer than five minutes for the purpose of milking (including a stand-off pad or yard) but does not include raceways; and

   b) 'Effluent' includes slurry and solid forms. It also includes sand trap cleanings.

2. A maximum of 500 m^3/year of dried solid effluent shall be discharged to 9.23 ha of land.

3. The consent holder shall advise the Taranaki Regional Council by sending an email to consents@trc.govt.nz if the volume of dairy farm exceeds the amount authorised in condition 2. The email shall include the consent number or dairy supply number.

4. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on the environment.

5. A stormwater diversion system and a sand trap system shall be installed, maintained and operated at the farm dairy. The diversion system shall prevent, as far as practicable, uncontaminated stormwater entering the effluent disposal system.

   Note. Farm dairy includes any stand-off pad or yard (see condition 1(a)).

6. No contaminants shall be discharged within:

   (a) 25 metres of any surface water body; or
   (b) 25 metres of any fenced urupa (burial ground) without the written approval of the relevant Iwi; or
   (c) 50 metres of any bore, well or spring used for water supply purposes; or
   (d) 150 metres of any dwelling that is not owned by the consent holder, or any marae, unless the written approval of the owner and occupier has been obtained to allow the discharge at a closer distance.

7. Over any 12 month period the Total Nitrogen applied to any hectare of land as a result of the discharge shall be no more than 200 kg.

   Advice Note: Any Nitrogen applied within effluent should be taken into account in the nutrient budget for that land.

8. The consent holder shall keep accurate records of effluent discharged including, but not necessarily limited to the:

   (a) effluent type (e.g. liquid, slurry, solid);
   (b) source of any solid effluent (e.g. anaerobic pond sludge, sand trap);
   (c) paddock and area (ha) that effluent was applied to; and
   (d) date the paddock received effluent.

   This information shall be provided to the Taranaki Regional Council upon request.

9. Where, for any cause (accidental or otherwise), effluent enters surface water or a subsurface drainage system, the consent holder shall:

   (a) immediately notify the Taranaki Regional Council on Ph. 0800 736 222 (notification must include either the consent number or farm dairy number); and
   (b) stop the discharge and immediately take steps to control and stop the escape of effluent to surface water; and
   (c) immediately take steps to ensure that a recurrence of the escape of effluent to surface water is prevented; and
   (d) report in writing to the Chief Executive, Taranaki Regional Council, describing the manner and cause of the escape and the steps taken to control it and to prevent it reoccurring. The report shall be provided to the Chief Executive within seven days of the occurrence.

10. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029 and/or June 2035, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

11. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within a period of 12-months immediately following a Regional Plan, that includes rules relating to discharges of farm dairy effluent, becoming operative. Any such review would be for the purposes of ensuring that the consent conditions have appropriate regard to that plan.

Signed at Stratford on 5 February 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	5 February 2016
Commencement Date:	5 February 2016

Conditions of Consent

Consent Granted:	To discharge pond sludge from farm dairy effluent onto and into land
Expiry Date:	1 June 2041
Review Date(s):	June 2023, June 2029, June 2035 and in accordance with special condition 11
Site Location:	893, 901, 911 Manaia Road, Kapuni (Kapuni 1)
Legal Description:	Lot 1 DP 4509 Sec 1 SO 11967 Blk XV Kaupokonui SD, Lot 6 Pt Lot 5 DP 4509 Pt Lot 2 DP 6157 Secs 51 & 55 Blk XV Kaupokonui SD (Discharge source & site)
Grid Reference (NZTM)	1697477E–5629140N 1696786E–5630300N 1697978E–5630246N
Catchment:	Kaupokonui
Tributary:	Dunns Creek

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent authorises the discharge of solid farm dairy effluent onto land. For the purposes of this consent:

   a) Farm dairy includes every area of the dairy cow milking process and includes covered and uncovered areas where cows reside for longer than five minutes for the purpose of milking (including a stand-off pad or yard) but does not include raceways; and

   b) 'Effluent' includes slurry and solid forms. It also includes sand trap cleanings.

2. A maximum of 1000 m^3/year of the solid farm dairy effluent shall be discharged to 14.1 ha of land.

3. The consent holder shall advise the Taranaki Regional Council by sending an email to consents@trc.govt.nz if the volume of dairy farm exceeds the amount authorised in condition 2. The email shall include the consent number or dairy supply number.

4. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on the environment.

5. A stormwater diversion system and a sand trap system shall be installed, maintained and operated at the farm dairy. The diversion system shall prevent, as far as practicable, uncontaminated stormwater entering the effluent disposal system.

   Note. Farm dairy includes any stand-off pad or yard (see condition 1(a)).

6. No contaminants shall be discharged within:

   (a) 25 metres of any surface water body; or
   (b) 25 metres of any fenced urupa (burial ground) without the written approval of the relevant Iwi; or
   (c) 50 metres of any bore, well or spring used for water supply purposes; or
   (d) 150 metres of any dwelling that is not owned by the consent holder, or any marae, unless the written approval of the owner and occupier has been obtained to allow the discharge at a closer distance.

7. Over any 12 month period the Total Nitrogen applied to any hectare of land as a result of the discharge shall be no more than 200 kg.

   Advice Note: Any Nitrogen applied within effluent should be taken into account in the nutrient budget for that land.

8. The consent holder shall keep accurate records of effluent discharged including, but not necessarily limited to the:

   (a) effluent type (e.g. liquid, slurry, solid);
   (b) source of any solid effluent (e.g. anaerobic pond sludge, sand trap);
   (c) paddock and area (ha) that effluent was applied to; and
   (d) date the paddock received effluent.

   This information shall be provided to the Taranaki Regional Council upon request.

9. Where, for any cause (accidental or otherwise), effluent enters surface water or a subsurface drainage system, the consent holder shall:

   (a) immediately notify the Taranaki Regional Council on Ph. 0800 736 222 (notification must include either the consent number or farm dairy number); and
   (b) stop the discharge and immediately take steps to control and stop the escape of effluent to surface water; and
   (c) immediately take steps to ensure that a recurrence of the escape of effluent to surface water is prevented; and
   (d) report in writing to the Chief Executive, Taranaki Regional Council, describing the manner and cause of the escape and the steps taken to control it and to prevent it reoccurring. The report shall be provided to the Chief Executive within seven days of the occurrence.

10. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029 and/or June 2035, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

11. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review within a period of 12-months immediately following a Regional Plan, that includes rules relating to discharges of farm dairy effluent, becoming operative. Any such review would be for the purposes of ensuring that the consent conditions have appropriate regard to that plan.

Signed at Stratford on 05 February 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Fonterra Limited PO Box 444 Hawera 4640
Decision Date:	10 March 2017
Commencement Date:	10 March 2017

Conditions of Consent

Consent Granted:	To install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed
Expiry Date:	01 June 2035
Review Date(s):	June 2023, June 2029
Site Location:	1319 Skeet Road, Kapuni
Grid Reference (NZTM)	1698599E - 5628827N
Catchment:	Waiokura

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The culvert pipe shall be made up of 2 pipes with diameters of no less than 1350 mm each and be no longer than 12 metres.

2. The fill over the top of the culvert pipe shall be no deeper than 1.5 metres.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 2 working days prior to the commencement of work. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

4. Between 1 May and 31 October no work shall be undertaken on any part of the stream bed that is covered by water.

5. The consent holder shall take all practicable steps to minimise stream bed disturbance, sedimentation and increased turbidity during installation of the culvert, including by:
   a) completing all works in the minimum time practicable;
   b) avoiding placement of excavated material in the flowing channel;
   c) keeping machinery out of the actively flowing channel, as far as practicable; and
   d) reinstating any disturbed areas as far as practicable.

6. A layer of rock riprap 1200 mm thick shall be installed in the stream bed. The riprap shall extend 5 metres downstream of the culvert outlet and 5 metres upstream of the culvert inlet, 1.5 metres up the banks on both sides of the stream and on the batter slope of the fill on both sides of the culvert. The batter shall be no steeper than 1.5 horizontal and 1 vertical. The rock shall have the following grading:
   - 100% less than 800 mm diameter;
   - 50% greater than 600 mm diameter;
   - 90% greater than 350 mm diameter.

7. The culvert shall not restrict fish passage.

8. The invert of the culvert shall be set below the existing stream bed by 250 mm so that it fills with bed material and simulates the natural bed.

9. The gradient of the culvert shall be no steeper than the natural gradient of the stream bed at the site.

10. On completion of works, the banks of the channel upstream and downstream of the culvert installation shall be no steeper than the existing natural banks. Where the bank consists of fill, the fill must be well compacted with batter slopes no steeper than 2 horizontal to 1 vertical.

11. The culvert shall remain the responsibility of the consent holder and be maintained so that:
    a) it does not become blocked, and at all times allows the free flow of water through both pipes; and
    b) the consent holder repairs any erosion, scour or instability of the stream bed or banks that the culvert causes.

12. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

13. This consent shall lapse on 31 March 2022, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

14. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2023 and/or June 2029, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 10 March 2017

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management