Fonterra Kapuni
Air and Water
Monitoring Programme
Annual Report
2017-2018

Technical Report 2018–96

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Executive summary

Fonterra Limited (the Company) operates a lactose manufacturing factory and inhalation grade lactose (IGL) 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. This report for the period July 2017 to June 2018 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 year under review the Company held up to 17 resource consents, which included a total of 150 conditions setting out the requirements that the Company must satisfy. The Company holds two consents to allow it to take and use water, six consents to discharge stormwater and/or cooling water into the Kaupokonui and Motumate Streams, four consents to discharge wastes to land, four 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. One of the land use consents was granted in March 2017 for the installation of a dual culvert in the Waiokura Stream to allow the reinstatement of a farm track across the stream. Four of the land use consents expired on 1 June 2017 with renewal applications being lodged on 21 July 2017. As a result three of the activities remained unconsented until a change in the *Resource Management Act (2001)* allowed Council to deem them permitted. The replacement consent for the use of the weir associated with the water abstraction consent was granted in December 2017.

Overall, during the monitoring period, the Company demonstrated a poor level of environmental performance.

The Council's monitoring programmes for the period under review together included 12 inspections, 166 water samples collected for physicochemical analysis, two macroinvertebrate surveys of receiving waters, and five ambient air quality analyses.

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 installed, however, the ongoing transmission and validity of the data have resulted in the full terms of the agreement not being met within the agreed timeframe. The problems with data transmission were addressed during the year under review. During the 2018-2019 year, Council was advised that the location in which the equipment was installed has resulted in the agreed accuracy and validation not being achievable. As the written agreement brought this monitoring within the scope of condition 1 of consent 0919, at the time of writing this report, Council was considering the enforcement options. This will be discussed further in the 2018-2019 report. During the year under review the cooling water that was discharged with the stormwater under consent 0924 was diverted to the cooling water tower and spray discharge system.

Ecological monitoring did not note any problems in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes.

Temperature increase limits on cooling water discharged 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. On two consecutive evenings the Company shut down the evaporators to avoid a potential consent exceedance when the upstream temperature in the Kaupokonui Stream reached 24.8°C. Riparian planting was maintained on the farms and factory site and a donation was received by the Council as per consent conditions.

Irrigation onto the two dairy farms was, in general, well managed, including the new dairy shed effluent. Nitrogen loading on the farms was reduced due to a decrease in loading from factory wastewater. No effect from irrigation was found during inspection, sampling or biological monitoring of the Kaupokonui and Waiokura Streams. A 20 m buffer to the bank of water courses was maintained during irrigation.

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, the Company's wastewater and dairy shed effluent (DSE) monitoring of both the component concentrations and volumes irrigated shows that, although there was an increase in the volume irrigated, there was a reduction in total nitrogen loading. It is noted however, that fewer wastewater samples were collected by the Company for analysis during the year under review. Due to the increase in the irrigation area utilised, the nitrogen concentrations in the impact bores, although elevated in some bores, are showing little, if any, increase overall. The exceptions to this one of the Farm 2 impact bores, which had an increased annual median nitrate concentration across the year under review.

Two of the control bores (Farm 2 and Farm 3 control bores) continued to show significant increases in groundwater nitrate concentrations that are in excess of drinking water standards. It has been signalled to the Company that the assessment of environmental effects required for the consent renewal in 2019 will need to explain this after suitable investigation.

During the year under review the stormwater from the northern half of the site was diverted to a containment pond that would allow the stormwater quality to be checked prior to being batch discharged. Sample results were within those prescribed by consent conditions, with the exception of an exceedance in the pH range in both of the pond discharges and the cooling water/stormwater discharges in January 2018. Although no effects were noted on the Kaupokonui Stream as a result of the stormwater discharges from the northern and southern stormwater outfalls, Inhalable Grade Lactose (IGL) plant, and stormwater detention ponds, and infringement notice was issued in relation to the breach of the consent.

Particulate deposition from air emissions was, in general, similar to the previous monitoring periods. At the monitoring site east of the southern stormwater pond the lactose deposition rate was found to be 20% over the guideline value. No complaints were received and visual inspections found no evidence of depositions. Odour surveys continued to note the occasional low level odour off site, with some odour observed at, and in the vicinity of, the effluent tank depending on the direction of the wind.

Although the Company generally demonstrated a high level of environmental performance and compliance when considered strictly against the Company's resource consents, overall the Company demonstrated poor environmental performance as defined in Section 1.1.4. An abatement notice and infringement notice were issued to the Company in relation to a lack of processing waste stewardship. This contributed to the resultant offensive and objectionable odours beyond the boundary of the waste contractors Hawera site during the conveyance of the material to a disposal site that was not consented to receive the material. All three parties involved in this incident were abated and infringed.

With respect to the administrative performance, there are still ongoing issues with provision of accurate real time monitoring data that was due by 30 September 2015. In addition to this, stormwater pond discharge monitoring by the Company failed to prevent the (albeit low flow) discharges that exceeded the pH range permitted by the consent. An infringement fine was issued. An improvement is therefore required in the Company's administrative performance as defined in Section 1.1.4.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the 2018-2019 year.

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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 2017 to June 2018 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 whey processing facility situated on Manaia Road at Kapuni, in the Kaupokonui catchment, along with two operational dairy farms used for wastewater irrigation (Figure 1).

This 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 26th combined report and 30th water related report by the Council for the Company.

1.1.1 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 through 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.

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

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

Section 4 presents recommendations to be implemented in the 2017-2018 monitoring year.

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

1.1.2 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 socio-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 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.

1.1.3 Evaluation of environmental 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 interpretations, 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 significant 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 in response to unauthorised incident reports, 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 in response to unauthorised incident reports. 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 in response to unauthorised incident reports. 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 failures 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 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

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 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 condensers is discharged to the stream via spray nozzles that reduce 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 Vector Gas Treatment Plant (Vector) 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 Vector 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 a wet scrubber. The scrubber removes any fine 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	

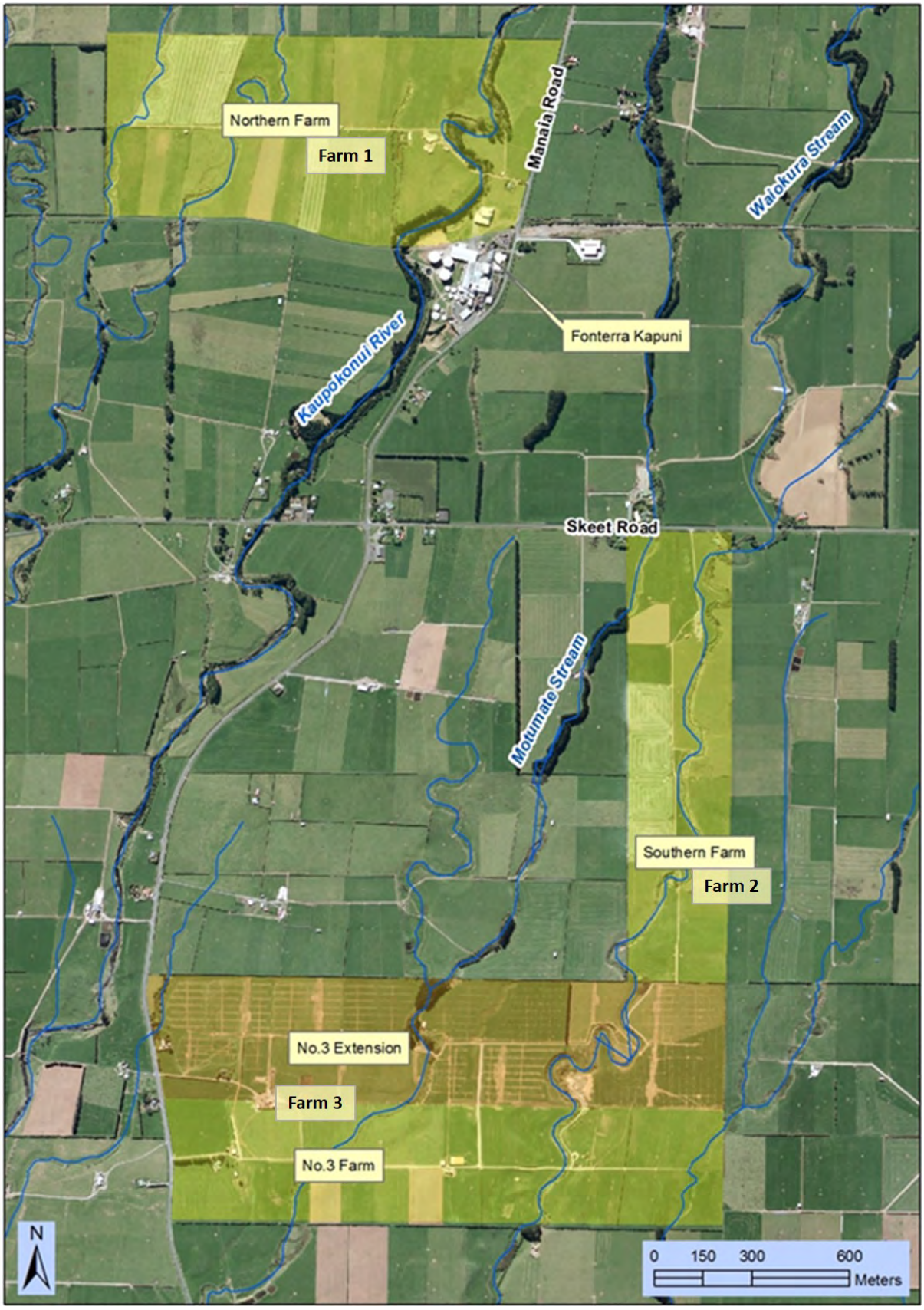


Figure 1 Location of Fonterra Ltd's lactose factory, farms and the Kaupokonui, Motumate and Waiokura Streams

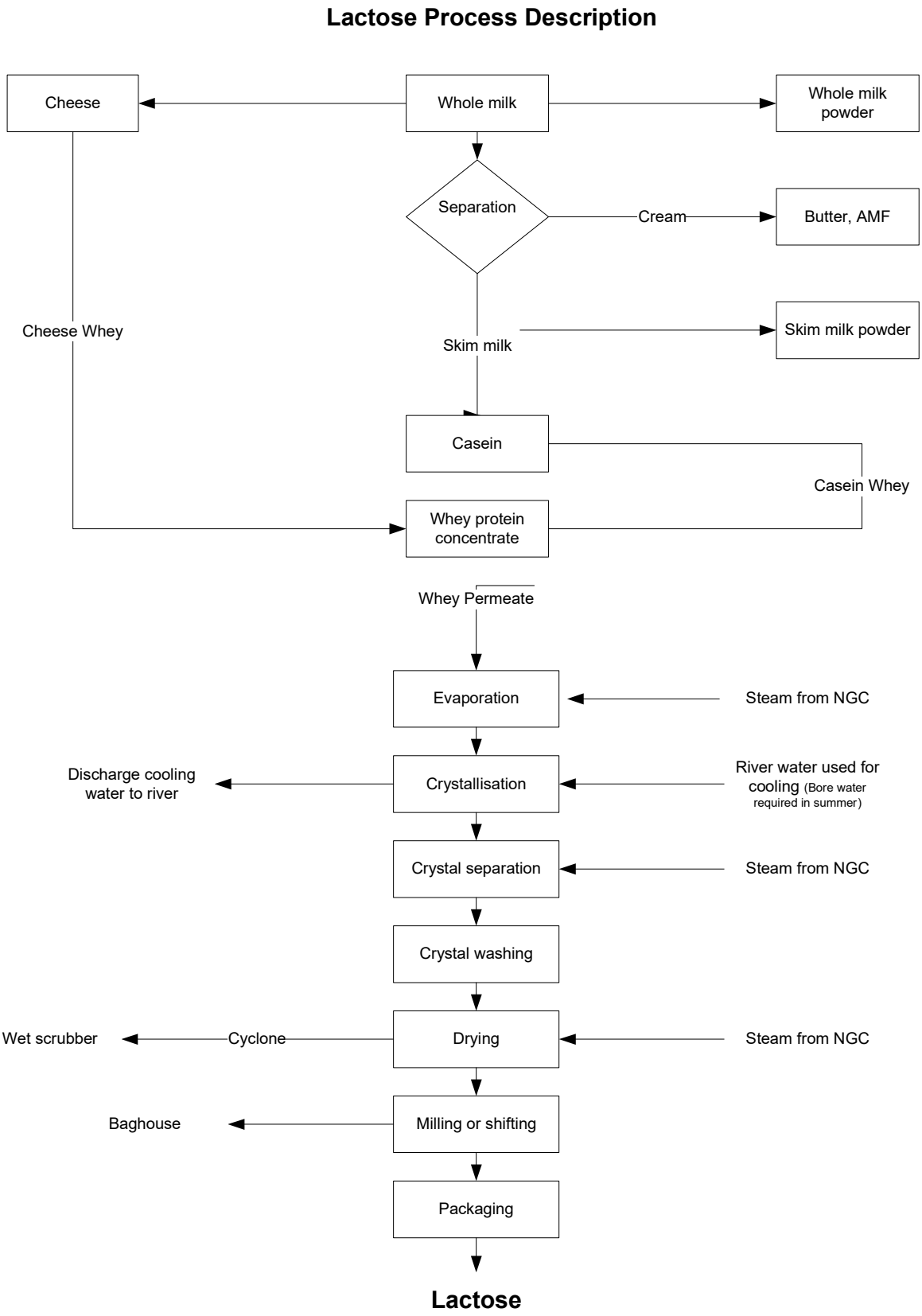


Figure 2 Lactose process diagram

1.3 Resource consents

A summary of the consents held by the Company in relation to activities at its Kapuni plant is given in Table 2 below, and the consents are discussed in Sections 1.3.1 to 1.3.5. The summary of consent conditions provided in these sections may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consents which are appended to this report (Appendix I).

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

Consent number	Purpose	Volume	Next review date	Expiry date 1 June	Activity's consent status at 30 June 18
0302-3	Take from Kaupokonui	19,500 m^3/day (225 L/s)	-	2019	Current
0919-3	Discharge cooling water to Kaupokonui	19,500 m^3/day	-	2019	Current
0920-3	Take from bore [Application to renew received 1 December 2016]	700 m^3/day	-	2017	Expired - S.124 Protection
0921-3	Discharge cooling water to trib. of Motumate Stream [Application to renew received 1 December 2016]	850 m^3/day	-	2017	Expired - S.124 Protection
0922-3	Discharge factory wastewater and DSE to land (North)	2,630 m^3/2 days, 120 m^3/d DSE	-	2019	Current
0923-3	Discharge factory wastewater and DSE to land (South)	3,834 m^3/2 days, 168 m^3/d DSE	-	2019	Current
0924-3	Discharge storm & cooling water to Kaupokonui	1,440 m^3/day	-	2019	Current
4032-5	Discharge emissions to air		-	2019	Current
4235-2	Discharge stormwater during factory shutdown periods [Separate consent for this activity no longer required]	240 m^3/day	-	2017	Expired - S.124 Protection
4604-2	Discharge stormwater from extension to Kaupokonui [Application to renew received 1 December 2016. Activity to be combined with 6423-3]	280 L/s	-	2017	Expired - S.124 Protection
4623-2	Structures for spray, stormwater, irrigation and take [Application to renew received 21 July 2017]		-	2017	Expired
4623-3	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes [granted 14 December 2017]		-	2019	Current

Consent number	Purpose	Volume	Next review date	Expiry date 1 June	Activity's consent status at 30 June 18
5368-1	Structure over Little Dunn's Creek [Application to renew received 21 July 2017]		-	2017	Deemed permitted [22 Nov 2017]
6422-1	Structure for stormwater outlet (IGL plant) [Application to renew received 21 July 2017]		-	2017	Deemed permitted [22 Nov 2017]
6423-1	Discharge stormwater to Kaupokonui (IGL plant) [Application to renew received 1 December 2016]		-	2017	Expired - S.124 Protection
6885-1	Structure for stormwater (pond) outlet [Application to renew received 21 July 2017]		-	2017	Deemed permitted [22 Nov 2017]
6948-1	Structure for pipeline over Motumate and Waiokura		-	2023	Current
9546-1	Install culvert in Waiokura Stream		2023	2029	Current
10214-1	Discharge solid dairy farm effluent to land		2023	2041	Current
10232-1	Discharge pond sludge from farm dairy effluent to land		2023	2041	Current
10412-1	Installation of a dual culvert in the Waiokura Stream		2035	2023	Current

m^3/day = cubic metres per day; L/s = litres per second; DSE = dairy shed effluent

Consent 5629-1, held by the Company to provide for the discharge of treated domestic effluent into land, was surrendered in March 2015, as the discharge met the standards of Rule 22 of the Regional Freshwater Plan as a permitted activity.

1.3.1 Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam of 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.

Kaupokonui Stream

The Company holds water permit **0302-3** to take and use up to 19,500 m^3/day (225 litres/second) of water from the Kaupokonui Stream for cooling water and general purposes associated with lactose manufacturing. This permit was issued by the Council on 9 June 1999 under Section 87(d) of the RMA. It is due to expire on 1 June 2019.

There are three special conditions attached to the consent.

Condition 1 requires that the consent holder, in conjunction with the Council, to undertake ecological monitoring associated with the abstraction.

Condition 2 stipulates that the consent holder records the daily rates of abstraction and make these records available to the Council.

Condition 3 deals with review procedures.

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:

- all water permits allowing the taking of 5L/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.

Groundwater

The Company also holds water permit **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. This permit was issued by the Council on 4 February 1999 under Section 87(d) of the RMA. It expired on 1 June 2017.

An application to renew the consent was received on 1 December 2017, and therefore under Section 124 of the RMA, the Company is allowed to operate under the conditions of the expired consent until a decision is made on the renewal application.

There are three special conditions attached to the consent.

Condition 1 requires the consent holder to record groundwater levels and rates of abstraction and make these records available to the Council.

Condition 2 stipulates that the consent holder allows the Council access to the bore for inspection or sampling purposes.

Condition 3 deals with review procedures.

1.3.2 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.

The Company holds six permits to discharge to surface water, three in relation to cooling water, and four to stormwater, one that provides for both types of discharge. All of the discharges are directly to Kaupokonui Stream at the plant site, except one, of cooling water to a tributary of Motumate Stream across Manaia Road.

1.3.2.1 Cooling water

Cooling towers and sprayers

The Company holds water discharge permit **0919-3** to cover the discharge of 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. This permit was issued by the Council on 9 June 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are eleven special conditions attached to the consent.

Condition 1 requires the consent holder to undertake physicochemical and ecological monitoring of the wastes and receiving waters, which includes the agreed monitoring discussed in Section 1.3.2.1.1.

Condition 2 describes effects which the discharge shall not give rise to in the receiving waters.

Condition 3 stipulates that the biochemical oxygen demand (BOD) shall not rise above 2 g/m^3 below the discharge.

Condition 4 requires that the discharge does not alter the temperature of the receiving water by more than 2 degrees Celsius for 90% of the time, and by more than 3 degrees at all times.

Condition 5 stipulates that the temperature of the receiving water shall not increase above 25 degrees.

Condition 6 requires the consent holder to continuously monitor the temperature of the receiving waters, and to forward this information to the Council.

Condition 7 allowed the Council to review conditions 4 and 5 of the consent in June 2001 for the purpose of evaluating the performance of the cooling system.

Condition 8 stipulates that the discharge not give rise to a thermal barrier to fish or any visible bacterial and/or fungal slime growths.

Condition 9 requires that no anti-corrosion agents, biocides, anti-flocculants or other chemicals be added to the cooling water without permission of the Council.

Condition 10 requires mitigation of the effects of the discharge by maintenance of existing riparian planting, and an annual donation to the Taranaki Tree Trust of $3,000.

Condition 11 deals with review of the conditions of the consent.

The Company holds water discharge permit **0924-3** to cover the discharge of up to 1,440 m^3/day of stormwater and cooling water from a lactose manufacturing plant through two outfalls into the Kaupokonui Stream. This permit was issued by the Council on 9 June 1999 under Section 87(e) of the RMA. It is due to expire on 1 June 2019.

There are 12 special conditions attached to the consent.

Condition 1 requires the consent holder to undertake physicochemical and ecological monitoring of the wastes and receiving waters which includes the agreed monitoring discussed in Section 1.3.2.1.1.

Conditions 2 describes effects which the discharge shall not give rise to in the receiving water.

Condition 3 stipulates that the filtered BOD shall not rise above 2 g/m^3 below the discharge.

Condition 4 requires that the discharge does not alter the temperature of the receiving water by more than 2 degrees Celsius for 90% of the time and by more than 3 degrees at all times.

Condition 5 stipulates that the temperature of the receiving water not increase above 25 degrees.

Condition 6 requires the consent holder to continuously monitor the temperature of the receiving waters, and to forward this information to the Council.

Condition 7 allowed the Council to review conditions 4 and 5 of the consent in June 2001 for the purpose of evaluating the performance of the cooling system.

Condition 8 sets limits on levels of oil and grease, pH and suspended solids in the discharge.

Condition 9 stipulates that the discharge not give rise to a thermal barrier to fish or any visible bacterial and/or fungal slime growths.

Condition 10 requires that no anti-corrosion agents, biocides, anti-flocculants or other chemicals be added to the cooling water without the permission of the Council.

Condition 11 requires the consent holder to maintain a contingency plan outlining measures and procedures to prevent spillage and remedy or mitigate effects of such a spillage.

Condition 12 deals with review of the conditions of the consent.

1.3.2.1.1 Notice to review consents 0919-3 and 0924-3

On 27 June 2014, Council invoked the review conditions on consents 0919-3 and 0924-3, which provide for discharge back to Kaupokonui Stream of cooling water taken under consent 0302-3. The reason for review was to impose five new monitoring conditions on both consents to obtain information on the amount of water that is returned to the stream, for water allocation purposes, and for assessment of the effects of the abstraction on the stream. The data gathered was also necessary for the preparation of an assessment of environmental effects in the consents replacement process due to be carried out by 2019.

After consultation, the Company requested that, upon agreement to implement the required monitoring measures by 31 August 2015, Council withdraw the notice of review. The notice of review was withdrawn on basis of the agreement outlined below, with the monitoring being within the scope of condition 1 of both consents.

The agreed monitoring measures related to (1) installation and maintenance of flow recording devices and (2) dataloggers, (3) certification of and (4) access to equipment, and (5) transmission to Council of a real time record of discharge volumes.

Specifically, the agreed monitoring measures are as follows:

1. "By 31 August 2015 the consent holder shall install, and thereafter maintain a flow recording device(s). The device shall be tamper-proof and shall measure and record the rate and volume of cooling water discharge to an accuracy of ±5%.
   Note: flow recording devices must be installed, and regularly maintained, in accordance with manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow recording devices have a limited lifespan.
2. By 31 August 2015, the consent holder shall install, and thereafter maintain a datalogger to automatically record discharge volumes from the flow recording devices(s). The datalogger shall be tamper-proof and shall record the date, the time (in New Zealand Standard Time) and the rate and volume of water discharge at intervals not exceeding 15 minutes.
   Note: dataloggers must be installed, and regularly maintained, in accordance with manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow recording devices and dataloggers have a limited lifespan.
3. Within 30 days of the installation of a flow recording device or datalogger, and at other times when reasonable notice is given, the consent holder shall provide the Chief Executive, Taranaki Regional Council with a document from a suitably qualified person certifying that:
   a. water measuring or recording equipment required by the conditions of this consent has been installed and/or maintained in accordance with the manufactures specifications; and/or

b. water measuring or recording equipment required by the conditions of this consent has been tested and shown to be operating to an accuracy of ±5%.

4. The flow recording device(s) shall be accessible to Taranaki Regional Council officers at all reasonable times for inspection and/or data retrieval. In addition the data logger shall be designed and installed so that Council officers can readily verify that it is accurately recording the required information.
5. From a date no later than 31 August 2015, the measurements made in accordance with condition 1 of this consent, shall be transmitted to the Taranaki Regional Councils computer system, in a format to be advised by the Chief Executive, Taranaki Regional Council, to maintain 'real time' record of the discharge volumes. The records shall:

   a. be in a format that, in the opinion of the Chief Executive, Taranaki Regional Council, is suitable for auditing; and

   b. specifically record the water discharged as 'zero' when no discharge(s) occurs."

In August 2015, the implementation period was extended to 30 September 2015, following delays associated with the installation of a new cooling tower system.

Motumate tributary

The Company holds water discharge permit **0921-3** to cover the discharge of 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. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It expired on 1 June 2017.

An application to renew the consent was received on 1 December 2017, and therefore under Section 124 of the RMA, the Comapany is allowed to operate under the conditions of the expired consent until a decision is made on the renewal application.

There are three special conditions attached to the consent.

Condition 1 describes effects which must not arise below the mixing zone in the receiving waters.

Condition 2 requires that the consent holder monitor the daily volume and temperature of the discharge.

Condition 3 deals with review of the conditions of the consent.

Combined cooling and original (southern) stormwaters

1.3.2.2 Stormwater

Northern factory extension

The Company held water discharge permit **4604-2** to cover the discharge of up to 280 litres/second of stormwater from the factory extension site via a 525 mm diameter pipe into the Kaupokonui Stream. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It expired on 1 June 2017.

An application was received to renew this consent, along with consent 6423-1 on 1 December 2017. It was agreed by Council that this activity could be covered under a global stormwater consent, 0924, upon the renewal of this consent. As the application was made six months prior to the expiry of 6404-2, the activity is covered under Section 124 of the RMA and the Company is allowed to operate under the conditions of the expired consent until a decision is made on the renewal application.

There are four special conditions attached to the consent.

Condition 1 describes effects which must not arise below the mixing zone.

Condition 2 sets limits on levels of oil and grease, pH and suspended solids in the discharge.

Condition 3 requires the consent holder to prepare and maintain a contingency plan outlining measures and procedures to be undertaken to prevent a spillage and measures to remedy or mitigate environmental effects of such a discharge.

Condition 4 deals with review of the consent conditions.

Inhalable grade lactose (IGL) plant

The Company held water discharge permit **6423-1** to cover the discharge of stormwater from an inhalation grade lactose plant (IGL) site into the Kaupokonui Stream. This permit was issued by the Council on 13 July 2004 under Section 87(e) of the RMA. It expired on 1 June 2017.

An application to renew the consent was received on 1 December 2017, and therefore under Section 124 of the RMA, the Company is allowed to operate under the conditions of the expired consent until a decision is made on the renewal application.

There are seven special conditions attached to this consent.

Condition 1 requires the consent holder to prepare and maintain a contingency plan outlining measures and procedures to be undertaken to prevent a spillage and measures to remedy or mitigate environmental effects of such a discharge.

Condition 2 stipulates that the consent be conducted in accordance with the information submitted in support of the application.

Condition 3 requires that the consent holder adopt the best practicable option to prevent or minimise any adverse effects of the discharge on any water body.

Condition 4 sets limits on the levels of pH, suspended solids, and hydrocarbons in the discharge.

Condition 5 describes effects which must not arise below the mixing zone.

Conditions 6 and 7 deal with lapse of consent and review of consent conditions.

1.3.3 Air discharge permit

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.

The Company holds air discharge permit **4032-5** to cover the discharge of emissions to air from the manufacture, drying, packing and storage of lactose and associated processes and from an inhalation grade lactose plant. This permit was issued by the Council on 17 April 2000 under Section 87(e) of the RMA. A change to the conditions of consent 4032-5 was made on 2 June 2004 to include the IGL plant. It is due to expire on 1 June 2019.

There are nine special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise emissions of particulate matter.

Condition 2 emphasises that the consent holder is bound by the obligations and duties specified in the RMA.

Condition 3 stipulates that particulate from the wet scrubber system not exceed 125 mg/m^3 of air.

Condition 4 requires that the consent holder consult with the Council prior to making alterations to the plant.

Conditions 5, 6 and 8 stipulate that the discharge not give rise to dangerous levels of airborne contaminants, offensive or objectionable dust or odour, or noxious levels of airborne contaminants at or beyond the boundary of the property.

Condition 7 allows the consent holder to apply for a change or cancellation to any of the conditions of the consent.

Condition 9 deals with review provisions.

1.3.4 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.

1.3.4.1 Factory wastewater and dairy shed effluent (DSE)

The Company holds discharge permits **0922-3** and **0923-3** to cover the discharge of 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. Consent **0922-3** covers up to 2,630 m^3/two consecutive days and refers to the Kaupokonui catchment, while **0923-3** covers the discharge of up to 3834 m^3/two consecutive days and refers to the Waiokura and Motumate catchments. Both permits were issued by the Council on 9 June 1999 under Section 87(e) of the RMA to provide for the lactose manufacturing plant wastewater. A change to the conditions of consent 0923-3 was made on 21 August 2006 to provide for extension of the land disposal area. Changes to conditions on both permits were made on 15 July 2015 to allow the inclusion of dairy shed effluent. The consents are due to expire on 1 June 2019.

There are nine special conditions attached to consent **0922-3.**

Condition 1 requires the consent holder to maintain an effluent spray irrigation management plan (SIMP), and matters which it should address are listed.

Condition 2 was inserted in July 2015 to set limits on volume of lactose manufacturing and of dairy effluents discharged.

Condition 3 stipulates that the consent be exercised in accordance with the procedures set out in the SIMP.

Condition 4 allows the SIMP to be reviewed on two months' notice, either by the consent holder or Council. This condition also stipulates that the SIMP is reviewed annually by the consent holder and provided to the Council by 1 July each year.

Condition 5 requires that the operation of the spray irrigation system is carried out in accordance with the SIMP; that relevant staff are regularly trained on the content and implementation of the plan; and staff are advised immediately of revisions or additions to the SIMP.

Condition 6 stipulates that there be no direct discharge of effluent to any watercourse.

Condition 7 requires that the system be operated in a manner which does not cause ponding.

Condition 8 stipulates that there be at least 20 metres from the edge of the spray zone to the bank of any watercourse.

Condition 9 requires the consent holder to monitor and collect various data on the spray irrigation system, with this is to be made available to the Council.

Condition 10 deals with review provisions.

There are 16 special conditions attached to consent **0923-3,** nine of which were the same as those on consent **0922-3,** when the two consents were issued. The change of consent on 21 August 2006 added six conditions that address:

- adoption of the best practicable option to minimise adverse effects (condition 1);
- prohibition of offensive or objectionable odour (condition 6);
- control of spray drift (condition 7);
- contamination of water supplies (condition 11);
- groundwater monitoring (condition 12); and
- change or cancellation of conditions (condition 14).

A condition was inserted on 15 July 2015 to set limits on volume of lactose manufacturing and of dairy effluents discharged.

1.3.4.2 Dairy solids and ponds sludge

The Company holds discharge permits **10214-1** and **10232-**1 to cover the discharge onto and into land of solid farm dairy effluent, and pond sludge from farm dairy effluent, respectively. Consent **10214-1** refers to the Waiokura and Motumate catchments, while consent **10232-1** refers to the Kaupokonui catchment. These consents were issued by the Council on 5 February 2016 under Section 87(e) of the RMA. Both are due to expire in June 2041.

There are 11 special conditions attached to both consents, which differ only on the limits set on volume of effluent allowed, and on area of land required.

Condition 1 defines the effluent that is to be discharged. Condition 2 sets limits on the amount of effluent and the area of land receiving it. Condition 3 requires Council to be notified if the effluent volume limit is exceeded.

Condition 4 requires the consent holder to adopt the best practicable option to minimise adverse effects on the environment.

Condition 5 requires the use of a stormwater diversion system and a sand trap.

Condition 6 sets buffer distances from surface water bodies, urupa, water supply sources and dwellings.

Condition 7 limits Total Nitrogen application rate. Condition 8 addresses the keeping of records.

Condition 9 deals with unauthorised discharges.

Conditions 10 and 11 are review conditions.

1.3.5 Land use consents

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 by a rule in a regional plan or by a resource consent.

Structures in Kaupokonui Stream

The Company holds land use consent **4623-3** to use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes. This permit was originally issued by the Council on 4 February 1999 to erect, place, use and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream under Section 87(a) of the RMA. It expired on 1 June 2017. The renewal application was

received on 21 July 2017 with consent 4623-3, which covers only the weir and associated damming of the Kaupokanui Stream, granted on 14 December 2017. It is due to expire on 1 June 2019.

The Company is currently going through an extensive re-consenting process for the other consents held for the Kapuni manufacturing site. It was discovered that four consents relating to existing structures in waterways, including consent 4623 for the existing weir, had expired in June 2017 and applications hadn't been lodged for their renewal.

An application was subsequently lodged to renew consent 4623 however the Company advised that it wished to take a holistic view of the Kaupokonui catchment and wanted to consider this application with other resource consents expiring in June 2019. Therefore they requested a short term consent expiring in June 2019.

The activity is in, adjacent to, or directly affecting a Statutory Acknowledgement of Ngāruahine. The Council sent a copy of the application to the Iwi and although they had some concerns they stated that they did not oppose the granting of the consent.

There are three conditions attached to the consent.

Condition 1 stipulates that the consent authorises the ongoing use of the existing weir as described in the application, and that any changes may need to be authorised by formal RMA processes.

Condition 2 required the weir to be maintained to ensure its safe and effective functioning.

Condition 3 prohibits restriction of fish passage.

Dunn's Creek bridge

The Company held land use consent **5368-1** to erect, place, use and maintain a bridge over Little Dunn's Creek a tributary of Dunn's Creek in the Kaupokonui catchment for access purposes. This permit was issued by the Council on 21 July 1998 under Section 87(a) of the RMA. It expired on 1 June 2017.

An application to renew this consent was not received until 21 July 2017, which is outside the RMA timeframes that allow Council to confer section 124 protection to the activities covered by the expired consent until a decision is made on the renewal. The application was put on hold under section 37A (5)(a) awaiting the outcome of an RMA review.

The structure was deemed to be a permitted activity on 22 November 2017 following changes in the RMA (Section 87BB) that allowed the Council to use its discretion to do so.

Northern stormwater outfall

The Company held land use consent **6422-1** to erect, place, and maintain a stormwater outlet structure in the bed of the Kaupokonui Stream. This permit was issued by the Council on 13 July 2004 under Section 87(a) of the RMA. It expired on 1 June 2017.

An application to renew this consent was not received until 21 July 2017, which is outside the RMA timeframes that allow Council to confer section 124 protection to the activities covered by the expired consent until a decision is made on the renewal. The application was put on hold under section 37A (5)(a) awaiting the outcome of an RMA review.

The structure was deemed to be a permitted activity on 22 November 2017 following changes in the RMA (Section 87BB) that allowed the Council to use its discretion to do so.

Southern stormwater outfall

The Company held land use consent **6885-1** to erect, place, use and maintain an outlet structure in the Kaupokonui Stream for stormwater discharge purposes. This permit was issued by the Council on 12 May 2006 under Section 87(a) of the RMA. It expired on 1 June 2017.

An application to renew this consent was not received until 21 July 2017, which is outside the RMA timeframes that allow Council to confer section 124 protection to the activities covered by the expired consent until a decision is made on the renewal. .The application was put on hold under section 37A (5)(a) awaiting the outcome of an RMA review.

The structure was deemed to be a permitted activity on 22 November 2017 following changes in the RMA (Section 87BB) that allowed the Council to use its discretion to do so.

Motumate and Waiokura pipeline crossings

The Company holds land use consent **6948-1** to erect, place, use and maintain and use pipeline crossings over the Motumate and Waiokura Streams, for the purpose of conveying irrigation wastewater. This permit was issued by the Council on 18 September 2006 under Section 87(a) of the RMA. It is due to expire on 1 June 2023.

There are nine special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to minimise effects on water quality.

Condition 2 stipulates that the consent is undertaken in accordance with documentation submitted in support of the application.

Condition 3 requires the consent holder to notify the Council prior to commencing installation.

Condition 4 requires the adoption of the best practicable option to minimise discharge of silt and other contaminants, and to minimise riverbed disturbance.

Condition 5 deals with riverbed disturbance and reinstatement.

Conditions 6 and 7 relate to the timing and notification of works.

Conditions 8 and 9 relate to lapse and review of consent.

Waiokura culverts

The Company holds land use consent **9546-1** to install a dual culvert in the Waiokura Stream, including the associated streambed and reclamation. This permit was issued by the Council on 18 April 2013 under Section 87(a) of the RMA. It is due to expire on 1 June 2029.

There are 22 conditions attached to the consent.

Condition 1 addresses notification of works.

Conditions 2 to 10, 14, 15, and 18 address the design, construction and maintenance of works.

Condition 11 prohibits works between 1 June and 31 October.

Condition 12 deals with riverbed disturbance and reinstatement.

Condition 13 prohibits the obstruction of fish passage.

Conditions 16 and 17 address the minimisation of sedimentation in the stream, and stabilisation of earthworks.

Condition 19 addresses the discovery of archaeological remains.

Condition 20 deals with removal of the structure.

Conditions 21 and 22 relate to lapse and review of the consent.

The Company holds land use consent **10412-1** to install a dual culvert in the Waiokura Stream, including the associated disturbance of the stream bed. This permit was issued by the Council on 18 April 2013 under Section 87(a) of the RMA. It is due to expire on 1 June 2029.

There are 14 conditions attached to the consent.

Conditions 1, 2, 6, and 8 to 11 address the design, construction and maintenance of works.

Condition 3 addresses notification of works.

Condition 4 prohibits works between 1 June and 31 October.

Condition 5 deals with riverbed disturbance and reinstatement, addressing the minimisation of sedimentation in the stream, and stabilisation of earthworks.

Condition 7 prohibits the obstruction of fish passage.

Condition 12 addresses the discovery of archaeological remains.

Conditions 13 and 14 relate to lapse and review of the consent.

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 lactose plant site and on farm wastewater disposal activities 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 year. 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 and land, including contaminated stormwater and process wastewaters. Air inspections focussed 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.

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 9 occasions and of the combined stormwater/cooling water discharge on 5 occasions. The samples were analysed for BOD_5 (total and filtered), pH, conductivity and turbidity. In addition, the stormwater discharge was also analysed for suspended solids and oil and grease.

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 and ammonia-N. The Motumate Stream was sampled at three sites on 6 occasions. The samples were analysed for temperature, ammoniacal nitrogen, BOD_5, conductivity, dissolved reactive phosphorus, nitrate, pH and sodium. The Waiokura Stream was sampled at three sites on 6 occasions. The samples were analysed for temperature, conductivity, dissolved reactive phosphorus, nitrate, pH and sodium.

Three samples were collected from the stormwater outfall from the factory extensions, two samples were collected from the stormwater outfall from the IGL plant, three samples were collected from the outlet of the new northern stormwater pond, with one additional grab sample from the pond itself and five were collected from the outlet of the southern stormwater pond. Stormwater samples were analysed for total BOD_5, conductivity, pH, turbidity, suspended solids and oil and grease.

Groundwater from ten bores on the three farms was sampled on up to seven occasions and the samples were analysed for temperature, conductivity, pH, and nitrate. In addition, filtered COD, ammonia, sodium and/or chloride were tested for on up to three of the occasions. The first of these surveys was one programmed for the 2016-2017 year, but undertaken on 4 July 2017.

Deposition gauges were placed at selected sites in the vicinity on one occasion. The collected samples 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, evaporator condensate, washings, processing and cooling wastes 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.

The triennial four site fish survey was last undertaken in the Kaupokonui Stream in June 2017 and is due next in the 2019-2020 monitoring year.

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, irrigation records, receiving water and coolant temperatures, and wastewater composition. 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.

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 production, stream and bore extraction volumes, and cooling water discharge 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, with the abstraction rate data provided to the Council being a 15 minute average.

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 is due again in August 2019. Table 3 contains a summary of statistics 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. Figure 3 and Figure 4 are based on the daily data provided in the monthly reports.

Table 3 Summary of water abstraction volumes from the Kaupokonui Stream

Month	Average daily abstraction[a] (m^3/day)	Minimum daily abstraction[a] (m^3/day)	Maximum daily abstraction[a] (m^3/day)	Number of days per month daily abstraction[a] >19 500 m^3	Average abstraction rate[b] (L/s)	Maximum abstraction rate[b] (L/s)	Total time per month abstraction rate[b]> 225 L/s	Missing records[b]
Jul 2017	3,183	101	7,420	0	42	151	0	4.71 d
Aug 2017	8,182	3,548	14,057	0	94	230	1 hr	No gaps
Sep 2017	9,467	6,252	11,967	0	110	221	0	No gaps
Oct 2017	10,416	8,017	13,629	0	120	212	0	1.83 d
Nov 2017	9,923	7,179	13,095	0	115	208	0	No gaps
Dec 2017	8,975	6,808	12,042	0	103	231	1 min 30 sec	18.75 hr
Jan 2018	9,436	7,092	16,438	0	110	222	0	1.01 d
Feb 2018	8,633	6,617	11,356	0	98	197	0	2.02 d

Month	Average daily abstraction[a] (m^3/day)	Minimum daily abstraction[a] (m^3/day)	Maximum daily abstraction[a] (m^3/day)	Number of days per month daily abstraction[a] >19 500 m^3	Average abstraction rate[b] (L/s)	Maximum abstraction rate[b] (L/s)	Total time per month abstraction rate[b]> 225 L/s	Missing records[b]
Mar 2018	10,138	6,016	13,735	0	117	222	0	No gaps
Apr 2018	7,819	5,608	12,261	0	91	222	0	17 hr
May 2018	6,360	4,504	9208.5	0	74	189	0	No gaps
Jun 2018	714	48	5,625	0	9	108	0	3 d

a From the Company's monthly reports
b from the electronic records forwarded to Council

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 2017-2018 monitoring period.

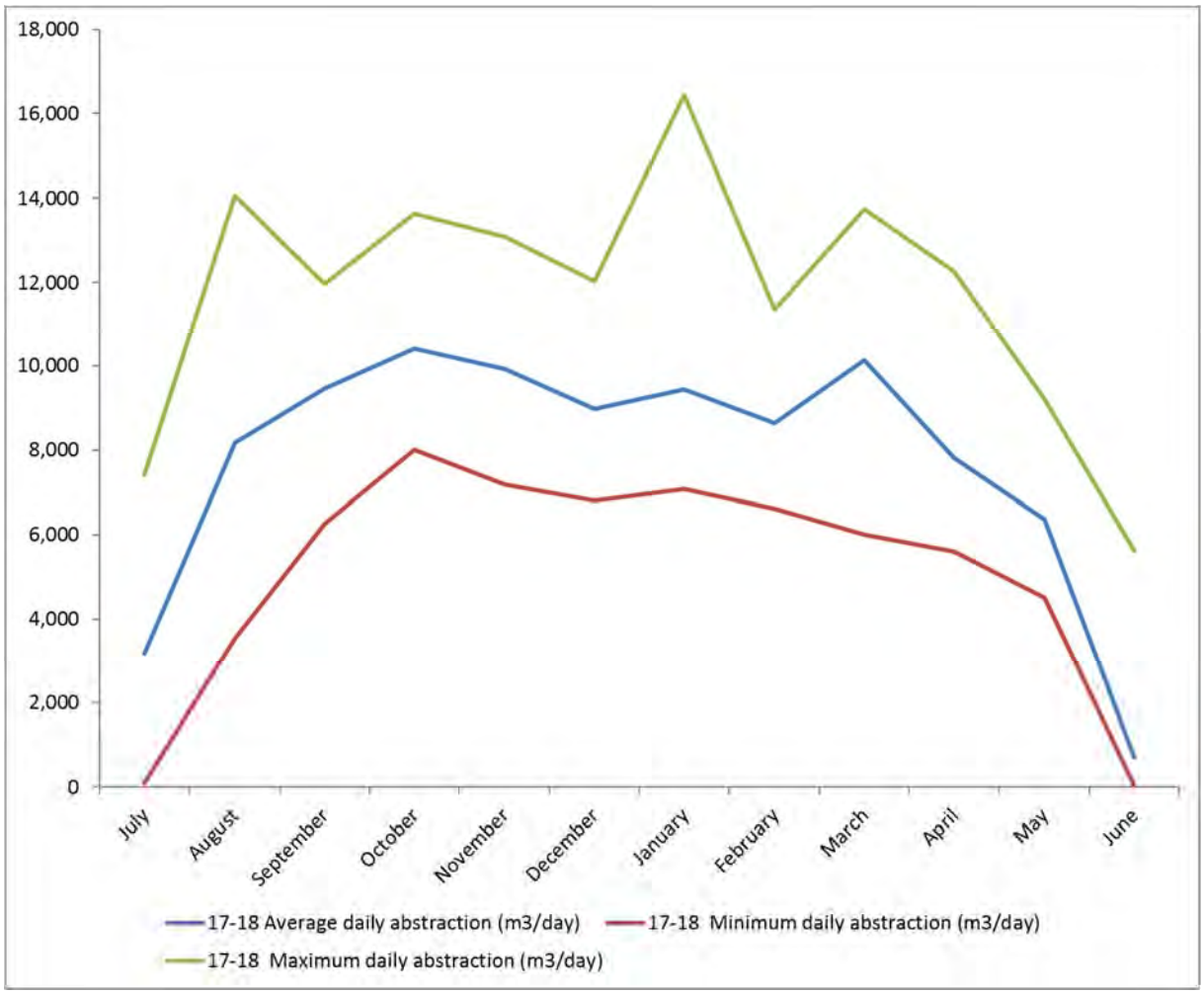


Figure 3 Monthly summary of water abstraction volumes from the Kaupokonui Stream from the Company's monthly reports

The abstraction rate from the daily electronic data showed that the authorised abstraction rate was exceeded for a total of 1 hr during August. However the 5 L/s maximum exceedance is within the allowed +/- 5% error of the flow recording device (+/- 11 L/s), and it was during a period of higher flows in the

Kaupokonui Stream. It is therefore considered that this would not have had any significant adverse effects on the receiving environment.

The Company provided 15 second data for the day of the December exceedance. This showed that the abstraction rate was exceeded for only 1 min 30 sec on 26 December 2017, with the maximum abstraction rate again being within the allowed +/- 5% error of the recording device. Although this was at a period of low flow (691 L/s at Glenn Road), the very short duration of the exceedance would have resulted in there being no significant adverse effect on the environment.

The total volume of 2,836,803 m^3 abstracted during 2017-2018 was 16% more than the amount taken in 2016-2017, but close to the median annual amount taken during the 2009 to 2017 period (2,883,870 m^3/year). The daily volume abstracted was maintained well below the 19,500 m^3 daily limit. During 2017-2018, a maximum daily abstraction of 16,438 m^3 was recorded on 8 January 2018, 84% of the consent limit. The changes in the river abstraction volumes since the 2009-2010 year are illustrated in Figure 4.

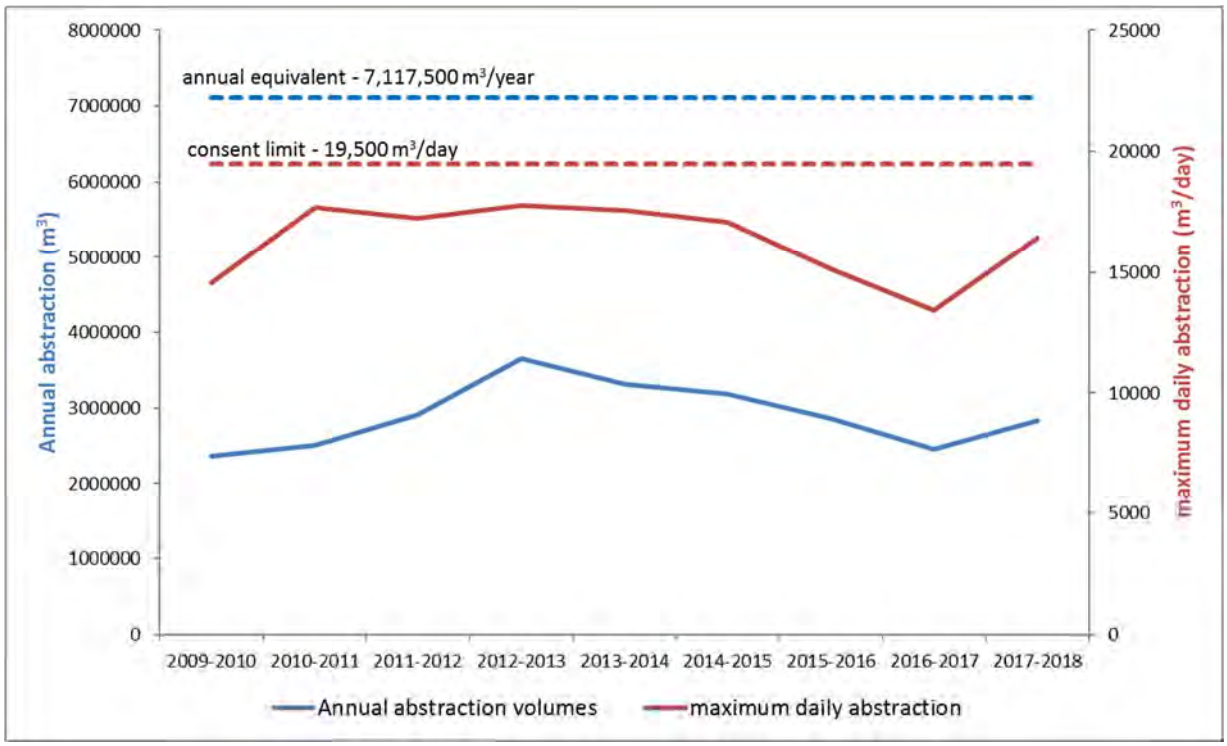


Figure 4 Daily and annual stream abstraction volumes July 2009 to June 2018 from the Company's monthly reports

The Company's abstraction of water from the Kaupokonui Stream was generally undertaken in a satisfactory manner and there were only three short instances where the consent limit was exceeded (Table 3 and Figure 5), however these were of short duration and were within the accuracy of the measuring device. The abstraction information supplied by the Company complied with the conditions of consent **0302-1** and the Resource Management Regulations, 2010.

The abstraction rate remained below 160 L/s for 95% of the year, with a total of 13 days and 1.5 hours of missing records.

In comparison to the daily abstraction volumes provided in the monthly reports, the electronic data record (Figure 6) indicated that the total annual abstraction was 2,668,445 m^3, which is 168,358 m^3 (6%) less. This may be accounted for by the 13 days of missing records and the accepted errors in measuring the flow (+/- 5%). The maximum daily abstraction volume on the electronic record is 15,231 m^3 on 8 January 2018. The monthly report contains a value 14,844 m^3 for this date, however it is noted that the Company reports the daily volumes based on 06:00-06:00 with the daily volume reported to the end of that period, rather than

midnight to midnight. When looking at a comparable time period, that is from 6am on 7 January to 6 am on 8 January (reported as their 8 January daily abstraction), the electronic record had a daily abstraction of 16,436 m^3/day compared with the 16,438 m/day from the daily report. This indicates that the data reporting discrepancy observed during the 2016-2017 period has been resolved.

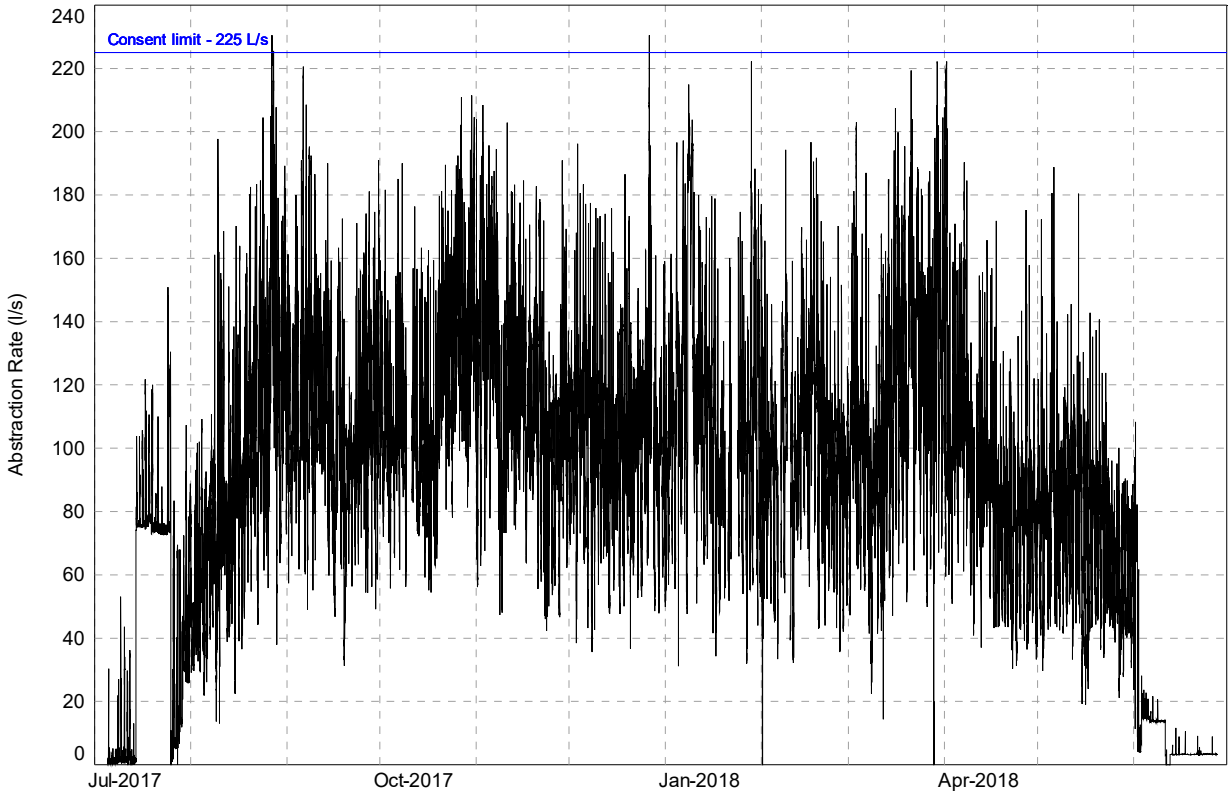


Figure 5 Abstraction rate from the Kaupokonui Stream (consent 0302-3), electronic record

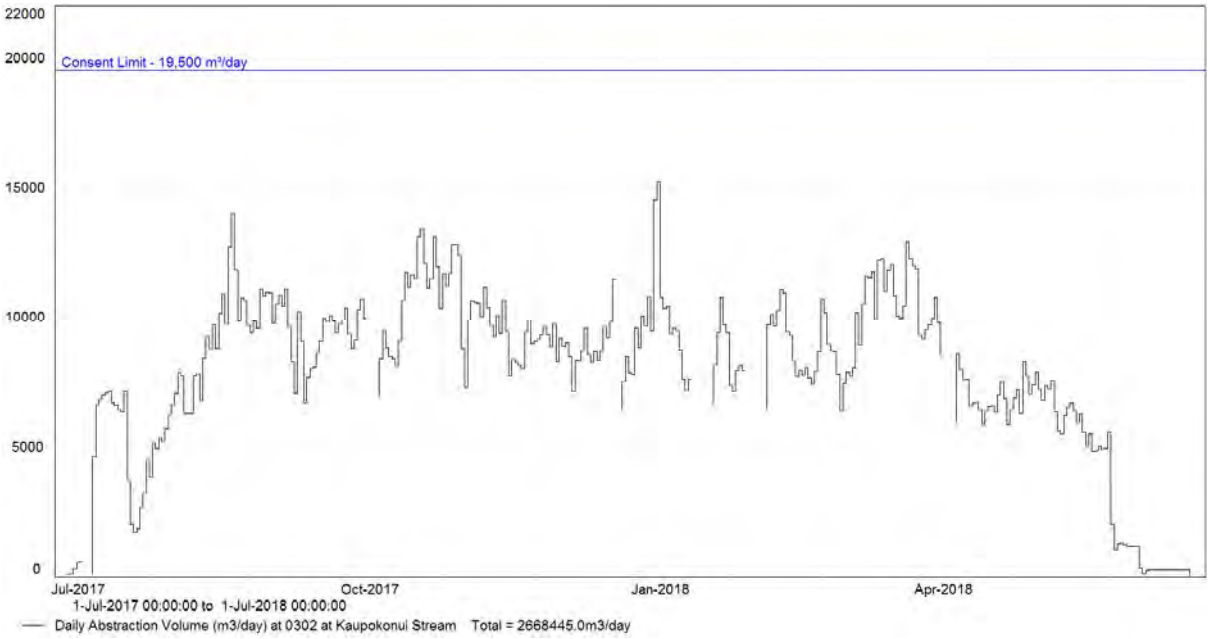


Figure 6 Daily abstraction volumes from the Kaupokonui Stream, electronic record

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 2016-2017 monitoring period, the bore was not used.

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, as discussed in section 1.3.2.1.1. 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.

Provision of an electronic record did not commence until 14 January 2016 following a meeting (3 December 2015) and follow-up correspondence. Since this time there were frequent gaps in the telemetered record, for example about 25% of the time in February 2016. The Company was informed in March 2016 that these were simultaneous across all parameters measured, suggesting a system fault. Although the data was being recorded by the Company and could be back-filled on request, this did not meet the agreed requirement of the data being transmitted to the Council computer system, enabling a "real time" record to be maintained by Council. This was followed up periodically by Council Officers, Council was advised that the cause of this issue was identified by the Company during the year under review. The main issue that caused a loss of

data transmission was related to issues with the Company's connection to the server that pushes this information to the Council server. Alerts were set up to notify the Company when this connection was lost so that the connection could be re-established as quickly as possible, substantially reducing the loss of data and providing a much better "real time" record. There are also some data gaps that result from issues with the Council's server connections. The data is reviewed monthly and a request is placed to back fill the gaps. There remains a small percentage of data that is not able to be back filled for various technical reasons, which are identified on a case-by-case basis. There was a substantial reduction on the missing discharge record for the 2017-2018 year, which amounted to a total of approximately 3% of what would be expected for a full dataset.

The more reliable provision of data enabled it to be determined that the consumptive use was being overestimated due to the fouling of the flow meter with solids from the untreated Kaupokonui Stream water. This resulted in the Company cleaning the affected parts on a monthly basis. Due to the agreed requirements around verification, the flow metering should be verified on each occasion, with records provided showing the as found and post maintenance accuracy of the flow measurement. During discussions around this requirement, it was identified that the meter had been installed in a way that would not allow either accurate flow recording or verification. The measuring device (and any verification device) needs to be placed in/on a pipe that is full. The Company's measuring device has been placed in a section of pipe that is not full, and it is therefore not capable of meeting the terms of the agreement. This is discussed further below and in Sections 3.1 and 3.3.

The discharge rate data provided for the year under review is given in Figure 7, along with the abstraction rate for comparison purposes. However, it is noted that the agreed documentation from a suitably qualified person certifying the installation, maintenance and accuracy of the flow recording device and data logger has not and cannot be provided to Council for the reasons outlined above.

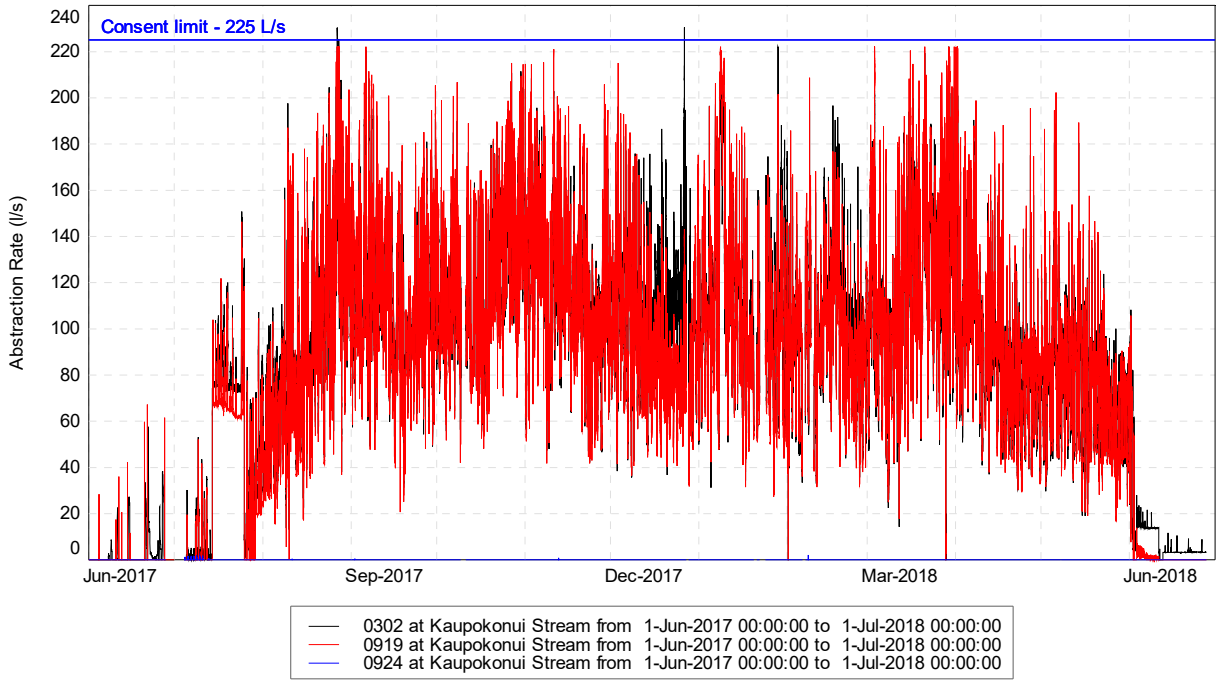


Figure 7 Discharge rates for consents 0919-3 and 0924-3, along with the abstraction rate for consent 0302-3, electronic record

As illustrated (Figure 7), the cooling water discharge permitted by consent 0924 was diverted to the cooling towers early in the year under review and the Council was informed that the disused cooling water/stormwater pipe was removed on 8 February 2018.

Analysis of the more complete data provided for the 2017-2018 year indicates that there are errors occurring that are outside the agreed +/- 5% for the measurement of the discharge rate.

On annual basis 2,737,717 m^3 was recorded as having been returned to the cooling tower. This is 39,272 m^3 more than the electronically provided abstraction volume. It is also noted that there were, times when return flow to the cooling tower exceeds abstraction volume by more than 10% (+/- 5% error on each meter) e.g. 15 minute averages at 19:00 NZST on 29 March 2018. The abstraction rate at this time was 185.3 L/s and discharge the discharge 215.3 L/s (16%). This indicates either periods of greater return or an over estimate of discharge rate as would be expected when measurements are made in a partially filled pipe. However, it is noted that there has, to date, been no independent verification of the discharge flow rate.

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. For the reasons already discussed, the discharge flow measuring system the Company installed to honour that agreement does not provide data suitable for this decision making, as illustrated in Figure 8 and Figure 9. Figure 8 shows the differential between the discharge and the abstraction rates, with negative valued indicating consumptive use and positive values indicating an increase return rate. Figure 9 shows the percentage of the time that the usage or return is at a given rate. The differential is typically in the range of approximately 27 L/s usage to 17 L/s additional return, with a maximum 15 minute average usage of 104 L/s and a maximum additional return of 75 L/s. In addition to the inaccuracies outlined, during the 2018-2019 year, as part of the continuing investigations the Council was advised that the location of the meter will also not take into account the evaporative losses at the cooling tower. Conflicting information has been provided to Council regarding the significance of the losses from this source. It is also noted that any of the evaporative losses and/or wind drift at the spray discharge will also not be accounted for, however these are generally expected to be minor. At the time of writing this report, the Council was considering enforcement options to ensure a means of obtaining more reliable information on the consumptive Kaupokonui Stream water use at the site are developed to bring about compliance with condition 1 of the consent. This will be discussed further in the 2018-2019 report.

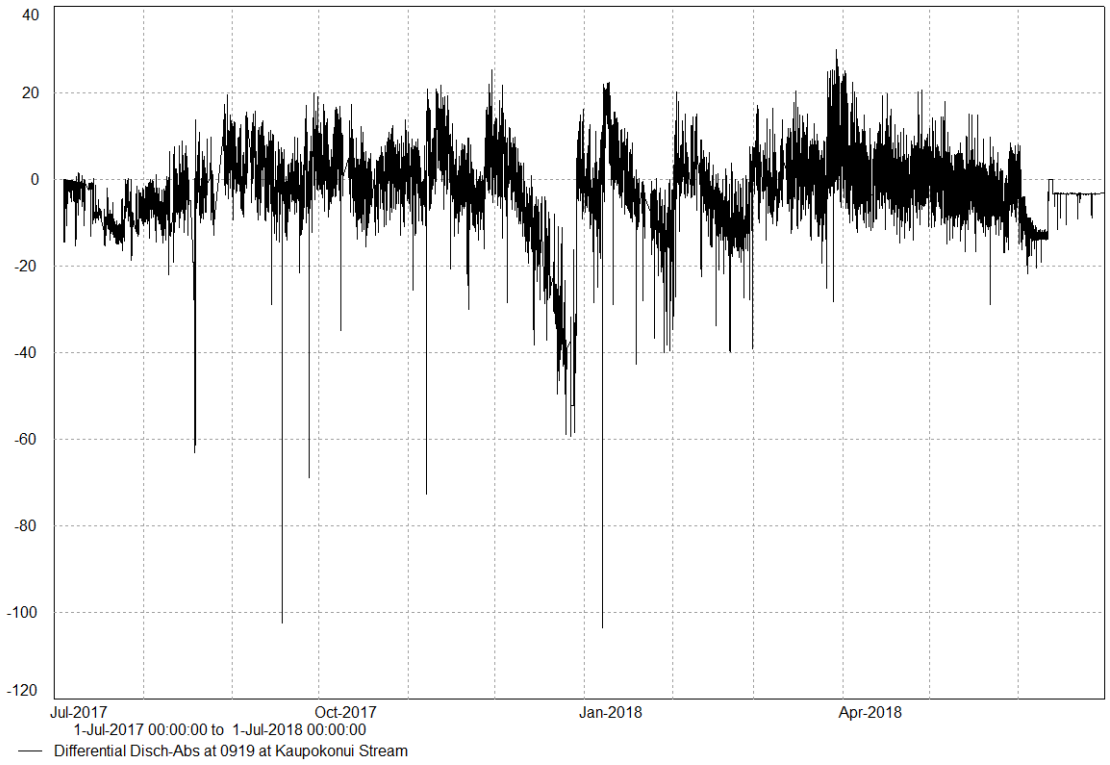


Figure 8 Differential between the rate of discharge to the cooling tower and the abstraction rate

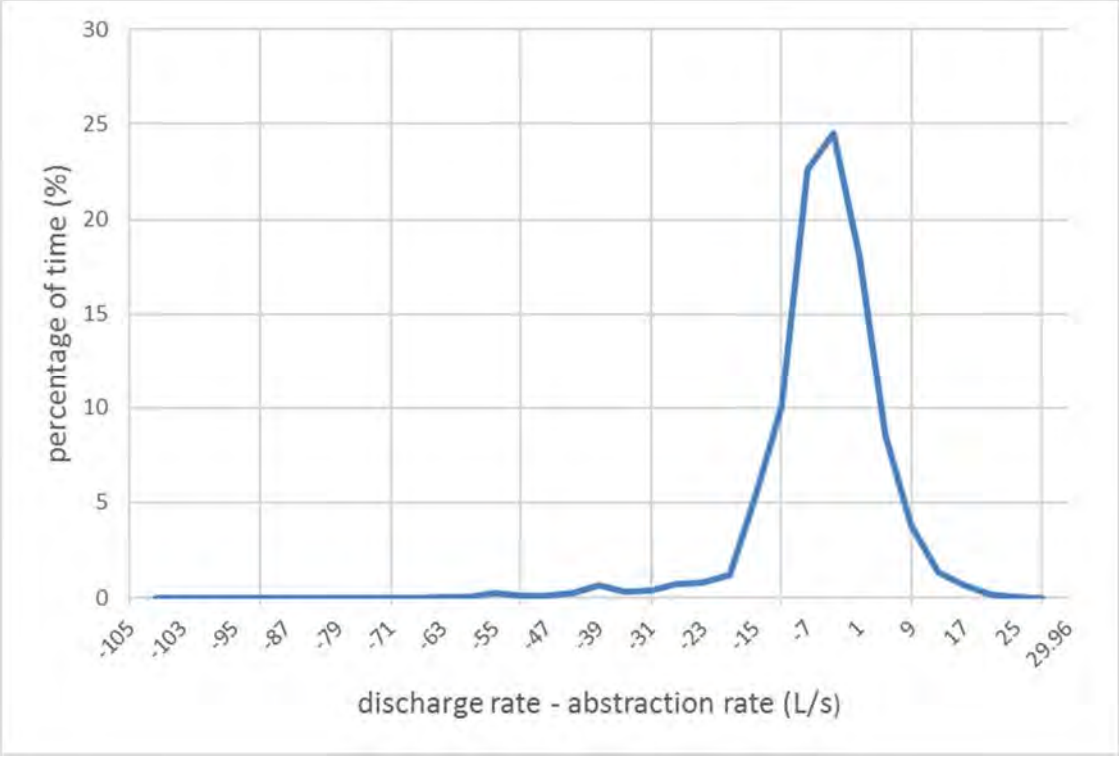


Figure 9 Probability density for the difference between the rate of discharge to the cooling tower and the abstraction rate

2.1.1.4 Cooling water discharge temperature

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 water tower, upstream of the sprayers. This monitoring is likely to be required by the renewed consent, and in the meantime will inform the assessment of effects being prepared by the Company for the renewal of the consent.

This data has been provided to Council electronically for the year under review (Figure 10). The data provided is 15 minute averages, however 15 second data was provided for the period 5 February 2018 to 7 February 2018 at 7 am. The median monthly discharge temperatures are given in Table 13.

Table 4 Cooling water temperature monthly statistical summary

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Jul 2017	5.6	49.6	9.5	6 days
Aug 2017	6.9	44.5	32.8	7 days 17 hr 45 min
Sep 2017	11.9	47.5	34.4	1 days 15 min
Oct 2017	17.7	44.1	35.3	3 days 30 min
Nov 2017	20.0	44.3	29.2	9 hr 15 min
Dec 2017	18.1	45.9	30.0	18 hr 45 min
Jan 2018	19.9	54.0	32.8	3 days 30 min
Feb 2018	18.2	51.2	36.9	no gaps
Mar 2018	18.8	45.7	32.1	no gaps
Apr 2018	13.9	44.3	32.0	no gaps
May 2018	10.4	44.2	32.5	no gaps
Jun 2018	3.4	42.0	10.0	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 and the Company's implementation of the "best practicable option".

The monitoring shows that the median monthly discharge temperature, as measured downstream of the cooling towers, is generally in the range of 30-37˚C during the warmer, lower stream flow months of the year. Although care needs to be taken when looking at the statistical analysis due the extent of the missing records. It must also be borne in mind that the discharge method itself (spray discharge) will provide further cooling prior to the cooling waters entry into the stream.

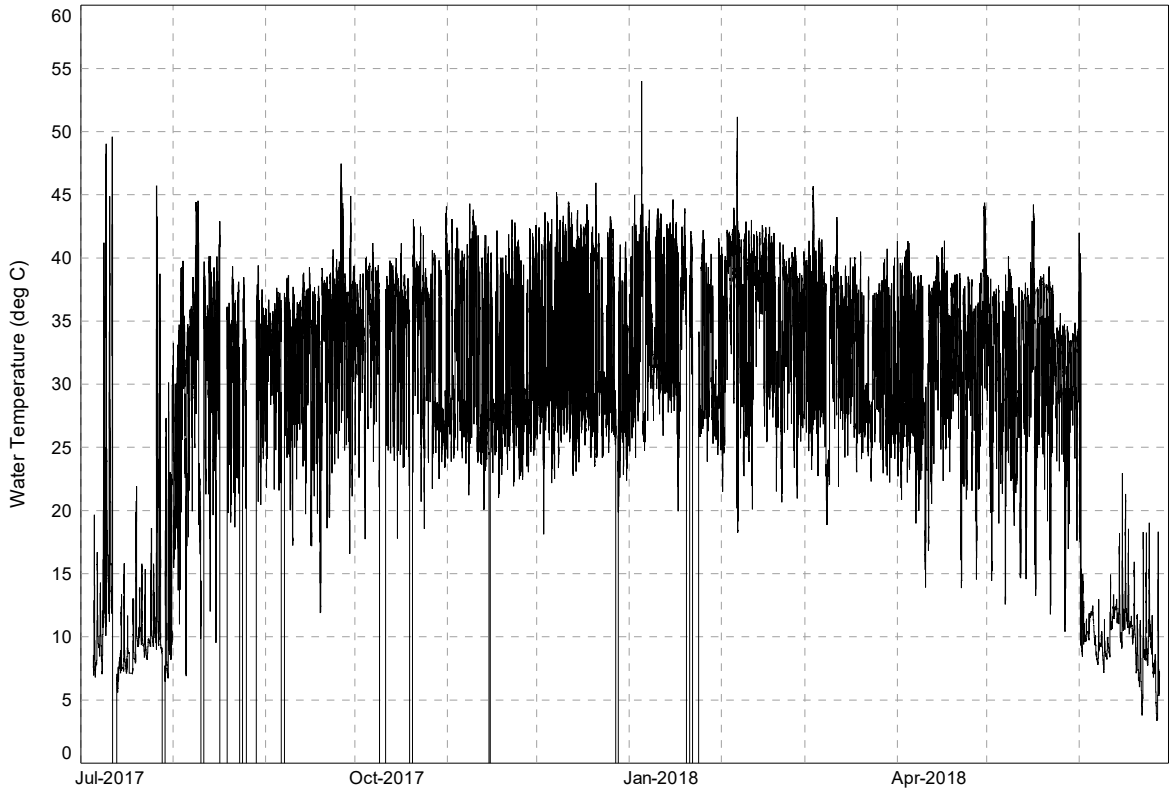


Figure 10 Temperature of the cooling water discharge permitted by consent 0919-3, electronic record

January's maximum temperature was recorded on 5 January 2018, with one 15 minute average temperature reported at 54˚C (at 5:15 am).

February's maximum temperature was recorded on 6 February 2018, with 1 minute and 30 seconds above 50˚C (at 7.21 am).

Further analysis and comparison of cooling water tower and operational performance is illustrated in Figure 11 and Figure 12. Cumulatively during the year under review the cooling water discharge is at or and at or above 40˚C for 6% of the time, generally occurring between November and March.

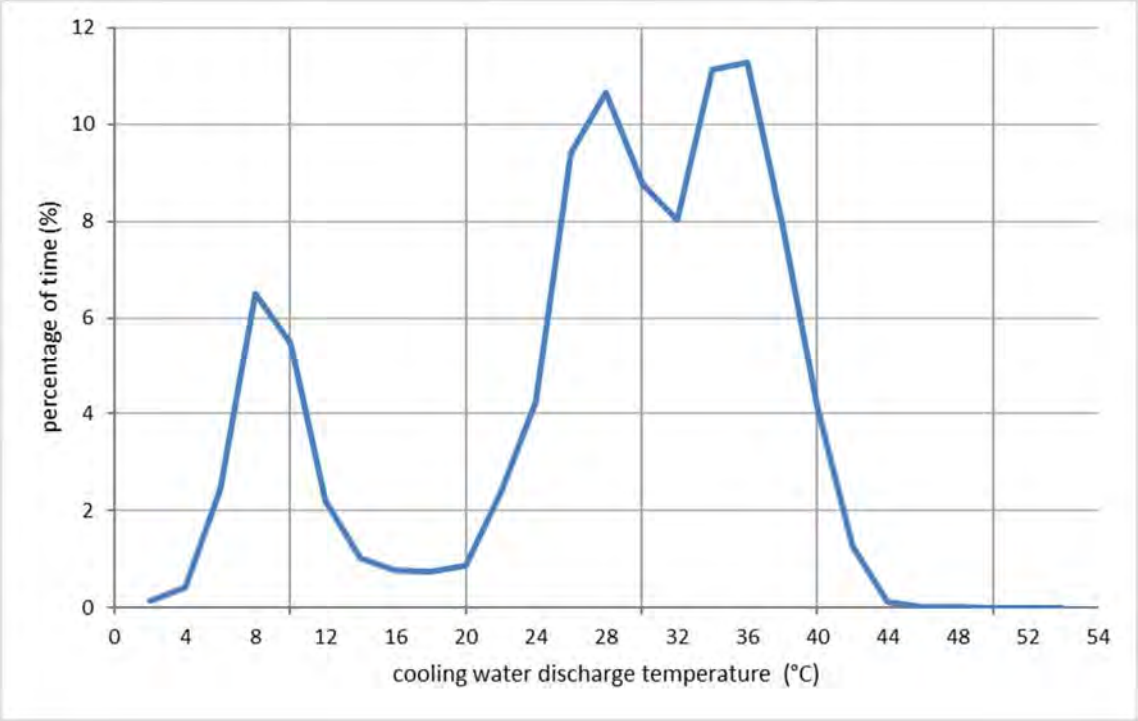


Figure 11 Cooling water tower discharge temperature probability density during the period under review from 1 July - 30 June

During the period 1 January to 30 March, the time of year when typically the stream flow is low and the water temperature is higher, the cooling water temperature is at or above 33˚C for 53% of the time, and is at or above 40˚C for 10% of the time (with no missing record).

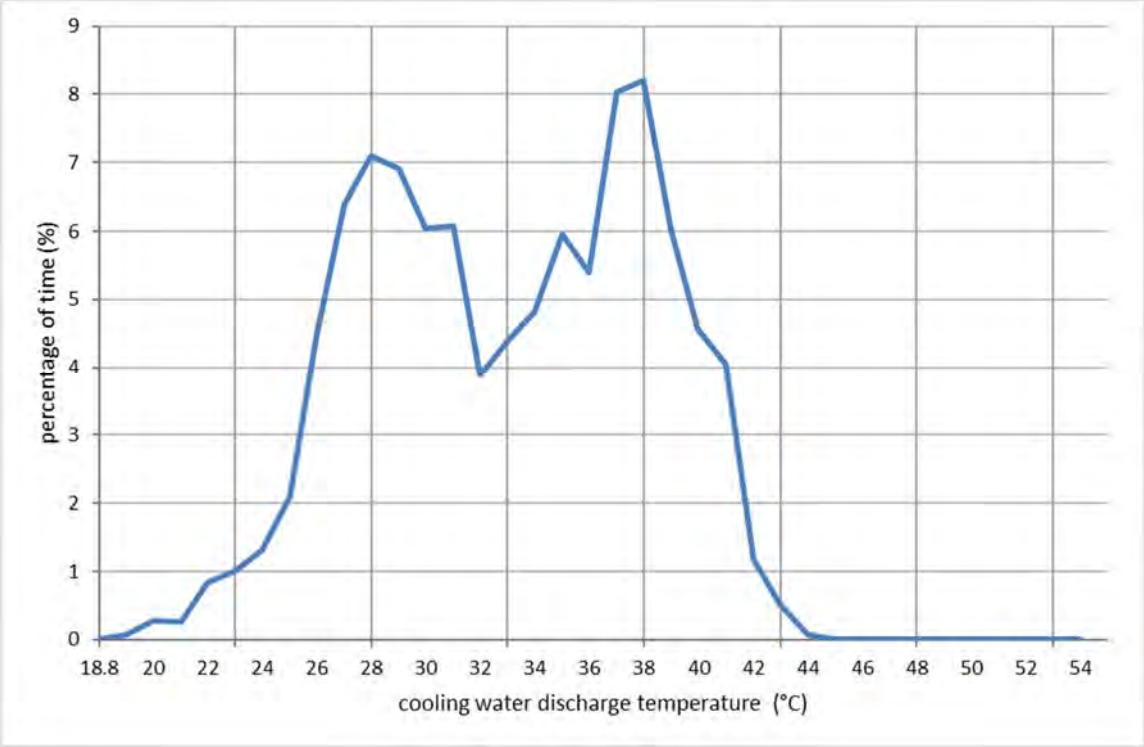


Figure 12 Cooling water tower discharge temperature probability density during the period under review, 1 January – 31 March

2.1.1.5 Irrigation records

In relation to the Company's spray irrigation of wastewater onto land (that is, the exercise of consents **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 5.

Table 5 Wastes irrigation records supplied by Fonterra Ltd

Month	Kapuni Farm 1							Farms 2 & 3						
	Factory			DSE			Total	Factory			DSE			
	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 2017	7	66	177	2	29	40	0	31	572	1,759	12	69	167	0
Aug 2017	29	425	832	12	80	118	0	31	1,254	1,807	1	0	65	0
Sep 2017	30	470	920	15	91	120	0	30	1,405	1,810	7	126	167	0
Oct 2017	31	544	829	12	104	118	0	31	1,552	1,981	10	87	167	0
Nov 2017	29	483	752	10	61	118	0	30	1,480	2,075	8	113	167	0
Dec 2017	31	469	876	23	86	120	0	31	1,257	1,756	19	116	167	0
Jan 2018	31	569	909	11	35	116	0	31	1,264	1,706	14	53	167	0
Feb 2018	28	446	1,000	4	68	83	0	28	1,176	1,639	0	0	0	0
Mar 2018	31	570	1,000	10	77	116	0	31	1,358	1,729	14	122	167	0
Apr 2018	30	451	747	3	52	85	0	30	1,232	1,814	7	108	142	0
May 2018	29	344	660	7	87	116	0	31	1,037	1,373	17	148	167	0
Jun 2018	2	1	1	0	0	0	0	27	254	1,717	15	116	167	0

Note: Average daily volume irrigated 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.

Irrigation of factory effluent occurred almost daily during the monitoring year. A total factory effluent volume of 576,183 m^3 was irrigated during the 2017-2018 year, with a distribution between farms of 25%, 17% and 58% for Farm 1, Farm 2 and Farm 3, respectively. This was an increase of 9.4% from the volume of 526,626 m^3 irrigated in the 2016-2017 year. The factory wastewater irrigation distribution between the farms during the year under review was similar to the previous year.

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, replacing the oxidation pond treatment systems which had previously discharged to Kaupokonui and Motumate Streams. On Farms 2 and 3 irrigation commenced for the season on 1 July 2017. A total volume of 14,199 m^3 was discharged during the year. On Farm 1, where irrigation commenced on 6 July 2017, a total volume of 9,352 m^3 was discharged.

The record shows that the volume limits on both consents were complied with throughout the 2017-2018 monitoring period.

2.1.1.6 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). The data recorded consists of 15 minute average values at all three monitoring points. 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 generally performed at monthly intervals by Company personnel, and checks were made by Council staff during monthly receiving water sampling surveys. Although Council had previously been advised that the accuracy of the temperature probes was +/- 0.1˚C, calibration records forwarded to Council for the year under review showed off-sets of up to 0.5˚C that were not being corrected for. Due to the absence of any specific consent requirements in this regard, this is a standard that had been adopted by the Company in line with the Water Temperature National Environmental Monitoring Standard (NEMS standard, which states that the accuracy of the sensors must be within +/- 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. Therefore currently the accuracy of the temperature recordings provided to Council may be up to +/- 0.8˚C, with a potential error of up to +/-1.6˚C on any calculated temperature differentials.

Since 19 March 2014, the upstream and downstream temperature data have been sent directly to Council by telemetry on a daily basis.

The temperature record over the 2016-2017 reporting period for the Kaupokonui Stream upstream and downstream of the lactose plant discharge is presented in Figure 13 and Figure 14. The change in temperature is given in Figure 15.

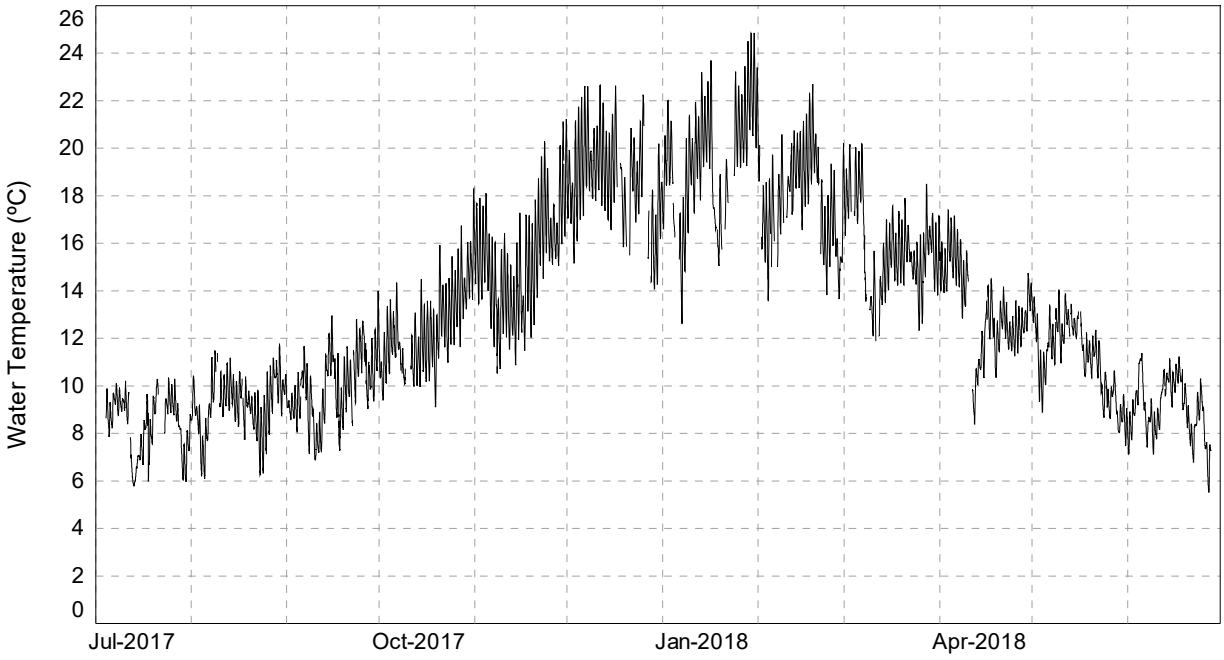


Figure 13 Water temperature (°C) records for the Kaupokonui Stream upstream of the lactose plant, electronic data

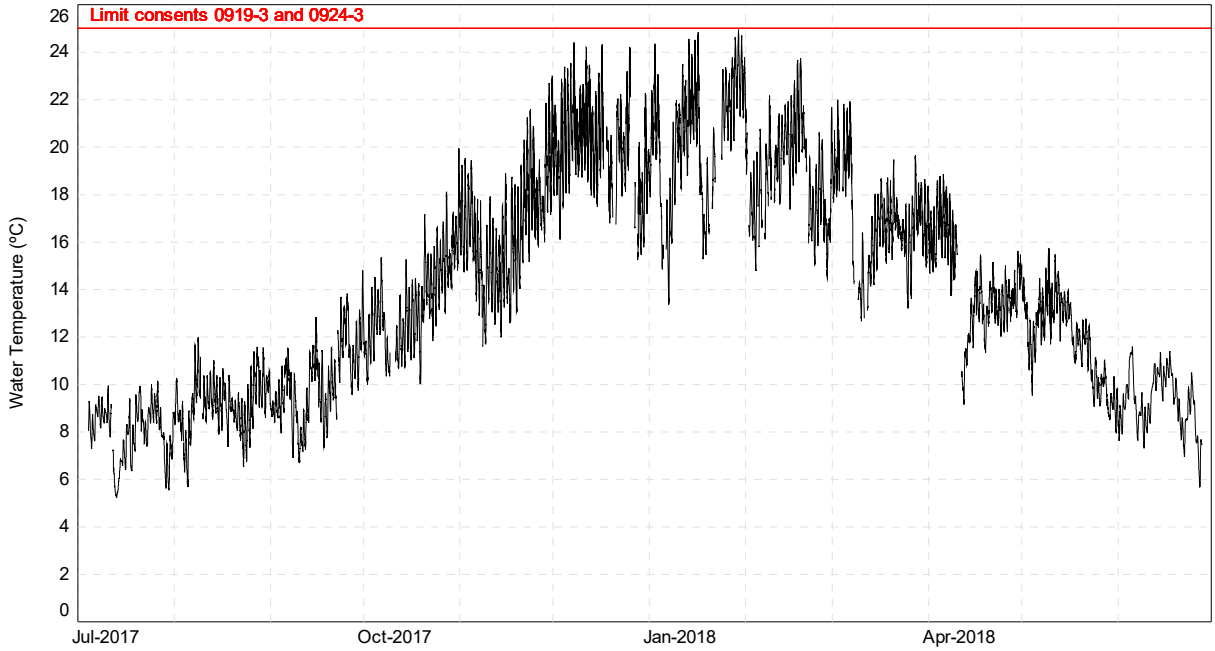


Figure 14 Water temperature (°C) records for the Kaupokonui Stream downstream of the lactose plant, electronic data

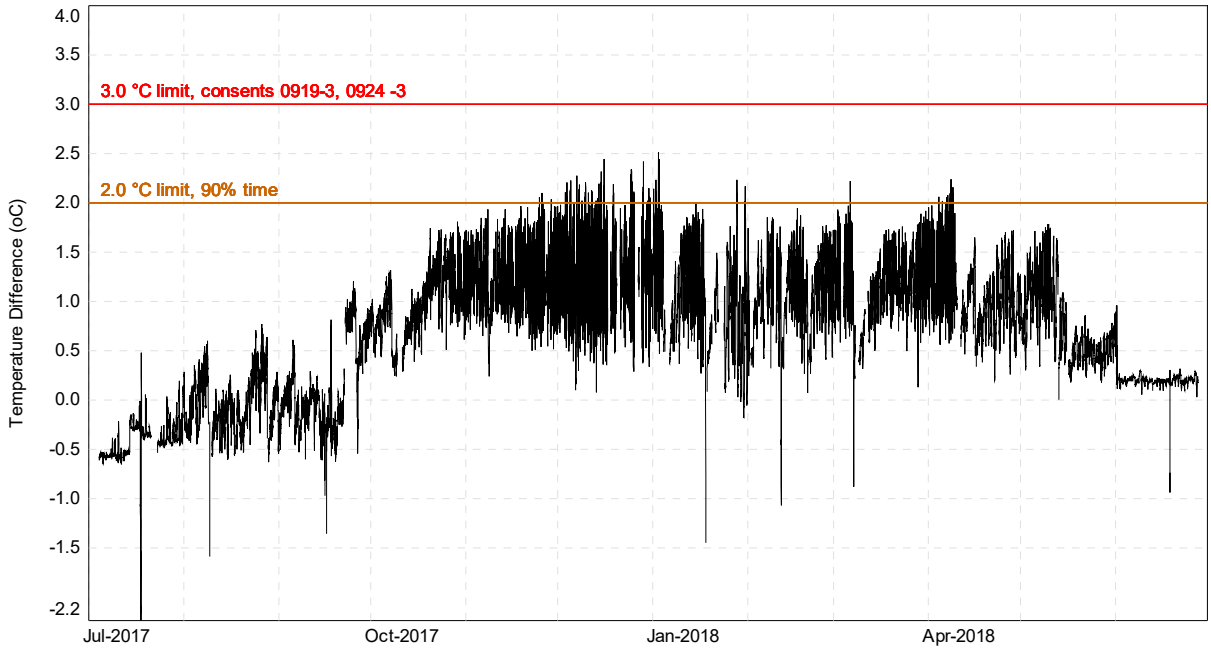


Figure 15 Kaupokonui Stream temperature change below the lactose plant, calculated from electronic data

A summary of the reported temperature change and maximum temperature data for 2017-2018 (15 minute data) is given in Table 6. 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 6 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 2016	98	0	0	0	-2.2	0.5	0	10.2	0
Aug 2016	40	0	0	0	-1.6	0.8	0	12.0	0
Sep 2016	51	0	0	0	-1.0	1.2	0	14.8	0
Oct 2016	0	0	0	0	0.2	1.8	0	20.0	0
Nov 2016	0	0.02	0	0	0.1	2.4	0	23.0	0
Dec 2016	0	1.4	0	0	0.1	2.4	0	24.4	0
Jan 2017	1.5	0.7	0	0	-1.4	2.5	0	25.0	0
Feb 2017	0.4	0	0	0	-1.1	2.0	0	24.8	0
Mar 2017	0.2	0	0	0	-0.9	2.2	0	22.0	0
Apr 2017	0	0.16	0	0	0.2	2.2	0	18.9	0
May 2017	0	0	0	0	0.0	1.8	0	15.8	0
Jun 2017	0.1	0	0	0	-0.9	1.0	0	11.6	0
Totals for 2017-2018	17	0.2	0.0	0.0	-2.2	2.5	0	25.0	0

Note:* =% of actual record (29 days 17 hrs and 45 min of missing record)

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 were occasions when temperature differences reached or exceeded 2˚C, during periods of low flow in Kaupokonui Stream. The month in which this occurred was December 2017, for 1.4% of the time with four days and three and a half hours (13%) of missing record.

Condition 4(b) of consents **0919-3** and **0924-3** 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). These limits were not exceeded during the 2017-2018.

Condition 5 of consents **0919-3** and **0924-3** requires that the discharge shall not raise the temperature of the receiving water above 25 °C at the boundary of the mixing zone. Figure 4 shows that this condition was complied with during the year under review. On 29 January and 30 January the Company shutdown their evaporators for a period of time to avoid a potential breach of this condition as the upstream temperature in the Kaupokonui Stream reached maximum temperature of 24.8 °C for over an hour each evening.

The data and summary provided in Figure 15 and Table 6 show that, although the temperature probes comply with the requirements of NEMS standard, there appear to be some issues with the precision of the recording of the temperature differential between the upstream and downstream sites. The data reported

indicated that there was a drop in stream temperature between the upstream and downstream sites for 16% of the time, compared to 23% of the time in the 2016-2017 year.

Table 7 shows the comparison between the stream temperatures recorded at the time of sampling during the monthly inspections and the temperature provided in the electronic record.

Table 7 Comparison between Council's stream temperatures at the time of sampling and the Company's electronic record provided to Council

Month	Upstream temperature (TRC – KPK000660) (˚C)	Upstream temperature (Fonterra) (˚C)	Differential (˚C)	Downstream temperature (TRC – KPK000679) (˚C)	Upstream temperature (Fonterra) (˚C)	Differential (˚C)
Jul 2017	9.6	8.9	-0.7	9.5	9.5	0
Aug 2017	9.9	9.9	0	10.8	9.7	-1.1
Sep 2017	9.9	9.7	-0.2	10.5	9.5	-1.0
Oct 2017	10.5	10.1	-0.4	11.0	11.5	+0.5
Nov 2017	13.2	13.1	-0.1	14.2	14.5	+0.3
Dec 2017	18.2	18.4	+0.2	19.2	20.1	+0.9
Jan 2018	15.0	15.6	+0.6	15.4	15.6	+0.2
Feb 2018	16.7	16.6	-0.1	18.6	18.3	-0.3
Mar 2018	14.0	14.4	+0.4	15.5	15.6	+0.1
Apr 2018	11.8	11.6	-0.2	12.8	13.0	+0.2
May 2018	9.2	11.5	+2.3	10.3	11.8	+1.5
Jun 2018	7.8	7.4	-0.4	7.8	7.8	0

It can be seen that, at times, there is quite a variation between the two temperatures obtained. However, it must be noted that the data comparison is between an instantaneous reading and a 15 minute average.

Council is discussing options with the Company to improve the precision of their temperature monitoring and recording, and this will be addressed during the renewal of the consents. In the meantime, it is recommended that the Council undertakes some parallel temperature monitoring to confirm compliance, as is the practice in place where the Council is monitoring other cooling water discharges to waterways.

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 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 2017-2018 the pH, organic strength, major mineral components, nutrients (including nitrogen species) and the metals copper and zinc were determined for 41 samples collected between 3 August 2017 and 27 June 2018. It is noted that the number of analyses performed has decreased progressively since the 2015-2016 year. The results are summarised in Table 8.

Table 8 Results of factory wastewater monitoring by Fonterra Ltd

Parameter	Unit	2017-2018		% change	2016-2017		% change	2015-2016	
		Median N = 42	Range		Median N = 43	Range		Median N = 47	Range
pH	pH	4.4	4.0 - 11.6	0	4.4	4.1 - 4.7	0	4.4	4.2 – 8.9
Chemical oxygen demand	g/m^3	6,760	592 - 13,720	-8	7,370	2,790 - 11,430	-3	7,600	17 – 20,940
Biochemical oxygen demand	g/m^3	3,200	360 6,300		-	-	-	-	-
Total Nitrogen	g/m^3N	72.5	45.0 - 147	-24	96	62 - 148	2	94	12 - 191
Nitrate	g/m^3N	43.0	14.5 - 87	5	41	14.8 - 94	-2	42	7 - 148
Nitrite	g/m^3N	0.7	0.1 - 16	-66	2.1	0.31 - 7.4	-9	2.3	0.2 – 4.9
Total Kjeldahl Nitrogen (TKN)	g/m^3N	28.0	5.0 - 118	-42	48	5.6 - 82	9	44	7 - 148
Calcium	g/m^3	182	98 - 298	-9	201	87 - 391	22	165	67 - 276
Magnesium	g/m^3	21.0	4.8 - 96	121	9.5	1 - 154	-50	19	2 - 86
Sodium	g/m^3	102	58 - 227	-18	125	61 - 199	-5	131	27 - 201
Potassium	g/m^3	110	40 - 340	6	104	52 - 480	-26	140	16 - 440
Total Phosphorus	g/m^3P	88.0	4.8 - 262	21	73	29 - 247	-27	100	3 - 302
Ash	g/m^3	941.0	469 - 2,112	-14	1,090	511 – 1,799	-	-	-
Sodium adsorption ratio		2.7	1.5 - 5.6	-18	3.3	1.5 - 5.2	-5	3.5	1.1 – 5.1
Copper	g/m^3	0.310	0.13 - 0.670	-	-	-	-	-	-
Zinc	g/m^3	0.410	0.13 - 0.660	-	-	-	-	-	-

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2015-2016, 2016-2017 and 2017-2018 monitoring years on the basis of median values, as described in Table 8. Wastewater organic strength in 2017-2018, was, on the whole similar to or less concentrated when compared with the 2016-2017 year. Although the maximum concentrations recorded for the chemical oxygen demand, Kjeldahl nitrogen and nitrite were higher than in the previous year, the median values for these parameters had reduced. It is also noted that the total nitrogen concentration continued to agree reasonably well with the sum of the individual nitrogen species in the 2016-2018 years, unlike the 2013-2015 seasons. Sodium adsorption ratio was again high on occasion, though well within the safe range for soil stability and with an 18% reduction in the median value. The only median values to have increased notably were magnesium and total phosphorus.

The annual volume of factory wastewater produced since 2009-2010, together with the annual mass of factory nitrogen irrigated, is presented in Figure 16. With respect to the mass discharge rate of wastewater components, factory wastewater volume has generally changed little since 2011-2012. Therefore, historically, the estimated mass discharge rate of the wastewater components has increased or reduced by about the same proportion as their respective concentrations. However, for the year under review it appears that there was a new maximum wastewater discharge volume, with a new minimum mass discharge rate of

nitrogen. It is noted thought that there were a reduced number of determinations of the wastewater nitrogen concentration, particularly when compared to the 2015-2016 year (approximately 10% reduction).

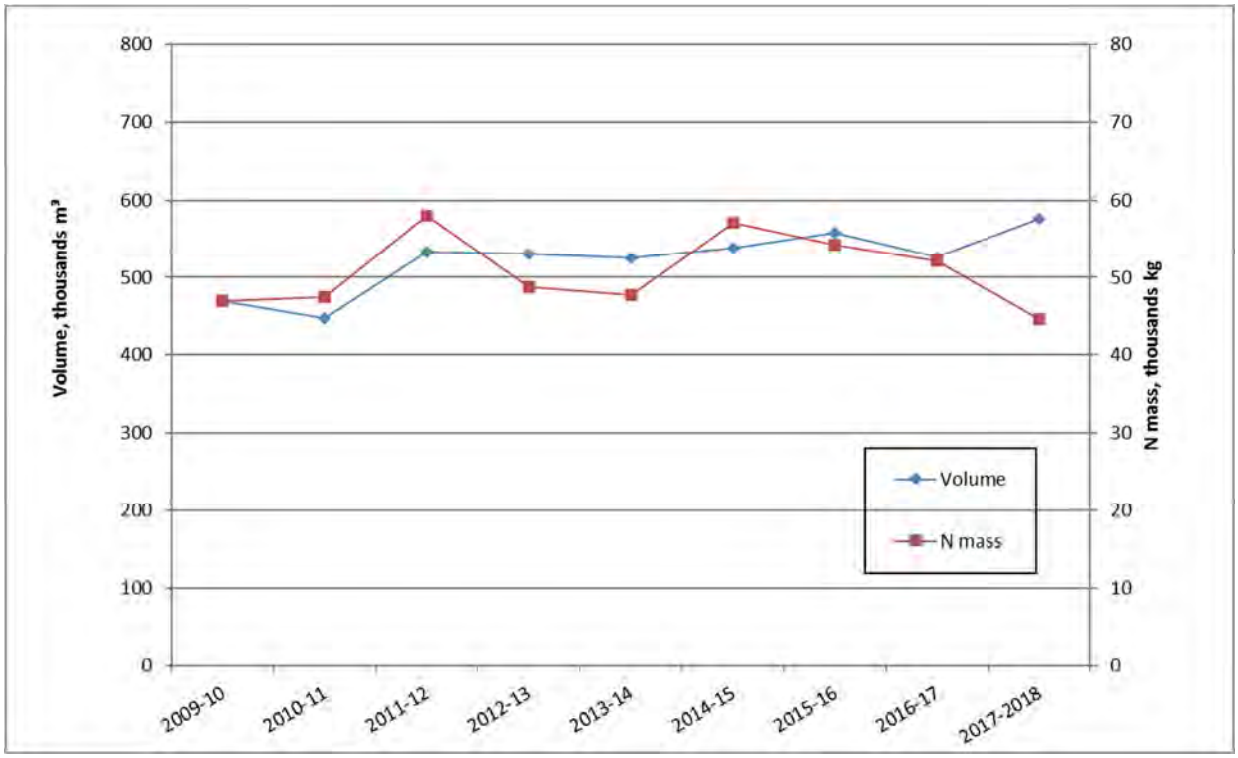


Figure 16 Annual volume of factory wastewater and estimated factory nitrogen mass irrigated, 2009 - 2017

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 24 samples were taken between 7 August 2017 and 30 May 2018 for Kapuni Farm 1, and 23 samples were taken between 3 August 2017 and 27 June 2018 for Farms 2 and 3. The results are summarised in Table 9. Although this is a reduction in the number of samples of 37% and 47% respectively, it is noted that the volumes of DSE irrigated decrease by 35% and 29% respectively.

Table 9 Results of dairy shed effluent monitoring by Fonterra Ltd

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 24	Range	2016-2017 median (N=38)	Median N = 23	Range	2016-2017 median (N=43)
pH	pH	7.7	4.7 - 8.1	7.9	8.0	6.8 - 8.3	8.0
Biochemical oxygen demand	g/m^3	240	100 - 3,900	234	480	120 - 3,500	520
Total Nitrogen	g/m^3N	79.5	47.0 - 147	115	206	100 - 320	190
Nitrate	g/m^3N	3.1	0.2 - 60.0	0.43	0.10	0.01 - 0.58	0.20

Parameter	Unit	Farm 1			Farms 2 & 3		
		Median N = 24	Range	2016-2017 median (N=38)	Median N = 23	Range	2016-2017 median (N=43)
Nitrite	g/m^3N	0.07	0.01 - 5.00	0.08	0.04	0.00 - 0.18	0.04
Total Kjeldahl Nitrogen (TKN)	g/m^3N	74.5	42.0 - 104	113	206.0	100 - 320	190
Calcium	g/m^3	79	43 - 213	85	106.0	2.4 - 184	98
Magnesium	g/m^3	24	5.0 - 90	20	36	5.0 - 107	12
Sodium	g/m^3	51	24 - 396	49	106	52.5 - 272	62
Potassium	g/m^3	250	135 - 525	370	780	520 - 1,400	620
Total Phosphorus	g/m^3P	42	26 - 100	50	75	44 - 280	80
Ash	g/m^3	779	418 - 1,130	941	1,815	859 - 3,584	1,315
Sodium adsorption ratio		3.21	1.23 - 5.60	1.9	3.2	6.8 - 5.6	2.5

Comparison of contaminant loadings from the factory wastewater and DSE

The DSE has lower organic (BOD compared to BOD and COD) and higher mineral strength than factory wastewater, and is slightly alkaline (Figure 17 and Figure 18). The effluent from Farm 1 had lower component concentrations than that of Farms 2 and 3, possibly owing to a larger presence of stormwater in the former. The median total nitrogen concentration in Farms 2 and 3 effluent (206 g/m^3), was about double the Farm 1 effluent (79.5 g/m^3), and almost three times that of factory wastewater (72.5 g/m^3). 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. It is noted, however, that the Farm 1 dairy shed effluent did contain predominantly nitrate nitrogen on 18 September 2017. The additional nitrogen load applied to the paddocks during the year under review from the Farm 1 and the Farm 2 and 3 DSE was about 3,986 Kg, that is, about another 10% when compared to the nitrogen applied in the factory wastewater.

Within the production season, measured organic strength of the wastewater strength (BOD) was significantly higher on the shoulders of the season (Figure 17), as was the case for the minerals (for example potassium as shown in Figure 22) and total phosphorus (Figure 23).

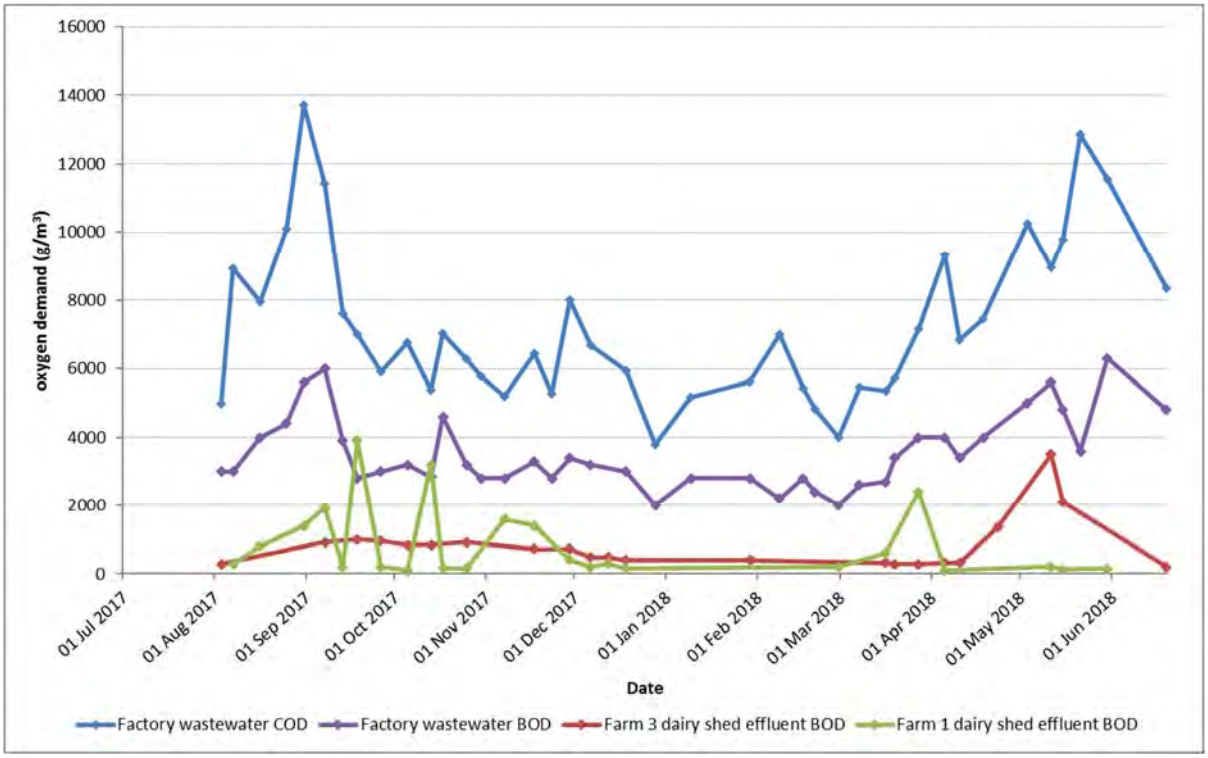


Figure 17 Oxygen demand of the factory wastewater and dairy shed effluents

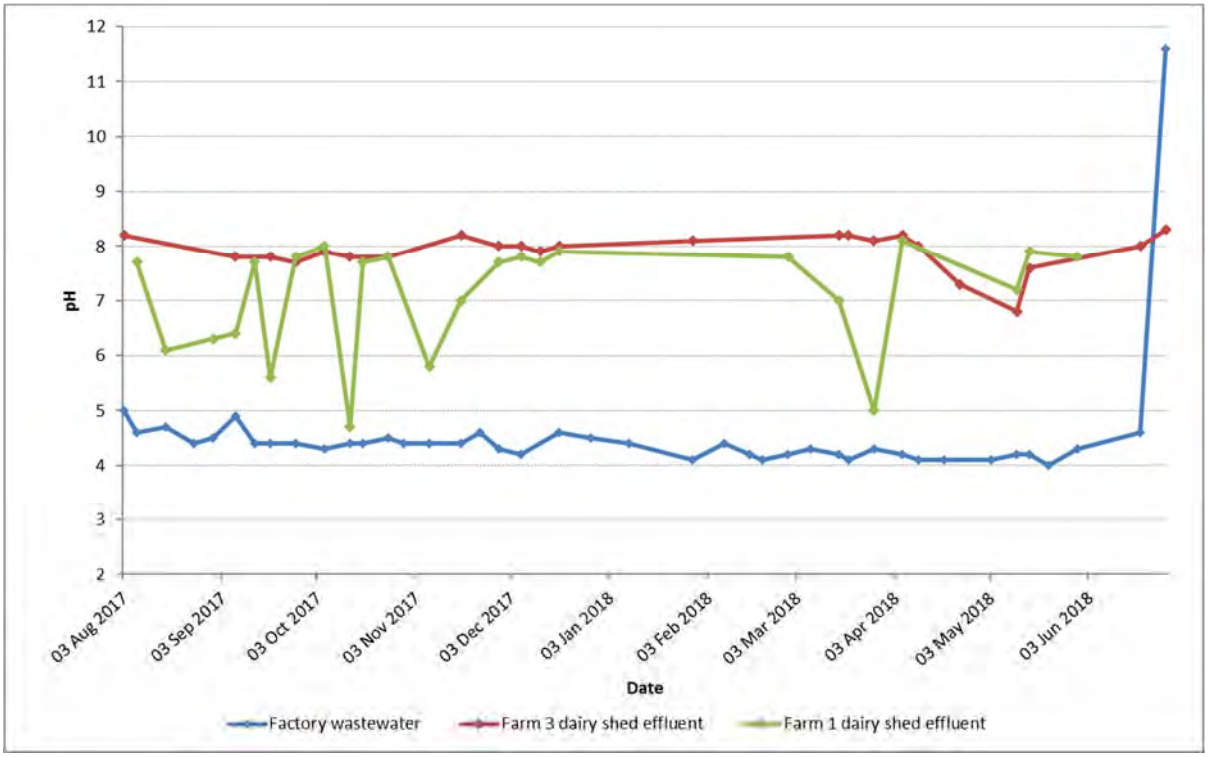


Figure 18 pH of the factory wastewater and dairy shed effluents

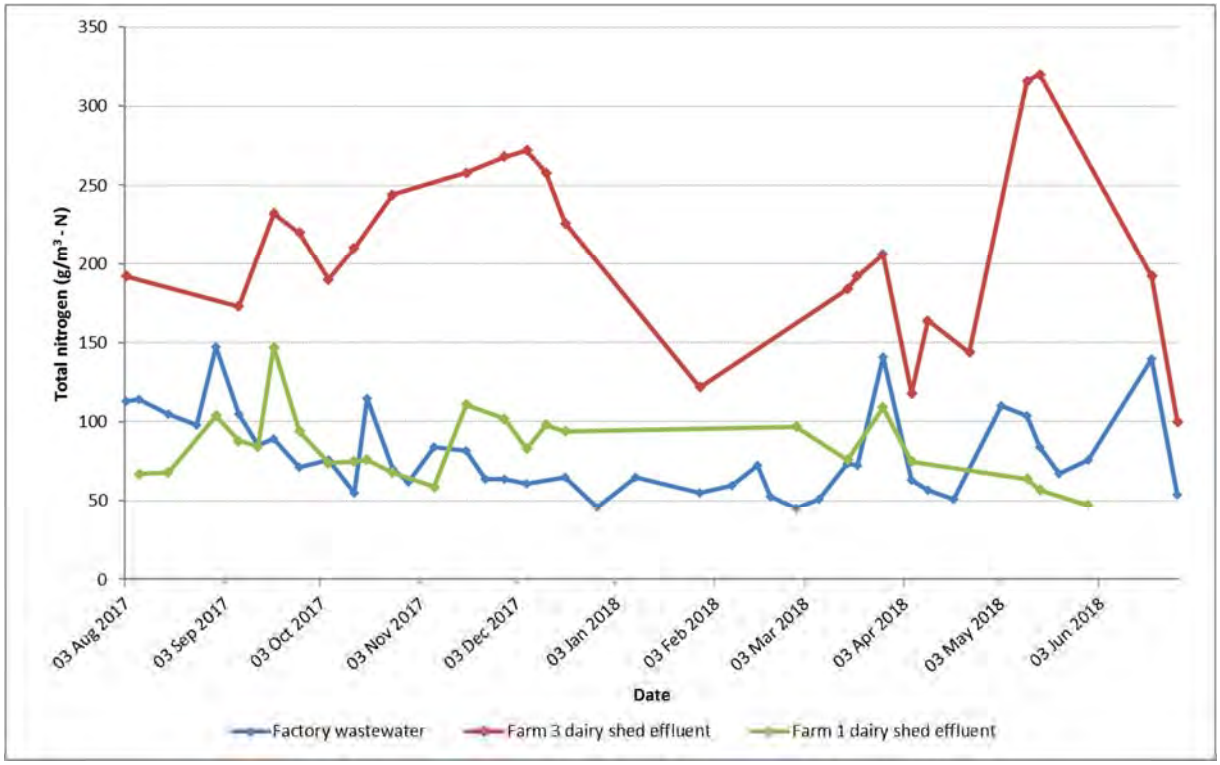


Figure 19 Total nitrogen of the factory wastewater and dairy shed effluents, 2017-2018

It is noted that the seasonal profile for the total nitrogen of the Farm 3 dairy shed effluent and the factory wastewater is quite different when compared to the previous monitoring period (Figure 20) as is the nitrate nitrogen of the Farm 1 DSE, which has much higher levels on the whole during the year under review, with the concentration higher than the factory wastewater on 18 September 2017 (Figure 21).

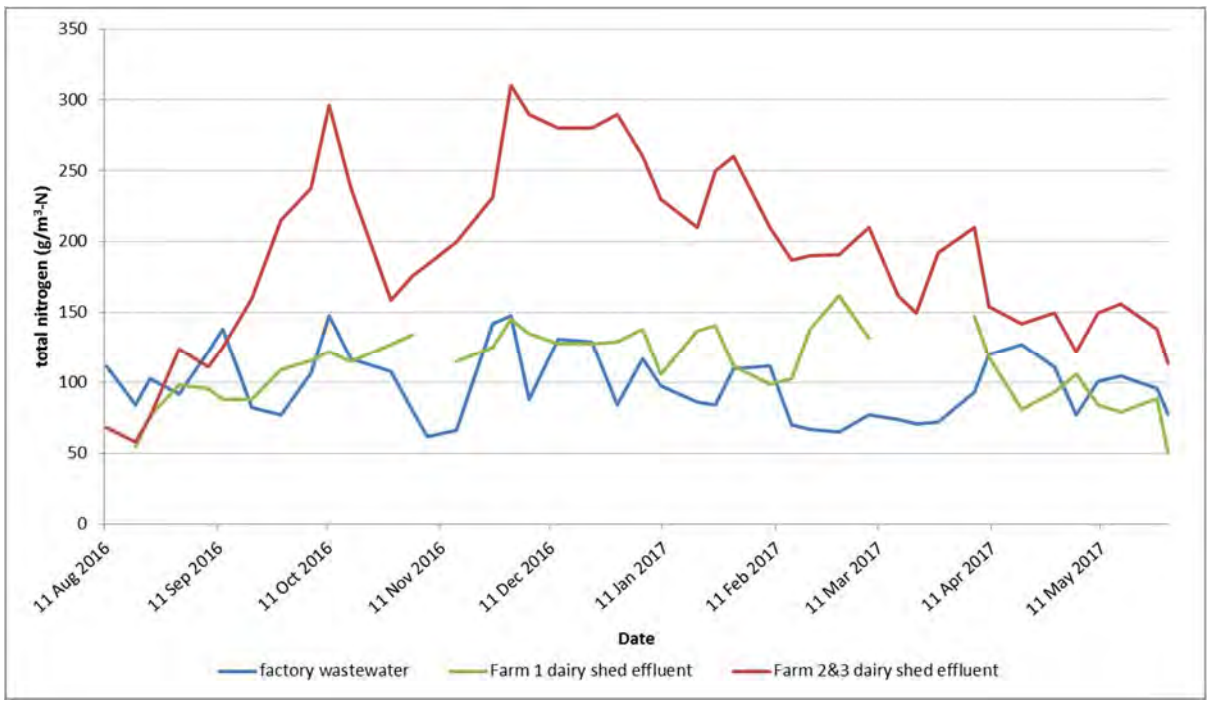


Figure 20 Total nitrogen of the factory wastewater and dairy shed effluents, 2016-2017

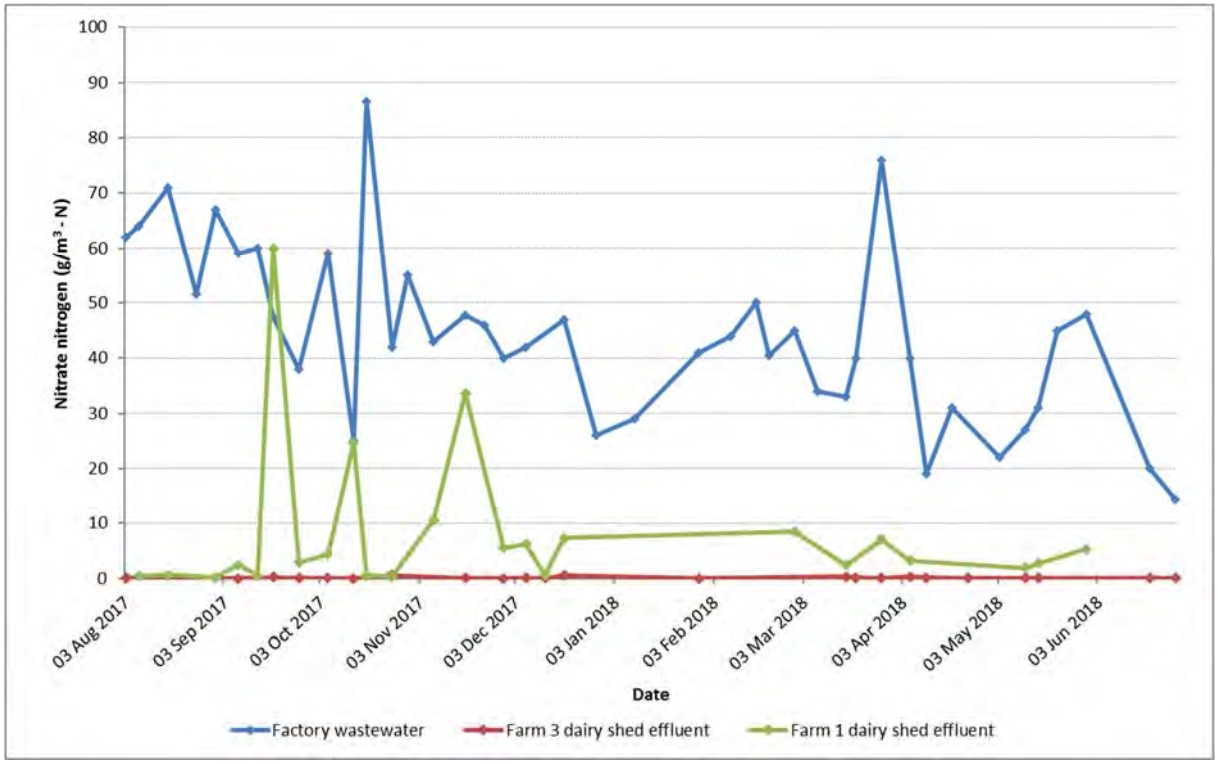


Figure 21 Nitrate nitrogen of the factory wastewater and dairy shed effluents

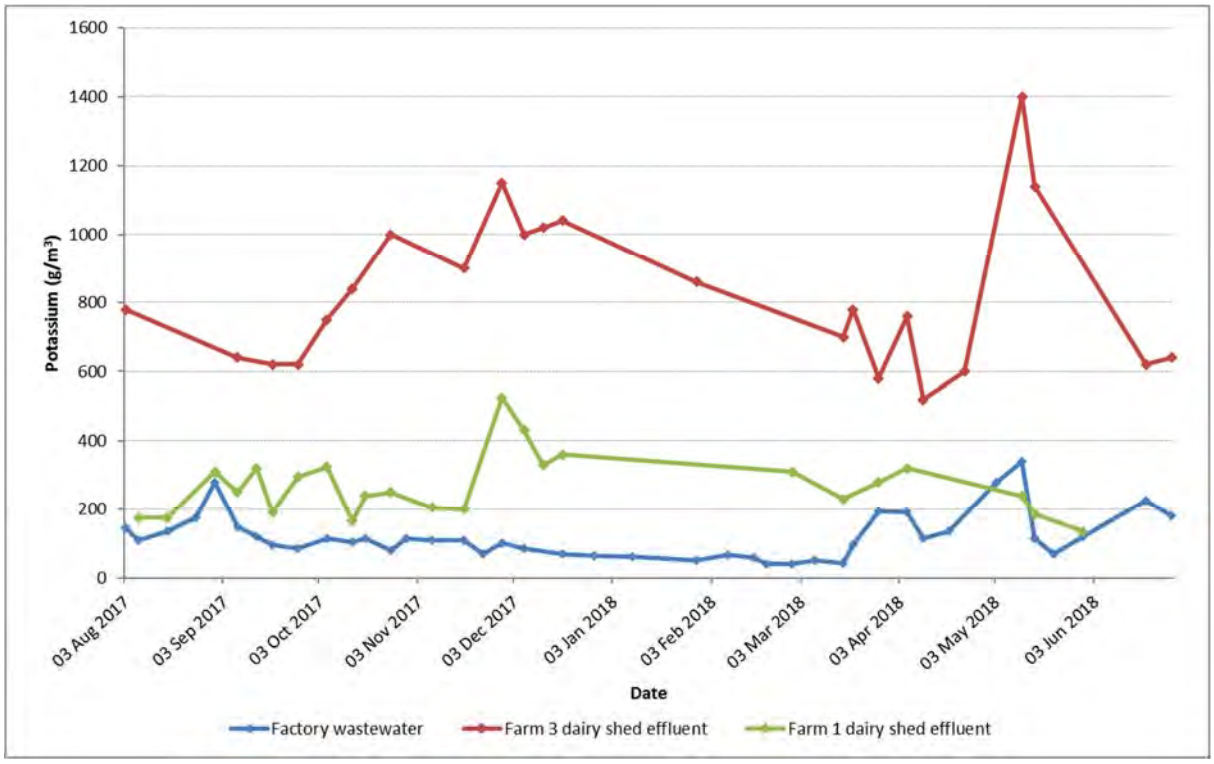


Figure 22 Potassium concentration of the factory wastewater and dairy shed effluents

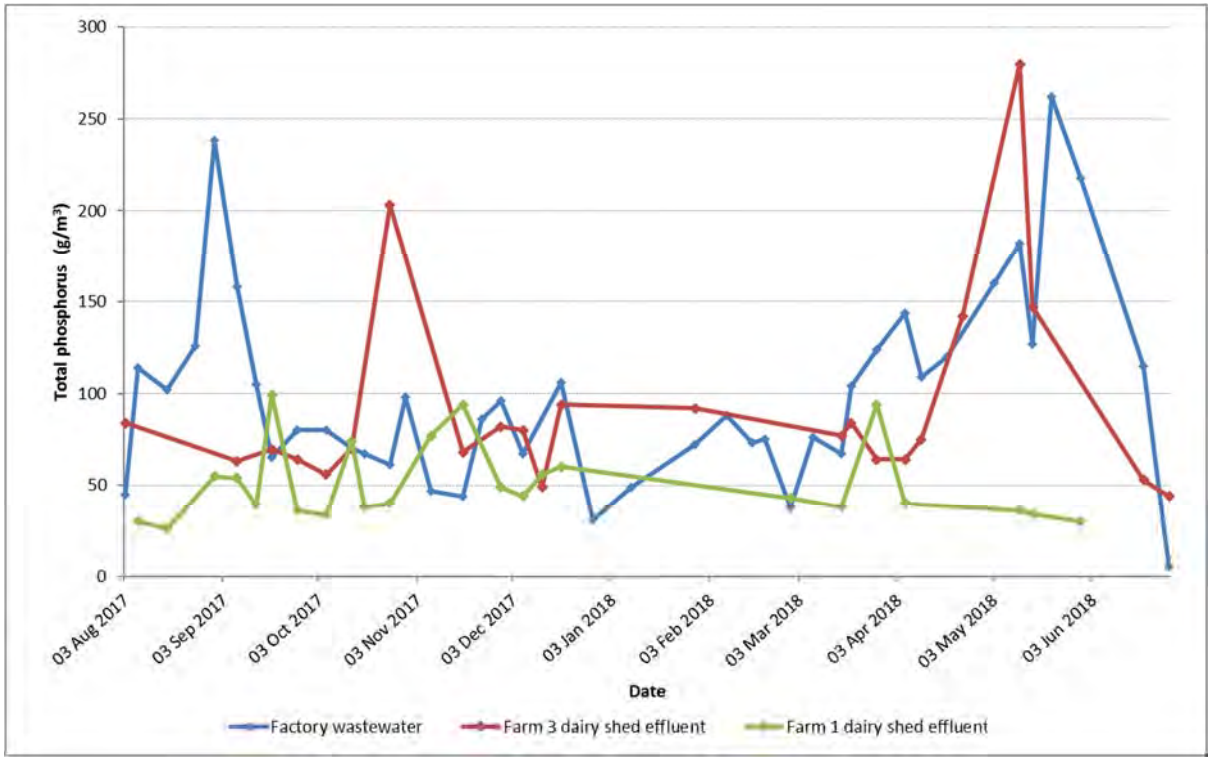


Figure 23 Phosphorus concentration of the factory wastewater and dairy shed effluents

Interlaboratory comparison

An interlaboratory comparison exercise was carried out on 28 September 2016 on 24-hour composite samples taken of factory wastewater and farms DSE by the Company. The results are given in Table 10.

Table 10 Results of interlaboratory comparison on factory and dairy effluents, 25 October 2017

Parameter	Unit	Factory wastewater		Dairy shed effluent (Farm 1)		Dairy shed effluent (Farms 2 & 3)	
		Fonterra (ICS)	TRC	Fonterra (ICS)	TRC	Fonterra (ICS)	TRC
Alkalinity, total to pH 4.5	g/m³ $CaCO_3$	-	<1	-	-	-	-
Biochemical oxygen demand (BOD)	g/m³	3,200	3,600	160	90	920	650
Calcium	g/m³	150	150	51	13.6	94	13.8
Chloride	g/m³	-	59.4	-	-	-	-
Chemical oxygen demand (COD)	g/m³	6,280	5700	-	-	-	-
Conductivity, 20°C	mS/m	-	123	-	138	-	362
Bicarbonate	g/m³ HCO_3	-	<0.6	-	-	-	-
Potassium	g/m³	80	81.8	250	187	1000	582
Potassium adsorption ratio		-	1.01	-	4.4	-	12.0
Magnesium	g/m³	57	14.3	57	20.1	57	29.0
Sodium	g/m³	87	46.5	35	39.6	83	85.7
Ammoniacal nitrogen	g/m³N	-	0.185	-	56.8	-	231
Nitrate + nitrite	g/m³N	42.5	0.43	0.3	0.06	0.57	0.22
Oil and grease	g/m³	-	1.6	-	-	-	-
pH	pH	4.5	4.4	7.8	7.8	7.8	7.6
Sodium adsorption ratio		2.18	1.93	3.85	1.60	2.37	3.01
Suspended solids	g/m³	-	380	-	-	-	940
Total Kjeldahl Nitrogen (TKN)	g/m³N	28	68.17	68	76.9	243	305
Total Nitrogen	g/m³N	70	68.6	68	77.0	244	305
Total Phosphorus	g/m³P	61	55.6	40.0	41.0	203	104
Ash	g/m³	849	-	653	-	1810	-
Nitrate	g/m³N	42	-	0.3	-	0.55	-
Nitrite	g/m³N	0.5	-	0	-	0.02	-

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 was the pH. Calcium, Potassium, and total nitrogen agreed well for the factory wastewater, with reasonably good agreement (about +/- 10%) for the BOD, COD, sodium adsorption ratio and total phosphorous. The other parameters were generally found to have been overestimated by Fonterra when compared to the Council

determinations. There were few parameters giving good or reasonably good agreement for the dairy shed effluents (sodium, and total nitrogen, Kjeldahl nitrogen and phosphorus for Farm 1 only). In the dairy shed effluent, the majority of the components were overestimated by Fonterra in comparison to the Council determinations, with the exception of sodium adsorption ratio, total nitrogen and Kjeldahl nitrogen, which were underestimated by about 20%. 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. Magnesium was the only parameter showing particularly poor agreement across all of the wastewater streams. This is only the third series of interlaboratory comparisons that have been undertaken, and these are scheduled to continue.

A wide range of parameters were tested by Council, for future reference. Historically, for nitrogen species, it has been determined that nitrate was the major single component in the factory wastewater, whereas the DSE was almost exclusively ammonia and organics (which are the components that are measured by TKN analysis). During the year under review, the Council laboratory obtained atypical results for the nitrate nitrogen and the TKN of the factory wastewater that is based on a calculation using the nitrate and total nitrogen results, which cannot be explained. It is noted though that there was still good agreement between the laboratories for the total nitrogen.

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 2017-2018 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.

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 at the site included:

- The diversion of all cooling waters to cooling tower and spray discharge system;
- The removal of the old stormwater/cooling water discharge line;
- The diversion of the stormwaters from around the lactose plant, the IGL plant, and the factory extension to a new northern stormwater pond; and
- Works undertaken on the southern stormwater pond liner in order to prevent losses from this pond.

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 fish pass installed by the Company under the guidance of the Council in March 2004, contained an adequate level of water during all inspections. Trout were observed around the weir during the October, November and December 2017 inspections.

2.1.2.1.3 Spray cooling wastes 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 is discharged directly to the stream under consent 0924-3. This was removed during the year under review 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.

The cooling water discharge system had variable performance during the monitoring year. The Company's recording system had some malfunctions, resulting in periods of missing records with regard to all electronic data including stream temperatures. General problems with electronic transmission and accuracy of monitoring data to Council are covered in sections 2.1.1.4 and 3.1.

Common causes of missing (or inaccurate) data in the temperature record were due to one or both instream temperature probes being removed from the stream during fresh conditions to prevent damage, or during calibration exercises. During these times a null switch is activated to avoid recording inaccurate data. Discussions were held at the September 2017 inspection regarding the apparent minus 0.6˚C temperature differential between the downstream and upstream temperature recordings obtained during the winter shutdown period. Historically, there had often been negative temperature differentials during this time of year, however the June and July 2017 temperature differentials were a lot more pronounced than in previous years. The Company undertook to investigate, and work is continuing around improving the accuracy of the Company's in stream temperature monitoring. As mentioned earlier, this matter has already been discussed in more detail elsewhere in this report.

Historically, the most common cause of missing data was due to a third party server going off line temporarily, which then did not accept data until the link was reset. Alerts have now been put in place so that the link can be re-established by Fonterra staff in a more timely fashion.

The growth in riparian vegetation continued to be effective at preventing spray drift of cooling water beyond the property.

2.1.2.1.4 Other discharges to the Kaupokonui Stream

The stormwater outfalls, from the IGL plant installed upstream of the old rail bridge and the detention pond downstream of the cooling water sprayers, did not cause concern during the monitoring period, due to either very low discharge rates or limited contamination of the discharge.

Photo 1 Valve on northern storm drain, and Reno mattresses laid out below storm drains to Kaupokonui Stream

A valve was installed on this stormwater outfall, in case of accidental spillage of chemicals, and Reno mattresses for erosion control are (were) laid below both northern stormwater outlets, as shown in Photo 1.

This arrangement was removed during the year under review following the commissioning of a northern stormwater pond.

During the October inspection it was noted that that IGL plant and factory extension stormwater pipes had been combined and the discharge location moved. 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 at the time of this inspection (Photo 2). The last samples that the Council obtained from the old stormwater outlets pictured above were on 21 September 2017, with samples from the new outfall collected at the inspections in October 2017 and January, March and May 2018, all of which were relatively low flow discharges. The first discharge the new pond was logged by the Company as being 8 March 2018. At the inspection on 15 March 2018 it was found that a recent storm had caused slips on the newly seeded pond walls and that work was being undertaken at the time of inspection to repair the damage. The stormwater pond outlet was open and only a minor, clear discharge was occurring.

Photo 2 Northern stormwater pond, stop valves and outfall to the Kaupokonui Stream

It was found that work to reduce losses was being undertaken on the southern stormwater pond liner during the inspection in December 2017. All stormwater from the upstream catchment was being directed to the wastewater pond while these works were occurring. At this inspection it was also noted that the new northern stormwater pond had been completed.

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 year under review that the Company intended to decommission this bore and withdraw the application to renew this consent at some point.

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 intended to withdraw the application to renew this consent at some point.

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. The total area farmed is 244 ha.

The majority of inspections noted spraying of wastewater onto paddocks well away from stock. No spray drift across streams was observed. Care is required while irrigating near watercourses particularly during wet and/or windy conditions. Spraying is not to occur within 20 m 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 Fonterra farms, which improved the performance of these areas in their ability to receive and assimilate the irrigated wastewater. Testing undertaken in May 2010 indicated that aeration is no longer required, unless there is visible sign of ponding. Some aeration was undertaken in February 2016.

On the whole, the general wastewater irrigation was found to be well managed. With the exception of some minor grass burn patches in one paddock on Farm 3 noted during the February 2018 inspection, the pasture receiving irrigation appeared to be healthy, with no ponding or run-off observed during the inspections. Buffer distances were being adhered to at the time of all inspections.

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 2018 monitoring period.

The Company has continued to invest in planting and fencing of waterways around the factory and Company farms, with a significant riparian programme of approximately $77,000 value over about 12 Km of the Kaupokonui Stream. 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. A total of $52,080.00 had been donated to the Trust, with $4,447.48 (+ GST) paid to the Council in the 2017-2018 year.

At the end of the 2017-2018 year, the Council had prepared 160 Riparian Management Plans (RMP's) fully or partially located in the Kaupokonui Stream catchment. Of these, 24 plans, covering 31 Km of streambank, meet the criteria for funding given in condition 10 of consent 0919-3 (that is, are located in the Kaupokonui Stream catchment above Fonterra's cooling water discharge). The riparian plan planting progress is illustrated in Figure 24.

Subject to confirmation by audit, the riparian plantings recommended in the plans that have received funding to the end of June 2018 (9 plans) covered a total stream bank distance of 33.8 Km, of which four (40)% were 100% completed.

This compares to 28 plans covering a total of 30.2 Km, of which four (14%) were 100% completed in the Kaupokonui Stream catchment downstream of the plant, and 160 plans covering a total of 760.7 Km, of which 20 (13%) were 100% completed in the wider Kaupokonui parent catchment.

During the 2017-2018 year two farms received rebates under this scheme totalling $3,323.44, which equated to 2,420 plants.

Taking into account the riparian planting that was already existing at the time the plans were developed, the progress towards full implementation of the additional planting required is shown in Table 11.

Table 11 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	92.9	33.8	59.1	30.2	761
Original additional recommended planting, Km	31.8	13.1	18.7	15.0	337
Planting Implemented, Km	11.1	7.2	3.9	8.5	166
Percentage implemented,%	35	55	21	57	49

It can be seen that the current data indicates that although there is a moderate implementation rate in the catchment as a whole (49%), there is a low implementation rate upstream of the plant (35%). As would be expected, there is a higher implementation rate on those farms that have received funding (55%) when compared to those that have not (21%). However, it is important to note that these figures may not include the additional planting that was facilitated and funded by the Company at the end of the 2016-2017 year.

It is also 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 that it only required 1.5 km of planting to increase the downstream percentage completion from 47% to 57% in the past year.

An example of riparian planting is given in Photo 3, 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.

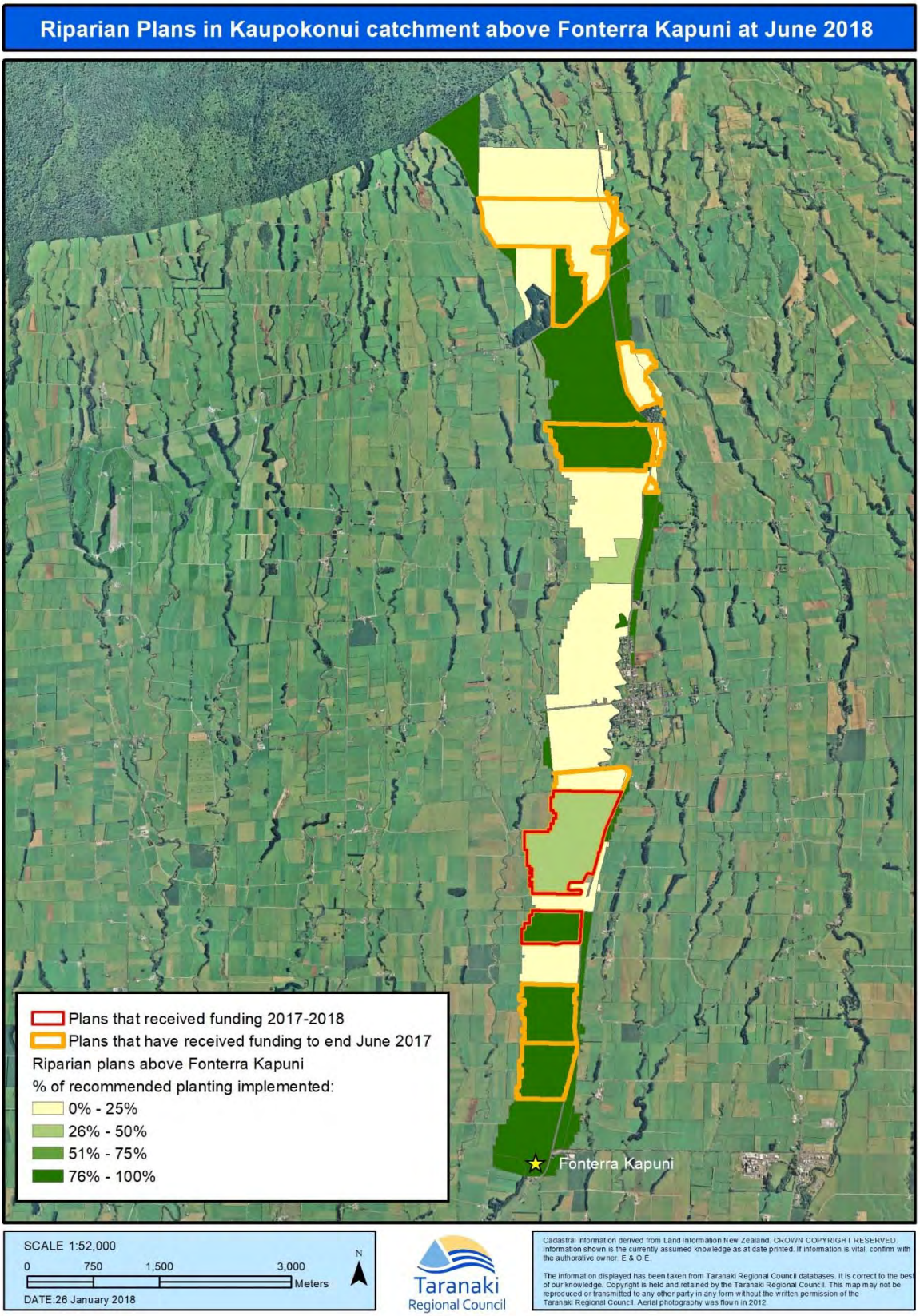


Figure 24 Riparian planting progress in the Kaupokonui Stream catchment above the lactose plant

In a separate project initiated by Fonterra 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 metres, 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, Fonterra 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.

All plantings were maintained in the 2017-2018 year.

Photo 3 Riparian plantings along Waiokura Stream, Farm 2 with fixed irrigators in operation

2.1.2.1.9 Disposal of solid wastes

Solid wastes from annual cleaning of the waste effluent tank and lime silo have been disposed of by burial on Farms 2 and 3 during the winter maintenance shut-down for a number of years. This activity is 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 is 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. Prior to the installation the Trommel, these solids were either accumulated in the wastewater

tank or were irrigated onto land within the wastewater. In October of that 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. Going forward the carbon filter wastes were to be removed from the site by a waste contractor. In January 2018, following the incident discussed Section 2.3, the inspecting officer was informed that the filtered material was now being removed from the site by a composting/fertiliser company for use in their products.

Carbon from the wastewater tank continued to be buried on farm during the cleaning operations that occur during the shutdown period.

2.1.3 Results of discharge monitoring

2.1.3.1 Physicochemical

2.1.3.1.1 Cooling waters' quality

Monthly sampling of the spray cooling water discharge (authorised by discharge permit **0919-3**) and the combined stormwater/cooling water pipe discharge (permit **0924-3**) 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 12. The combined cooling water/stormwater discharge was diverted to the cooling tower prior to 1 August 2017, and the pipework was removed on 8 February 2018. In the intervening time the electronic flow meter records showed that there was the occasional low flow discharge (15 minute average of up to around 2 L/s).

Composite samples of the stormwater/cooling water discharge were collected on all bar one occasion between the flow diversion and pipe removal. For the spray cooling water, all of the samples collected during the year under review were composite samples, however there were two occasions when a composite sample was not available at the time of inspection.

Table 12 Results of the analysis of stormwater/cooling water and spray cooling water discharge during the year under review

Waste	Spray cooling water					Stormwater/cooling water – Pipe removed 8 Feb 2018						
Site code	STW 002017					STW 002018						
Date	BOD_5		Condy @ 20˚C	pH	Turbid-ity	BOD5		Condy @ 20˚C	Oil and grease	pH	Susp-ended solids	Turbid-ity
	Total	Filtered				Total	Filtered					
	g/m³	g/m³	mS/m	pH	NTU	g/m³	g/m³	mS/m	g/m³	pH	g/m³	NTU
20 Jul 2017	0.9	0.7	11.0	7.4	1.5	Insufficient Volume						
17 Aug 2017	0.7	0.5	9.1	7.6	2.0	4	1.6	9.9	<0.5	7.4	46	31
21 Sep 2017	Pump not working on composite sampler. Company waiting on new part					2.1	0.7	44.6	<0.5	6.9	15	37
19 Oct 2017	6.8	3.4	10.5	7.6	42	1.1	0.8	44.9	<0.5	6.6	5	17
16 Nov 2017	<0.5	<0.5	10.2	7.8	0.52	1.2	<0.5	42.1	<0.5	6.9	23	93
12 Dec 2017	<0.5	<0.5	10.8	7.8	0.54	Insufficient Volume						
18 Jan 2018	1.5	1.0	7.4	7.5	6.9	490	370	38.4	-	**4.7**	44	22
15 Feb 2018	0.7	<0.5	8.3	7.7	1.8	Site disestablished – pipe removed						
15 Mar 2018	<0.5	<0.5	9.7	7.4	0.9							

Waste	Spray cooling water					Stormwater/cooling water – Pipe removed 8 Feb 2018						
Site code	STW 002017					STW 002018						
Date	BOD_5		Condy @ 20˚C	pH	Turbid-ity	BOD5		Condy @ 20˚C	Oil and grease	pH	Susp-ended solids	Turbid-ity
	Total	Filtered				Total	Filtered					
	g/m³	g/m³	mS/m	pH	NTU	g/m³	g/m³	mS/m	g/m³	pH	g/m³	NTU
26 Apr 2018[a]	< 2	< 2	10.7	7.5	1.69							
17 May 2018	Insufficient Volume – discharge occurring in preceding 24 hours											
22 June 17°	-	-	-	-	-							
Consent limit	-	-	-	-	-	-	-	-	**<15**	**6.0 – 8.5**	**<100**	-
Range	0.7-6.8	<0.5-3.4	7.4–11.0	7.4–7.8	0.52-42	1.1-490	0.7-370	9.9–44.9	<0.5-<0.5	4.7-7.4	5-46	17-93
Median	0.9	<0.5	10.2	7.6	1.7	42.1	1.2	42.1	<0.5	6.9	23	31

[a] Change to Hill Laboratories for analytical determinations

° No spray cooling water discharge, as plant not operating

Both discharges have been sampled (mainly as 24 hour composites) and analysed by the Council during previous monitoring periods. A summary of these results is presented in Table 13.

Table 13 Summary of cooling water discharge quality from the Council surveys during the period March 1992 to June 2017

Waste	Spray cooling water				'Stormwater/cooling' water		
Parameter	Unit	No. of samples	Range	Median	No. of samples	Range	Median
BOD_5	g/m³	215	<0.5 - 460	2.3	230	<0.5 - 1100	2.5
BOD_5 (filtered)	g/m³	198	<0.5 - 91	1.1	211	<0.5 - 1100	1.4
Conductivity at 20˚C	mS/m	216	3.1 - 46.8	9.8	237	5.4 - 132	10.8
Oil and grease	g/m	2	<0.5	<0.5	94	<0.5 - 4.3	<0.5
pH	pH	97	5.8 - 8.2	7.4	141	4.6 - 10.6	7.2
Turbidity	NTU	104	0.51 - 120	3.9	120	0.26 - 110	4.0

For the spray cooling water, there were no notable seasonal variations in the parameters monitored. The median total BOD remained low following the three successive years when it decreased significantly (2016-2017 annual median of 0.5 g/m³ down from 1.2 g/m³ in 2015-2016, 4.7 g/m³ in 2014-2015 and 7.2 g/m³ in 2013-2014).

For the stormwater/cooling water, the annual median total BOD (organics) increased from 2.9 g/m³ for the 2016-2017 year to 42.1 g/m³ during the year under review. This significant change in the nature of the discharge and the electronic flow data support the likelihood that these discharges were low flow seeps through the disused discharge line. With the exception of the sample collected on 18 January 2017, the filtered BOD values were similar to those for the previous five seasons. An elevated total BOD of 490 g/m³ was found in the composite sample taken on 18 January. On this occasion the conductivity, pH, and suspended solids were atypical for the stormwater/cooling water discharge. The pipe was subsequently removed. No significant effect of the discharge was found in the receiving water on either occasion, either as BOD increase, which was increased only slightly (Figure 27), or as visible biological growth.

Historically, contaminated 'stormwater/cooling water' was dealt with by diversion to the effluent irrigation system (by means of the Company's internal conductivity/turbidity-based alarm system) or by the location and elimination of a major contamination source.

2.1.3.1.2 Stormwater quality

Discharges from stormwater pipe outlets to the stream were 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 6. The northern stormwater pond, to which the stormwater from areas surrounding the lactose plant and IGL plant were diverted, was commissioned early in the 2017-2018 year. The discharge from the southern area outside the lactose plant itself was previously combined with cooling water and discharges from this point during the year under review have been addressed in section 2.1.3.1.1 above. The diversion of the stormwater discharges was undertaken progressively during the year under review with the IGL plant and factory extension stormwater pipes found to have been combined and the discharge location moved at the inspection on 19 October 2017 and the first sample collected from what would become the northern stormwater pond outfall (STW002099) on this occasion. The northern stormwater pond was found to be in operation at the inspection on 12 December 2017. According to the Company's records, the first recorded discharge from the new pond system was on 8 March 2018.

Discharges were found to be occurring on less than half of the inspections, and some of these were very small volumes.

2.1.3.1.2.1 Northern outfall

A grab sample was collected from the discharge (STW001062, see Table 12) on three occasions during year under review and analysed by the Council's laboratory. These results are presented in Table 14 below.

Table 14 Results of the analysis of monthly grab samples of the stormwater from the northern factory extensions outfall discharge during the year under review

Date	BOD_5	Chlorine		Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
		Free	Total					
	g/m^3	g/m^3	g/m^3	mS/m	g/m^3	pH	g/m^3	NTU
20 Jul 2017	2.4	<0.1	<0.1	22.3	<0.5	6.9	<2	0.6
17 Aug 2017	1.8	<0.1	<0.1	17.6	<0.5	7.0	<2	2.2
21 Sep 2017	2.9	<0.1	<0.1	2.01	<0.5	6.8	11	8.2
Consent limit	-	-	-	-	**15**	**6.0 – 8.5**	**100**	-
1995-2017								
No of samples	122	25	25	126	85	115	97	89
Minimum	<0.5	<0.1	0.1	0.6	<0.5	3.8	2	0.17
Maximum	1400	1.6	1.6	38.4	2.2	8.7	32	29
Median	5.6	<0.0	<0.1	10.7	0.2	7.0	3	2.6

BOD_5 was slightly elevated on each of the occasions monitored, indicating some minor organic contamination, although all results were below the historical median for this parameter. The slight elevations may have been a result of lactose powder deposition within the stormwater catchment. A slight organic odour was noted on one occasion. No chlorine was detectable in the samples collected, which is as expected following the introduction of de-chlorination post July 2016.

The limits on pH, oil and grease, and suspended solids prescribed by conditions on consent **4604-2** were complied with.

2.1.3.1.2.2 IGL plant outfall

The IGL plant stormwater outfall (STW001109, Table 13) was discharging during two inspections the year under review. The results of the grab samples collected are presented in Table 15 below.

Table 15 Results of the analysis of grab sample of the stormwater from the IGL outfall discharge during the year under review

Date	BOD_5	Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
	g/m^3	mS/m	g/m^3		g/m^3	NTU
17 Aug 2017	>22	6.3	<0.5	7.9	57	31
21 Sep 2017	1.4	0.85	<0.5	7.0	11	11
Consent limit	-	-	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	-
2005-2017						
No of samples	26	28.0	19	28	26	27
Minimum	0.5	0.6	<0.5	6.5	<2	1.1
Maximum	41	22.6	0.8	8.0	62	230
Median	3.4	7.2	0.2	7.0	6	5.0

The sample collected on 17 August 2017 exerted an elevated biochemical oxygen demand. There was no sign of undesirable biological growths noted in the receiving waters below the discharge point at the time of sampling and a review of the survey data showed that there was no change in the BOD of the receiving water (Figure 27).

The limits prescribed by conditions of consent **6423-1** were complied with.

2.1.3.1.2.3 Northern stormwater pond outfall

Samples were collected of the discharge from the new northern stormwater pond outfall (site STW002099, Table 16) on three occasions during the period under review, and one sample was collected from the pond. It is noted that the pond had not yet been constructed at the time of the October survey, and that the combined diverted flow from the IGL plant stormwater and factory extension stormwater was discharging at a very low flow rate (0.05 L/s). The January and March samples were collected after the stormwater pond had been commissioned.

Table 16 Results of the analysis of grab samples of the northern stormwater pond during year under review

Date	Flow rate (estimated)	BOD_5	Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
	L/s	g/m^3	mS/m	g/m^3		g/m^3	NTU
19 Oct 2017	0.05	1.7	26.7	<0.5	8.2	2	0.91
18 Jan 2018	2	250	4.8	0.5	**6.0**	9	10

Date	Flow rate (estimated)	BOD_5	Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
	L/s	g/m^3	mS/m	g/m^3		g/m^3	NTU
15 Mar 2018	0.003	290	50.6	0.6	**6.4**	27	8.3
17 May 2018^[a]	0	5	6.5	<5	7.0	<14	4.8
Consent limit	**-**	**-**	**-**	**15 (hydrocarbons)**	**6.5 – 8.5**	**100**	

^ Grab sample from the pond

[a] Change to contract laboratory for sample analysis

The biochemical oxygen demands observed in the samples collected on 18 January and 15 March 2018 were high, and the pH was also marginally outside the permitted range. However, there was no effect observed in the Kaupokonui Stream on either of these occasions. In January the stream was in fresh at the time of the survey, and in March the discharge flow rate was too low to have an observable impact on the pH or BOD of the stream (Figure 26 and Figure 27).

The limits prescribed by consent conditions for hydrocarbons and suspended solids were complied with at the time of the sampling surveys.

2.1.3.1.2.4 Southern stormwater pond outfall

Samples were also collected from the outlet of the stormwater pond (Site STW002078, Table 17 and Photo 4) on five occasions during the year under review, with the stormwater pond outlet valve reported to have been closed on two of these sampling occasions, suggesting groundwater seepage. Again, the high BOD, low pH, discharge in January had no observable effect on the Kaupokonui Stream, which was in fresh at the time of the sampling survey. This consent exceedance was, however, recorded as an unauthorised discharge and an infringement notice was issued.

Table 17 Results of the analysis of grab samples of the southern stormwater pond discharge during the year under review

Date	Flow rate (estimated)	BOD_5	Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
	L/s	g/m^3	mS/m	g/m^3		g/m^3	NTU
20 Jul 2017	-	<0.5	34.3	<0.5	7.5	<2	1
17 Aug 2017	-	17	36.9	<0.5	7.4	10	6.3
18 Jan 2018	<0.1	920	39	<0.5	**4.6**	48	26
17 May 2018^[a]	0.5	5	26.4	< 6	6.9	26	13.1
21 Jun 2018^[a]	1	< 2	41.3	< 4	7.7	< 3	0.25
Consent limit	**-**	**-**	**-**	**15 (hydrocarbons)**	**6.5 – 8.5**	**100**	
2008-2017							
No of samples	-	29	31	26	30	27	30
Minimum	-	<0.5	4.6	<0.5	6.6	<2	0.05
Maximum	-	28	48.8	<0.5	7.9	150	31

Date	Flow rate (estimated)	BOD_5	Conductivity at 20˚C	Oil and grease	pH	Suspended solids	Turbidity
	L/s	g/m^3	mS/m	g/m^3		g/m^3	NTU
Median	-	1.1	39.1	0.2	7.4	2	0.98

^ Stormwater pond outlet valve closed

[a] Change to contract laboratory for sample analysis

Photo 4 Outfall from stormwater pond to Kaupokonui Stream

Conductivity values at this site have been found to vary widely, 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 re-grouted in July 2009, but some infiltration continued). Limits prescribed by conditions on consent **0924-3** were complied with.

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 were located in the Kaupokonui Stream (Figure 25).

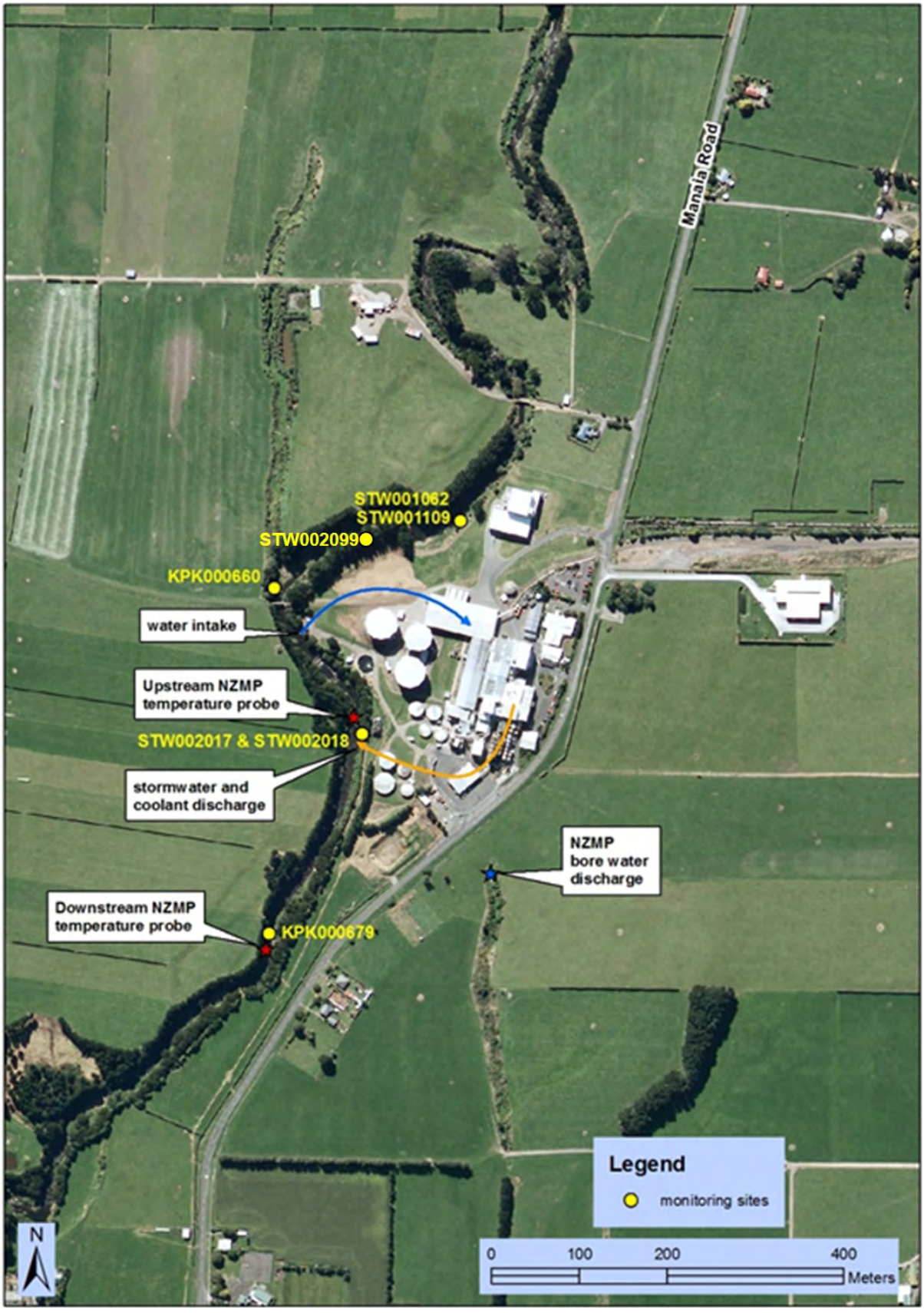


Figure 25 Section of Kaupokonui Stream for physicochemical monitoring in relation to Fonterra Ltd's waste discharges to water

Table 18 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	Immediately upstream of rail bridge	1697613	5629791
KPK000679	Kaupokonui Stream	150 m downstream of spray cool discharge zone	1697607	5629399

Sampling was performed under varying flow conditions ranging from 0.86 m^3/s to about 17.2 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 0.74 m^3/s. A record of flows (hydrograph) over the reporting period is presented in Figure 49 . Samples were taken in the mornings. The results of this monitoring are contained in Appendix II and summarised in Table 19. Past Council sampling results from these sites are presented in summary form in Table 20. It is noted that the Council moved to using a contract laboratory for analytical work in April 2018.

Table 19 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
Total BOD_5	g/m^3	<0.5 - 2.1	0.5	<0.5 - 2.1	0.5	<0.5 - 2.1	0.6
Filtered BOD_5	g/m^3	<0.5 - 1.2	<0.5	<0.5 - 1.4	<0.5	<0.5 - 1	<0.5
Conductivity @ 20˚C	mS/m	0.37 - 9.8	8.5	3.8 - 10.8	9	3.6 - 11.1	9.35
DRP	g/m^3 P	<0.003 - 0.027	0.017	<0.003 - 0.027	0.019	<0.003 - 0.026	0.018
Ammonia-N	g/m^3 N	0.012 - 0.097	0.031	0.01 - 0.083	0.022	0.01 - 0.074	0.023
Nitrate+Nitrite	g/m^3 N	0.06 - 0.98	0.75	0.07 - 1.1	0.875	0.06 - 1.18	0.895
pH	pH	7.2 - 7.9	7.6	7.2 - 7.9	7.6	6.9 - 8.1	7.6
Temperature	˚C	7.6 - 17.7	10.9	7.8 - 18.2	11.15	7.8 - 19.2	11.9
Turbidity	NTU	0.58 - 11	1.1	0.58 - 10	0.98	0.42 - 10	1.185

Table 20 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2017

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Total BOD_5	g/m^3	222	0.5 - >8.3	0.6	243	<0.5 - 7.5	0.6	225	<0.5 - >8	0.7
Filtered BOD_5	g/m^3	222	<0.5 - 1.8	0.2	224	<0.5 - 2.4	0.2	224	<0.5 - >8	0.5
Conductivity @ 20˚C	mS/m	225	3.3 - 11.1	9.1	235	3.3 - 11.8	9.5	227	3.2 - 11.9	9.7
DRP	g/m^3 P	36	0.006 - 0.097	0.014	36	0.007 - 0.101	0.017	36	0.007 - 0.103	0.02
Ammonia-N	g/m^3 N	224	<0.003 - 0.869	0.021	224	0.003 - 0.147	0.016	224	<0.003 - 0.248	0.017

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Nitrate+Nitrite	g/m^3 N	93	0.12 - 1.26	0.39	93	0.12 - 1.36	0.45	93	0.11 - 1.40	0.50
pH	pH	222	6.8 - 8.5	7.7	231	6.6 - 9.0	7.7	223	7.0 - 8.6	7.8
Temperature	˚C	223	4.9 - 19.1	12.1	240	5.1 - 19.5	12.5	226	5.2 - 21.7	13.6
Turbidity	NTU	122	0.39 - 120	1.05	125	0.40 - 130	1.00	124	0.43 - 160	1.10

The receiving water quality sampling results (and Appendix II) indicated that there were minimal impacts from the stormwater and cooling water discharges measured in the Kaupokonui Stream, at time of sampling, with no sewage fungus noted over the monitoring period. The biggest pH change was from 7.7 at site KPK000660 to 6.9 at KPK000679 on 17 May 2018. This is a change of greater than +/- 0.5 pH units that is considered to present a barrier to the passage of fish. At the time of this sampling run, the stream flow was receding from a fresh that had a peak flow of 50 m^3/s the previous day. There was only one discharge occurring from the Company's site at the time of the survey, which was from the southern stormwater pond. Although this was at a pH of 6.9, the discharge rate from the pond was low, at approximately 0.5 L/s, as the outlet valve was closed. The change of pH observed in the stream was therefore unlikely to be as a result of activities at the Company's site.

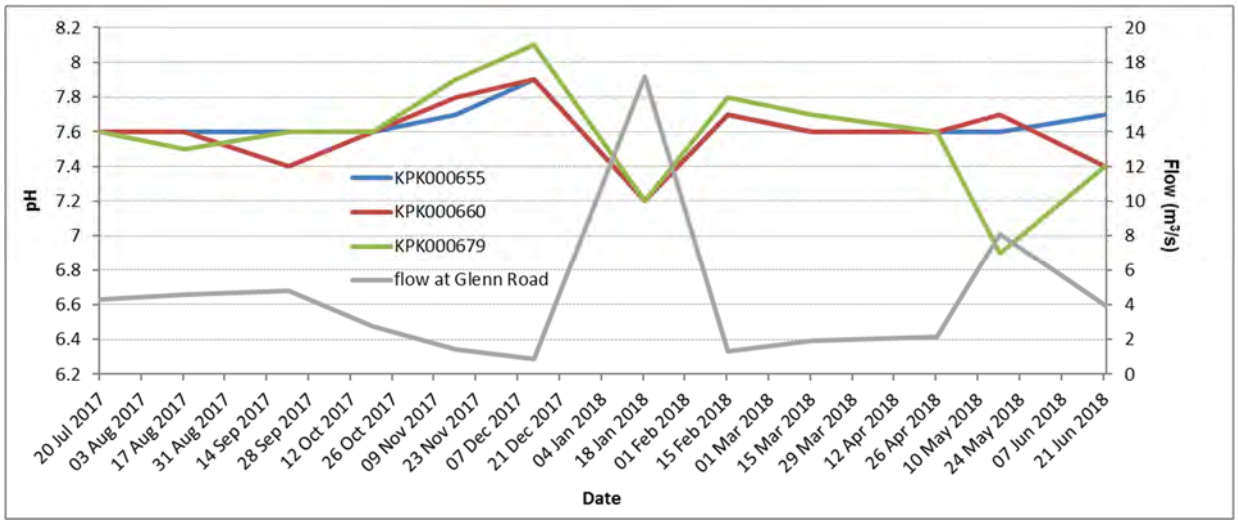


Figure 26 Downstream pH changes in the Kaupokonui Stream from the monthly stream surveys

The consent limit on maximum concentration of filtered BOD of 2 g/m^3, in the river at the mixing zone periphery, was complied with all but one of the twelve monitoring occasions. On 18 January, the BOD of the stream at the control site was already elevated at 2.1 g/m^3 (filtered; 1.2 g/m^3) and the stream was in fresh (17.2 m^3/s at Glenn Road). The BOD of the sample collected at the stream site below the lactose plants discharges was unchanged and the filtered BOD had reduced to 1.0 g/m^3 confirming that the lactose plant was not having any contributing effects on the BOD of the stream at the time of the survey.

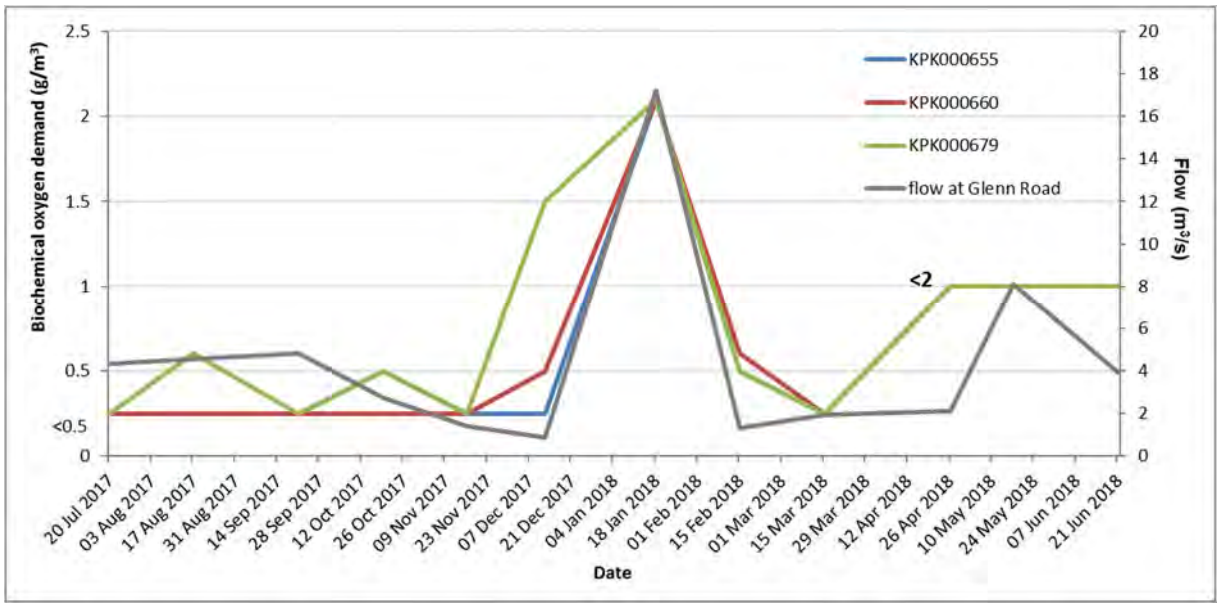


Figure 27 Downstream biochemical oxygen demand changes in the Kaupokonui Stream from the monthly stream surveys

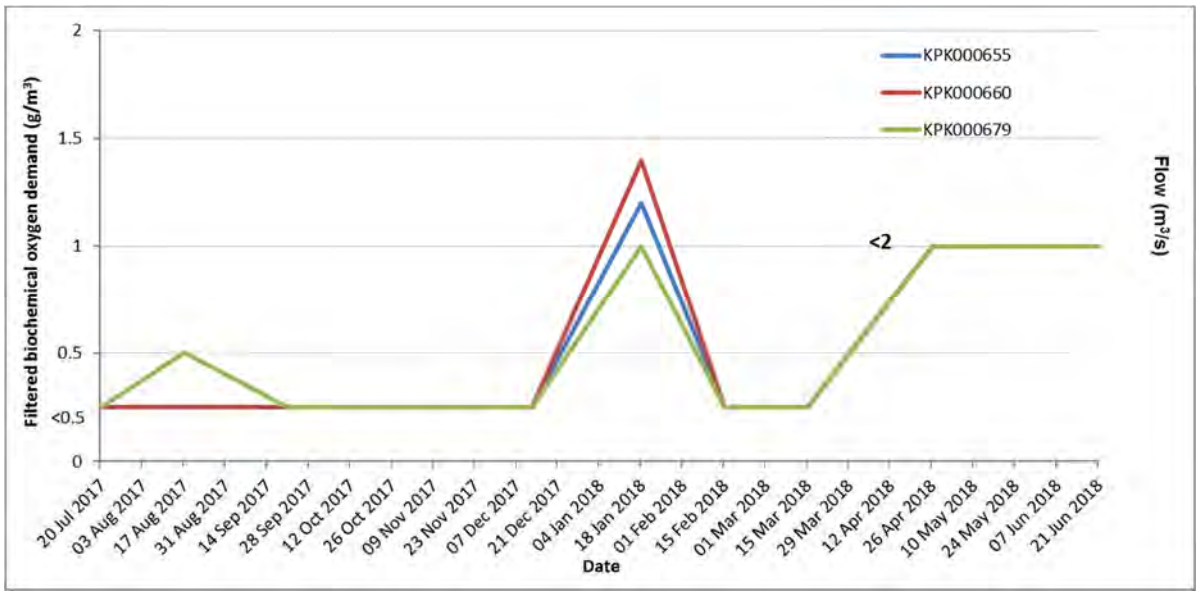


Figure 28 Downstream filtered biochemical oxygen demand changes in the Kaupokonui Stream from the monthly stream surveys

Ammoniacal nitrogen generally decreased in a downstream direction, as one would expect where there are no additional ammoniacal nitrogen inputs. The only occasion on which the downstream site contained the most ammoniacal nitrogen was on 15 March 2018, when there was also a slight increase in the nitrate-nitrite nitrogen between the upstream site and the site below the northern stormwater pond.

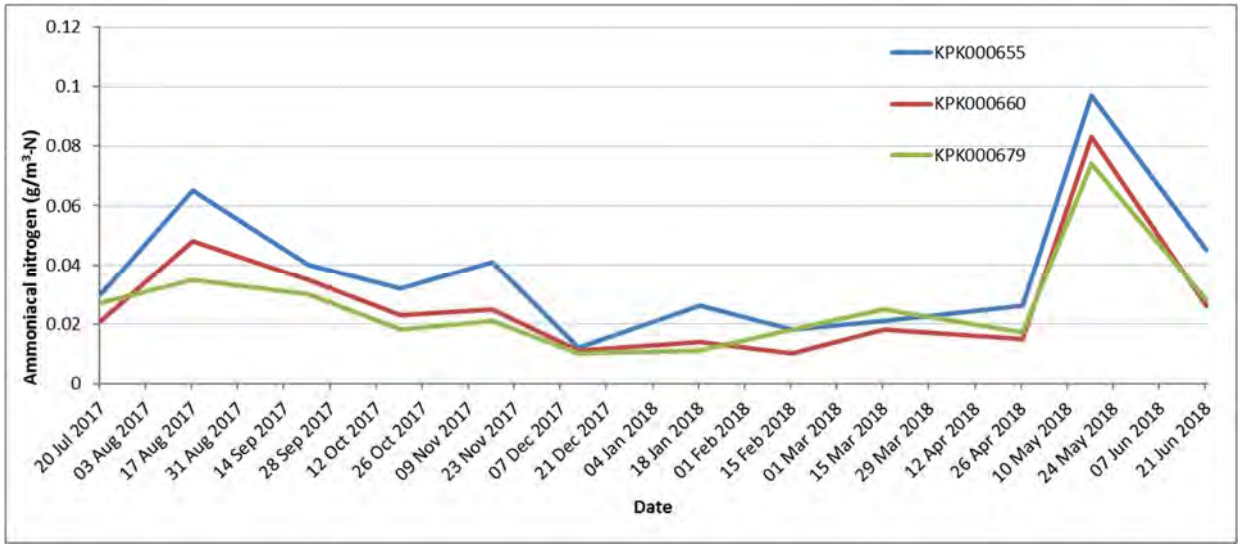


Figure 29 Downstream ammoniacal nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys

Conductivity and nitrate-nitrite nitrogen both increase slightly in a downstream direction, whilst ammoniacal nitrogen generally decreases. Although the nitrate-nitrite nitrogen concentrations are well below the drinking water standards (11.3 g/m^3) and the National Objective Frameworks bottom lines (9.8 g/m^3 annual 95 percentile and 6.9 g/m^3 annual median), it may be prudent to add total nitrogen to the analysis suite at some point in the future to help quantify relative influences of the instream oxidation of the reduced ammoniacal form of nitrogen, compared to increased nitrates due to additional inorganic nitrogen inputs.

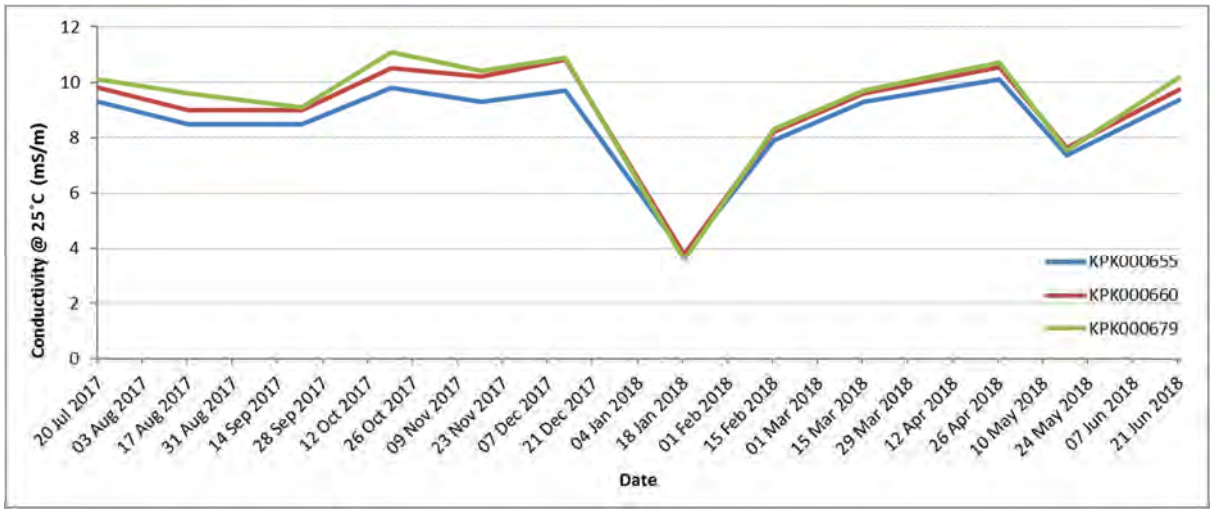


Figure 30 Downstream conductivity changes in the Kaupokonui Stream from the monthly stream surveys

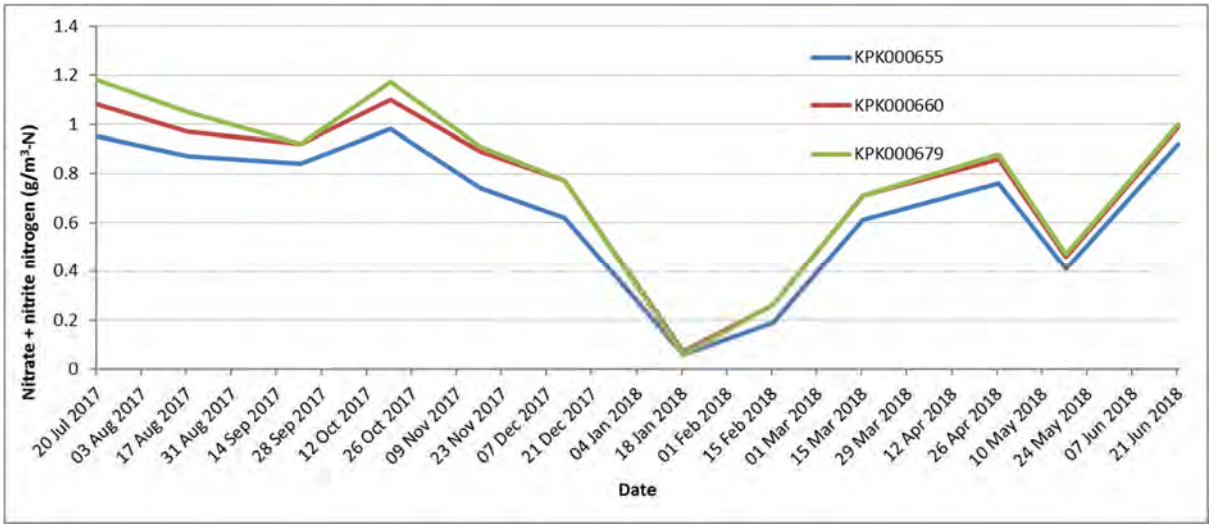


Figure 31 Downstream nitrate-nitrite nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys

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 32).

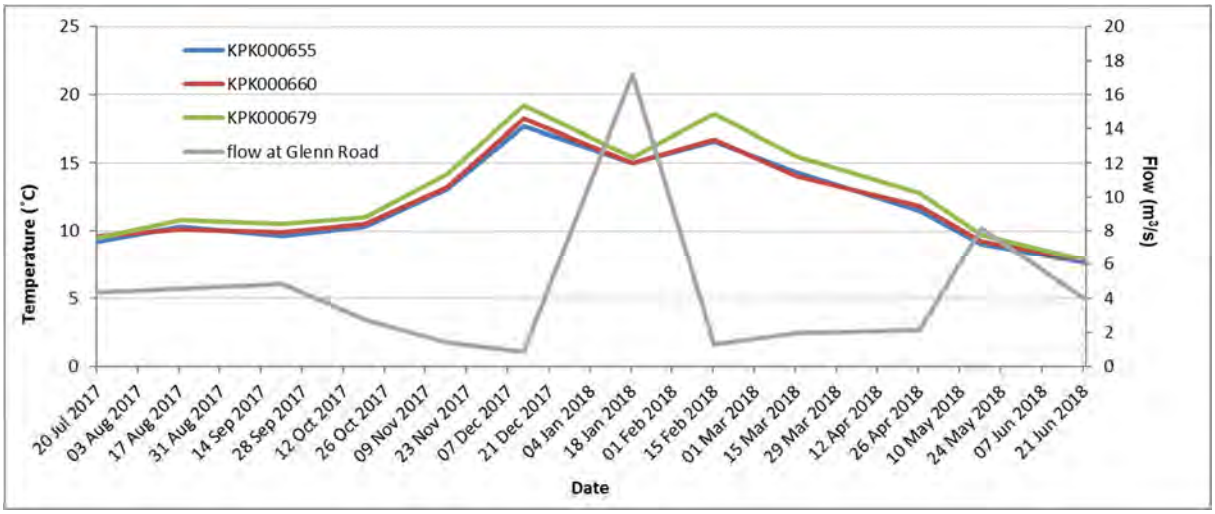
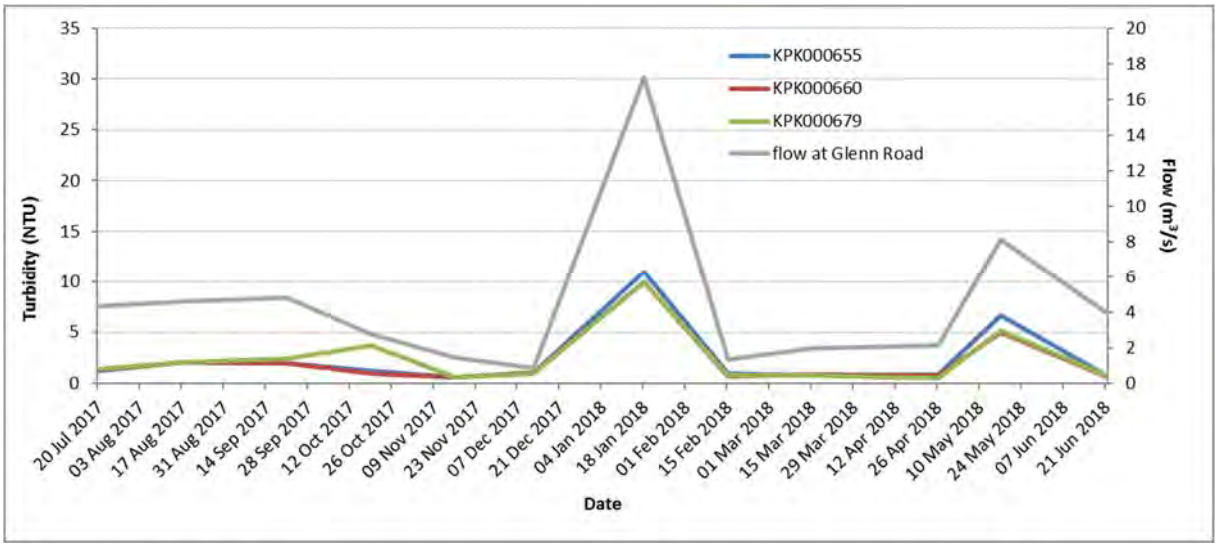


Figure 32 Downstream temperature changes in the Kaupokonui Stream from the monthly stream surveys

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 humidity.

There were no significant changes in clarity, as indicated by turbidity measurements and field comments. There was a minor increase in turbidity at the time of the October survey when the spray cooling water discharge composite (STW002017) had a turbidity of 47 NTU. Otherwise, natural variation in clarity was observed, in relation to stream flow and rainfall.



The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 22 year period prior to the 2017-2018 monitoring period (Table 20) and during this period (Table 19), shows that generally, apart from a single lapse in May 2007, there has been very 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. Ten bores were sampled on the three wastewater spray irrigation farm properties, as described in Table 21 and depicted in Figure 33. 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 21 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
	South-west	Impact (new)	GND2052	7.0	1697216	5626790
	South-east	Impact	GND0700	4.5	1697445	5626790
	South	Impact (deep)	GND2007	37/113	1697780	5626924

Relocation and replacement of the original 'impact' bores on the Southern and No. 2 farms was performed in April 1998 (see TRC 98-73), in consultation with the consent holder and following investigations into groundwater contours and flow directions at each of these farms' monitoring sites.

A summary of groundwater quality data previously collected by the Council from the farm bores is presented in Table 22 for comparison with data collected during the recent monitoring period. The shaded bores are those no longer monitored.

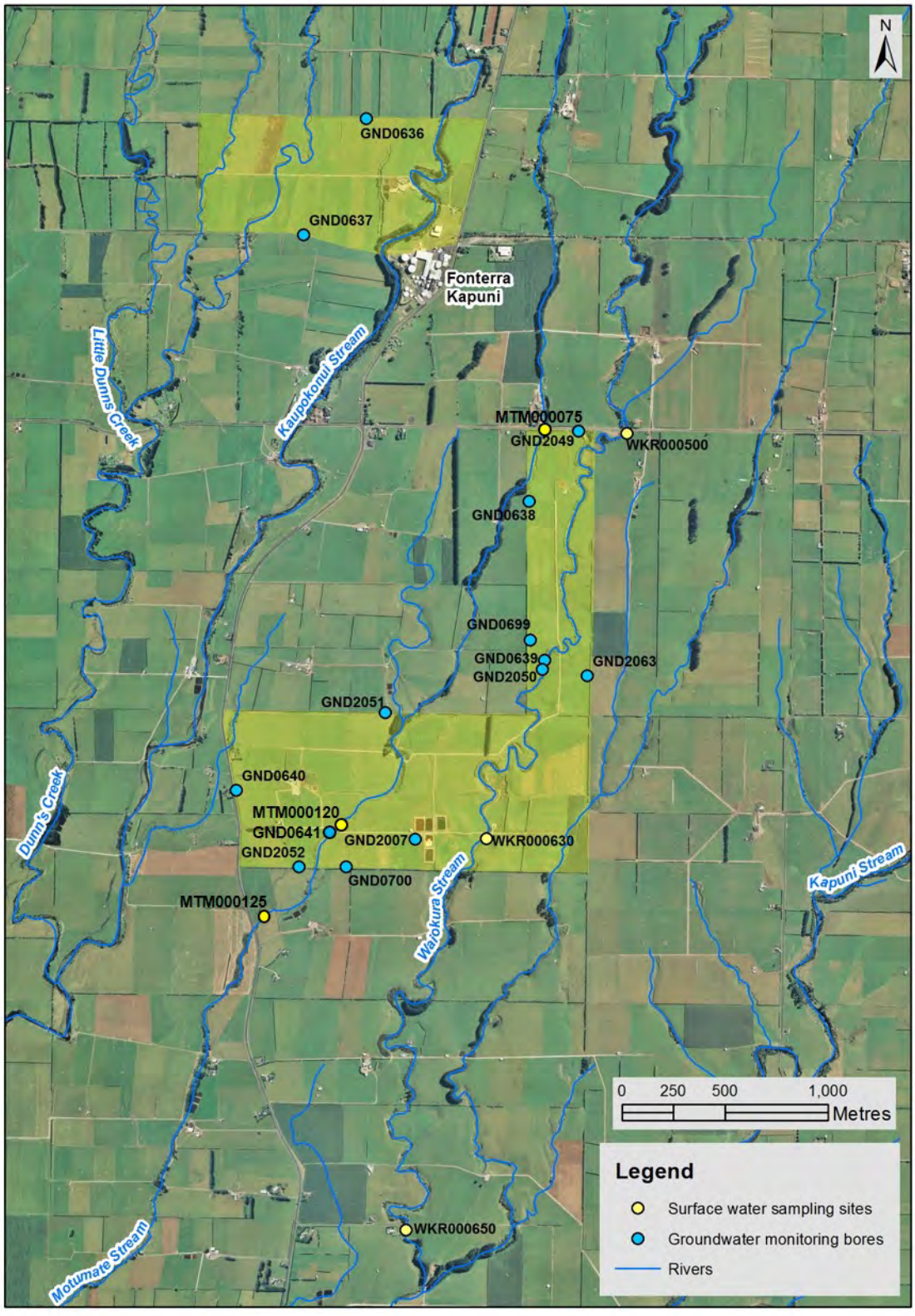


Figure 33 Groundwater monitoring bores, Motumate and Waiokura Stream sampling site locations on the three Company farms

Table 22 Summary of previous Council groundwater quality sampling performed during the period October 1991 to June 2017

Parameter		Level		pH		Conductivity @ 20˚C		Sodium		Nitrate-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	101	1.55-4.83 (2.92)	151	5.8-7.1 (6.5)	151	26.4 -57.7 (29.9)	84	12.0-56 (25.7)	134	3.7-31 (8.2)	72	<5-27 (6)
	Impact GND0637	87	2.77-6.15 (4.14)	125	6.1-7.8 (6.5)	123	34.0-82.4 (57.3)	81	40-179 (78)	124	1.5-33 (13.26)	68	<5-50 (7)
Farm 2	Control ('new') GND2049	60	1.73-3.80 (2.57)	62	6.2-7.2 (6.4)	62	21.2-48.3 (38.0)	30	26-36 (31)	61	2.4-23 (14.9)	29	<5-7 (<5)
	Impact ('central') GND0638	87	1.08-3.68 (2.58)	122	4.7-6.9 (6.5)	121	54.4-149 (73.7)	78	67-136 (91)	121	<0.01-49 (8.3)	72	<5-1600 (13)
	Impact ('original') GND0639	55	1.90-4.22 (2.87)	73	6.5-7.5 (6.9)	73	43.7-82.6 (64.1)	49	73-157 (118)	73	3.8-29 (12.0)	44	<5-57 (12)
	Impact ('new') GND2050	62	1.60-3.20 (2.64)	63	6.5-7.0 (6.8)	63	13.7-71.1 (54.6)	30	49-102 (69)	62	<0.01-13.0 (0.86)	29	<5-21 (6)
	Impact GND2063	59	1.55-5.22 (3.43)	60	6.1-6.9 (6.5)	60	25.2-49.1 (30.0)	29	35-59 (40)	59	0.4-18.6 (3.1	28	<5-24 (5)
Farm 3	Control ('original') GND0640	18	0.85-3.24 (1.99)	51	6.4-7.0 (6.8	51	21.0-41.8 (25.9)	45	28-49 (29)	51	<0.01-3.4 (0.13)	42	4-30 (6)
	Control ('new") GND2051	60	1.86-4.46 (3.07)	60	6.3-7.2 (6.5)	60	25.4-61.1 (32.8)	29	24-37 (29)	60	0.03-30 (7.0)	29	<5-31 (8)
	Impact GND0641	34	1.01–2.94 (1.57)	52	6.3-6.8 (6.5)	53	25.2-63.6 (55.9)	35	30-57 (42)	53	0.87-15.6 (10.7)	32	<5-34 (8)
	Impact ('original') GND0700	84	0.40-4.60 (2.14)	96	5.6-7.2 (6.7)	96	30.3-154 (61.0)	56	39-188 (81)	97	0.02-47 (7.8)	56	<5-33 (6)
	Impact ('new') GND2052	60	1.30-4.38 (2.49)	60	6.4-7.3 (6.6)	60	18.9-42.6 (32.7)	29	35-55 (43)	60	<0.01-12.9 (1.9)	29	<5-29 (<5)
	Impact ('deep') GND2007	0	-	48	6.7-8.0 (7.7)	48	32.4-35.3 (33.4)	26	35-39 (37)	48	<0.01-0.10 (<0.01)	23	<5-44 (10)

* COD = filtered prior to 2006

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 23. The full set of results is given in Appendix III.

Table 23 Results of groundwater quality sampling on Farm 1

Waste		Control (GND0636)			Impact (GND0637)		
Parameter	**Unit**	**No.**	**Range**	**Median**	**No.**	**Range**	**Median**
Chloride	g/m^3	3	29.6 - 48.8	32.9	3	38.1 - 53.9	41.5
COD	g/m^3	2	<5 - <5	<5	2	<5 - <5	<5
Conductivity @20˚C	mS/m	7	26.6 - 39.6	27.9	7	37.4 - 61.1	55.2
Water level	m	7	1.88 - 3.42	2.5	7	3.02 - 5.09	3.68
Sodium	g/m^3	2	21.8 - 24.4	23.1	2	43.6 - 64.4	54
Ammoniacal nitrogen	g/m^{3}N	3	<0.003 - 0.007	<0.003	3	<0.003 - 0.006	<0.003
Nitrate+nitrite	g/m^{3}N	7	4.9 - 11.9	6.76	7	5.32 - 11.6	8.76
pH		7	6.4 - 6.7	6.5	7	6.5 - 6.7	6.6
Temperature	˚C	7	13.6 - 15.1	14.0	7	14.1 - 15.6	14.3

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 appears that this has stabilised somewhat. The median nitrate-N concentration of 6.8 g/m^3 was similar to the 2016-2017 median of 6.6 g/m^3, but still lower than the historical median of 8.2 g/m^3. The highest concentration recorded in this bore during the year under review was 11.9 g/m^3 compared to the peak concentrations of 6.9 g/m^3 in February and May 2017 and 11.2 g/m^3 recorded in June 2015, when groundwater level was high. It is noted that the two occasions on which the nitrate concentration was above the drinking water standard were again at times of higher groundwater levels. This is consistent with the observation that heavy rainfall tends to flush more nitrate into the groundwater.

Water quality at the impact bore GND0637 showed a marked elevation in sodium, chloride and conductivity levels when compared with the control bore, consistent with the effect of leaching of wastewater from spray irrigation disposal to shallow groundwater. The sodium concentration appears to be reducing, overall, with all values recorded during the year under review being below the historical median (refer to Figure 34 and Table 22). The COD of both bores was found to be low at each of the sampling surveys. Although the nitrate concentration was lower at this site than the control bore on three of the monitoring occasions, it is noted that this bore has a lower groundwater level, and that both the median values for the 2017-2018 year and for the historical data are both higher at this bore than at the control bore

Figure 35 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. Levels of nitrate-N in the impact bore were high in winter/spring 2017 and winter 2018, with the concentrations found to be above the drinking water standard (11.3 g/m^3) in each bore at one of the surveys during these periods. One control bore and one impact bore sample was found to contain a nitrate concentration above the drinking water standard. These were the 2017-2018 maximums of 11.9 g/m^3 at the control bore on 1 June 2018 and 11.6 g/m^3 at the control bore on 4 July 2017 When looking at the changes in groundwater level and nitrate concentration between at the time of the July 2017 survey (Figure 36), it is likely that the effects of irrigation are evident in the impact bore. This may be a continuation of the effect noted in the May and June surveys in the 2016-2017 year when, additionally, the groundwater level also increased to a greater extent at the impact bore than at the control bore. Although on this occasion the groundwater levels at the two sites were consistent with each other, the nitrate nitrogen concentration was significantly higher on the down gradient farm boundary than at the control bore. Without on site 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 in the assessment of environmental effects and renewed discharge consent.

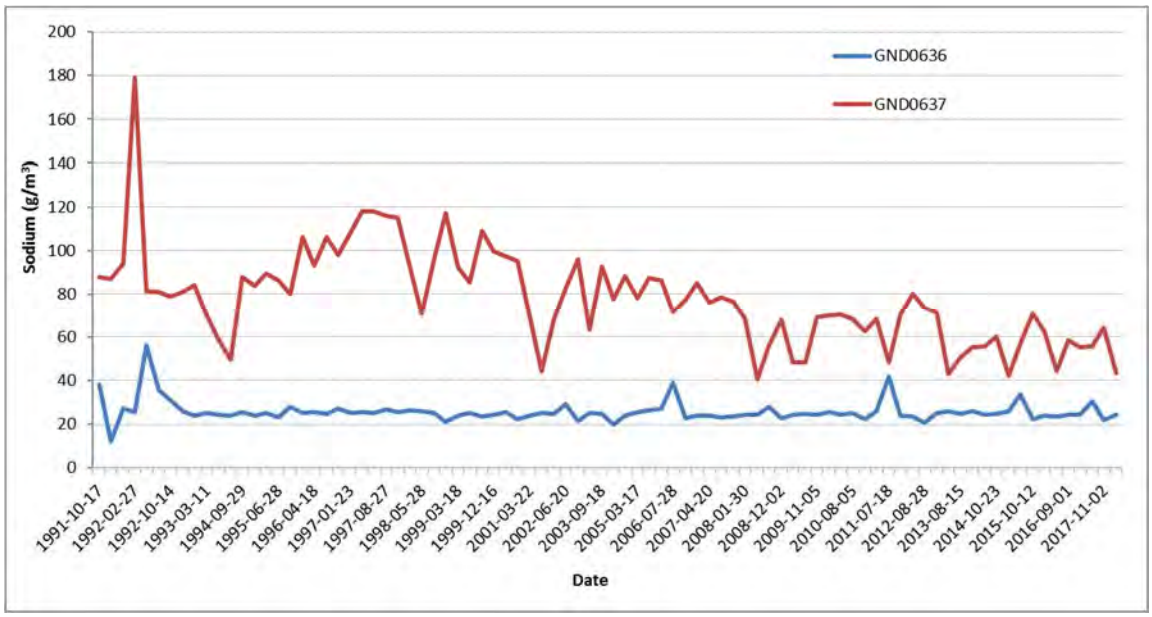


Figure 34 Long term trends in groundwater sodium concentration at Farm 1

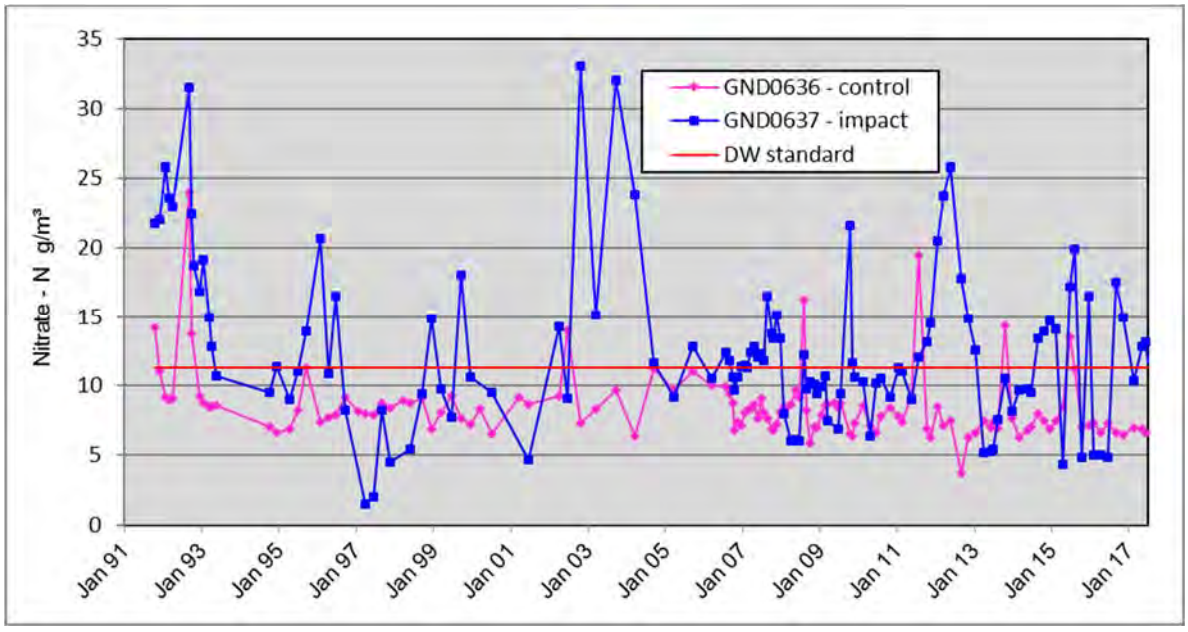


Figure 35 Long term trends in groundwater Nitrate-N concentration at Farm 1

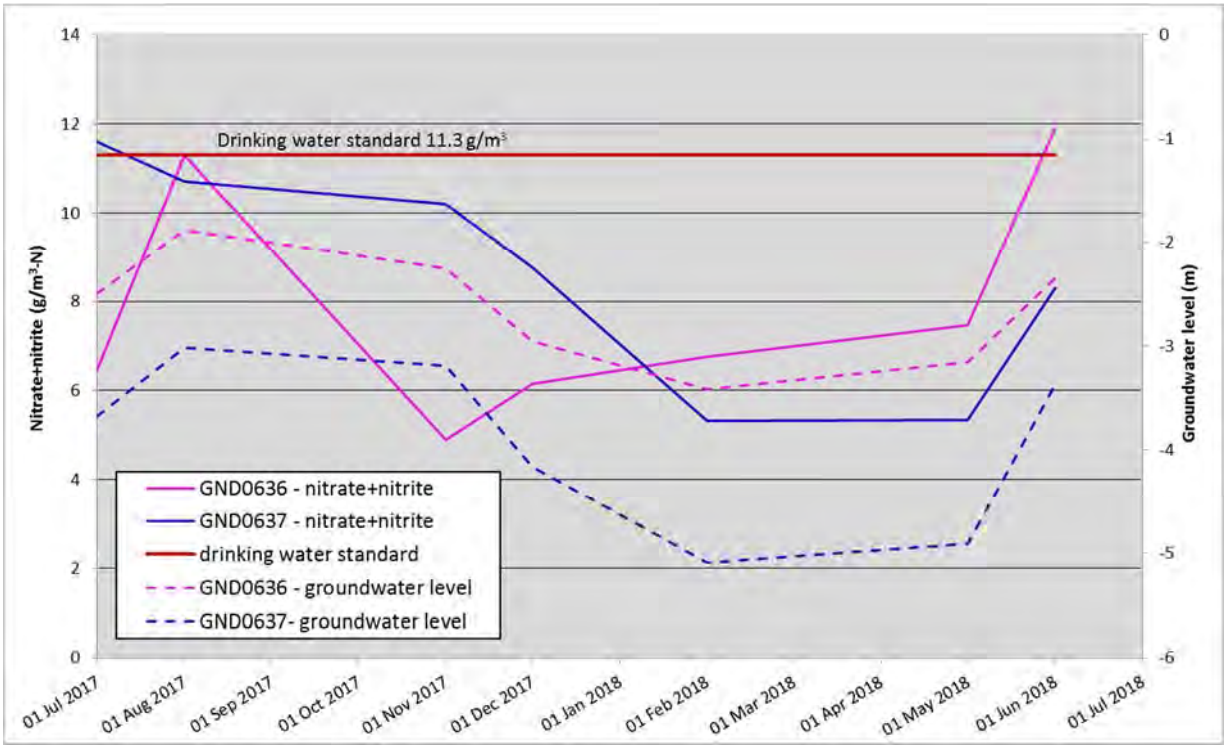


Figure 36 Farm 1 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.2 Farm 2 groundwater

The results of groundwater monitoring on this farm during the year under review are summarised in Table 24. The full set of results is given in Appendix III.

Table 24 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
Chloride	g/m^3	3	29 - 36	31.1	2	49.5 - 49.7	49.6	3	58.1 - 70.3	59.4	3	53.2 - 63.8	53.6	3	35.1 - 57.1	36
COD	g/m^3	2	<5 - 5	<5	1	-	<5	2	<5 - <5	<5	2	<5 - 9	5	2	<5 - 5	<5
Conductivity @20˚C	mS/m	7	34.5 - 42.4	39	6	68.7 - 78.1	72.0	7	59.2 - 68.6	65.4	7	55.8 - 72.4	60.3	7	30.3 - 38.1	31.5
Water level	m	7	1.96 - 3.35	2.4	6	1.64 - 2.9	2.285	7	2.19 - 3.75	2.51	7	2.03 - 2.93	2.54	7	2.6 - 4.65	3.28
Sodium	g/m^3	2	30.6 - 33.7	32.2	1	-	76.2	2	110 - 111	110	2	57.2 - 60.8	59	2	37.6 - 42.5	40.0
Ammoniacal nitrogen	g/m^{3}N	3	<0.003 - 0.056	<0.003	2	0.005 - 0.012	0.009	3	<0.003 - 0.005	0.003	3	<0.003 - 0.372	0.24	3	<0.003 - 0.02	0.015
Nitrate+nitrite	g/m^{3}N	7	14.9 - 22.4	19.7	6	5.96 - 9.25	7.71	7	8.67 - 11.7	10.1	7	0.06 - 13.3	8.25	7	4.53 - 9.3	7.78
pH		7	6.3 - 6.5	6.4	6	6.6 - 6.7	6.6	7	6.9 - 6.9	6.9	7	6.6 - 6.9	6.8	7	6.3 - 6.6	6.4
Temperature	˚C	7	13.5 - 15.2	14.9	6	14.7 - 15.3	14.9	7	13.9 - 15.4	14.2	7	13.8 - 15.4	14.7	7	13.8 - 14.9	14.5

The control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road. (Refer to Figure 33). This replaced the original 'control' bore, GND0638, which is situated on the western boundary with about 350 m of irrigated paddocks up-gradient, and was affected by ponding of effluent in Spring 2006 and possibly again in spring 2007. For this reason, wastewater is now irrigated only in summer in the paddock (new number 13B) immediately up-gradient.

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 37 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 control bore (GND0638) with the new control bore (GND2049).

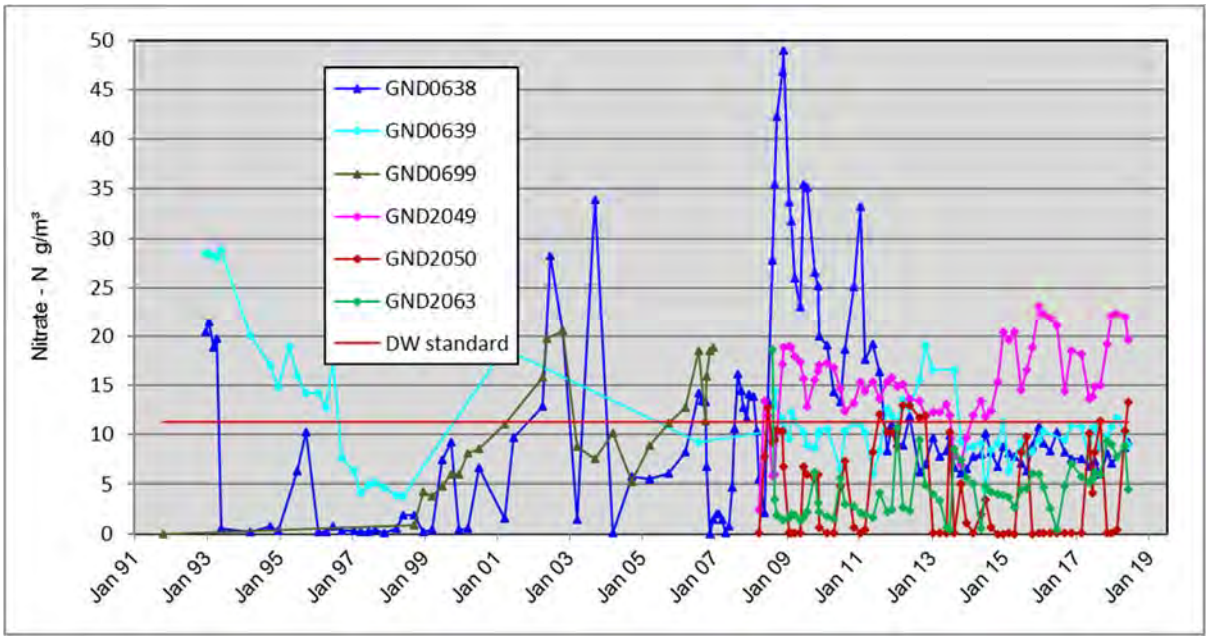


Figure 37 Long term trends in groundwater Nitrate-N concentration at Farm 2

The control bore, GND2049, continued to show the influence of an unknown source, with the nitrate-N concentration ranging from 14.9 to 22.4 g/m^3 during the monitoring period. The annual median had been increasing from 13 to 22 g/m^3 between 2013-2015 and 2015-2016. This is in comparison to the 2016-2017 annual median of 14.4 g/m^3 and the 2017-2018 annual median of 19.7 g/m^3. The historical median continued to increase slightly, with a change from 14.4 to 14.9 g/m^3 For the assessment of environmental effects to accompany the consent renewal application, the Company has been asked to investigate whether the nitrate comes from farming activities up-gradient across Manaia Road, from "mounding" of factory effluent applied down gradient, or by some other mechanism. The conductivity, pH, sodium and chloride levels of the control bore were within the normal ranges that are found in adjacent farming areas. COD and ammonia were low, indicating little leaching of organics.

At the bore inside the irrigation area, GND0638, nitrate-N concentration reduced from the peak of 49 g/m^3 recorded during 2008-2009 down to 8 g/m^3 in 2012. For the five years from June 2012 to June 2017 it had been fluctuating between 6 to 11 g/m^3, remaining just below the drinking water standard of 11.3 g/m^3. During the year under review the fluctuations were less pronounced with the range being 6 to 9.3 g/m^3, but with a slightly higher annual median of 7.7 g/m^3 (compared to 7.5 g/m^3 in 2016-2017). Conductivity, sodium and chloride values were elevated, as might be expected underneath such a wastewater irrigation area, though COD and ammonia levels were low.

At the impact bore GND0639 it was found that the nitrate concentration varied inversely with the groundwater levels, with one sample exceeding the drinking water standards at a time when the ground water levels were at their lowest. It is possible that the marked reductions in nitrate-N at this bore could be occurring as a result of denitrification, therefore consideration should be given to the addition of total nitrogen and ammoniacal nitrogen to the analysis suite if this finding continues.

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 (shown in Figure 38). Over the total record, the nitrate-N concentration is typically in the range 3 to 13 g/m^3 during winter and spring, falling to <1 g/m^3 in summer and autumn. Denitrification is a likely explanation, as ammonia concentration varies inversely with nitrate, reaching >0.5 g/m^{3}N, while a low oxygen level (that is, conducive to denitrification) has been recorded. During the year under review, the nitrate-N concentration was low in the spring and summer and was higher in autumn winter (8 to 13.3 g/m^3) when the groundwater levels were at the highest. It is noted that the conductivity, sodium and chloride values were elevated at GND2050 when compared to the control bore.

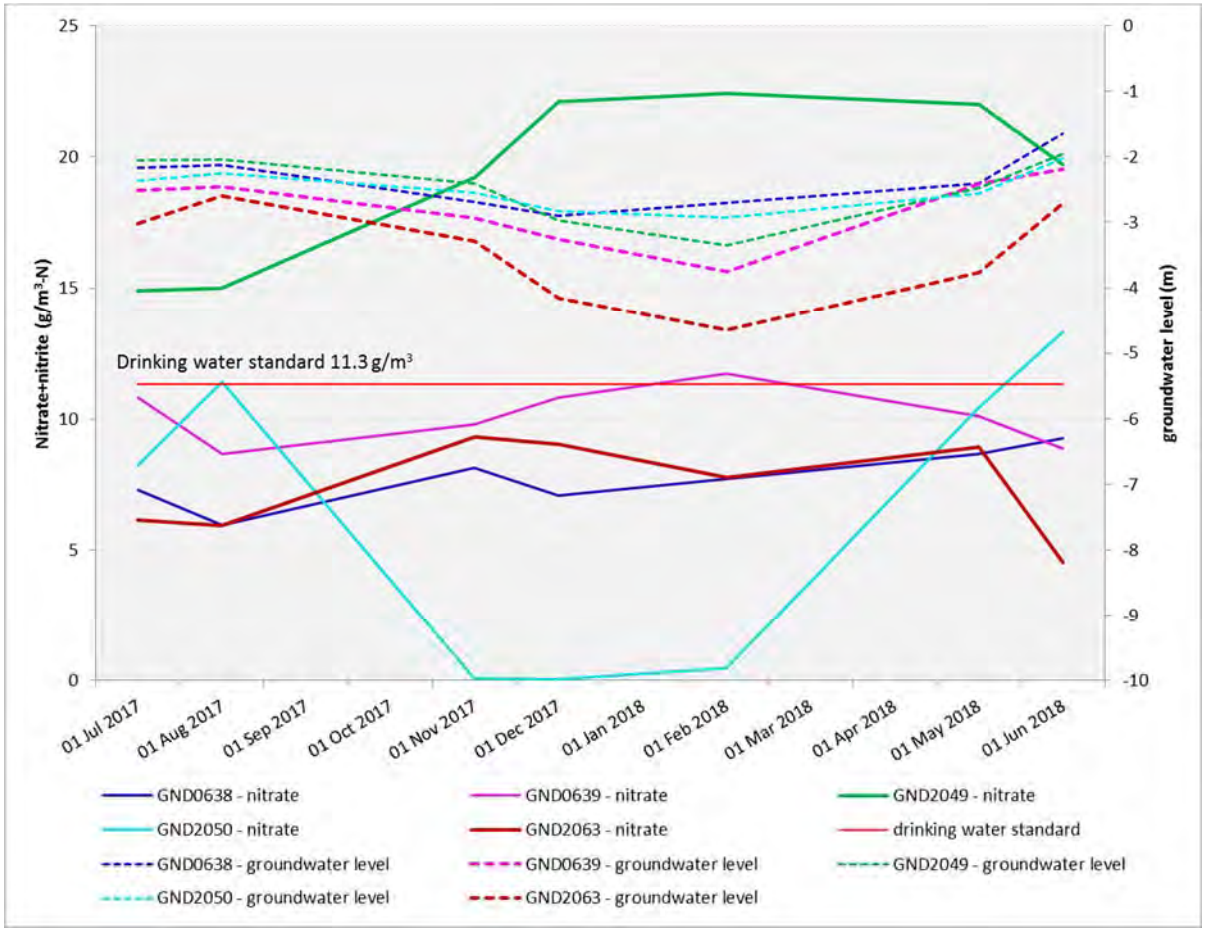


Figure 38 Farm 2 groundwater levels and nitrate + nitrite nitrogen concentrations and groundwater levels during the year under review

The relative concentrations of selected parameters, conductivity, pH, sodium and chloride, are shown in Figure 39 to Figure 42.

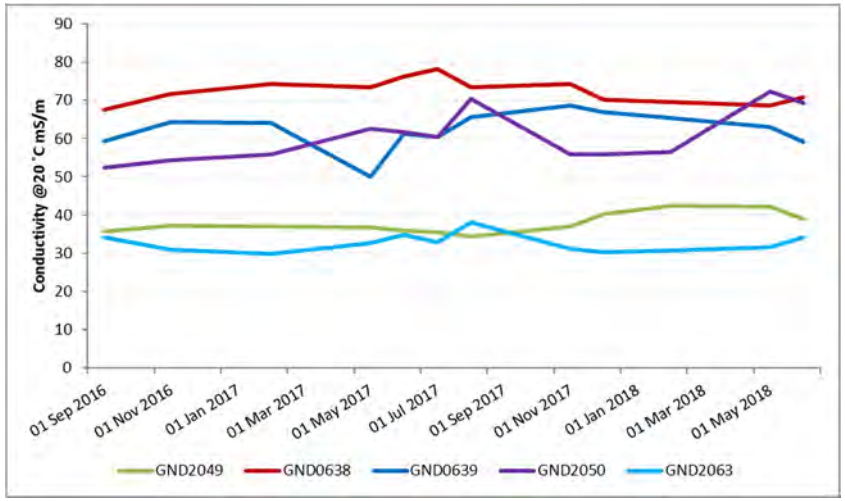


Figure 39 Groundwater conductivity at Farm 2 bores, June 2016 to date

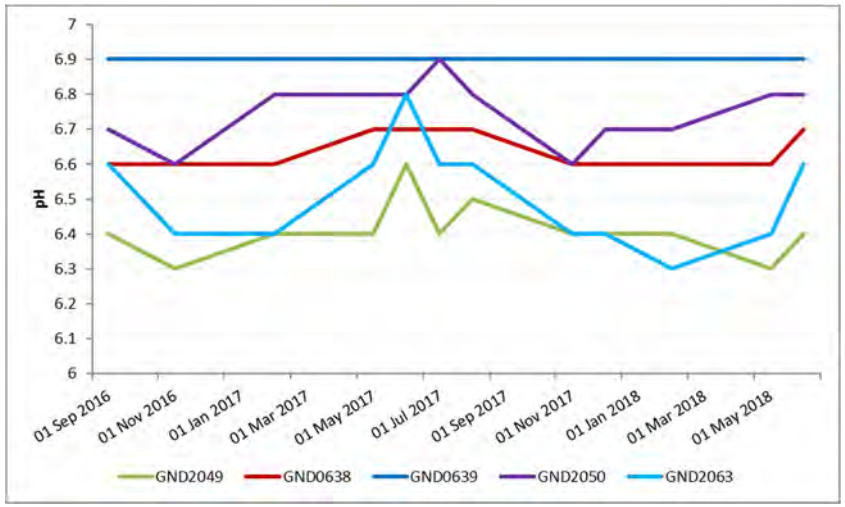


Figure 40 Groundwater pH at Farm 2 bores, June 2016 to date

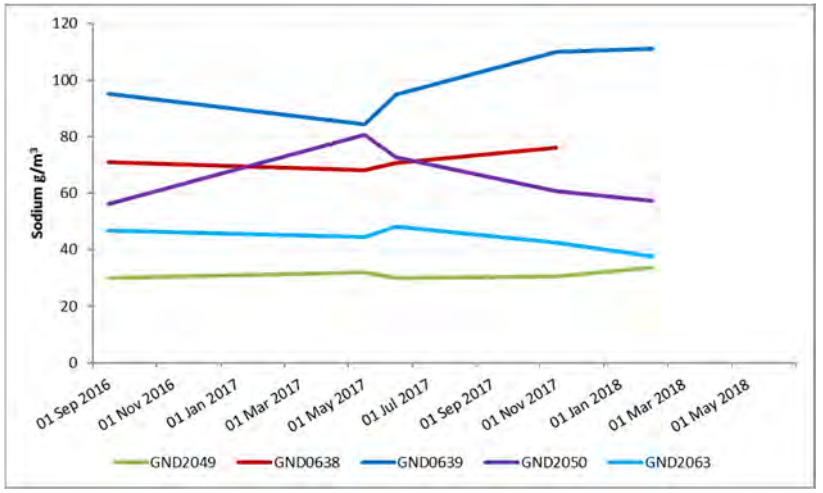


Figure 41 Groundwater sodium concentration at Farm 2, June 2016 to date

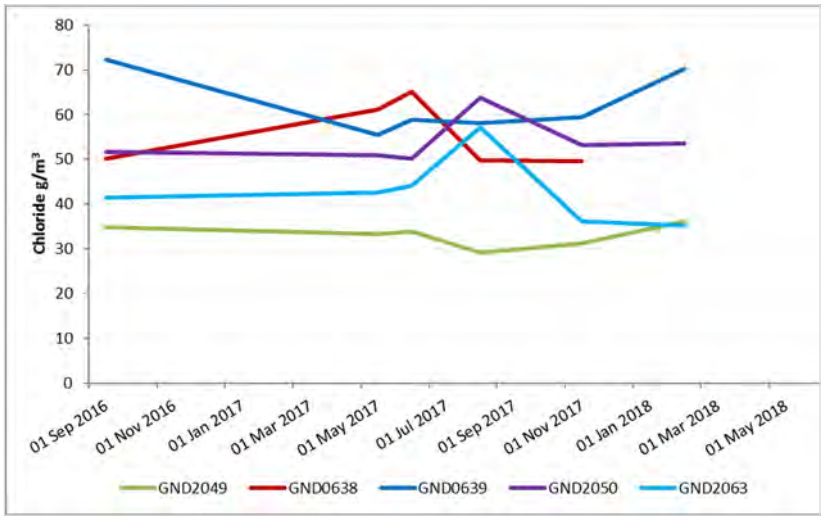


Figure 42 Groundwater chloride concentration at Farm 2 bores, June 2016 to date

2.1.5.3 Farm 3 groundwater

The results of groundwater monitoring on this farm during the period under review are summarised in Table 25. The full set of results is given in Appendix III.

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 during the 2017-2018 period due to the bailer becoming stuck inside the bore in May 2013. The bore was not able to be unblocked and had no longer been used. Given that:

- the location of this bore is close to the banks of the Motumate Stream, and
- the historical data shows that the nitrate concentrations in the groundwater at this monitoring location were fluctuating between 8 and 15.5 g/m^3, and
- the results were often above both the drinking water guideline (11.3 g/m^3) and the National Objective Frameworks bottom line (9.8 g/m^3 annual 95 percentile and 6.9 g/m^3 annual median),

further attempts should be made to re-instate this bore.

In the meantime, the monitoring of the Motumate Stream, provisionally provided for in the programme to monitor potential effects from the discharge of cooling water, initiated in November 2018 to monitor for potential effects on the stream from irrigation activities.

Table 25 Results of groundwater quality sampling on Farm 3

Parameter	Unit	Control (GND2051)			Impact (GND0700)			Impact (GND2052)		
		No.	Range	Median	No.	Range	Median	No.	Range	median
Chloride	g/m^3	3	41.7 - 77	61.8	3	64.7 - 95.6	67.3	3	46.4 - 50.6	47.6
COD	g/m^3	2	<5 - <5	<5	2	7 - 14	10.5	2	<5 - 5	<5
Conductivity @20˚C	mS/m	7	30.2 - 59.7	39.4	7	36.2 - 71.2	47.2	7	28.5 - 45	39.2
Water level	m	7	2.26 - 3.85	3.32	7	1.05 - 2.95	2.13	7	1.66 - 3.17	2.36
Sodium	g/m^3	2	25.6 - 31.0	28.3	2	58.0 - 60.7	59.4	2	44.0 - 47.1	45.6
Ammoniacal nitrogen	g/m^3N	3	0.004 - 0.010	0.005	3	<0.003 - 0.060	0.037	3	<0.003 - 0.032	0.037
Nitrate+nitrite	g/m^3N	7	3.39 - 29.6	13.6	7	0.38 - 7.25	2.17	7	0.01 - 6.31	2.71
pH		7	6.3 - 6.5	6.4	7	6.7 - 6.9	6.8	7	6.6 - 6.7	6.6
Temperature	˚C	7	14 - 15.1	14.3	7	13.7 - 15.4	14.9	7	14.4 - 15.7	14.6

The impact of wastewater irrigation upon the old impact bore (GND0700) was reflected in elevated sodium, chloride, and conductivity levels (Figure 43, Figure 44, and Figure 45).

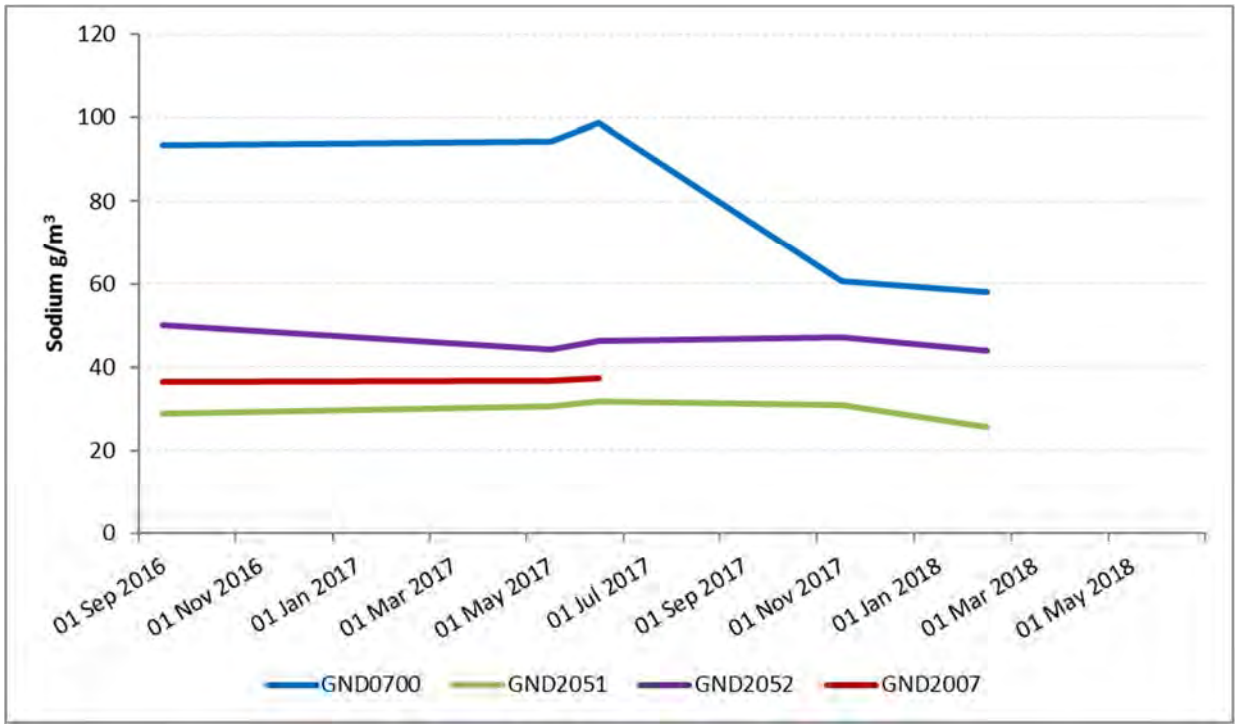


Figure 43 Groundwater sodium concentration at Farm 3 bores, June 2016 to date

It is noted that the chloride concentration and conductivity of the new control bore GND2051 are also elevated.

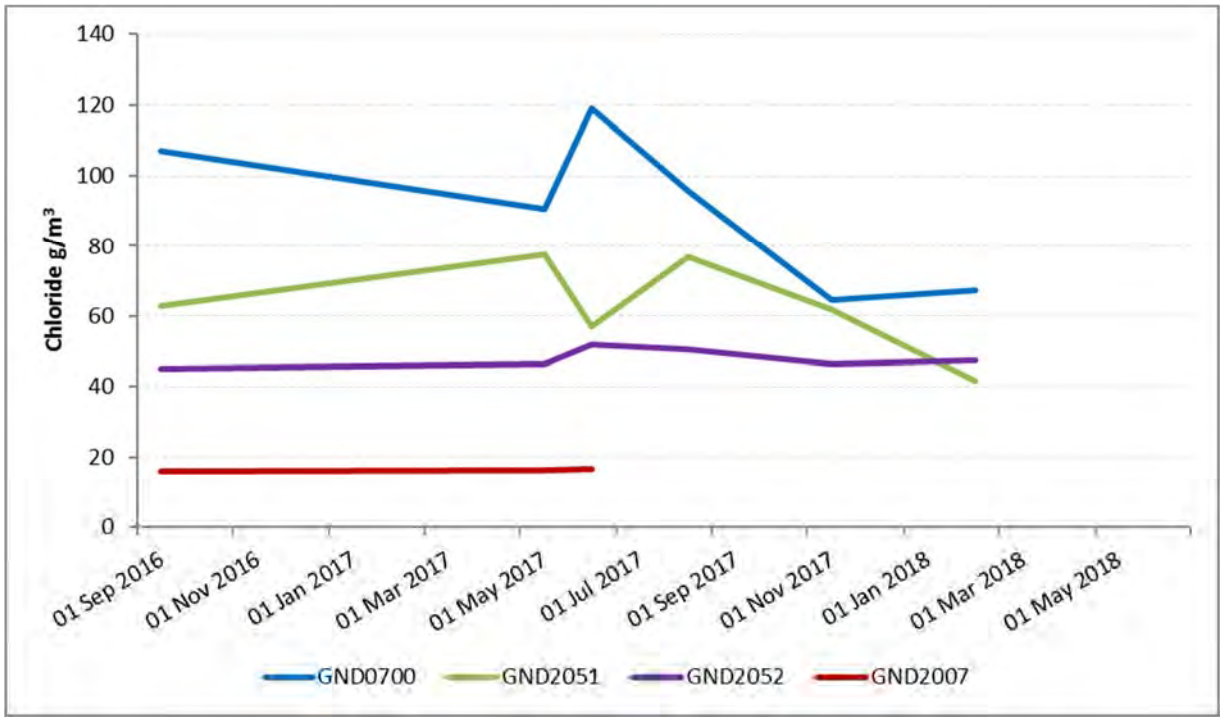


Figure 44 Groundwater chloride concentration at Farm 3 bores, June 2016 to date

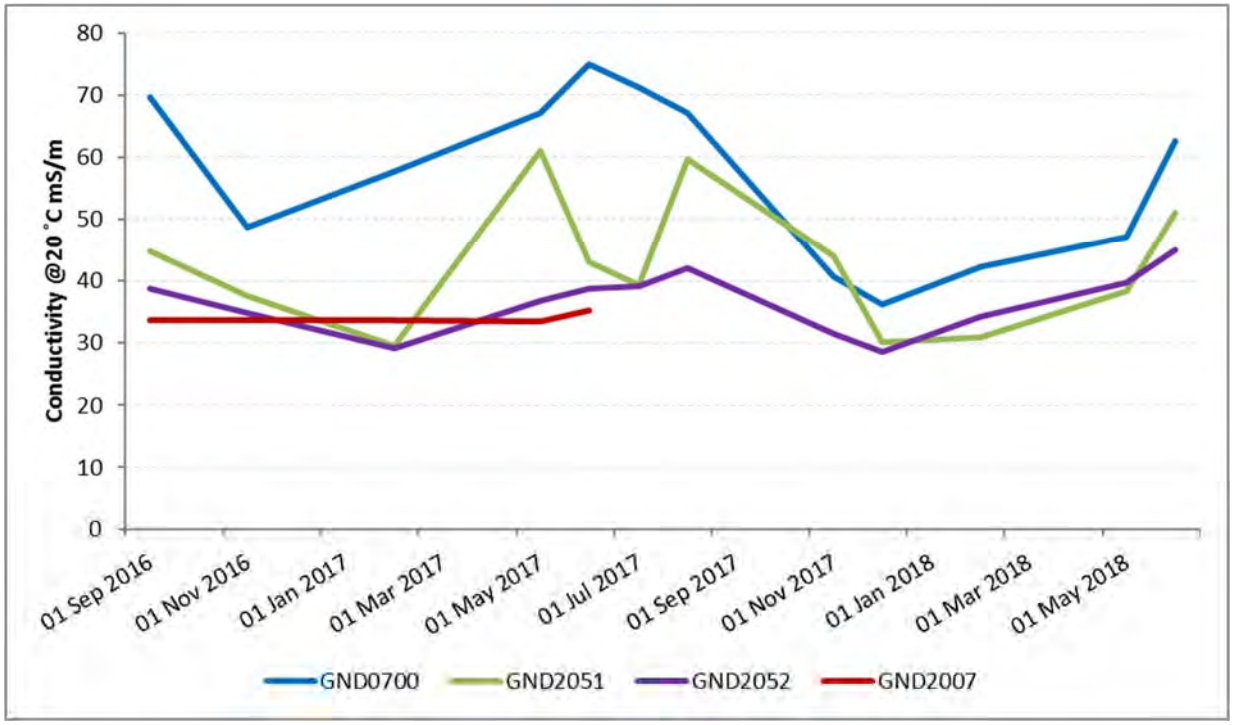


Figure 45 Groundwater conductivity at Farm 3 bores, June 2016 to date

Figure 46 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), with the old and new control bores, GND0640 (until 2007) and GND2051.

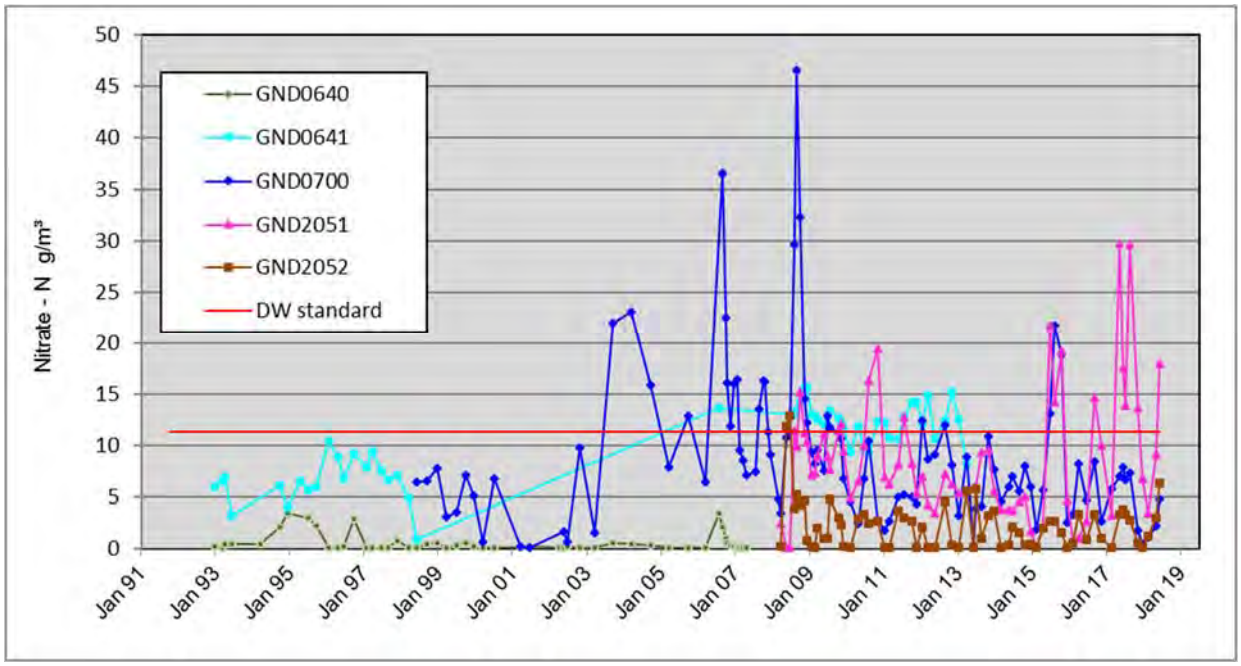


Figure 46 Trends in groundwater Nitrate-N concentration at Farm 3

At the new control bore (GND20501), nitrate-N values were elevated, with a median value of 13.6 g/m³ (compared to 14.6 g/m³ in 2016-2017 and 3.6 g/m³ in 2015-2016); and a spike to 29.6 g/m³ coinciding with higher groundwater levels found at the sampling survey on 24 August 2017. This nitrate-N concentration is a new maximum for this monitoring location. The older impact bore GND0700 yielded lower levels of

nitrate-N, with a median value of 2.17 g/m^3; with a much smaller rise in concentration with the increased groundwater level.

The new impact bore GND2052 had a much lower median nitrate-N value (2.71 g/m^3) during the year under review when compared to the 2016-2017 year (6.94 g/m^3). Overall, the results showed that the impact bores were experiencing only minor effects and indicate good management of nitrogen application rates in the vicinity of these two 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 has been 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.

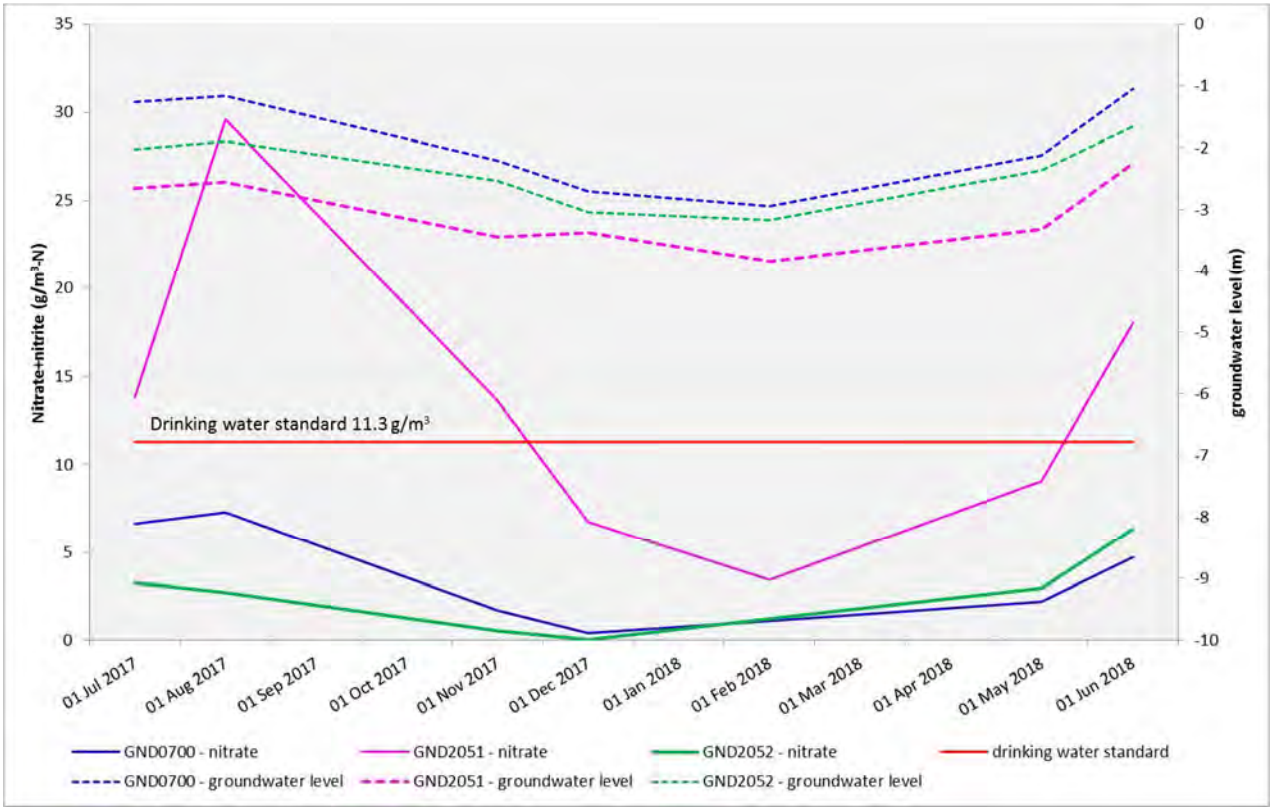


Figure 47 Farm 3 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

Historically, GND2049 and GND2051 show elevations in chloride, conductivity, and to a lesser extent sodium, that occur during the same surveys as the elevations in nitrate-N occur.

However, the relative contaminant concentrations are different in the other impact bores. It is noted 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.

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. A summary of the groundwater nitrate monitoring results is given in Table 26.

Table 26 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	7	4.9 - **11.9**	6.76
	GND0637	South	Impact	7	5.32 - **11.6**	8.76
Farm 2	GND2049	North	Control (new)	7	**14.9** - **22.4**	**19.7**
	GND0638	West	Impact	6	5.96 - 9.25	7.71
	GND0639	South-west	Impact	7	8.67 - **11.7**	10.1
	GND2050	South-west	Impact (new)	7	0.06 - **13.3**	8.25
	GND2063	South-east	Impact	7	4.53 - 9.3	7.78
Farm 3	GND2051	North	Control (new)	7	3.39 - **29.6**	**13.6**
	GND2052	South-west	Impact (new)	7	0.01 - 6.31	2.71
	GND0700	South-east	Impact	7	0.38 - 7.25	2.17
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%.

In 2017-2018, a total metered volume of 576,183 m^3 of factory effluent was generated, which had a (time-based) average total nitrogen concentration of 77.6 g/m^3 (42 samples, range 45 - 147 g/m^3), giving a total nitrogen mass of 44,644 kg. When applied to 164 ha, at an average depth of 351 mm, this amounted to an overall annual nitrogen application rate of 272 kg/ha. The calculated annual nitrogen application rates for Farm 1 (51 ha), Farm 2 (26 ha) and Farm 3 (87 ha) are 214, 291 and 301 kg/ha, respectively, assuming that

the effluent has been evenly distributed across the available irrigation area on all three farms. The average rate for Farms 2 and 3 was 299 kg/ha.

For dairy shed effluent, on Farm 1, a total metered volume of 9,352 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 84 g/m^3 (24 samples, range 47-147 g/m^3), giving a total mass of 809 kg. When applied to 51 ha, at an average depth of 18 mm, this amounted to an overall annual nitrogen application rate of 16 kg/ha.

For dairy shed effluent, on Farms 2 and 3, a total metered volume of 14,199 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 212 g/m^3 (23 samples, range 100 – 320 g/m^3), giving a total mass of 3,177 kg. When applied to 113 ha, at an average depth of 13 mm, this amounted to an overall annual nitrogen application rate of 28 kg/ha.

The total mass of nitrogen from DSE irrigated decreased from 5,384 kg in 2016-2017 to 3,986 Kg in 2017-2018; a reduction of 1,398 kg. The factory wastewater annual nitrogen mass also reduced by 7,533 kg. The DSE total nitrogen amounted to 8.2% of nitrogen mass irrigated.

The combined nitrogen loading rate for 2017-2018 from irrigation of factory wastewater and DSE was 230 kg/ha on Farm 1 and 326 kg/ha on Farms 2 and 3. A comparison of the nitrogen application rates in recent years are given in Table 27.

Table 27 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
2016-2017	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
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 since the 2013-2014 year, they decreased again during the year under review. Based on these calculations the addition of the DSE has not had a significant effect on the 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 8 and Table 9), along with relying on the assumption that the waste has been irrigated uniformly across all paddocks. The (time-based) average total nitrogen concentrations were also calculated from fewer results than they have been in previous years (refer Table 8 and Table 9)

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.

On Farm 1 during the 2016-2017 year, it appears that, overall, the base nitrate levels under the irrigation areas may have increased. During this period 80% of the nitrate-N concentrations in GND0637 were found to be above the drinking water standard. This compares to about 50% of the total dataset for this bore. During the year under review, it was found that there were generally lower nitrate-N concentrations than the previous year. At the control site (GND0636) there were two of the seven samples that contained nitrate-N concentrations at or above the drinking water standard and one of seven samples at the impact bore (GND0637). It is noted that although there were higher nitrate-N levels found at the control bore than at the impact bore on occasion, the annual median concentration was lower at the control bore than at the impact bore. The median values obtained for the year under review for both sites were lower than their respective historical medians.

The findings on Farm 2 during the year under review were similar to the 2016-2017 year. It continues to appear that the nitrogen loadings have been better managed since the beginning of the 2013-2014 year, with only 2 of the impact bore samples (both at GND2050) being at, or above, the drinking water standard. However, it is noted that the annual median nitrate-N concentration at this bore has increased from 0.05 g/m^3 in 2016-2017 to 8.25 g/m^3 in the 2017-2018 year. In addition to this, the elevated concentrations at the control bore (GND2049) continued, with all samples being above the drinking water standard, and an increase in the annual median from 14.4 g/m^3 in 2016-2017 to 19.7 g/m^3 in 2017-2018.

On Farm 3, it had appeared that nitrate levels under the irrigation areas have decreased and are stabilising in response to the increase in irrigated area. During the year under review it was found that this was the case only at the impact bore GND0700, which had an annual median lower than the historical median and the 2016-2017 annual median. The newer impact bore (GND2052) had an annual median higher than the historical median and the 2016-2017 annual median for the site. It is noted that GND0641, which generally fluctuated around the drinking water standard, had not been sampled since the bore became blocked in 2013, and that the nitrate levels in the control bore (GND2049) has continued to contain elevated levels of nitrate-N with the 2017-2018 similar to the new historical maximum value of 29.8 g/m^3 recorded during the 2016-2017 year. The 29.6 g/m^3 maximum recorded for this site during the year under review is more than double the drinking water standard of 11.3 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 heavy rainfall events and 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 a spikes in nitrate level observed during the year under review. Bores GND0636 (Farm 1 control bore), GND02050 (Farm 2 impact bore), GND2051 (Farm 3 control bore), and to a lesser extent, GND0700 (Farm 3 impact bore) all had spikes in the nitrate-N that coincided with the higher groundwater levels apparent in all of the bores in August 2017 and June 2018, which is consistent with the above theory.

In contrast, bores GND0637 (Farm 1 impact bore) and GND0639 (Farm 2 impact bore) both had their highest nitrate-N concentrations at times when the groundwater levels were measured to be low in these bores (July 2017 and February 2018). The Farm 2 control bore (GND2049) was found to have consistently high nitrate-N concentrations (greater than 20 g/m^3) through the period December 2017 to May 2018, while groundwater levels were lower.

The results for the two relatively new control bores, at the upslope boundaries of Farm 2 and Farm 3, have continued to show significant increases in groundwater nitrate-N levels in excess of the drinking water standard. This may be as a result 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 2016-2017 annual report, it has been signalled to the Company that the Assessment of Environmental Effects (AEE) for the consent renewal will 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.

2.1.6 Motumate Stream surface water quality

In combination with groundwater monitoring, some spatial synoptic surface water monitoring was conducted at three sites on the Motumate Stream adjacent to and downstream of the Company's farms (Figure 33, Table 28). These sites were previously monitored from November 2009 to April 2013, with approximately bi-monthly sampling recommencing in November 2017.

Table 28 Water quality monitoring sites in the Motumate Stream

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

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 of analytical work performed by the Council's laboratory in the 2017-2018 monitoring period are presented in Table 29, and a summary of the monitoring previously performed is presented in Table 30.

The results for the 2017-2018 monitoring period indicate a slight increase in conductivity, biochemical oxygen demand, and the sodium levels in the samples downstream of the control site (MTM000075) on all survey occasions (Table 29), but these were not significant enough to be considered a significant adverse environmental effect. The nitrate-N concentration showed a large seasonal fluctuation, varying from about 2.0 g/m^3 in summer to 9 g/m^3 in winter. This is a larger variation than was observed in the Waiokura Stream, which was in the range of approximately 1.7 to 4.3 g/m^3. On all occasions the nitrate-N results for the downstream sites were lower than at the control site. The ammoniacal nitrogen concentration was similar at sites MTM000075 and MTM000125, but showed an increase at site MTM000125. 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. Adding total nitrogen to the analysis suite would help ascertain whether there are any nitrogen inputs or uptakes occurring through the stretch of the stream monitored.

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.

Table 29 Results of Motumate Stream quality sampling for the year under review

Parameter	Unit	02 Nov 2017			13 Feb 2018			02 May 2018			01 Jun 2018		
		MTM000075	MTM000120	MTM000125	MTM000075	MTM000120	MTM000125	MTM000075	MTM000120	MTM000125	MTM000075	MTM000120	MTM000125
Time		12:15	12:00	12:30	12:00	11:45	12:15	12:15	12:35	12:45	12:45	12:10	12:40
Biochemical oxygen demand	g/m^3	0.6	0.5	0.7	1	1.2	1.2	0.9	1.4	1.7	0.8	1.4	1.6
Conductivity @20˚C	mS/m	32.3	36.6	38.5	33.4	38.2	38.5	31.7	37.7	38.4	37.1	42	42.1
Dissolved reactive phosphorus	g/m^3	0.066	0.047	0.107	0.091	0.076	0.056	0.054	0.053	0.077	0.04	0.047	0.063
Sodium	g/m^3	25.5	34.9	36.8	26.5	35.8	36						
Unionised ammonia	g/m^3	0.0004	0.00023	0.00255	0.00065	0.00106	0.00171	0.0004	0.00023	0.0008	0.00023	0.00026	0.00091
Ammoniacal nitrogen	g/m^3 N	0.0388	0.034	0.292	0.028	0.037	0.091	0.042	0.038	0.102	0.038	0.042	0.113
Nitrate + nitrite	g/m^3 N	7.51	6.85	6.86	2.16	1.02	0.98	4.7	4.39	4.4	9.6	8.8	8.12
pH		7.5	7.3	7.4	7.7	7.8	7.6	7.5	7.3	7.4	7.4	7.4	7.5
Temperature	˚C	15	15.3	15.8	19.9	19.6	20	13.8	14.1	14.4	11.1	11.3	11.6
Turbidity	NTU	9.6	13	8.2	5.1	6.2	5.2	5.8	5.9	6.8	4	6.2	8.1

Table 30 Summary of Motumate Stream water quality data from the Council surveys during the period November 2009 to April 2013

Parameter	Unit	MTM000075			MTM000120			MTM000125		
		No.	Range	Median	No.	Range	Median	No.	Range	Result
Biochemical oxygen demand	g/m^3	10	0.7 - 18	1.9	11	1.5 - 13	4.9	0	-	-
Conductivity @20˚C	mS/m	11	28.7 - 64.1	31.1	11	34.2 - 61.7	37.5	1	-	47.0
Dissolved reactive phosphorus	g/m^3	3	0.051 - 0.154	0.089	3	0.094 - 0.380	0.172	0	-	-
Sodium	g/m^3	7	21.9 - 32	25.4	7	30.9 - 40.8	34.3	0	-	-
Ammoniacal nitrogen	g/m^3 N	6	0.05 - 7.26	0.075	6	0.114 - 2.90	0.676	1	-	3.38
Nitrate + nitrite	g/m^3 N	9	0.95 - 6.07	4.56	9	1.92 - 5.31	4.53	0	-	-
pH		11	7.5 - 7.8	7.6	11	7.1 - 7.6	7.5	1	-	7.4
Temperature	˚C	11	10.8 - 17.6	13.3	11	11.6 - 17.5	14.1	1	-	16.1
Turbidity	NTU	4	7.3 - 63	17	4	12 - 36	18	0	-	-

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 33, Table 31). This was carried out approximately bi-monthly.

Table 31 Water quality monitoring sites in the Waiokura Stream

Site	Site code	Description	Map reference, NZTM	
			Easting	Northing
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 of analytical work performed by the Council's laboratory in the 2017-2018 monitoring period are presented in Table 32, and a summary of the monitoring previously performed is presented in Table 33.

Table 32 Results of Waiokura Stream quality sampling for the year under review

Parameter	Unit	Site 1(WKR000500)			Site 2 (WKR000630)			Site 3 (WKR000650)		
		No.	Range	Median	No.	Range	Median	No.	Range	median
Conductivity @20˚C	mS/m	6	20.1 - 22.5	21.5	6	21 - 23.5	22.75	6	22 - 28.5	23.8
Dissolved reactive phosphorus	g/m^3	6	0.035 - 0.172	0.045	6	0.034 - 0.08	0.041	6	0.036 - 0.444	0.049
Sodium	g/m^3	6	18.4 - 21.3	20.2	6	19.4 - 23.0	22.3	6	20.8 - 24.9	24.0
Nitrate + nitrite	g/m^3 N	6	1.77 - 4.13	3.12	6	1.74 - 4.24	3.32	6	1.68 - 4.27	3.54
pH		6	7.6 - 7.8	7.6	6	7.6 - 7.8	7.6	6	7.5 - 7.8	7.6
Temperature	˚C	6	11.3 - 17.4	13.2	6	11.5 - 18	13.8	6	11.3 - 18.6	13.7

Table 33 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2017

Parameter	Unit	Site 1(WKR000500)			Site 2 (WKR000630)			Site 3 (WKR000650)		
		No.	Range	Median	No.	Range	Median	No.	Range	median
Conductivity @20˚C	mS/m	117	16.6 - 30.4	21.1	119	17.0 - 25.3	22.3	118	15.0 - 27.4	23.2
Dissolved reactive phosphorus	g/m^3	63	0.012 - 0.088	0.032	64	0.013 - 0.095	0.032	63	0.016 - 0.117	0.03
Sodium	g/m^3	116	14.8 - 25.4	19.5	117	9.4 - 24.9	21.4	116	13.9 - 62.4	22.5
Nitrate + nitrite	g/m^3 N	105	1.27 - 4.02	2.71	105	1.03 - 6.51	2.92	105	1.03 - 4.25	2.85
pH		83	6.6 - 8.0	7.6	85	6.9 - 8.2	7.6	83	7.0 - 8.1	7.7
Temperature	˚C	119	7.1 - 18.0	12.3	120	8.3 - 20.2	12.6	119	8.1 - 19.6	12.6

The results for the 2017-2018 monitoring period again indicate a slight increase in conductivity and the sodium levels in the samples downstream of the control site (WKR000500) on all survey occasions (Table 32), but not significant enough to be considered an environmental effect. Nitrate-N concentration showed a seasonal fluctuation, varying from about 4.2 g/m^3 in spring to 1.8 g/m^3 in summer. This was much less of a fluctuation than was observed in the 2016-2017 year (6.8 to 2.0 g/m^3). The median nitrate concentration for 2017-2018 was again higher at all three sites than the respective long-term median value, as was the median sodium concentration.

During the year under review, it was found that the largest progressive downstream increase in nitrate-N was on 8 January 2018 (2.5 g/m^3 to 3.5 g/m^3) and that there were noticeable changes in conductivity and dissolved reactive phosphorus between sites WKR000630 and WKR000650 on 6 March 2018. On 8 January 2018 there was no rainfall recorded, however there was 102 mm of rain recorded as having fallen over 3 and 4 January. There was only 292 m^3 of factory effluent recorded as having been irrigated on Farm 2 and 1,058 m^3 of factory wastewater irrigated on Farm 3. On 6 March 2018 there was 80 mm of rainfall recorded, with 804 m^3 of factory wastewater irrigated on Farm 2 and 923 m^3 irrigated on Farm 3. There was no flow elevation recorded at the Glenn Road flow recorder on either of these days. 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.

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 48. 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. The current temperature conditions within the mixing zone and the validity of this assumption will be investigated by the Company during the preparation of the AEE for the renewal of the cooling water discharge consent(s)

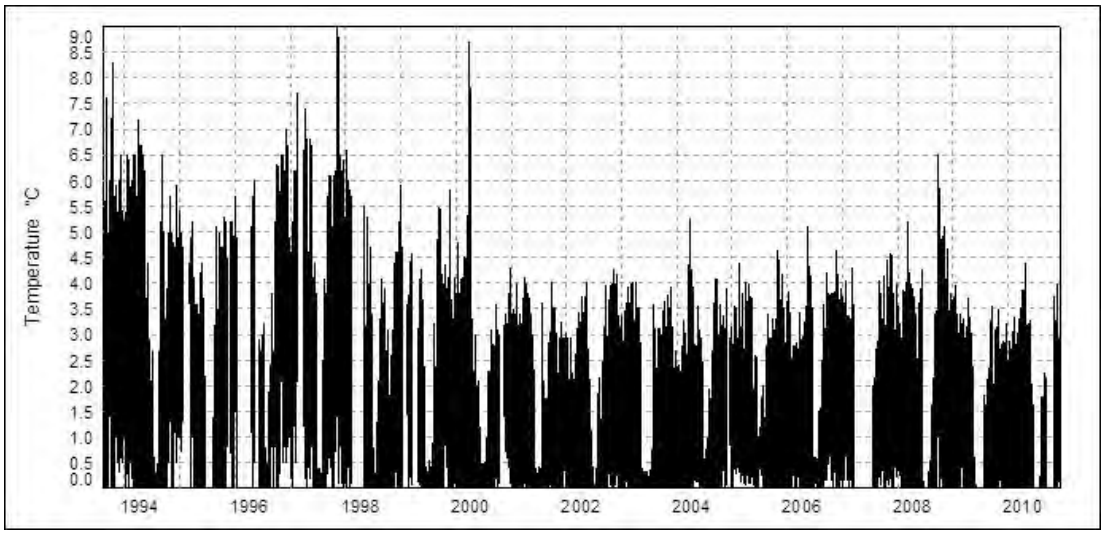


Figure 48 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Ltd spray cooling water discharge zone, 1993-2010

Instead, 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 is discussed below in section 2.1.8.3.

Kaupokonui Stream flow records for the monitoring period for the Glenn Road recording station are presented in Figure 49.

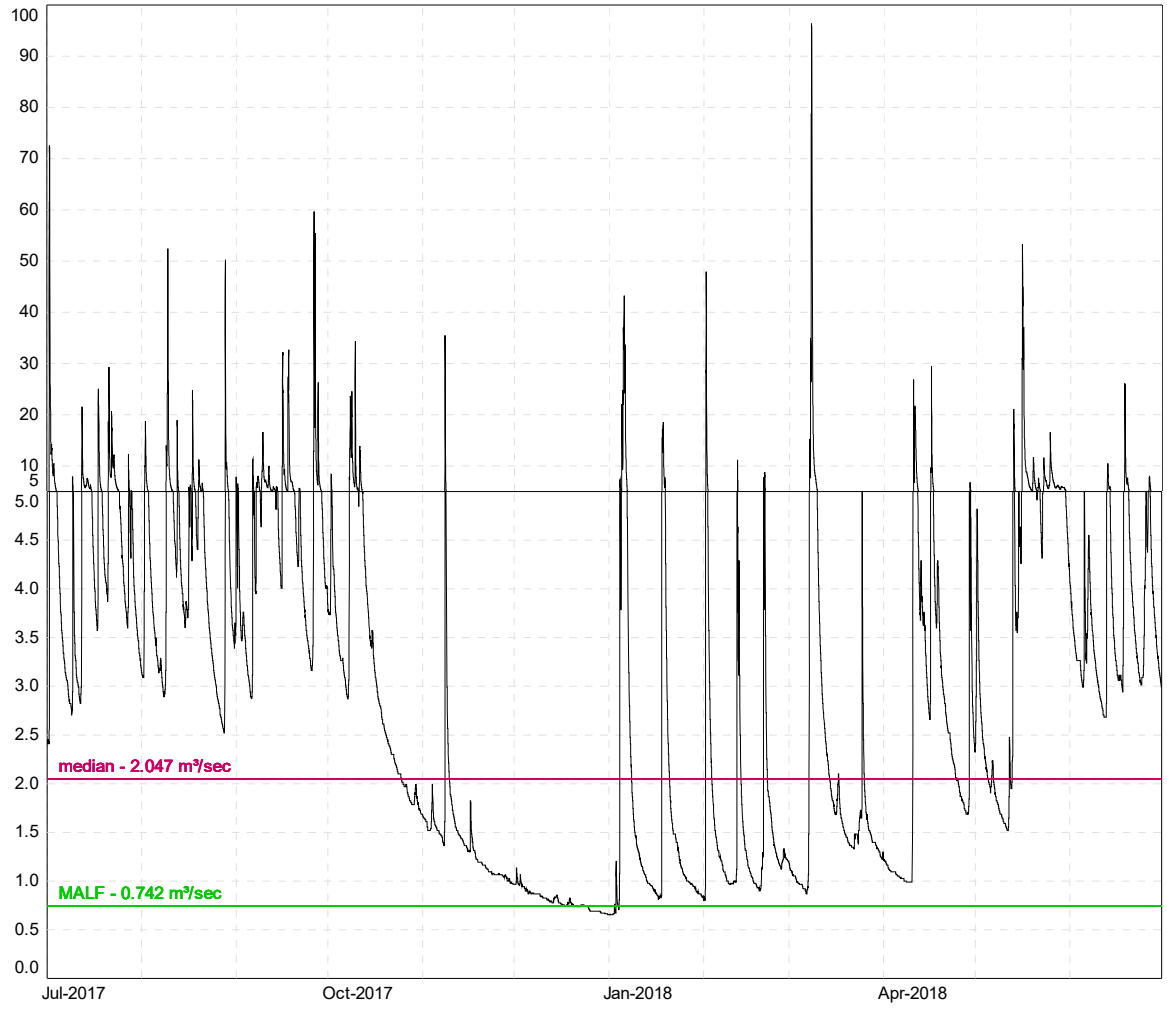


Figure 49 Kaupokonui Stream at Glenn Road flow record (m^3/s) for the year under review

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.

Water temperature records for these two sites are illustrated in Figure 50 and Figure 51.

A monthly summary of these data is included in Table 34.

During the year under review, the stream temperature at Glenn Road reached a maximum of 27.4˚C on 29 January 2018 at 15:30 NZDT and 27.3˚C on 30 January from 15:30 to 15:45 NZST. The maximum temperatures at the beach were 27.8˚C on 29 January 2018 from 15:30 to 16:30 NZDT and 27.8˚C on 30 January from 15:45 to16:30 NZST. These temperatures are approximately 3˚C higher than the maximum temperatures observed during the 2016-2017 year.

On 29 January at 15:30 and 15:45 NZST the temperature of the Kaupokonui Stream upstream of the Company's site were 24.0 and 24.1˚C respectively and the temperature downstream of the sprayers were also 24.3 and 24.4˚C respectively. It is noted that the stream temperature at Glenn Road and the coast often peaks somewhere between approximately two to three and a half hours earlier than in the vicinity of the lactose plant. The highest temperatures recorded upstream and downstream of the sprayers on this day were: 24.8˚C from 18:00 to 19:00 NZST (upstream); and 25.0˚C from at 18:00 NZST (downstream). The Company's reported cooling water discharge rate was about 105 L/s at 27˚C.

On 30 January between 15:30 and 16:30 NZST the temperature of the Kaupokonui Stream upstream of the Company's site was between 24.2 and 24.4˚C and the temperature downstream of the sprayers were between 24.3 and 24.6˚C. The highest temperatures recorded upstream and downstream of the sprayers on this day were: 24.8˚C from 17:30 to 18:45 NZST (upstream); and 24.7˚C from 17:45 to 10:00 NZST (downstream). The Company's reported cooling water discharge rate was between about 65 and 51 L/s at 27˚C.

On 30 January, the Company advised Council that for the first time, the Company had shut down all of the evaporators during the evening of the 29 January, and that they would do so again that night to avoid a potential breach of consent.

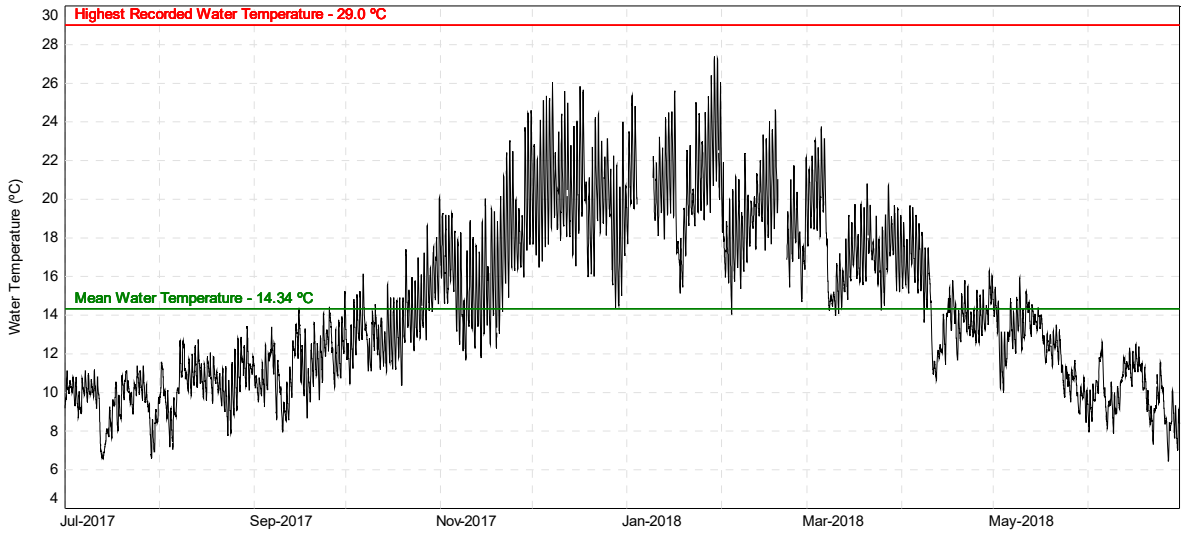


Figure 50 Water temperature (°C) records for the Kaupokonui Stream at Glenn Rd during the year under review

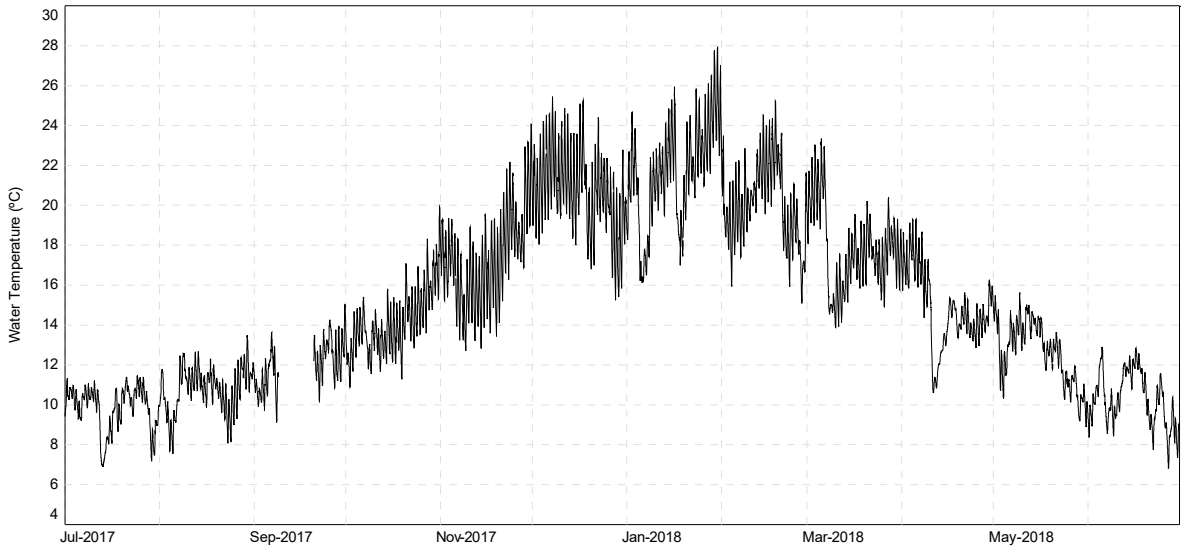


Figure 51 Water temperature (°C) records for the Kaupokonui Stream at beach during the year under review

Table 34 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
July 2017	6.6	11.4	9.5	6.9	11.5	9.8
August 2017	7.1	13.4	10.6	7.5	13.5	10.8
September 2017	7.9	15.3	11.4	?	?	?
October 2017	10.4	20.1	13.7	10.9	19.9	14.1
November 2017	11.7	24.6	16.8	12.7	24.1	17.3
December 2017	14.4	26.0	20.2	15.3	25.5	20.7
January 2018	15.1	27.4	21.0	16.1	27.9	21.6
February 2018	14.0	24.6	18.8	15.1	25.2	20.1
March 2018	14.0	23.8	17.6	13.9	23.4	17.8
April 2018	10.6	19.7	14.6	10.6	19.3	14.8
May 2018	8.4	15.9	12.3	8.9	15.6	12.6
June 2018	6.4	12.6	9.9	6.8	12.9	10.3

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 10% of the year at Glenn Road and 15% of the year near the mouth, while the annual median water temperatures were 13.3˚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 31% of the time at Glenn Road and 37% of the time at the coast. The median temperatures during this period were 18.8˚C and 19.5˚C respectively.

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

In-stream 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 prior to consent renewal (2019).

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 new fish pass. However, new 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 metres. 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 metres. 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 metres.

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.

2.1.8.3.1 Fish survey

The fish survey was not scheduled to take place in the year under review. It is next scheduled for the 2019-2020 year. A discussion of the results of the most recent survey are included below for reference.

During the year under review there were trout observed as being present around the intake area (i.e. above the fishpass) at the time of three of the 12 site inspections.

A four-site fish survey was undertaken in the Kaupokonui Stream on 2 June 2017, 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 35 and shown in Figure 52.

Table 35 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	KPK000660	Upstream of intake weir	E1697613 N5629791	15.98	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 some kilometres downstream of the factory is an orphaned structure, the Glenn Road weir, which currently does not have adequate fish passage provision.

Four fish species were recorded during this survey, being longfin and shortfin eel, redfin bully and brown trout. Redfin bully were recorded in very low abundance, reflecting the impact of the Glenn Road weir.

Upstream of the Kapuni Lactose weir, longfin and shortfin eels and redfin bully were recorded, providing no indication that this weir is posing a significant barrier to fish passage. Although the numbers of juvenile eels recorded was less than that recorded in 2014, this is considered to be due to the timing of the two surveys.

There were no significant differences between the fish communities recorded at site 3 (downstream of the cooling water discharge), and that recorded at the other three sites. Where differences were recorded, as with the previous survey which recorded a higher abundance of eels between 250 mm and 450 mm at site 3, these differences can largely be attributed to the variation in habitat between the sites.

Overall, it is considered that the activities of the Kapuni Lactose factory have not adversely affected the fish communities of the Kaupokonui Stream. It is hoped that as the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, that the diversity and abundance of fish in this stretch of stream will improve.

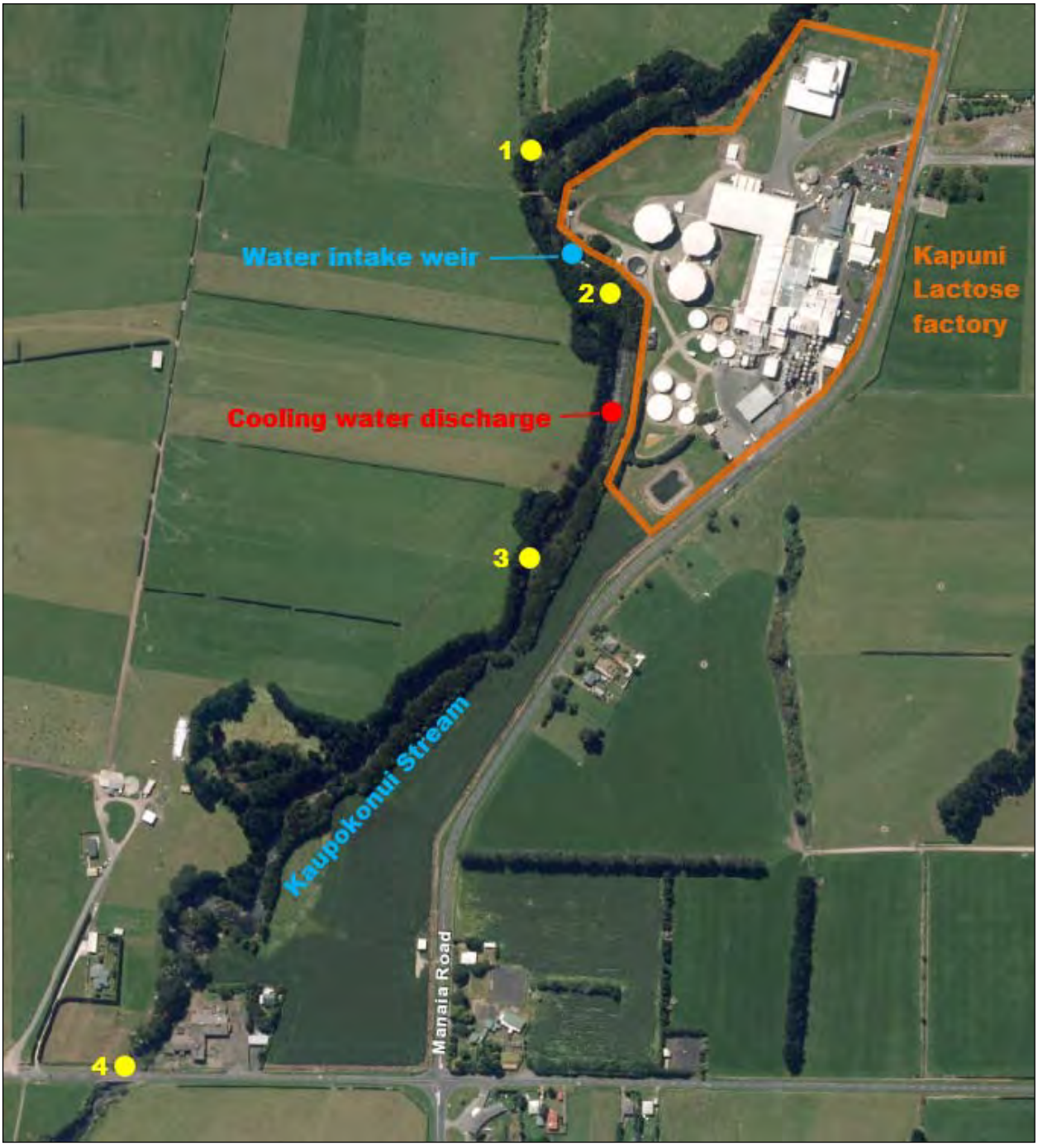


Figure 52 Fish monitoring sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory

The 2014 survey was completed in January, during the elver migration period, while the 2017 survey was completed in June, when the elvers will have had more time to distribute further within the catchment.

2.1.8.4 Macroinvertebrate surveys

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui Stream on 31 October 2017 and 1 March 2018. Two sites in the Waiokura Stream were sampled in March 2018. Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths"). The sites monitored are described in Table 36 and shown in Figure 54.

Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The reports are included as Appendix V. The report summaries are provided below.

Table 36 Biomonitoring sites in the Kaupokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaupokonui River	3b	KPK000655	1 km u/s of railway bridge
	4	KPK000660	Railway, above factory
	5	KPK000679	160m below cooling water discharge zone
	6	KPK000685	Skeet Road
	7	KPK000880	Glenn Road
Waiokura Stream	U	WKR000500	Skeet Road
	D	WKR000650	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.

31 October 2017

This survey was undertaken following a moderate period of receding flows in the Kaupokonui River, and followed 19 days after a flow event in excess of three times median flow and 20 days after an event in excess of seven times median flow. The Kaupokonui River had a moderate, clear, uncoloured and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.810 m^3/sec, slightly less than the median flow (2.050 m^3/sec), and approximately two and a half times mean annual low flow (0.746 m^3/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 16.8°C to 18.3°C. Periphyton mats were patchy at sites 3b and 5, while filamentous periphyton was absent at these sites. No periphyton mats were noted at site 4, where the rocks supported a slippery film only. Sites 6 and 7 supported patchy growths of algal mats and filaments. Cobbles, gravel and boulders were the predominant substrate at all sites in the river.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'very good' community health at all sites. MCI scores were similar but variable at the four upstream sites, but decreased significantly at site 7. There is normally a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. Although the current survey recorded this deterioration, the MCI scores were indicative of better water quality overall, probably reflecting the typical seasonal differences at these sites. The MCI scores at the sites 3b, 4, 5 and 6 were significantly higher than their historical median scores, while the MCI scores at site 7 was slightly above the historical median. It is also worth noting that site 5, recorded the highest MCI score to date at this site, by four units. $SQMCI_s$ scores varied between sites, with the highest score recorded at site 5, which was a significantly higher score than sites 3b and 4, and site 7 recording a significantly lower score than all other sites. The results varied by up to 0.9 unit at sites 3b-6, which although is a significant result, probably reflects variable sampling effort and the patchy nature of macroinvertebrate communities. The result at site 7 is again likely related to the progressive deterioration typical of ringplain streams and rivers in a downstream direction.

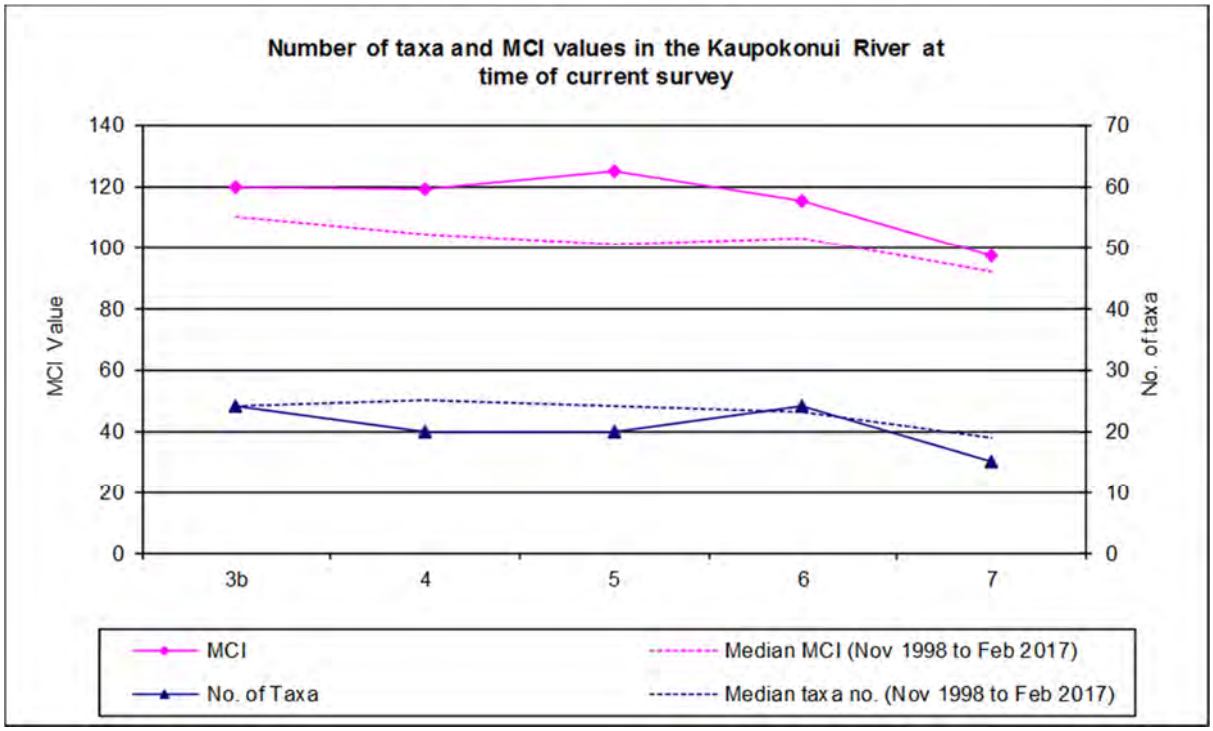


Figure 53 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'very good' or 'good' health throughout most of the reach surveyed. The high MCI and $SQMCI_s$ scores at site 5 indicate that the cooling water discharge was not having a significant impact on the macroinvertebrate communities at the time of this survey. The macroinvertebrate communities at all sites were in above average condition. However, site 7 was in 'poor' condition, showing the usual influence from the Dunns Creek tributary within the reach between sites 6 and 7, and the natural progressive downstream deterioration.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and the communities were in above average condition, and in similar or better condition than that recorded in the previous summer survey (which did not show the seasonal decline typically observed at these sites). Similarities in community composition, including the characteristic taxa, were generally consistent for all sites. The current survey did not record the presence of sewage fungus and bloodworm midges were rare, also indicating a lack of impacts from the cooling water discharge.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the current survey.

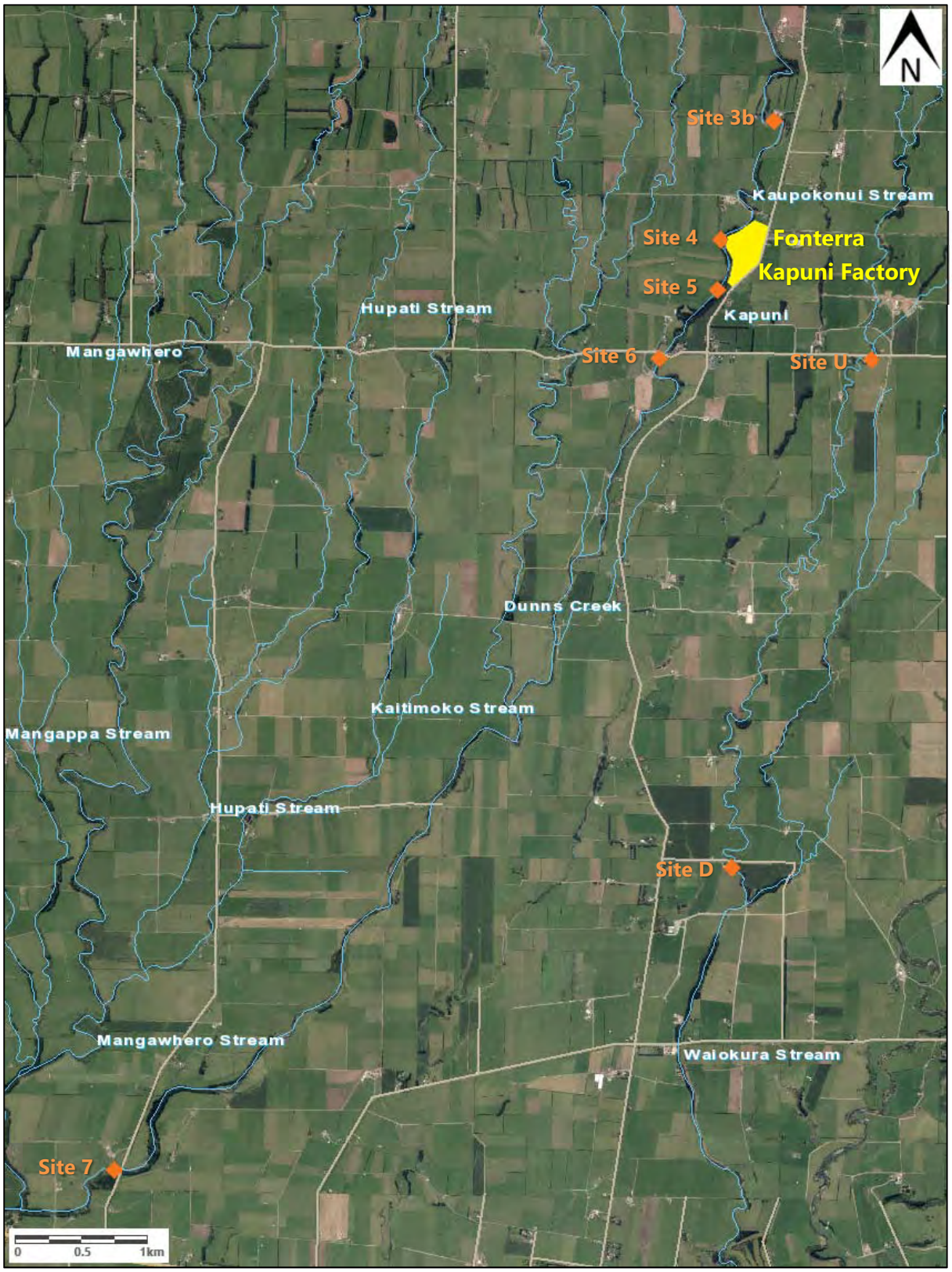


Figure 54 Biomonitoring sites in the Kaupokonui River sampled in relation to the Company's factory discharges

1 March 2018

This survey was undertaken following a short period of receding flows in the Kaupokonui River, and followed 7 days after a flow event in excess of three and 27 days after a flow event in excess of seven times median flow. The Kaupokonui River had a low, clear, uncoloured and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.203 m^3/sec, less than half the median flow (2.050 m^3/sec), and above the mean annual low flow (0.746 m^3/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 18.3°C to 19.9°C. Periphyton mats were patchy at all sites, while filamentous periphyton was absent at site 4, patchy at sites 3b, 5 and 6 and widespread at site 7, despite the relatively recent occurrence of scouring flows. Cobbles, gravel and boulders were the predominant substrate at all sites in the river. The Waiokura Stream sites had a finer substrate with the bed primarily composed of gravels and cobbles at site U, and gravels and sand at site D. Aquatic vegetation grew throughout the stream at site D, while no macrophytes were recorded growing at site U. Algae were noted only as slippery films on the substrate at both sites.

The Waiokura Stream had experienced an extended period of stable flows prior, with this survey performed 112 and 140 days after flow events in excess of three and seven times median flow respectively.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'good' community health at all sites. MCI scores varied between sites, but generally reduced in a downstream direction. The variable MCI scores is likely a reflection of variable sampling effort, rather than of changes in water quality, as there was no clear correlation with the $SQMCI_S$ scores. There is normally a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers, which was recorded in the current survey. Although the current survey recorded this deterioration, the MCI scores were indicative of better water quality overall, probably a reflection of the wet summer that preceded this survey. The MCI scores at site 4 was significantly higher than the historical median scores, while the MCI scores at sites 3b, 5 and 6 were slightly above their historical medians. $SQMCI_S$ scores were variable between sites, with the upstream site 3b having a significantly lower score than sites 4 and 5, and site 7 having a significantly lower score than any other site. Despite this significant difference at site 3b, the results reflect the fact that the four upper sites communities were dominated by similar taxa, in particular the 'highly sensitive' mayfly *Deleatidium*, which was extremely abundant at all sites except site 7.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. As is typical, the poorest community, in 'fair' health, was found at site 7. This represents the usual influence from the Dunns Creek tributary within the reach between sites 6 and 7 as well as the natural progressive downstream deterioration which is often observed in ringplain streams and rivers.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and the communities were in average to above average condition, and in similar or slightly poorer condition than that recorded in the previous spring survey, a relatively typical result for a summer survey. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites. The current survey did not record the presence of sewage fungus or bloodworm midges, also indicating a lack of impacts from the cooling water discharge.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the current survey.

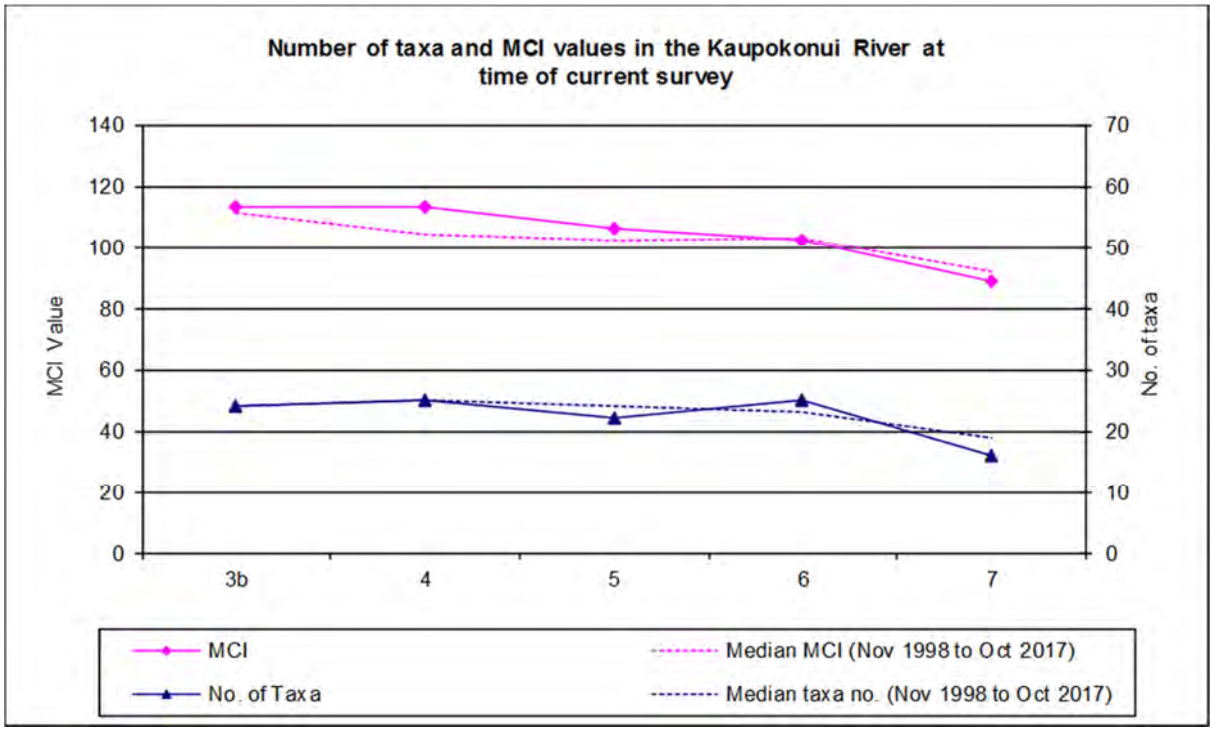


Figure 55 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

The Waiokura Stream communities indicated that conditions during this survey were fairly typical when compared with previous surveys at these two sites to date. The MCI value recorded at the downstream site was slightly lower than that recorded upstream, and exhibited the usual slight deterioration in MCI score. This is largely attributable to the distance between the sites and the marked habitat differences between sites, especially the predominance of macrophytes at site D, rather than to any effects from the application of wastes to land from the Company's factory. The $SQMCI_S$ scores also indicated that both sites were in average health, with the scores at both sites being similar to the historical medians, and showing no significant change between the two sites. There were some subtle changes in macroinvertebrate community compositions between the sites, which were associated with differences in habitat, principally an increase in macrophytes and periphyton at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

2.2 Air

2.2.1 Inspections

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the 2017-2018 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.

Officers of the Council carried out inspections in relation to air emissions, of the Kapuni lactose plant, during the 2017-2018 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. Lactose odours were noted along Manaia Road during the inspection on 12 December 2017, however these were not considered objectionable. On-site odours were noted during inspections, particularly in the vicinity of the effluent tank.

2.2.2 Emission monitoring

A wet scrubber system was commissioned by the Company in October 1998. The wet scrubber system links the exhaust streams from the pre-drier stack and the refined fluid bed drier.

Table 37 is included for comparison of results prior to the installation of the wet scrubber system.

Table 37 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 25 October 2017 by CRL Energy, using USEPA method 17. The determination was from one approximately 60 minute period compared to previous years when the determination has been the average result from three tests each conducted over 60 minute periods. No information was reported 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 38 below, along with previous averaged CRL and Council results since 1998.

Table 38 Summary of isokinetic stack analysis of the flash drier for 1998-2017

Date	Production rate (t/hr)	Stack emission rate (dsm3/hr)	Emission (mg/dsm3)*	Comments
5 November 1998			<10	No visible emissions noticed
25 February 1999			<10	No visible emissions noticed
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

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 2017 were 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 39, Table 40 and Table 41. There are currently no consent limits on these sources, however the renewed consent will contain particulate emissions limits for each of these stacks. All particulate emission rates measured during the year under review were below the 125 mg/m^3 limit that applies to the flash dryer

Table 39 Summary of isokinetic stack analysis of the small drier for 2016 and 2017

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

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

Table 40 Summary of isokinetic stack analysis of the supertab north dryer for 2016 and 2017

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 (combined with south)	18863	93	1.7
25 October 2017[b]	Not provided	20616	24.7	0.50

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

Table 41 Summary of isokinetic stack analysis of the supertab south dryer for 2016 and 2017

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 (combined with north)	21831	138	3.0
25 October 2017[b]	Not provided	20208	47.4	0.98

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

2.2.3 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 three weeks during spring. 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 42 and Figure 56.

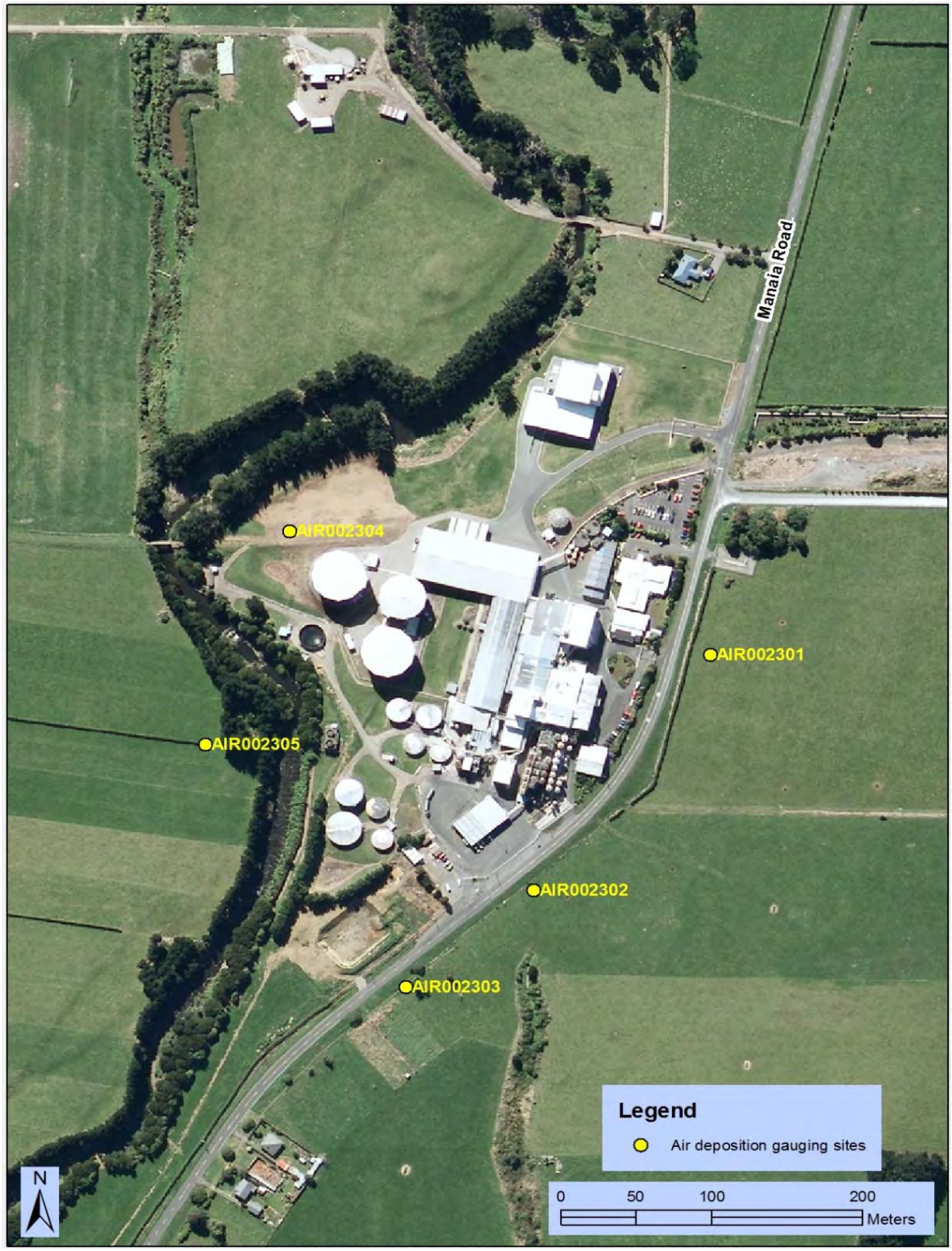


Figure 56 Location of air deposition gauging sites

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 0.13 g/ 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 57 and Table 43.

Prior to the commissioning of the wet scrubber in October 1998, deposition rates of up to 1300 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 42 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

Northerly winds predominated (over 30% of the time) during the gauge deployment, north westerly components were for 25% of the time and the remainder in the range of about 2 to 12% of the time.

The deposition rates obtained during the periods under review were generally low and similar to the most recent monitoring periods, with the exception of site AIR02303. The lactose deposition rate recorded at this site was above the historical median for this monitoring location and about 20% higher than the guideline value. This gauge was downwind of the factory for approximately a third of the time during the survey and there were no reported issues relating to organic contamination of the gauge. However, it is noted that there were no complaints received regarding particulate deposition during the deployment period of the gauges.

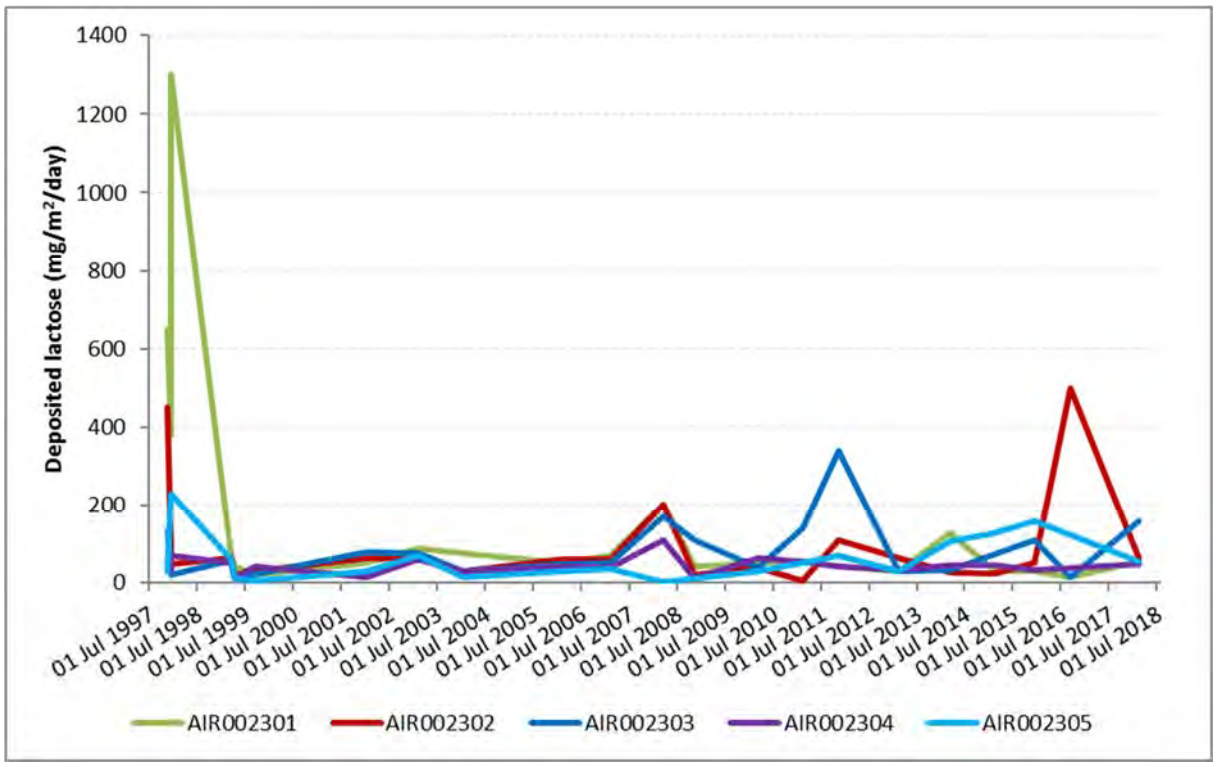


Figure 57 Deposition gauge results from 1997 to date

Table 43 Deposition gauge results from 1997to date

Period	Number of days	Deposited lactose mg/m^2/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	-
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

* gauge contents contaminated by bird/bird droppings

2.3 Investigations, interventions and incidents

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 consent holder. During the monitoring period 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.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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 company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2017-2018 period, the Council was required to undertake additional investigations and interventions, and record incidents, in association with the Company's conditions in resource consents, and provisions in Regional Plans on two occasions.

2 November 2017

A complaint was received regarding an offensive odour at Ingram's Bin Hire (Ingram's) site in Hawera. The investigation found that a waste product from the Fonterra Kapuni lactose plant had been stockpiled at the Ingram's site prior to being disposed of at the Malandra Downs green waste site, in breach of their resource consent 7374-1. This consent does not permit the discharge of material of this nature or from this source.

The processing wastes were identified as a mixture of diatomaceous earth and activated carbon used to purify the lactose liquor during the manufacture of lactose. This material, which is not permitted under the resource consent or provisions in Regional Plans had been disposed of at three locations on the Malandra Downs site.

Photo 5 Example of the Company's lactose manufacturing processing wastes disposed of at the Malandra Downs site

Abatement notices were issued to all three parties, with the one issued to the Company to undertake works to remove all unauthorised materials from the green waste site to ensure compliance with Resource Consent 7374-1. 4, and to further ensure that the removed unauthorised materials are disposed of in an approved manner. Letters were sent to the parties involved requesting an explanation. An infringement notice was subsequently issued to each of the three companies involved in this incident.

Reinspection found that the abatement notices were being complied with at the time of inspection, and an application to vary the consent was lodged to enable the acceptance of this material. The application is currently on hold awaiting non notified approval from DoC.

Council has been advised that this material is now being disposed of appropriately at a consented composting facility within resource consent conditions, and inspections have found that no further discharges have occurred at the Malanda Downs site.

18 January 2018

It was found that a stormwater discharge sample collected during a routine sampling survey had breached resource consent conditions at the Fonterra Lactose factory, Kapuni. Sample results showed that the discharge from the southern stormwater pond had breached resource consent condition regarding the pH of the discharge. The receiving water samples found no deleterious effects were occurring at the time of sampling. An infringement notice was issued.

3 Discussion

3.1 Discussion of plant performance

Generally the on-site 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. There were however two infringement notices issued to the Company during the year under review, which will be discussed later in this section.

A number of improvements were made at the site during the year under review, including the diversion off all site cooling water to the cooling tower and spray discharge system and the diversion of all stormwater from the northern part of the site to a containment pond allowing the stormwaters quality to be checked prior to discharge.

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 2018. The main amendments to the plan related to the changes in the stormwater drainage at the site, with the installation of the stormwater pond for the IGL and northern extension parts of the site. Council requested that the plan be amended to include notification of spills. 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, but that the irrigation management plan was reviewed in June 2018. No significant changes were made other than that the section covering effluent solids disposal was completed, and some administrative changes were made regarding the updating of consents and job titles. Council has also been informed that a whole farm management plan is being developed for the two farms that will accompany the consent renewal application. The plan will integrate the irrigation management and the farm management practices to ensure that the operation of these two activities are themselves well integrated.

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, and volume and composition of effluent sprayed to pasture on the two farms. Daily volumes and temperature maxima 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 additional electronic data has been provided to Council for the water abstraction and discharge flow rates, and for the cooling water discharge temperature. Compliance with consent conditions was demonstrated for stream temperature and dairy effluent volume. However, following review of the electronic 2016-2017 data and temperature probe calibration records, it became apparent that the level of accuracy advised to Council in February 2016 was no longer being maintained. As discussed previously, in the absence of any specific consent requirements the monitoring should, and does, meet the requirements of the NEMS standard. It is currently being signalled that greater certainty will be required in relation to the temperature monitoring data used to inform the AEE for the consent renewal, and it is expected that the renewed consent will require greater accuracy and precision for the temperature records. The data provided in the 2017-2018 year continued to meet NEMS requirements and further discussions were held with the Company about improved accuracy moving forward. In the meantime a period of parallel temperature monitoring is recommended to be undertaken to confirm compliance, as is the practice from time to time for other significant cooling water discharge consents in the region.

Electronic transmission to Council of cooling water discharge volume data was instituted during the 2015-2016 year following an agreement by Council in July 2014 not to review the discharge consents, but to have

this information provided by agreement, in order to have the information available to Council for water allocation purposes. This monitoring falls, which is within the scope of condition 1 of consents 0919 and 0924, required the installation of new flow monitoring equipment on the cooling water and cooling water/stormwater discharge lines. The provision of this data (originally due by 31 August 2015 and rescheduled to 30 September 2015) was delayed by more than three months (until January 2016), while landscaping was completed around new cooling towers, and data transmission processes were established. Transmission of electronic abstraction data already collected by the Company was established at the same time. (Electronic transmission of water temperature upstream and downstream in the Kaupokonui had been in place since March 2014). During the 2015-2016 and 2016-2017 and start of the 2017-2018 years there were ongoing problems with transmission of the data, in terms of missing record and of accuracy. In the interim, the daily values that were supplied by the Company in its monthly report were used to determine consent compliance retrospectively on volumes and temperatures. Investigations in the 2017-2018 year allowed most of the missing data to be backfilled, and corrupt data to be corrected for the 2016-2017 year. However, further assessment of the data during the 2018-2019 year identified that there remained an issue with the accuracy of the flow meter for the cooling water discharge covered by consent 0919-3 during the year under review. Council was informed that the Company incorrectly installed the flow meter in a location that means it will not be capable of delivering, nor being certified as delivering, data of the agreed accuracy without significant further capital investment. The location also results in the discharge flow rate not capturing any losses at the cooling tower, which is thought to be the major source of water "usage" at the site. At the time of writing this report enforcement options were being considered, with the possibility of an abatement notice being issued to bring about compliance with condition 1 of consent 0919. This will be discussed further in the 2018-2019 report.

The main cooling system was replaced in August 2015, in order to reduce the temperature of the discharge and ensure compliance with the temperature limit on consent 0919. The monthly median cooling water temperature upstream of the spray discharge system during the year under review was 29 to 37°C. There is no temperature monitoring undertaken of the cooling water entering the stream or of the stream itself at the point of discharge, however a degree of further evaporative cooling is expected due to the discharge mechanism. 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.

Two incidents were recorded; an unauthorised discharge of process waste that caused offensive and objectionable odours beyond the boundary of the waste contractors site, this was considered a significant adverse effect. The waste was enroute to being disposed of, in breach of consent conditions, at another consent holder's green waste site. Due to a lack of waste stewardship an abatement notice was issued to the Company, along with the other two parties involved, requiring that the material be removed and disposed of appropriately. An infringement fine was subsequently issued to all three parties. Following this the Company ensured that the waste was disposed of at an appropriate location in a consented manner. A second infringement notice was issued to the Company after stormwater from the southern stormwater pond was discharges with a pH that was outside consent conditions. Other discharges from the site breached consent conditions at the time of the same sampling survey. However, on this occasion, there were no resultant significant adverse effects.

Recorded annual abstraction volume from Kaupokonui Stream increased in the 2017-2018 year, which follows decreases in the two previous monitoring period of 14% in the 2016-2017and about 10% in 2015-2016. Across the whole season, the median measured strength of wastewater irrigated onto land remained similar to the previous year, but with an increased volume of waste irrigated. Despite this, the estimated total mass of nitrogen calculated indicated a decrease, but this was calculated based on fewer wastewater samples analysed by the Company during the year under review than in previous years.

Disposal of DSE to land via the factory effluent spray irrigation system was established in 2015-2016, replacing the oxidation pond treatment systems which had discharged to a Kaupokonui 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 combined factory wastewater and DSE in the 2017-2018 year was 20% less than the previous year on Farm 1 and 14% less than the previous year on Farms 2 and 3. Again it is noted that the 2017-2018 calculations were based on less frequent analytical determinations during this season.

Two major projects were completed during the 2007-2008 reporting period which have had long-term beneficial effects on environmental performance: extension of the wastewater irrigation system, and construction of a stormwater detention system.

The 41% extension of irrigation area, from 120 to 169 ha in 2006, with little change in effluent volume and nitrogen mass has significantly reduced loading rates on soil and groundwater, and the use of automated in-ground irrigators has greatly improved the management of the combined waste disposal and farming operation.

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. As discussed a similar system was put in place for the remainder of the site during the year under review.

Riparian planting was maintained on the factory site and a payment was received by the Council as per consent conditions.

3.2 Environmental effects of exercise of consents

An assumption had previously been made that the abstraction for the cooling water was close to being non-consumptive. Following the resolution of the issues that affected the cooling water discharge rates provided for the 2016-2017 year, it was stated in the 2016-2017 Annual Report that assessment of the consumptive nature of the abstraction, and the impact this may be having on the flow of the Kaupokonui Stream could now be made once sufficient data was available, noting that any losses due to evaporation or wind drift at the point of discharge is additional to any measured water consumption through the plant. During the year under review, with more data at hand it was found that the data being supplied did not meet the agreed standards as far as accuracy was concerned, an Council was also informed that the flow meter was positioned upstream of the cooling towers, considered to be the main consumptive use at the site. As a result the consumptive nature of the water take, and potential effects on the stream cannot be reliably assessed from a water allocation perspective, and is a noncompliance with condition 1 of consent 0919. However, it is noted that ecological monitoring did not find any significant adverse effects in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes during the year under review.

The discharge of cooling water did not have a visible effect on receiving waters during the monitoring period, and there was good compliance with discharge permit conditions. Although there were consent exceedances in relation to the pH of both of the stormwater pond discharges and the cooling water/stormwater discharge on one occasion, due to the relative flow conditions prevailing at the time of the survey, no adverse effects were found. Biological monitoring of the Kaupokonui Stream during spring 2017 and summer 2018 did not show any significant adverse effect of the cooling or stormwater discharges to the stream on streambed communities.

A fish survey carried out in winter 2017 found no indication that the weir was posing a significant barrier to fish passage, or that cooling water had adversely affected the fish communities, and trout were seen above the weir on three of the site inspections during the year under review. It is noted however, that the fish

survey report states that only the best swimmers would be expected to be able to negotiate the Glenn Road weir. The next survey is due in summer 2020.

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. However, it is noted that 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. The consent also prohibits downstream temperatures in excess of 25˚C downstream of the plant as a result of the cooling water discharges. During the year under review, the upstream temperature reached 24.8˚C, at which time the Company shut down the evaporators until the stream temperature dropped and they could be restarted. This was done on two consecutive evenings to ensure that this condition was not breached.

Irrigation onto the dairy farms was, in general, well managed. At inspection it was found that a 20 m buffer to the bank of water courses was maintained. A small patch of dead grass was noted at one of the 12 inspections carried out. This was considered to be a short term, minor effect only.

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 increased 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. This was reversed for 2015-2016, and maintained for 2016-2017. The nitrogen application rates decreased by about 20% on Farm 1 and 14% on Farms 2 and 3, returning to similar application rates to those in 2012-2013. There was a reduction in the number of occasions on which the nitrate concentration in the groundwater bore at the southern boundary of Farm 1 was above the drinking water standard. In contrast to the 2016-2017 year, there were also two samples collected from the Farm 1 control bore that exceeded the drinking water standard. The control bore for Farm 2 (GND2049) was again consistently above the drinking water standard and the control bore for Farm 3 (GND2051) was above the standard in four of the seven samples collected. The reason for this elevation in the control bores is to be investigated by the Company and presented in the AEE for the consent renewal. The farm 2 impact bores where the drinking water standard was exceeded in some of the samples collected during the year under review were the two sites near the Waiokura Stream (GND2050 -two of seven samples and GND0639 – one of seven samples). Although the nitrate concentrations were elevated in the two Farm 3 impact bores at times, they remained below the drinking water standard.

Biological surveys found no effect on the stream communities of Kaupokonui Stream or Waiokura Stream in relation to land irrigation.

Prior to their decommissioning, the stormwater discharged from the northern outfall complied with the conditions of consent **4604-2** and the stormwater discharged from the IGL plant stormwater outfall complied with the conditions of consent **6423-1.**

Particulate deposition from air emissions were generally similar to the previous monitoring periods, with all but one sites within the guideline target value set by the Council. The exception to this was site AIR002303, south of the site opposite the southern stormwater pond, which was downwind of the site for a significant period of time during the survey and was about 20% higher than the guideline value. However, no complaints were received by Council in relation to deposited particulates and inspections found no evidence of depositions. Odour surveys continued to note a very occasional low level of odour off site, with some odour observed around the effluent tank and in the vicinity of this depending on the direction of the wind. There were no odours noted in the vicinity of the Pro-liq ponds during the year under review.

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Table 44 to Table 61

Table 44 Summary of performance for Consent 0302-3

Purpose: ***To take and use up to 19,500 cubic metres/day (225 litres/second) 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**

Table 45 Summary of performance for Consent 0919-3

Purpose: ***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***		
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	**No. See Table 46**
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	Yes
6. Continuous monitoring of temperature of receiving water required	Temperature information supplied by the Company	Yes, with minor loss of record
7. Review of conditions 4 and 5	No further provision for review	N/A
8. No thermal barrier or growths as a result of discharge within the mixing zone	Temperature information, site inspections, fish survey in 2017	Yes
9. No anti-corrosion agents, biocides, anti-flocculants or other chemicals added to cooling water	Site inspections, sample collection	Yes

Purpose: *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*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
10. Maintenance of riparian zone and annual donation to Taranaki Tree Trust	Site inspections, donation received	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		**Improvement required**

Table 46 Summary of performance for agreed monitoring additional to consent 0919-3

Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014		
Agreed monitoring	**Status**	**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	Deferred to 30 September 2015. First data provided 14 January 2016, but is upstream of cooling tower and continues to be affected by errors	**Data not to required standard of accuracy.**
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	Deferred to 30 September 2015. First data provided 14 January 2016. Accuracy issues continuing.	**Data not to required standard of accuracy.**
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	**No certification received**

Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014		
Agreed monitoring	**Status**	**Agreed monitoring standards met**
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy	Council advised that verification is not possible	Not assessed
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	Deferred to 30 September 2015. First data provided 14 January 2016	**Daily data not auditable during the year under review due to errors**
Overall assessment of consent compliance and environmental performance in respect of this agreement		**N/A**
Overall assessment of administrative performance in respect of this agreement		**Improvement required**

Table 47 Summary of performance for Consent 0920-3

Purpose: ***To take up to 700 cubic metres/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**

Table 48 Summary of performance for Consent 0921-3

Purpose: ***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***		
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

Purpose: *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*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
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**

Table 49 Summary of performance for Consent 0922-3

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. Maintenance of effluent spray irrigation plan, with specific matters to be covered in plan		Not Assessed
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 and upon two months' notice by Council	Plan reviewed and updated June 2018	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 metre '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**

Table 50 Summary of performance for Consent 0923-3

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	**One minor patch of grass burn observed**
2. Maintenance of effluent spray irrigation plan		Not Assessed
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 June 2018	Yes
6. Operation of system in accordance with plan. Staff training	Site and farm inspections	Yes
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	Yes
12. Remediation in case of contamination of groundwater or roof water supply		N/A
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		**Good**
Overall assessment of administrative performance in respect of this consent		**High**

Table 51 Summary of performance for Consent 0924-3

Purpose: *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*		
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	Yes
6. Consent holder to constantly monitor the temperature of the receiving waters	Consent holder maintains temperature probes in stream, 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	**One exceedance of pH limit from the stormwater/cooling water line and one from the southern pond. Infringement notice issued**
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. Latest plan on record April 2018.	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		**Good**
Overall assessment of administrative performance in respect of this consent		**Improvement required**

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

Table 52 Summary of performance for agreed monitoring additional to consent 0924-3

Additional monitoring proposed by the Company that allowed the notice of review to be withdrawn in August 2014		
Agreed monitoring	**Status**	**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	Deferred to 30 September 2015. First data provided 14 January 2016. Flow diverted and line decommissioned early in the season, with pipe removed February 2018	Not assessed
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	Deferred to 30 September 2015. First data provided 14 January 2016	Not assessed
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	Not assessed
4. Flow recording devices accessible to Council for inspection, data retrieval and verification of accuracy		Not assessed
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	Deferred to 30 September 2015. First data provided 14 January 2016	Not assessed
Overall assessment of consent compliance and environmental performance in respect of this agreement		**N/A**
Overall assessment of administrative performance in respect of this agreement		**N/A**

Table 53 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

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?**
3. Limits of particulate from wet scrubber	Stack testing in October 2017	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**

Table 54 Summary of performance for Consent 4235-2

Purpose: *To discharge up to 240 cubic metres/day of stormwater from the factory site via the existing stormwater system into the Kaupokonui Stream only during factory shutdown periods*		
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	Yes
2. Levels of contaminants not to be exceeded in discharge	No sampling was undertaken during period under review	N/A
3. Contingency plan	Plan dated April 2018	Yes
4. Definition: Factory shut down when no whey is being processed		N/A
5. Review of consent	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**

Table 55 Summary of performance for Consent 4604-2

Purpose: *To discharge up to 280 litres/second 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	**One minor pH range exceedance post installation of northern stormwater pond**
3. Contingency planning	Latest plan on record April 2018	Yes
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		**Good**

Table 56 Summary of performance for Consent 4623-3 (from 14 December 2017)

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. No maintenance required	Yes
3. Required prior notice of commencement of maintenance work	Inspection, no works found or notified during the period the consent was in effect	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**

Table 57 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	Latest plan on record April 2018	Yes
2. Exercise of consent in accordance with application	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?**
3. Best practicable option to minimise environmental impacts	Site inspections	Yes
4. Limits on pH, suspended solids and hydrocarbons in the discharge	Sample collection	**One minor pH range exceedance post installation of northern stormwater pond**
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		**Good**

Table 58 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		N/A
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		N/A
5. Minimise disturbance of riverbed		N/A
6. Works resulting in downstream discolouration to be undertaken between November and April		N/A
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**

Table 59 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	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 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**

Table 60 Summary of performance of Consent 10214-1

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**

Table 61 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**

Table 62 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**

Although the Company generally demonstrated a high level of environmental performance and compliance when considered strictly against the Company's resource consents, overall the Company demonstrated poor environmental performance as defined in Section 1.1.4. An abatement notice and infringement notice were issued to the Company in relation to a lack of processing waste stewardship that contributed to the resultant offensive and objectionable odours beyond the boundary of the waste contractors Hawera site during the conveyance of the material to a disposal site that was not consented to receive the material.

With respect to the administrative performance, there are still ongoing issues with provision of accurate real time monitoring data that was due by 30 September 2015. In addition to this, stormwater pond discharge monitoring by the Company failed to prevent the (all be it low flow) discharges that exceeded the pH range permitted by the consent. An infringement fine was issued. An improvement is therefore required in the Company's administrative performance as defined in Section 1.1.4.

3.4 Recommendations from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of air emissions from the Company's Kapuni site in the 2017-2018 year continue at the same level as in 2016-2017.
2. THAT monitoring of abstractions and discharges at the Company's Kapuni site in the 2017-2018 year continue to be exercised as in 2016-2017
3. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the Company investigate the increasing nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores for inclusion in the assessment of environmental effects that will accompany the consent renewal applications.

Recommendations 1 – 3 were implemented, with recommendation 4 still to be fully implemented.

3.5 Alterations to monitoring programmes for 2018-2019

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.

In the case of Fonterra Limited, the programme for 2017-2018 was essentially the same as that for 2015-2016, with the implementation of the provisional Motumate Stream monitoring commencing in November 2017. It is now proposed that for 2018-2019, the frequency and range of minerals monitored in the receiving waters in the vicinity of the Farm 2 and 3 waste irrigation areas is increased, and that parallel stream temperature monitoring is undertaken.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to adjust this baseline programme should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

4 Recommendations

1. THAT in the first instance, monitoring of air emissions from the Company's Kapuni site in the 2018-2019 year continue at the same level as in 2017-2018.
2. THAT monitoring of abstractions and discharges at the Company's Kapuni site in the 2018-2019 year be amended from that in 2016-2017 by the inclusion of additional mineral and organic strength monitoring of the receiving waters in the vicinity of the Farm 2 and Farm 3 waste irrigation areas, and that a period of parallel stream temperature monitoring be undertaken.
3. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the Company investigate the increasing nitrate nitrogen concentrations in the Farm 2 and Farm 3 control bores for inclusion in the assessment of environmental effects that will accompany the consent renewal applications.

Glossary of common terms and abbreviations

The following abbreviations and terms are 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 20˚C and expressed in mS/m.
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.

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Appendix I

Resource consents held by Fonterra Limited

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

Consent number	Purpose	Next review date	Expiry date 1 June	Activity's consent status at 30 June 18	Document number	Changed from last year?
0302-3	Take from Kaupokonui	-	2019	Current	1509557	Same
0919-3	Discharge cooling water to Kaupokonui	-	2019	Current	1509459	same
0920-3	Take from bore [Application to renew received 1 December 2016]	-	2017	Expired - S.124 Protection	1509239	same
0921-3	Discharge cooling water to trib. of Motumate Stream [Application to renew received 1 December 2016]	-	2017	Expired - S.124 Protection	1509441	same
0922-3.0	Discharge factory wastewater and DSE to land (North)	-	2019	Current	1540193	same
0923-3.3	Discharge factory wastewater and DSE to land (South)	-	2019	Current	1540202	same
0924-3	Discharge storm & cooling water to Kaupokonui	-	2019	Current	1509523	same
4032-5	Discharge emissions to air	-	2019	Current	1509537	same
4235-2	Discharge stormwater during factory shutdown periods [Separate consent for this activity no longer required]	-	2017	Expired - S.124 Protection	1509118	same
4604-2	Discharge stormwater from extension to Kaupokonui [Application to renew received 1 December 2016. Activity to be combined with 6423-3]	-	2017	Expired - S.124 Protection	1509422	same
4623-2	Structures for spray, stormwater, irrigation and take [Application to renew received 21 July 2017]	-	2017	Expired	1509296	same
4623-3	To use a weir in the bed of the Kaupokonui Stream, and to dam water for water supply purposes [granted 14 December 2017]	-	2019	Current	1982449	NEW
5368-1	Structure over Little Dunn's Creek	-	2017	Deemed permitted	1509201	same

Consent number	Purpose	Next review date	Expiry date 1 June	Activity's consent status at 30 June 18	Document number	Changed from last year?
	[Application to renew received 21 July 2017]			[22 Nov 2017]		
6422-1	Structure for stormwater outlet (IGL plant) [Application to renew received 21 July 2017]	-	2017	Deemed permitted [22 Nov 2017]	1509288	same
6423-1	Discharge stormwater to Kaupokonui (IGL plant) [Application to renew received 1 December 2016]	-	2017	Expired - S.124 Protection	1509712	same
6885-1	Structure for stormwater (pond) outlet [Application to renew received 21 July 2017]	-	2017	Deemed permitted [22 Nov 2017]	1509312	same
6948-1	Structure for pipeline over Motumate and Waiokura	-	2023	Current	1509704	same
9546-1	Install culvert in Waiokura Stream	2023	2029	Current	1509618	same
10214-1	Discharge solid dairy farm effluent to land	2023	2041	Current	1637694	same
10232-1	Discharge pond sludge from farm dairy effluent to land	2023	2041	Current	1637702	same
10412-1	Installation of a dual culvert in the Waiokura Stream	2035	2023	Current	1832653	same

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

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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

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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

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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

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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

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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

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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

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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 240 cubic metres/day of stormwater from the factory site via the existing stormwater system into the Kaupokonui Stream only during factory shutdown periods
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 allowing for a mixing zone of 150 metres extending downstream of the periphery of the spray discharge zone, 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 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 g/m^3

3. That the consent holder shall prepare and 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.

4. That the purpose of this consent the factory shall be deemed to be shut down when no whey is being processed.

5. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during 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

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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

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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:	4 February 1999
Commencement Date:	4 February 1999

Conditions of Consent

Consent Granted:	To erect, place, use and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream
Expiry Date:	1 June 2017
Site Location:	Manaia Road Kapuni Kaponga
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 notify the Taranaki Regional Council at least 48 hours prior to undertaking any maintenance works that would involve disturbance of, or deposition to the river bed or discharges to water.

2. That the structure[s] authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

3. That the consent holder shall adopt the best practicable option [as defined in the Resource Management Act] to avoid or minimise the discharge of silt or other contaminants into water or onto the river bed and to avoid or minimise the disturbance of the river bed and any adverse effects on water quality.

4. That structures which are the subject of this consent shall not obstruct the passage of eels, mature fish, juveniles and adult trout.

5. That 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 by the written approval of the Chief Executive, Taranaki Regional Council.

6. That 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.

7. 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 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

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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

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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:	21 July 1998
Commencement Date:	21 July 1998

Conditions of Consent

Consent Granted:	To erect, place, use and maintain a bridge over Little Dunns Creek a tributary of Dunns Creek in the Kaupokonui catchment for access purposes
Expiry Date:	1 June 2017
Site Location:	Little Dunns Creek, Manaia Road, Kapuni
Legal Description:	Road Reserve Blk XV Kaupokonui SD
Grid Reference (NZTM)	1696440E-5630060N
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 notify the Taranaki Regional Council at least 48 hours prior to commencement, and upon completion of the initial construction, and again prior to, and upon completion of, any subsequent maintenance works which might involve disturbance of the streambed or discharges to the watercourse.

2. That the structure licenced by this consent shall be constructed and maintained in accordance with the documentation submitted in support of application 401.

3. That during the construction, and any subsequent maintenance of the bridge and its approaches, the consent holder shall observe every practicable measure to prevent the discharge or placement of silt and/or organics and/or cement products and/or any other contaminants into the watercourse.

4. That the structure covered by this consent shall be removed and the area reinstated, if and when it is no longer required.

5. That the consent holder shall ensure that there is not discharge of contaminated stormwater to the watercourse from the bridge or its approaches.

6. 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 adequately deal with the environmental effects arising from the exercise of this consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Transferred at Stratford on 13 April 2015

For and on behalf of
Taranaki Regional Council

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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:	13 July 2004
Commencement Date:	13 July 2004

Conditions of Consent

Consent Granted:	To erect, place and maintain a stormwater outlet structure in the bed of 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. The consent holder shall notify the Chief Executive, Taranaki Regional Council in writing at least 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the river bed or discharges to water.

2. The structure authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of application 3197 and shall be maintained to ensure the conditions of this consent are met. In the case of any contradiction between the documentation submitted in support of application 3197 and the conditions of this consent, the conditions of this consent shall prevail.

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. 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.

5. 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.

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

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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

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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:	12 May 2006
Commencement Date:	12 May 2006

Conditions of Consent

Consent Granted:	To erect, place and maintain an outlet structure in the Kaupokonui Stream for stormwater discharge purposes
Expiry Date:	1 June 2017
Site Location:	Manaia Road, Kapuni
Legal Description:	Lot 6 Pt Lot 5 DP 4509 Pt Lot 2 DP 6157 Secs 51 & 55 Blk XV Kaupokonui SD
Grid Reference (NZTM)	1697690E-5629540N
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 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.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4214. In the case of any contradiction between the documentation submitted in support of application 4214 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 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.

4. 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.

5. 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.

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 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

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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

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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 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

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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

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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

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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

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A D McLay
Director - Resource Management

Appendix II

Analytical monitoring results for the Kaupokonui and Waiokura Streams

(Kaupokonui Stream sites KPK000655, KPK000660, KPK000679)
(Waiokura Stream sites WKR000500, WKR000630, WKR000650)

Sample date: 20 July 2017 (flow at Glenn Road – 4.3 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:17	10:02	10:40	The stream was at moderate flow, and appeared clear. There was good agreement between the measured and telemetered temperatures.
Total BOD	g/m^3	<0.5	<0.5	<0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	9.3	9.8	10.1	
DRP	g/m^3P	0.016	0.014	0.016	
Ammonia-N	g/m^3N	0.03	0.021	0.027	
Nitrate-N	g/m^3N	0.95	1.08	1.18	
pH	pH	7.6	7.6	7.6	
Temperature	°C	9.2	9.6	9.5	
Turbidity	NTU	1.2	1.3	1.4	

Sample date: 17 August 2017 (flow at Glenn Road – 4.6 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:20	10:15	11:03	The stream was at moderate flow.
Total BOD	g/m^3	<0.5	<0.5	0.6	
Filtered BOD	g/m^3	<0.5	<0.5	0.5	
Conductivity	mS/m	8.5	9	9.6	
DRP	g/m^3P	0.027	0.023	0.023	
Ammonia-N	g/m^3N	0.065	0.048	0.035	
Nitrate-N	g/m^3N	0.87	0.97	1.05	
pH	pH	7.6	7.6	7.5	
Temperature	°C	10.3	10.1	10.8	
Turbidity	NTU	2	2	2	

Sample date: 21 September 2017 (flow at Glenn Road – 4.8 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:40	10:35	11:05	Clean clear flow. At upstream site - trickle flow discharge of effluent from race running into stream just dowstream of bridge and some dripping from sides of bridge. Sample collected under bridge away from localised visible effects.
Total BOD	g/m^3	<0.5	<0.5	<0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	8.5	9	9.1	
DRP	g/m^3P	0.023	0.027	0.024	
Ammonia-N	g/m^3N	0.04	0.035	0.03	
Nitrate-N	g/m^3N	0.84	0.92	0.92	
pH	pH	7.6	7.4	7.6	
Temperature	°C	9.6	9.9	10.5	
Turbidity	NTU	1.9	1.9	2.4	

Sample date: 19 October 2017 (flow at Glenn Road – 2.7 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	10:26	11:28	12:10	Clear flow. Upstream sample collected 50 m downstream of farm bridge. Three trout observed around intake
Total BOD	g/m^3	0.5	<0.5	0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	9.8	10.5	11.1	
DRP	g/m^3P	0.015	0.015	0.017	
Ammonia-N	g/m^3N	0.032	0.023	0.018	
Nitrate-N	g/m^3N	0.98	1.1	1.17	
pH	pH	7.6	7.6	7.6	
Temperature	°C	10.3	10.5	11.0	
Turbidity	NTU	1.2	0.96	3.7	

Sample date: 16 November 2017 (flow at Glenn Road – 1.41 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	10:10	10:44	11:24	Clear moderate flow. Four trout observed around intake.
Total BOD	g/m^3	<0.5	<0.5	<0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	9.3	10.2	10.4	
DRP	g/m^3P	0.024	0.023	0.026	
Ammonia-N	g/m^3N	0.041	0.025	0.021	
Nitrate-N	g/m^3N	0.74	0.89	0.91	
pH	pH	7.7	7.8	7.9	
Temperature	°C	13.1	13.2	14.2	
Turbidity	NTU	0.58	0.58	0.59	

Sample date: 12 December 2017 (flow at Glenn Road – 0.86 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:29	10:37	11:08	Clear moderate flow. Three trout observed around intake.
Total BOD	g/m^3	<0.5	0.5	1.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	9.7	10.8	10.9	
DRP	g/m^3P	0.017	0.019	0.018	
Ammonia-N	g/m^3N	0.012	0.011	0.01	
Nitrate-N	g/m^3N	0.62	0.77	0.77	
pH	pH	7.9	7.9	8.1	
Temperature	°C	17.7	18.2	19.2	
Turbidity	NTU	1	1	0.97	

Sample date: 18 January 2018 (flow at Glenn Road – 17.2 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:17	09:46	10:33	Stream in high flow, turbid, no odour. Site KPK000655 sampled upstream of bridge.
Total BOD	g/m^3	2.1	2.1	2.1	
Filtered BOD	g/m^3	1.2	1.4	1	
Conductivity	mS/m	3.8	3.8	3.6	
DRP	g/m^3P	<0.003	<0.003	<0.003	
Ammonia-N	g/m^3N	0.026	0.014	0.011	
Nitrate-N	g/m^3N	0.06	0.07	0.06	
pH	pH	7.2	7.2	7.2	
Temperature	°C	15	15	15.4	
Turbidity	NTU	11	10	10	

Sample date: 15 February 2018 (flow at Glenn Road – 1.3 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:25	08:45	09:10	Moderate flow.
Total BOD	g/m^3	0.5	0.6	0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	7.9	8.2	8.3	
DRP	g/m^3P	0.014	0.014	0.015	
Ammonia-N	g/m^3N	0.018	0.01	0.018	
Nitrate-N	g/m^3N	0.19	0.26	0.26	
pH	pH	7.7	7.7	7.8	
Temperature	°C	16.6	16.7	18.6	
Turbidity	NTU	0.95	0.68	0.72	

Sample date: 15 March 2018 (flow at Glenn Road – 2.0 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:29	10:15	10:53	Clear moderate flow.
Total BOD	g/m^3	<0.5	<0.5	<0.5	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	9.3	9.6	9.7	
DRP	g/m^3P	0.022	0.022	0.024	
Ammonia-N	g/m^3N	0.021	0.018	0.025	
Nitrate-N	g/m^3N	0.61	0.71	0.71	
pH	pH	7.6	7.6	7.7	
Temperature	°C	14.3	14	15.5	
Turbidity	NTU	0.78	0.82	0.74	

Sample date: 26 April 2018 (flow at Glenn Road – 2.1 m^3/s). Analysed at contract laboratory

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:58	10:23	10:48	Clear moderate flow.
Total BOD	g/m^3	< 2	< 2	< 2	
Filtered BOD	g/m^3	< 2	< 2	< 2	
Conductivity	mS/m	10.1	10.5	10.7	
DRP	g/m^3P	0.014	0.014	0.014	
Ammonia-N	g/m^3N	0.026	0.015	0.017	
Nitrate-N	g/m^3N	0.76	0.86	0.88	
pH	pH	7.6	7.6	7.6	
Temperature	°C	11.5	11.8	12.8	
Turbidity	NTU	0.87	0.74	0.42	

Sample date: 17 May 2018 (flow at Glenn Road – 8.9 m^3/s). Analysed at contract laboratory

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:16	09:55	10:20	Swift, moderate and slightly turbid flow.
Total BOD	g/m^3	< 2	< 2	< 2	
Filtered BOD	g/m^3	< 2	< 2	< 2	
Conductivity	mS/m	8.2	8.4	8.8	
DRP	g/m^3P	0.02	0.02	0.023	
Ammonia-N	g/m^3N	0.097	0.083	0.074	
Nitrate-N	g/m^3N	0.41	0.46	0.47	
pH	pH	7.6	7.7	6.9	
Temperature	°C	9.0	9.2	10.3	
Turbidity	NTU	6.6	5.0	5.2	

Sample date: 21 June 2018 (flow at Glenn Road – 4.0 m^3/s). Analysed at contract laboratory

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:35	09:10	09:43	Clear moderate flow.
Total BOD	g/m^3	< 2	< 2	< 2	
Filtered BOD	g/m^3	< 2	< 2	< 2	
Conductivity	mS/m	7	6.7	6.7	
DRP	g/m^3P	0.016	0.016	0.016	
Ammonia-N	g/m^3N	0.045	0.026	0.028	
Nitrate-N	g/m^3N	0.92	0.99	1.0	
pH	pH	7.7	7.4	7.4	
Temperature	°C	7.6	7.8	7.8	
Turbidity	NTU	0.77	0.62	0.71	

Sample date: 3 July 2017

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	11:45	12:00	12:15
Conductivity	mS/m	22	21	20.1
DRP	g/m^{3}P	0.043	0.041	0.042
Sodium	g/m^3	20.8	19.4	18.4
Nitrate-N	g/m^{3}N	3.54	3.47	3.44
pH	pH	7.6	7.6	7.6
Temperature	°C	11.8	11.7	11.7

Sample date: 4 September 2017

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	10:30	10:45	11:00
Conductivity	mS/m	21.9	23.5	24.1
DRP	g/m^{3}P	0.036	0.041	0.039
Sodium	g/m^3	20.2	22	23
Nitrate-N	g/m^{3}N	4.13	4.24	4.27
pH	pH	7.7	7.7	7.7
Temperature	°C	11.3	11.5	11.3

Sample date: 6 November 2017

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	08:45	09:15	09:40
Conductivity	mS/m	21.5	23	23.7
DRP	g/m^{3}P	0.035	0.034	0.036
Sodium	g/m^3	20.3	22.7	23.8
Nitrate-N	g/m^{3}N	3.7	3.72	3.8
pH	pH	7.7	7.6	7.8
Temperature	°C	12.6	13.6	13.1

Sample date: 8 January 2018

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	09:40	10:00	10:10
Conductivity	mS/m	21.4	22.6	23.9
DRP	g/m³P	0.063	0.059	0.055
Sodium	g/m³	21.3	23.0	24.9
Nitrate-N	g/m³N	2.48	3.18	3.54
pH	pH	7.6	7.7	7.5
Temperature	°C	15.7	17.1	16.8

Sample date: 6 March 2018

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	09:00	09:15	09:30
Conductivity	mS/m	21.5	22.9	28.5
DRP	g/m³P	0.047	0.038	0.444
Sodium	g/m³	20.1	22.0	24.8
Nitrate-N	g/m³N	1.77	1.74	1.68
pH	pH	7.8	7.8	7.6
Temperature	°C	17.4	18.0	18.6

Sample date: 1 May 2018

Parameter	Unit	Site		
		WKR000500	WKR000630	WKR000650
Time	NZST	09:35	09:50	10:10
Conductivity	mS/m	22.5	22.4	23.5
DRP	g/m³P	0.172	0.08	0.088
Sodium	g/m³	20.2	22.6	24.3
Nitrate-N	g/m³N	2.81	2.70	3.03
pH	pH	7.6	7.6	7.6
Temperature	°C	13.9	14.1	14.3

Appendix III

Groundwater monitoring data

Site	Date	Time NZST	LEVEL m	TEMP Deg.C	CONDY mS/m@20C	PH pH	NNN g/m³ N	CL g/m³	NA g/m³	NH_4 g/m³ N	COD g/m³
Farm 1											
GND0636	04-Jul-17	12:10	2.5	13.8	30.3	6.6	6.5				
	24-Aug-17	13:15	1.9	14.0	39.6	6.7	11.3	48.8		<0.003	
	02-Nov-17	13:10	2.3	13.6	26.7	6.5	4.9	29.6	21.8	<0.003	<5
	18-Dec-17	12:00	3.0	14.5	26.6	6.5	6.1				
	13-Feb-18	12:45	3.4	14.6	27.9	6.4	6.8	32.9	24.4	0.007	<5
	02-May-18	13:50	3.2	15.1	27.8	6.5	7.5				
	01-Jun-18	13:15	2.4	14.0	37.3	6.7	11.9				
GND0637	04-Jul-17	14:00	3.7	14.1	52.7	6.6	11.6				
	24-Aug-17	11:55	3.0	14.3	55.5	6.6	10.7	41.5		<0.003	
	02-Nov-17	12:50	3.2	14.4	59.8	6.5	10.2	53.9	64.4	<0.003	<5
	18-Dec-17	11:30	4.2	14.3	61.1	6.6	8.8				
	13-Feb-18	12:20	5.1	15.6	37.4	6.6	5.3	38.1	43.6	0.006	<5
	02-May-18	13:30	4.9	14.3	38.6	6.6	5.3				
	01-Jun-18	12:55	3.4	14.1	55.2	6.7	8.3				
Farm 2											
GND2049	04-Jul-17	8:45	2.1	14.4	35.5	6.4	14.9				
	24-Aug-17	9:45	2.0	13.9	34.5	6.5	15.0	29.0		<0.003	
	02-Nov-17	9:50	2.4	13.5	37.1	6.4	19.2	31.1	30.6	<0.003	<5
	18-Dec-17	8:50	3.0	14.9	40.2	6.4	22.1				
	13-Feb-18	9:05	3.4	15.0	42.4	6.4	22.4	36.0	33.7	0.056	<5
	02-May-18	9:45	2.5	15.2	42.3	6.3	22.0				
	01-Jun-18	10:00	2.0	14.9	39.0	6.4	19.7				
GND0638	04-Jul-17	9:00	2.2	14.9	78.1	6.7	7.3				
	24-Aug-17	10:10	2.1	14.7	73.4	6.7	6.0	49.7		0.005	
	02-Nov-17	9:30	2.7	14.7	74.3	6.6	8.1	49.5	76.2	0.012	<5
	18-Dec-17	8:30	2.9	14.8	70.1	6.6	7.1				
	02-May-18	10:00	2.4	15.3	68.7	6.6	8.7				
	01-Jun-18	10:20	1.6	15.1	70.7	6.7	9.3				
GND0639	04-Jul-17	9:20	2.5	14.1	60.5	6.9	10.8				
	24-Aug-17	10:30	2.5	14.2	65.6	6.9	8.7	58.1		<0.003	
	02-Nov-17	10:10	2.9	13.9	68.6	6.9	9.8	59.4	110	0.003	<5

Site	Date	Time NZST	LEVEL m	TEMP Deg.C	CONDY mS/m@20C	PH pH	NNN g/m^3 N	CL g/m^3	NA g/m^3	NH_4 g/m^3 N	COD g/m^3
	18-Dec-17	9:00	3.3	14.0	67.0	6.9	10.8				
	13-Feb-18	9:15	3.8	14.8	65.4	6.9	11.7	70.3	111	0.005	10
	02-May-18	10:15	2.4	15.4	62.9	6.9	10.1				
	01-Jun-18	10:35	2.2	15.0	59.2	6.9	8.9				
GND2050	04-Jul-17	9:45	2.4	13.9	60.3	6.9	8.3				
	24-Aug-17	10:45	2.3	13.8	70.3	6.8	11.4	63.8		<0.003	
	02-Nov-17	10:15	2.5	14.7	55.8	6.6	0.07	53.2	60.8	0.24	<5
	18-Dec-17	9:20	2.8	14.5	55.9	6.7	0.06				
	13-Feb-18	9:35	2.9	14.8	56.5	6.7	0.46	53.6	57.2	0.372	9
	02-May-18	10:35	2.6	15.4	72.4	6.8	10.4				
	01-Jun-18	10:45	2.0	15.0	69.2	6.8	13.3				
Farm 3											
GND2051	04-Jul-17	10:20	2.7	14.3	39.4	6.4	13.8				
	24-Aug-17	11:30	2.6	14.2	59.7	6.3	29.6	77.0		0.010	
	02-Nov-17	11:00	3.5	14.3	44.0	6.3	13.6	61.8	31.0	0.005	<5
	18-Dec-17	9:50	3.4	14.0	30.2	6.5	6.7				
	13-Feb-18	10:15	3.9	14.8	30.9	6.4	3.4	41.7	25.6	0.004	<5
	02-May-18	11:35	3.3	15.1	38.4	6.4	9.0				
	01-Jun-18	11:15	2.3	14.5	51.1	6.5	18.0				
GND2052	04-Jul-17	10:55	2.0	14.4	39.2	6.7	3.3				
	24-Aug-17	11:50	1.9	14.4	42.0	6.6	2.7	50.6		<0.003	
	02-Nov-17	11:20	2.5	14.8	31.6	6.6	0.5	46.4	47.1	0.010	<5
	18-Dec-17	10:00	3.1	14.5	28.5	6.6	0.0				
	13-Feb-18	10:40	3.2	15.7	34.3	6.6	1.2	47.6	44.0	0.032	5
	02-May-18	11:40	2.4	14.8	39.7	6.6	2.9				
	01-Jun-18	11:30	1.7	14.6	45.0	6.7	6.3				
GND0700	04-Jul-17	11:20	1.3	14.4	71.2	6.8	6.6				
	24-Aug-17	12:25	1.2	13.7	67.2	6.8	7.3	95.6		<0.003	
	02-Nov-17	11:45	2.2	13.9	40.8	6.7	1.7	64.7	60.7	0.037	7
	18-Dec-17	10:45	2.7	14.9	36.2	6.9	0.4				
	13-Feb-18	11:20	3.0	15.0	42.3	6.7	1.1	67.3	58.0	0.060	14
	02-May-18	12:00	2.1	15.4	47.2	6.7	2.2				

Site	Date	Time NZST	LEVEL m	TEMP Deg.C	CONDY mS/m@20C	PH pH	NNN g/m^3 N	CL g/m^3	NA g/m^3	NH_4 g/m^3 N	COD g/m^3
	01-Jun-18	12:30	1.1	14.9	62.7	6.9	4.7				

Appendix IV

Report on fish survey of Kaupokonui Stream
2 June 2017

To	Lorraine Smith, Job Manager
From	Bart Jansma, Scientific Officer
Report No.	BJ300
Doc No.	1924237
Date	30 August 2017

Fish survey in the Kaupokonui Stream in relation to the Fonterra Kapuni lactose factory and weir, June 2017

Introduction

The Fonterra Kapuni lactose factory, located on Manaia Road, Kapuni, sits alongside the Kaupokonui Stream. There are numerous consents held in relation to this factory, a number of which have the potential to impact on the fish communities of the Kaupokonui Stream. For example, the discharge of cooling water could potentially increase the water temperature of the stream, beyond the tolerance limits of those fish species inhabiting it, and the weir associated with the water intake (Figure 1), could pose a barrier to the passage of migrant fish.

Fish monitoring is a relatively recent addition to the monitoring programme for the Fonterra Kapuni lactose factory. The current survey is the second undertaken in relation to the Kapuni Lactose factory since April 1999, and is scheduled to be repeated on a three yearly basis. Results from previously surveys are detailed in reports included in the references section.

Before any results are interpreted, it is necessary to provide some context. Located downstream of the Kapuni Lactose factory, there is a weir known locally as the Glenn Road weir. This weir is an orphaned structure, but is considered to have some historical significance. It also presents a significant barrier to the passage of most fish, with only the best climbers being able to negotiate it. It is considered highly unlikely that swimming species, such as common smelt, inanga and torrentfish, could negotiate this weir, and as such they are not expected to be in the Kaupokonui River near the lactose factory.

Figure 1 Kaupokonui Stream, Kapuni Lactose weir and fish pass

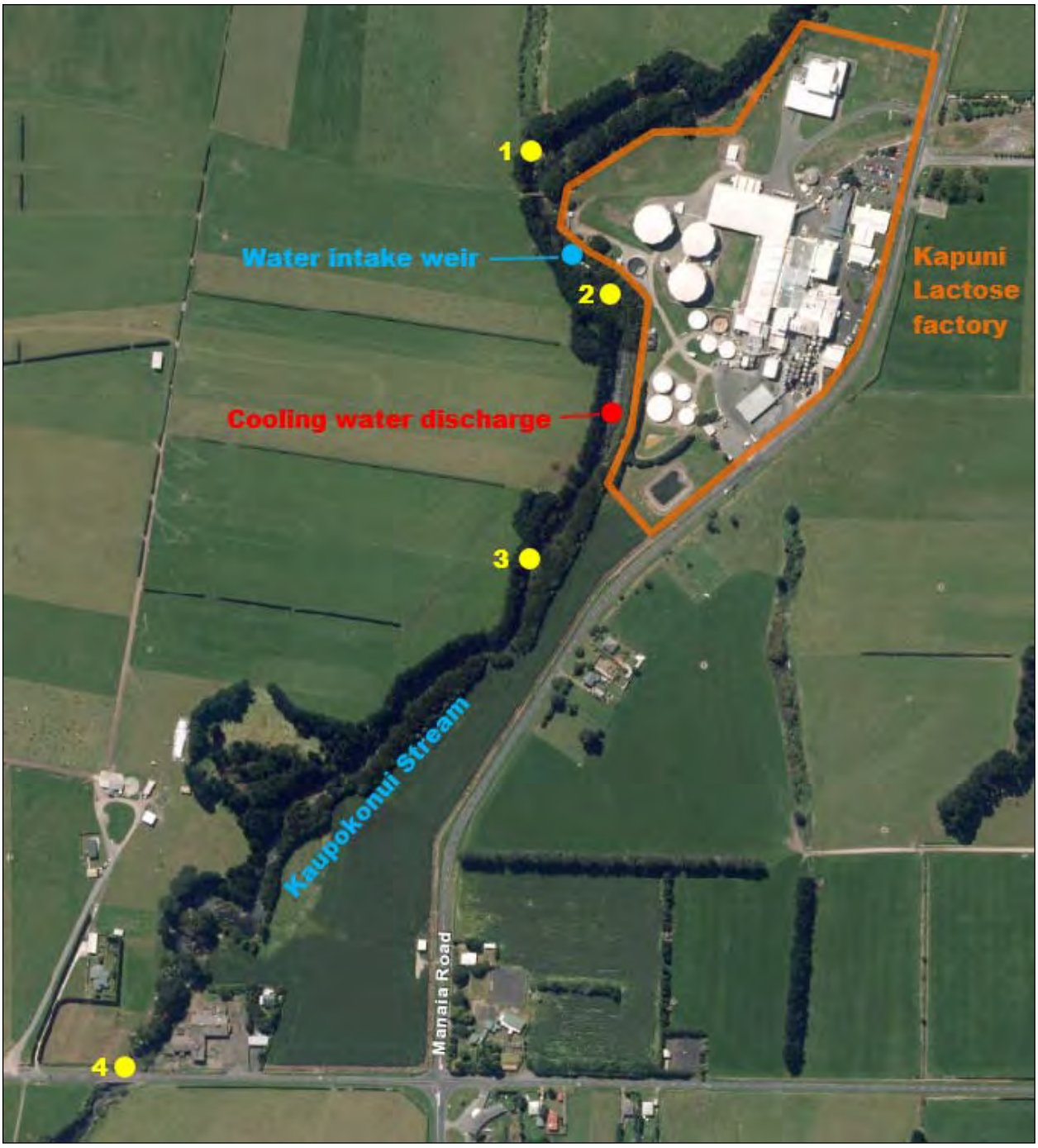

Figure 2 Sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory

Methods

The current survey was performed at four sites in the Kaupokonui Stream on 2 June 2017. Details of the sites surveyed in the current survey are presented in Table 1, and their locations are shown in Figure 2.

The sites were surveyed using the electric fishing method, which employed a Kainga EFM machine. Those fish captured were identified and counted, where possible. Inevitably, some fish eluded capture, although some were identified before reaching cover. The length of each fish was estimated, following which they were released. The results of this survey are presented in Table 3 together with the results of previous surveys.

In addition, the area surveyed was estimated, and some observations made regarding the habitat present at the sites surveyed.

Table 1 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	KPK000660	Upstream of intake weir	E1697613 N5629791	15.98	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

Results

The sites surveyed all included similar habitat, with the substrate comprising predominantly boulders and cobbles, with lesser proportions of gravels and sand. With the exception of site 4, all sites enjoyed partial shading, while undercut banks were noted at sites 1, 2 and 4. Overhanging vegetation was observed at sites 1 and 3. Water clarity was good during this survey, with uncoloured and clear flow at all sites.

The results for the 2014 survey are summarised in Table 2, while the results for the current survey are summarised in Table 2.

Table 2 Fish species, abundance and length range (mm) recorded in January 2014.

Site:		Site 1	Site 2	Site 3	Site 4
Area fished (m^2):		36	72	80	84
Longfin eel (*Anguilla dieffenbachii*)	Number	13	9	9	6
	Length range	100-200	100-150	100-400	150-400
Shortfin eel (*Anguilla australis*)	Number	7	1	-	9
	Length range	100-200	130	-	100-400
Unidentified eel	Number	-	2	2	2
	Length range	-	200-600	100-100	200-350
Redfin bully	Number	-	-	1	1
	Length range	-	-	40	40
Unidentified bully	Number	-	-	-	1
	Length range	-	-	-	80
Rainbow trout	Number	-	-	1	
	Length range	-	-	120	
Unidentified trout	Number	-	-	-	1
	Length range	-	-	-	100
Crayfish	Number	3	10	1	2
Total number of species		2	2	3	4
Total number of fish		20	12	13	20

Table 3 Fish species, abundance and length range (mm) recorded during the current survey.

Site:		Site 1	Site 2	Site 3	Site 4
Area fished (m^2):		84	65	70	84
Longfin eel (*Anguilla dieffenbachii*)	Number	4	4	-	1
	Length range	100-150	80-250	-	150
Shortfin eel (*Anguilla australis*)	Number	1	1	5	1
	Length range	350	200	200-400	300
Unidentified eel	Number	1	1	-	-
	Length range	200	150	-	-
Redfin bully	Number	2	-	2	3
	Length range	50-80	-	50-60	60-90
Unidentified bully	Number	-	1	-	-
	Length range	-	60	-	-
Brown trout	Number	-	1	-	-
	Length range	-	150	-	-
Crayfish	Number	1	-	-	-
Total number of species		3	3	2	3
Total number of fish		8	8	7	5

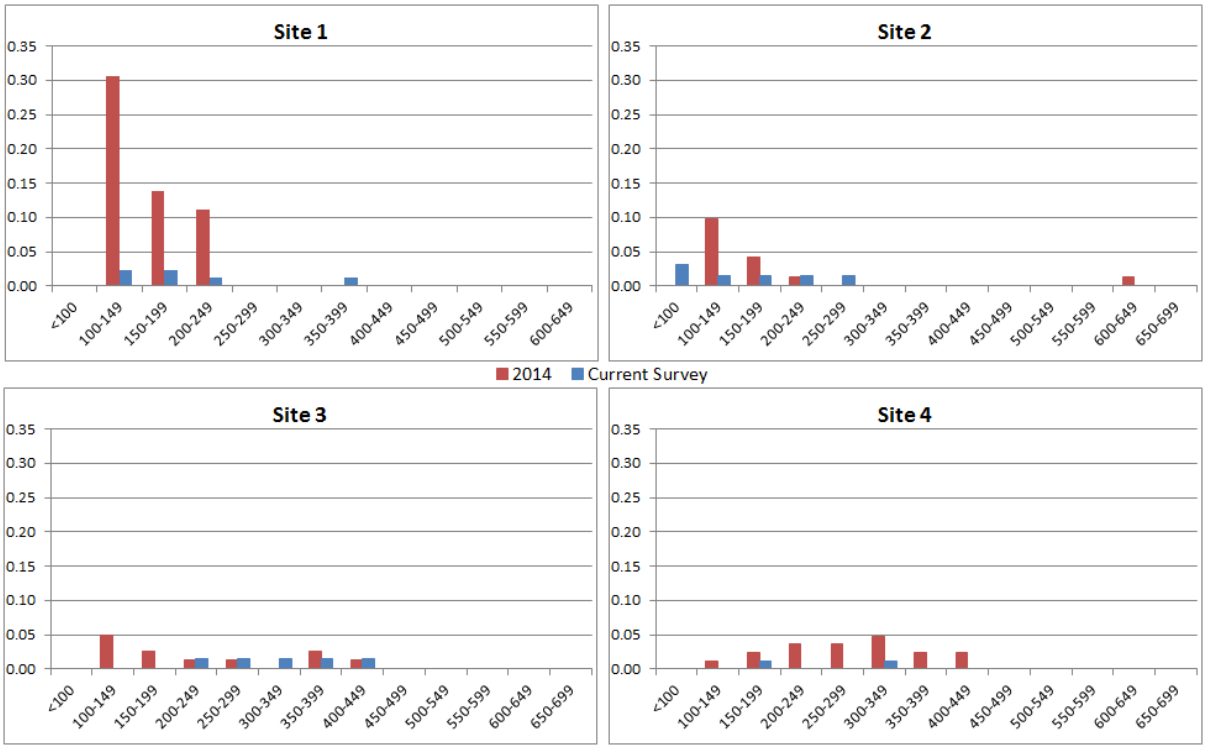

Figure 3 The size of range of eels recorded at each site, compared with the results from the 2014 survey. The data is displayed as number of eels/m^2 surveyed.

Length distribution data for all eels recorded are presented in Figure 3, while the number of fish recorded per square metre is presented in Figure 4. These figures include the results of the previous survey, completed in January 2014.

A total of four species were recorded in the current survey, with three species recorded at sites 1, 2 and 4 while site 3 recorded two species. Longfin eel and shortfin eel were recorded both upstream and downstream of the weir, as were redfin bully. This represents an improvement in the distribution of redfin bully from the previous survey, but like in the previous survey, they were still recorded very low abundance. A juvenile brown trout was recorded at site 2 (Photo 1), and freshwater crayfish were recorded at site 1 only. This relatively low species abundance and low redfin bully abundance is an indication that the Glenn Road weir is still having a significant deleterious effect on upstream fish migration. The previous survey found that it was unlikely that the Kapuni Lactose weir was posing a significant barrier to fish passage, and this has been confirmed in the current survey, with the presence of redfin bully upstream. Compared with the previous survey, there was a significant reduction in the numbers of juvenile eels recorded at all sites (Figure 3). This is likely to be a reflection of the timing of the survey, as the 2014 survey was completed during the elver migration period. With the 2017 survey being completed in June, the elvers will have distributed further within the catchment. Like that recorded in the previous survey, there was no evidence of fish accrual immediately downstream of the weir (Figure 4). This would have been evident by higher fish abundance per square metre at site 2 than any other site, especially site 1.

Photo 1 Juvenile brown trout, site 2

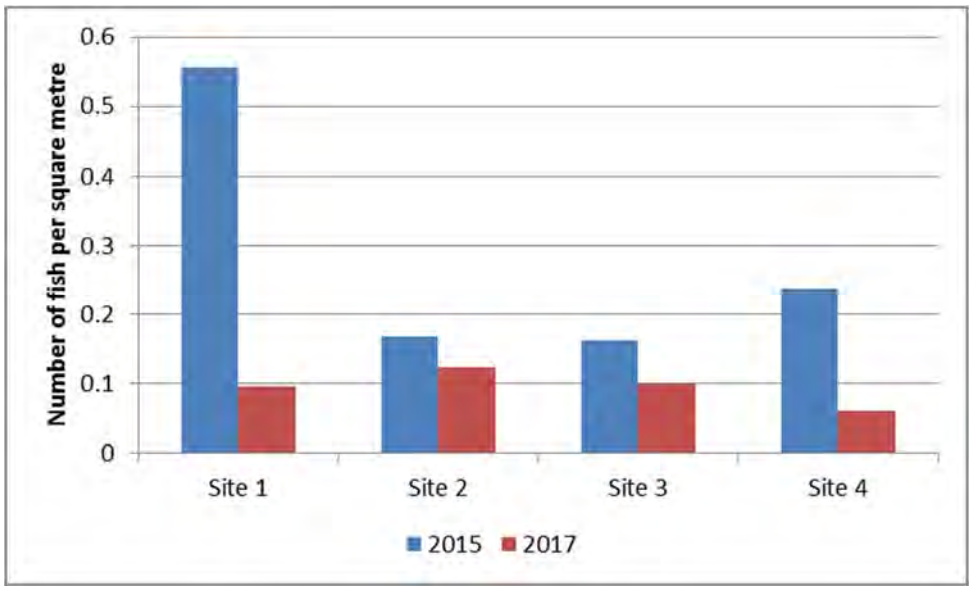

Figure 4 The average number of fish recorded per square metre sampled at each site

There is also no evidence that the discharge of cooling water to the Kaupokonui Stream has had a significant impact on the fish communities. Although the results of the current survey show a lower species richness and abundance than that recorded in the previous survey, this is considered a reflection of the timing of the survey, and the fact that fish are free to move within the river. The results for site 3, the site most likely to show the greatest impact from the cooling water discharge, were not significantly different to that recorded at the other three sites. The previous survey recorded some differences in small eel distribution, with sites 3 and 4 having higher numbers of eels longer than 250mm. It was suggested that this could be an indication that the cooling water discharge had caused an increase in food supply downstream, for example through nutrients contamination of the discharge, but that it is also likely to be related to the increased boulder habitat observed at sites 3 and 4, which provides ideal habitat for these small eels. Overall the results from the current survey, coupled with the findings of the macroinvertebrate survey undertaken in February 2017 (Jansma, 2017), indicates that there is little evidence that the discharge of cooling water has affected the biological communities of the Kaupokonui Stream.

Summary and Conclusions

A four-site fish survey was undertaken in the Kaupokonui Stream on 2 June 2017, 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 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 some kilometres downstream of the factory is an orphaned structure, the Glenn Road weir, which currently does not have adequate fish passage provision.

Four fish species were recorded during this survey, being longfin and shortfin eel, redfin bully and brown trout. Redfin bully were recorded in very low abundance, reflecting the impact of the Glenn Road weir.

Upstream of the Kapuni Lactose weir, longfin and shortfin eels and redfin bully were recorded, providing no indication that this weir is posing a significant barrier to fish passage. Although the numbers of juvenile eels recorded was less than that recorded in 2014, this is considered to be due to the timing of the two surveys.

The 2014 survey was completed during the elver migration period, while the 2017 survey was completed in June, when the elvers will have had more time to distribute further within the catchment.

There were no significant differences between the fish communities recorded at site 3 (downstream of the cooling water discharge), and that recorded at the other three sites. Where differences were recorded, as with the previous survey which recorded a higher abundance of eels between 250mm and 450mm at site 3, these differences can largely be attributed to the variation in habitat between the sites.

Overall, it is considered that the activities of the Kapuni Lactose factory have not adversely affected the fish communities of the Kaupokonui Stream. It is hoped that as the riparian planting of the catchment matures, and passage remediation works at the Glenn Road weir are undertaken, that the diversity and abundance of fish in this stretch of stream will improve.

References

Jansma, B, 2015: Fish survey in the Kaupokonui Stream in relation to the Fonterra Kapuni lactose factory and weir, January 2014. Report No. BJ247.

Jansma, B 20174: Biomonitoring of the Kaupokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, February 2017. Report No. BJ299.

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.

Appendix V

Biomonitoring reports

To	Job Manager, Lorraine Smith
From	Environmental Scientists, Bart Jansma and Katie Blakemore
Report No	KB063
Doc No	2109290
Date	20 August 2018

Biomonitoring of the Kaupokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, October 2017

Introduction

This biological survey was the first of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2017-2018 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

0919 to discharge cooling water to the Kaupokonui River;
0922 to spray irrigate wastewater and stormwater to land in the Kaupokonui catchment;
0923 to spray irrigate wastewater and stormwater to land in the Waiokura and Motumate catchments;
0924 to discharge stormwater and cooling water to the Kaupokonui River;
4235 to discharge stormwater to the Kaupokonui River during factory shutdown periods;
4604 to discharge stormwater to the Kaupokonui River from the factory extension;
6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui River

Methods

The standard '400 ml kick-sampling' technique was used on 31 October 2017 to collect streambed macroinvertebrates from five sites in the Kaupokonui River in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1). Sites in the Waiokura Stream are sampled only once per year, in the summer survey. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 Biomonitoring sites in the Kaupokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaupokonui River	3b	KPK000655	1 km u/s of railway bridge
	4	KPK000660	Railway, above factory
	5	KPK000679	160m below cooling water discharge
	6	KPK000685	Skeet Road
	7	KPK000880	Glenn Road
Waiokura Stream	U	WKR000500	Skeet Road
	D	WKR000650	At Hicks (Thomas) Road

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value ($SQMCI_S$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.

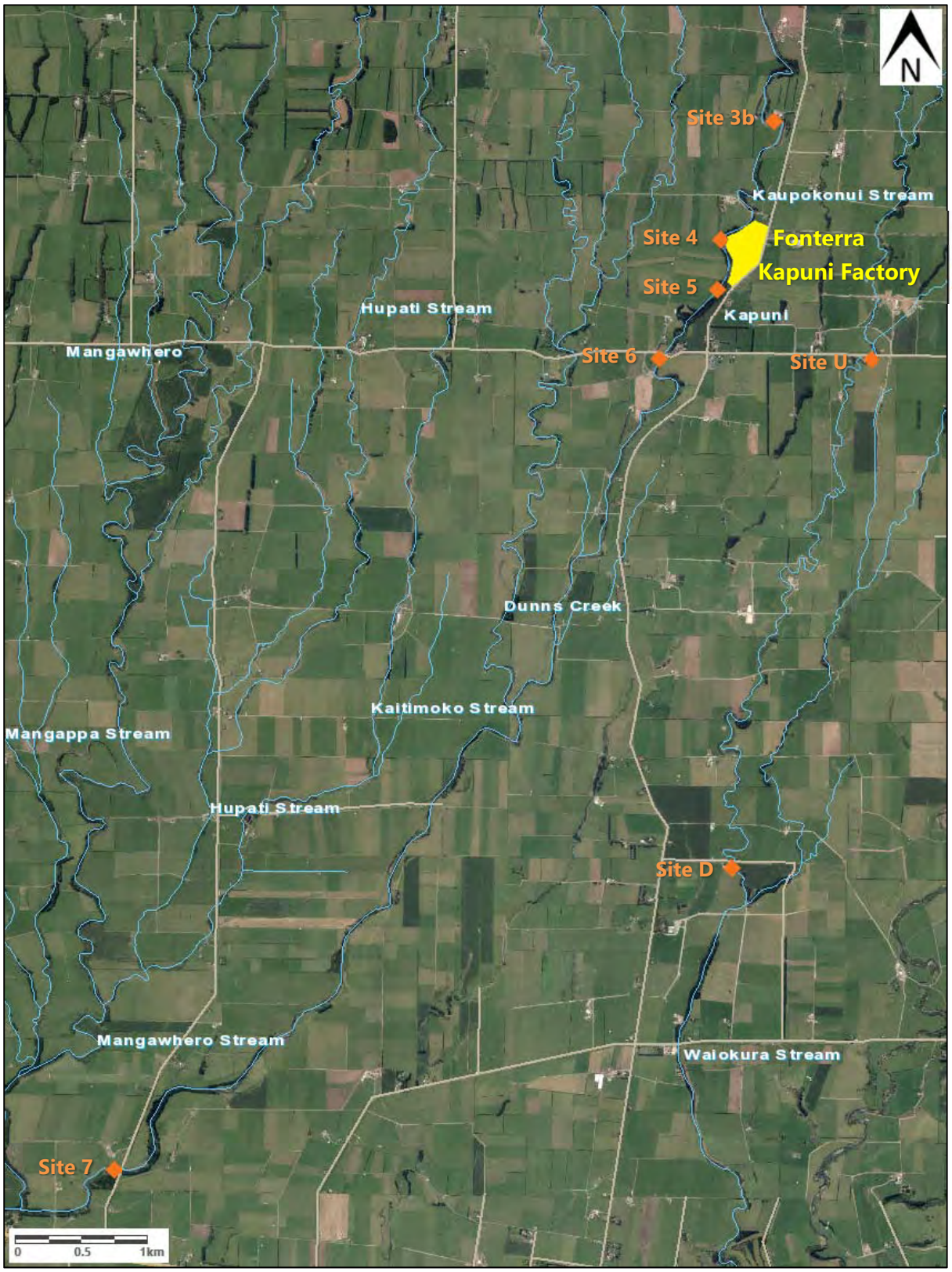

Figure 1 Biomonitoring sites in the Kaupokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a moderate period of receding flows in the Kaupokonui River, and followed 19 days after a flow event in excess of three times median flow and 20 days after an event in excess of seven times median flow. The Kaupokonui River had a moderate, clear, uncoloured and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.810 m^3/sec, slightly less than the median flow (2.050 m^3/sec), and approximately two and a half times mean annual low flow (0.746 m^3/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 16.8°C to 18.3°C. Periphyton mats were patchy at sites 3b and 5, while filamentous periphyton was absent at these sites. No periphyton mats were noted at site 4, where the rocks supported a slippery film only. Sites 6 and 7 supported patchy growths of algal mats and filaments. Cobbles, gravel and boulders were the predominant substrate at all sites in the river.

Macroinvertebrate communities

Kaupokonui River

Historically the mid to lower reaches of the Kaupokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Generally, the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7).

Table 2 Numbers of taxa and MCI values recorded previously in the Kaupokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	53	24	13-28	*24*	24	106	68-125	*110*	120
4	67	23	8-32	*25*	20	97	65-128	*104*	119
5	48	23	11-28	*24*	20	99	65-121	*101*	125
6	67	21	4-30	*23*	24	93	40-125	*103*	115
7	58	18	7-31	*19*	15	90	57-110	*92*	97

In this February 2018 survey, all sampling sites supported between 15 and 24 taxa. These results were all within five taxa of the site medians from data since 1998. MCI scores at all sites were higher than their respective median values for surveys since November 1998, significantly so at sites 4, 5 and 6 (Stark, 1998), and were higher than their respective median values for surveys since 1985, with this difference being significant for all sites except site 7 (Table 2, Figure 2). Taxa richness was relatively similar between sites with the highest number (24) recorded at sites 3b and 6 and the lowest number (15) recorded at site 7. MCI scores overall decreased in a downstream direction, with similar scores between sites 3b to 6, but a significantly lower score at site 7. MCI scores ranged from 97 to 125 units, reflecting relatively 'fair' to 'very good' physicochemical water quality. There was no obvious impact of the cooling water discharges in the mid-reaches of the river as indicated by the lack of sewage fungus at the downstream sites. In the current survey, there was a eighteen unit decrease in scores between sites 6 and 7, dissimilar to that recorded in the previous spring (2017) survey (which recorded a three unit increase). As in most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the typical decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain, over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account.

The 'fair' to 'very good' MCI scores were also reflected by the results of the microscopic scan for undesirable biological growths, which recorded no such growths at any site. This is a continuation of the improvement recorded from the spring October 2014 survey, which recorded sewage fungus at sites 5 and 6. This indicates that the cooling water discharge either had improved in quality, or was being better assimilated.

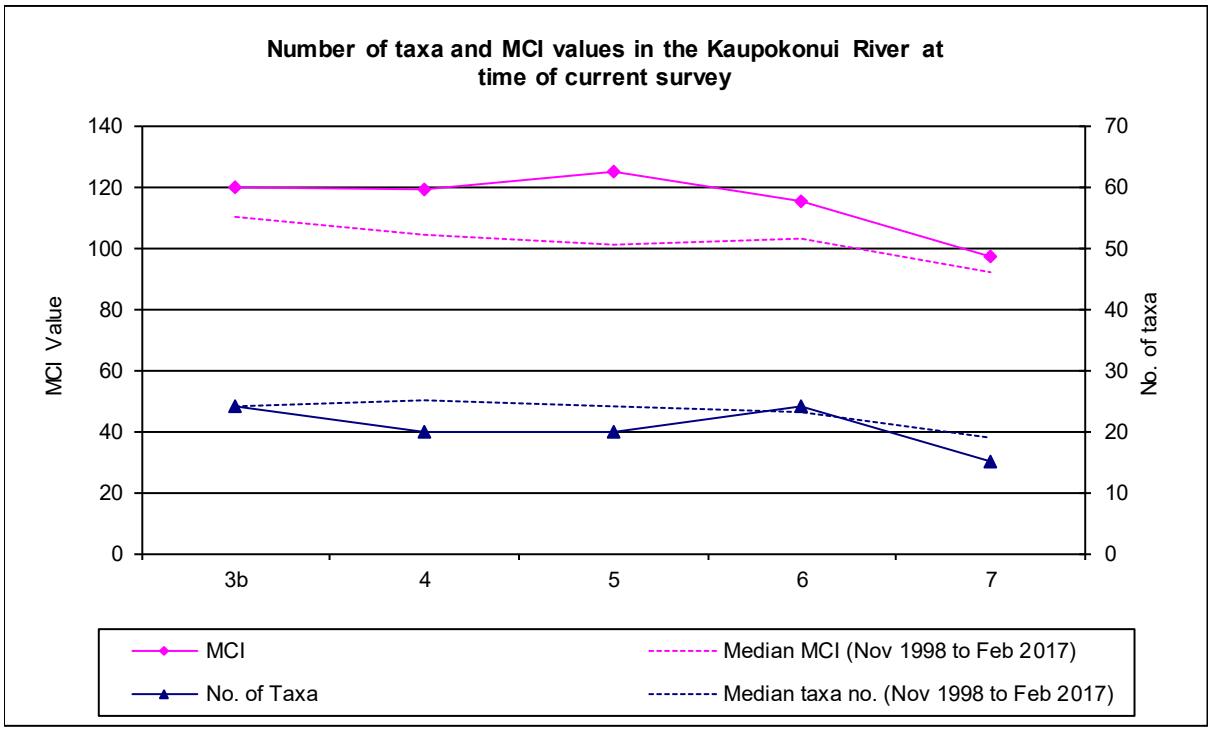

Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni samples on 31 October 2017

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB17394	FWB17395	FWB17396	FWB17397	FWB17398
ANNELIDA (WORMS)	Oligochaeta	1	R	R	-	-	R
	Lumbricidae	5	-	-	-	-	R
MOLLUSCA	*Potamopyrgus*	4	R	-	-	-	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R	C	R	R
	Coloburiscus	7	VA	VA	VA	A	R
	Deleatidium	8	XA	XA	XA	XA	XA
	Nesameletus	9	A	C	A	A	-
	Zephlebia group	7	-	R	-	-	-
PLECOPTERA (STONEFLIES)	*Acroperla*	5	-	-	R	R	-
	Megaleptoperla	9	R	-	-	-	-
	Zelandobius	5	A	C	R	C	-
	Zelandoperla	8	R	-	R	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	A	C	A	C
	Hydraenidae	8	C	C	R	R	-
	Ptilodactylidae	8	-	-	-	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C	C	C	-
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	A	C	C	C	A
	Costachorema	7	C	C	C	C	C
	Hydrobiosis	5	-	-	-	C	C
	Neurochorema	6	R	-	-	-	-
	Plectrocnemia	8	R	-	R	-	-
	Beraeoptera	8	VA	VA	A	C	-
	Olinga	9	C	C	R	R	-
	Pycnocentrodes	5	XA	XA	A	A	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	A	C	A	A	A
	Eriopterini	5	R	R	R	R	-
	Chironomus	1	-	-	R	R	-
	Maoridiamesa	3	C	R	A	VA	XA
	Orthocladiinae	2	R	-	-	A	VA
	Tanytarsini	3	R	-	-	R	R
	Austrosimulium	3	-	R	-	R	-
ACARINA (MITES)	Acarina	5	-	R	-	-	R
		No of taxa	24	20	20	24	15
		MCI	120	119	125	115	97
		SQMCIs	6.6	6.6	7.5	6.9	5.2
		EPT (taxa)	14	11	13	13	7
		%EPT (taxa)	58	55	65	54	47
'Tolerant' taxa	'Moderately sensitive' taxa		'Highly sensitive' taxa				

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 3b (KPK000655)

A moderate richness of 24 taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was equal to both the long term median number of taxa recorded at this site to date (Table 2) and the median richness of more recent records (since 1998). It is also six taxa more than that recorded in the previous survey (which was lowest richness recorded at this site since 1998). The community was characterised by ten taxa including three 'highly sensitive' taxa [mayflies (*Deleatidium* and *Nesameletus*) and caddisly (*Beraeoptera*)]; six 'moderately sensitive' taxa [mayfly (*Coloburiscus*), stonefly (*Zelandobius*), elmid beetles, dobsonfly *(Archichauliodes*), caddisfly (*Pycnocentrodes*) and cranefly (*Aphrophila*)]; and one 'tolerant' taxon [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*)]. This dominance represented an increase in the relative

proportions of 'highly sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous summer (2017) survey.

The moderate proportion of 'tolerant' taxa in the community (25% of taxa richness) was reflected in the MCI score (120) which was similar to that which would be expected for a spring survey. This score was two units higher than that recorded in the previous summer survey (Figure 3). The presence of nine 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaupokonui River catchment.

The MCI score of 120 units was equal to the third highest score recorded at this site to date, (Figure 3), being ten units higher than the median score for surveys since 1998 and fourteen units higher than the median from all surveys conducted to date (Figure 2, Table 2), a statistically significant result (Stark, 1998). There were substantially more 'sensitive' taxa recorded in abundance than 'tolerant' taxa, and the extreme abundance of the 'highly sensitive' *Deleatidium* mayfly resulted in the $SQMCI_s$ value of 6.6 units, a non-significant 0.4 units lower than the $SQMCI_s$ value found at this site by the previous summer survey.

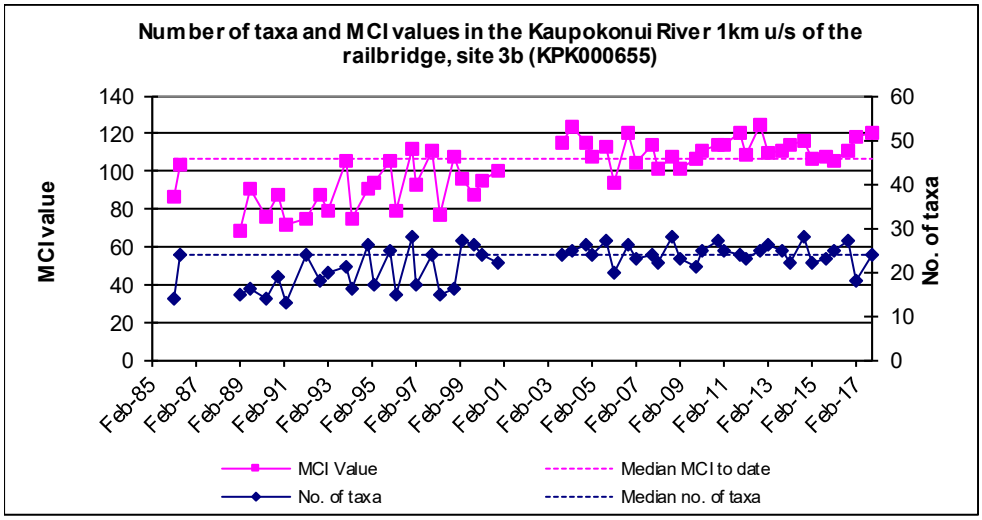

Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

Site 4 (KPK000660)

A moderate richness of 20 macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. This taxa richness was similar to the numbers of taxa recorded in recent monitoring years (Figure 4), and four less than that recorded at site 3b by this current survey (Table 3).

The community was characterised by two 'highly sensitive' taxa [mayfly (*Deleatidium*) and caddisfly (*Beraeoptera*)]; and three 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles and caddisfly (*Pycnocentrodes*)}. There were no significant changes in taxon abundance between sites 3b and 4 (Table 3).

The MCI score at site 4 was a non-significant (Stark, 1998) one unit less than the score recorded upstream at site 3b (Table 3). The MCI score was fifteen units more than the median of values since 1998 and twenty-two higher than the historic median recorded to date (Table 3, Figure 4). This was a significant improvement from that recorded in the previous survey. The current result indicated 'good' generic health (TRC, 2015) and that this site had moderate physicochemical water quality preceding this survey.

The $SQMCI_s$ value of 6.6 units was equal to that recorded at site 3b (Table 3), reflecting the fact that the communities were dominated by similar taxa and indication that the community had not been recently

adversely affected by land irrigation upstream of this site. Some prior surveys had noted that deterioration in biological 'health' between sites 3b and 4 may also be attributable to the discharge of treated dairy shed effluent to inflowing tributary a short distance upstream of site 4. The very similar MCI and $SQMCI_s$ scores indicate that there were no such effects were evident in the current survey.

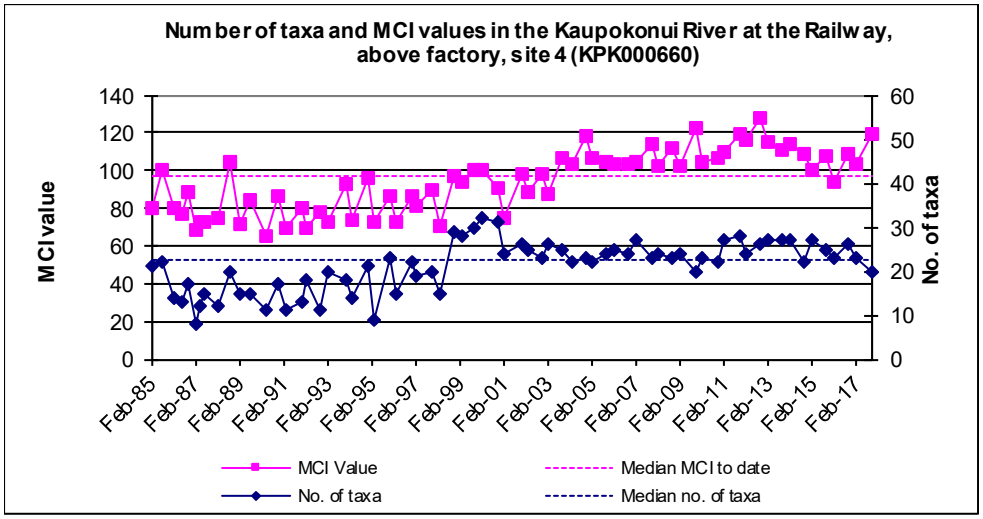

Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaupokonui River since February 1985

Site 5 (KPK000679)

A moderate richness of twenty macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was four taxa less than the median number of taxa recorded at this site since 1998, and one less than that recorded by the previous survey (Table 2, Figure 2). This richness was also equal to that recorded at site 4, located upstream of the cooling water discharges.

The community was characterised by three 'highly sensitive' taxa [mayflies (*Deleatidium* and *Nesameletus*) and caddisfly (*Beraeoptera*)]; three 'moderately sensitive' taxa [mayfly (*Coloburiscus*), caddisfly (*Pycnocentrodes*) and cranefly (*Aphrophila*)]; and one 'tolerant' taxon [midge larvae (*Maoridiamesa*)] (Table 3). This represents a slight increases in the number of abundant taxa from that recorded in the previous (summer 2017) survey.

The MCI score (125 units) was the highest score recorded at this site to date by four units. This score was significantly higher than the preceding score (114 units) (Stark, 1998) (Figure 5). It was also a significant twenty-four units higher than the median score since 1998 and twenty-six units higher than the median of scores from all surveys to date (Figure 2, Table 2). This MCI score was similar to that that recorded at site 4 upstream of the cooling water spray discharge due to the similarities in community composition, with 16 taxa common to both sites, of the 24 taxa recorded across both sites. There was no evidence of the sewage fungus recorded at this site.

The relatively high $SQMCI_S$ value (7.5 units) was a significant 0.9 unit higher than that recorded at sites 3b and 4. This is a direct reflection of the numerical dominance of 'highly sensitive' taxa in the community, and a low proportion of tolerant taxa (15%) present in the community.

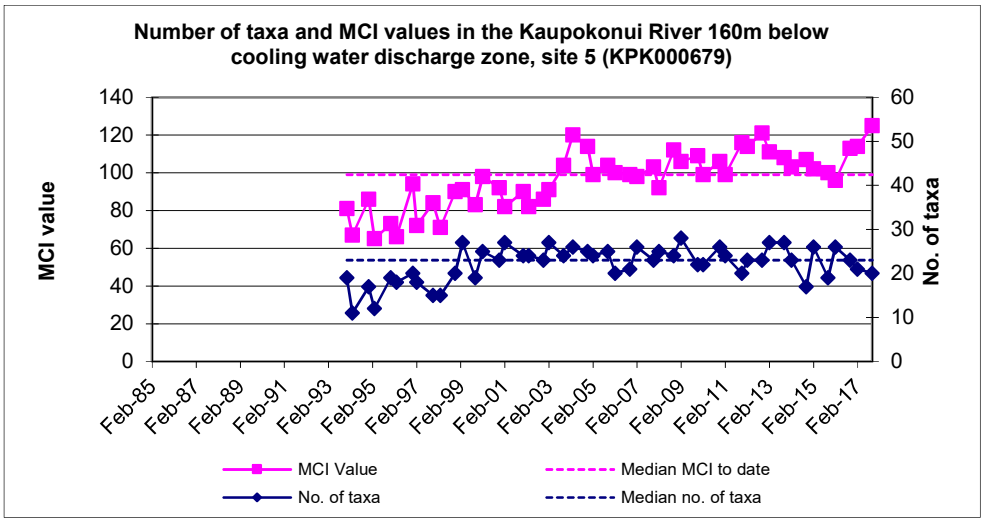

Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaupokonui River

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, 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. The spring 2014 survey again recorded the presence of sewage fungus, but in that case, there was no obvious impact on the macroinvertebrate communities, with bloodworm midges being absent and no decline in MCI or $SQMCI_S$ scores. 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 sewage fungus; neither did it indicate any change in macroinvertebrate communities caused by the cooling water discharge.

Site 6 (KPK000685)

A richness of 24 taxa was recorded at site 6, just downstream of Skeet Road, a further 700 m below the cooling water discharges. This was one taxon more than the median number of taxa since 1998 for this site, and three more than the historical median, and similar to that recorded at sites 4 and 5 upstream (Table 2, Figure 2 and Figure 6).

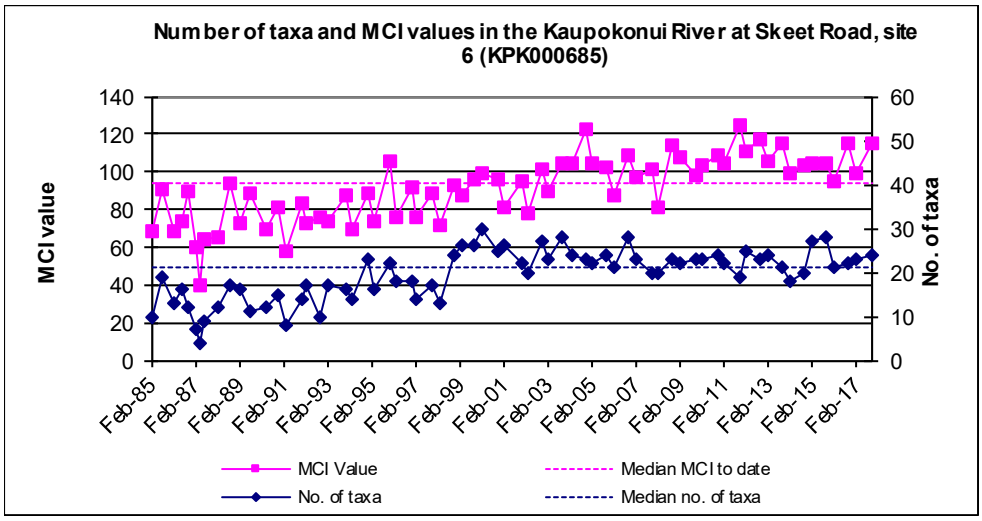

Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaupokonui River, at Skeet Road, since February 1985

This community was characterised by a similar number of taxa as at site 5 with two 'highly sensitive' taxa [mayflies (*Deleatidium* and *Nesameletus*)], four 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, stony cased caddisfly (*Pycnocentrodes*), and cranefly (*Aphrophila*)]; and two 'tolerant' taxa [midge larvae (*Maoridiamesa* and Orthocladiinae)] (Table 3). This represented an increase in the number of 'tolerant' taxa recorded in abundance, as orthoclad midges were not recorded at site 5.

The MCI score of 99 units was six units higher than the historical median for this site but four units less than the median of scores recorded since 1998. This represents a 16 unit increase from the summer (2017) survey, but is equal to the prior spring (2016) survey, both of which were equal to the fourth highest score recorded at this site to date (Figure 6, Table 2). The MCI score at this site can be variable (Figure 6) and this year the result was reflective of 'good' water quality, similar to that recorded at the other sites surveyed in this survey, but within the range of recent scores recorded at this site.

The $SQMCI_s$ score (6.9 units) was 0.6 unit less than that recorded at site 5, suggesting little change in the health of the community structure. Two taxa exhibited a significant change in abundance at this site (from site 5), reflecting relatively similar communities. This indicated that the subtle effects recorded by some past surveys were not present at the time of the current survey, with the changes in the community not considered significant in terms of impacts on the macroinvertebrate community health recorded at this site.

Site 7 (KPK000880)

A moderately low richness of 15 taxa was recorded at site 7, at Upper Glenn Road (Table 2), slightly lower than both the long term median and the median richness of surveys since 1998. Characteristic taxa included one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; one 'moderately sensitive' taxon [cranefly (*Aphrophila*)]; and three 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*), and midges (*Maoridiamesa* and orthoclads)]. Of the 27 taxa recorded across sites 6 and 7, only 12 were common to both sites, reflective of a degree of natural change in macroinvertebrate communities normally found in a downstream direction, over such a distance.

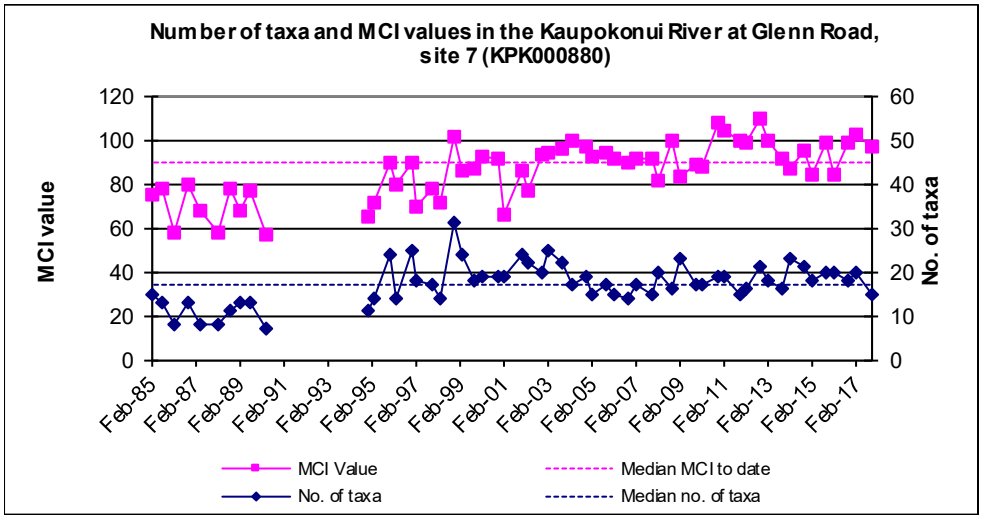

Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaupokonui River, since February 1985

The proportion of 'tolerant' taxa (33% of taxa number) decreased from that recorded in the previous summer (2017) survey, but despite this, the MCI score decreased slightly to 97 units. This score was five units above the median of scores since 1998, and seven units higher than the historic median at this site (Table 2, Figure 7). Just downstream of this site, water temperatures only exceeded 20˚C on one occasion in the month prior to this survey, which compares favourably with the maximum water temperature recorded in the month prior to the previous summer survey (24.4˚C). The current MCI score was eighteen units lower than that recorded at site 6, some 9 km upstream, a statistically significant result (Stark, 1998). It is typical of this site to record a markedly lower MCI score than site 6, which is usually considered a reflection of the natural downstream deterioration typical of ringplain streams and rivers. Streams and rivers at this altitude and distance from the National Park boundary typically seeing a reduction in MCI score of approximately 0.6 MCI unit/km (Stark and Fowles, 2009). This constrasts with the previous (summer 2017) result, which was the first time since 2006 that site 7 has recorded an MCI score that was higher than that recorded at site 6 upstream.

The $SQMCI_S$ score (5.2) showed a significant decrease of 1.7 units from site 6 (Table 3). This lack of change reflects the differences within the communities, with three significant changes in abundance between sites 6 and 7. This result is congruent with past surveys, which have generally shown a decreasing trend in $SQMCI_S$ scores between sites 6 and 7, (especially in the summer surveys). This is usually attributed to the distance between the sites and the influence of the Dunns Creek tributary, which joins the river between the two sites. Occasionally, there had been little difference, due to site 6 showing impacts from the cooling water discharge. However, in the current survey, there was no significant evidence of cooling water discharge influence at site 6 and site 7 appeared in average health.

Summary and Conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River on 31 October 2017. Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths").

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.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'very good' community health at all sites. MCI scores were similar but variable at the four upstream sites, but decreased significantly at site 7. There is normally a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. Although the current survey recorded this deterioration, the MCI scores were indicative of better water quality overall, probably reflecting the typical seasonal differences at these sites. The MCI scores at the sites 3b, 4, 5 and 6 were significantly higher than their historical median scores, while the MCI scores at site 7 was slightly above the historical median. It is also worth noting that site 5, recorded the highest MCI score to date at this site, by four units. $SQMCI_s$ scores varied between sites, with the highest score recorded at site 5, which was a significantly higher score than sites 3b and 4, and site 7 recording a significantly lower score than all other sites. The results varied by up to 0.9 unit at sites 3b-6, which although is a significant result, probably reflects variable sampling effort and the patchy nature of macroinvertebrate communities. The result at site 7 is again likely related to the progressive deterioration typical of ringplain streams and rivers in a downstream direction.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'very good' or 'good' health throughout most of the reach surveyed. The high MCI and $SQMCI_s$ scores at site 5 indicate that the cooling water discharge was not having a significant impact on the macroinvertebrate communities at the time of this survey. The macroinvertebrate communities at all sites were in above average condition. However, site 7 was in 'poor' condition, showing the usual influence from the Dunns Creek tributary within the reach between sites 6 and 7, and the natural progressive downstream deterioration.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and the communities were in above average condition, and in similar or better condition than that recorded in the previous summer survey (which did not show the seasonal decline typically observed at these sites). Similarities in community composition, including the characteristic taxa, were generally consistent for all sites. The current survey did not record the presence of sewage fungus and bloodworm midges were rare, also indicating a lack of impacts from the cooling water discharge.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the

macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the current survey.

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To	Job Manager, Lorraine Smith
From	Environmental Scientists, Bart Jansma and Katie Blakemore
Report No	KB064
Doc No	2110154
Date	21 August 2018

Biomonitoring of the Kaupokonui River and Waiokura Stream in relation to the Fonterra Kapuni farm and factory, March 2018

Introduction

This biological survey was the second of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2017-2018 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports listed in the references section of this report.

This survey relates to the following consents held by Fonterra Kapuni Ltd:

0919 to discharge cooling water to the Kaupokonui River;
0922 to spray irrigate wastewater and stormwater to land in the Kaupokonui catchment;
0923 to spray irrigate wastewater and stormwater to land in the Waiokura and Motumate catchments;
0924 to discharge stormwater and cooling water to the Kaupokonui River;
4235 to discharge stormwater to the Kaupokonui River during factory shutdown periods;
4604 to discharge stormwater to the Kaupokonui River from the factory extension;
6423 to discharge stormwater from an inhalation grade lactose plant site into the Kaupokonui River

Methods

The standard '400 ml kick-sampling' technique was used on 1 March 2018 to collect streambed macroinvertebrates from five sites in the Kaupokonui River and two sites in the Waiokura Stream in relation to discharges to the river and on to land in the catchment (Table 1, Figure 1). The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Table 1 Biomonitoring sites in the Kaupokonui River and Waiokura Stream

Stream	Site No.	Site Code	Location
Kaupokonui River	3b	KPK000655	1 km u/s of railway bridge
	4	KPK000660	Railway, above factory
	5	KPK000679	160m below cooling water discharge
	6	KPK000685	Skeet Road
	7	KPK000880	Glenn Road
Waiokura Stream	U	WKR000500	Skeet Road
	D	WKR000650	At Hicks (Thomas) Road

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001).

Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20, produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value ($SQMCI_S$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

When necessary, sub-samples of periphyton (algae and other microflora) taken from the macroinvertebrate samples were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths") at a microscopic level. The presence of masses of these organisms can be an indicator of organic enrichment within a stream.

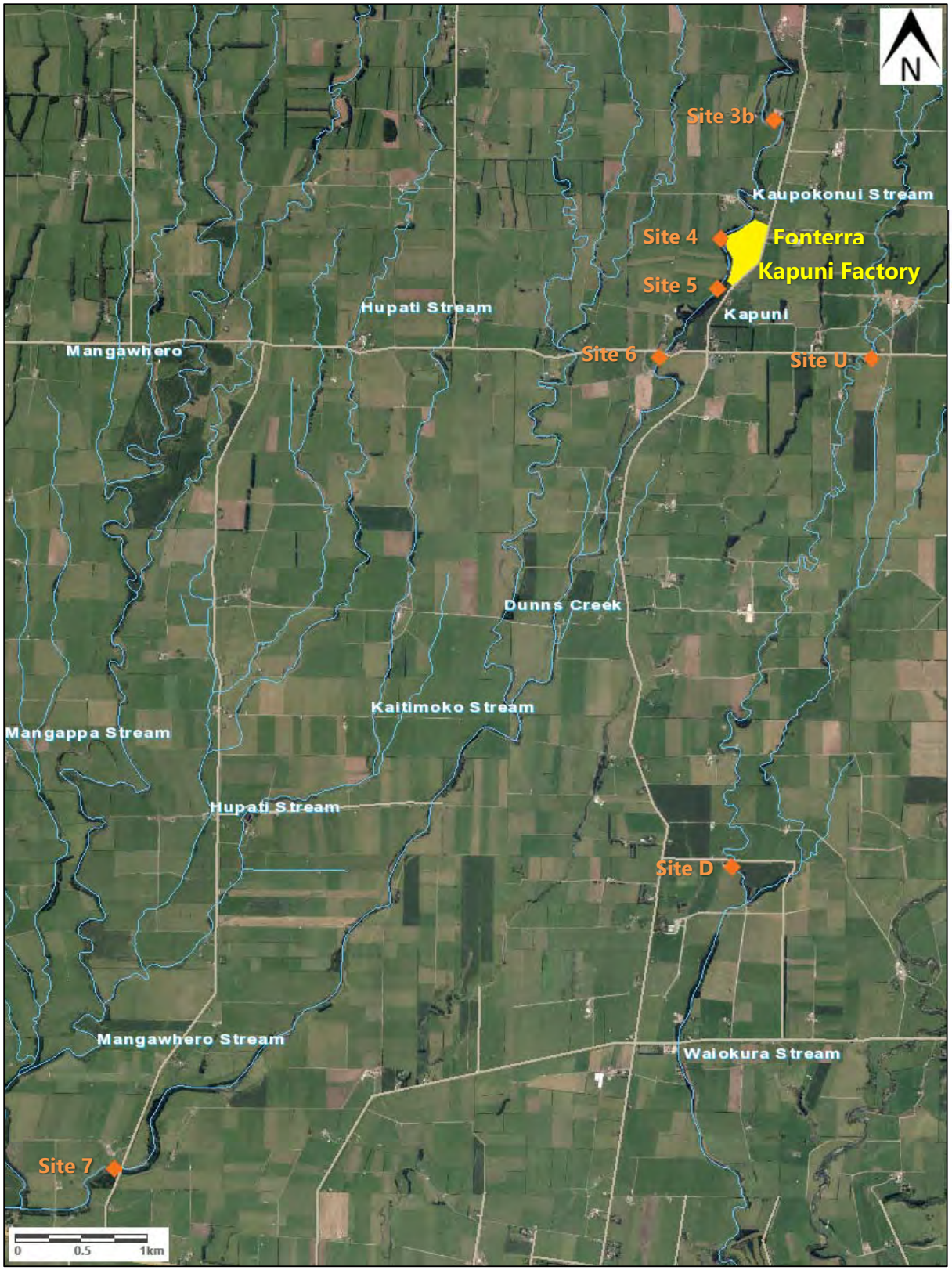

Figure 1 Biomonitoring sites in the Kaupokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a short period of receding flows in the Kaupokonui River, and followed 7 days after a flow event in excess of three and 27 days after a flow event in excess of seven times median flow. The Kaupokonui River had a low, clear, uncoloured and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 1.203 m^3/sec, less than half the median flow (2.050 m^3/sec), and above the mean annual low flow (0.746 m^3/sec) for the Kaupokonui River.

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 18.3°C to 19.9°C. Periphyton mats were patchy at all sites, while filamentous periphyton was absent at site 4, patchy at sites 3b, 5 and 6 and widespread at site 7, despite the relatively recent occurrence of scouring flows. Cobbles, gravel and boulders were the predominant substrate at all sites in the river. The Waiokura Stream sites had a finer substrate with the bed primarily composed of gravels and cobbles at site U, and gravels and sand at site D. Aquatic vegetation grew throughout the stream at site D, while no macrophytes were recorded growing at site U. Algae were noted only as slippery films on the substrate at both sites. The Waiokura Stream had experienced an extended period of stable flows prior, with this survey performed 112 and 140 days after flow events in excess of three and seven times median flow respectively.

Macroinvertebrate communities

Kaupokonui River

Historically the mid to lower reaches of the Kaupokonui River have shown the effects of nutrient enrichment from the surrounding farmland, and in past years (mainly prior to 2000) there have been a number of surveys showing detectable impacts of discharges from the lactose factory on the riverbed fauna. On many past sampling occasions, the sites immediately upstream and downstream of the Fonterra Kapuni factory supported moderate numbers of taxa, with relatively low proportions of 'sensitive' taxa (such as mayflies and stoneflies), resulting in median MCI values in the low 80s (Table 2). Since 1998 however, macroinvertebrate communities have improved throughout the reach and have shown higher numbers of taxa and MCI scores on most occasions. Median values for both the total data set and the results since 1998 are included in Table 2. Faunal results from the current survey are presented in full in Table 3.

Generally, the summer (February to March) surveys have found lower proportions of 'sensitive' taxa resulting in lower MCI values than the spring (October to November) surveys (see Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7).

Table 2 Numbers of taxa and MCI values recorded previously in the Kaupokonui River (since 1985), together with current results

Site	Number of previous surveys	Numbers of taxa				MCI values			
		Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey	Median (all data)	Range (all data)	Median (Nov 1998 to date)	Current survey
3b	54	24	13-28	*24*	24	107	68-125	*111*	113
4	68	23	8-32	*25*	25	98	65-128	*104*	113
5	49	23	11-28	*24*	22	99	65-125	*102*	106
6	68	21	4-30	*23*	25	94	40-125	*103*	102
7	59	17	7-31	*19*	16	90	57-110	*92*	89

In this March 2018 survey, all sampling sites supported between 16 and 25 taxa. These results were all within three taxa of the site medians from data since 1998. MCI scores at all sites were similar to than their respective median values for surveys since November 1998, and were higher than their respective median values for surveys since 1985 (Table 2, Figure 2). Taxa richness was relatively similar between sites with the highest number (25) recorded at site 4 and the lowest number (16) recorded at site 3b. MCI scores decreased in a downstream direction with the highest score (113 units) recorded at sites 3b and 4 and site 7 recording the lowest score (89 units). MCI scores ranged from 89 to 113 units, reflecting relatively 'fair' to 'good' physicochemical water quality. There was no obvious impact of the cooling water discharges in the mid-reaches of the river as indicated by the lack of sewage fungus at the downstream sites. In the current survey, there was a thirteen unit decrease in scores between sites 6 and 7. As in most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the typical decrease in MCI with distance downstream in the lower mid-reaches of the Taranaki ringplain, over a stream distance of about 9 km (of 5 units (Stark and Fowles, 2009)) should also be taken into account. The 'fair' to 'good' MCI scores were also reflected by the results of the microscopic scan for undesirable biological growths, which recorded no such growths at any site. This is a continuation of the improvement recorded from the spring October 2014 survey, which recorded sewage fungus at sites 5 and 6. This indicates that the cooling water discharge either had improved in quality, or was being better assimilated.

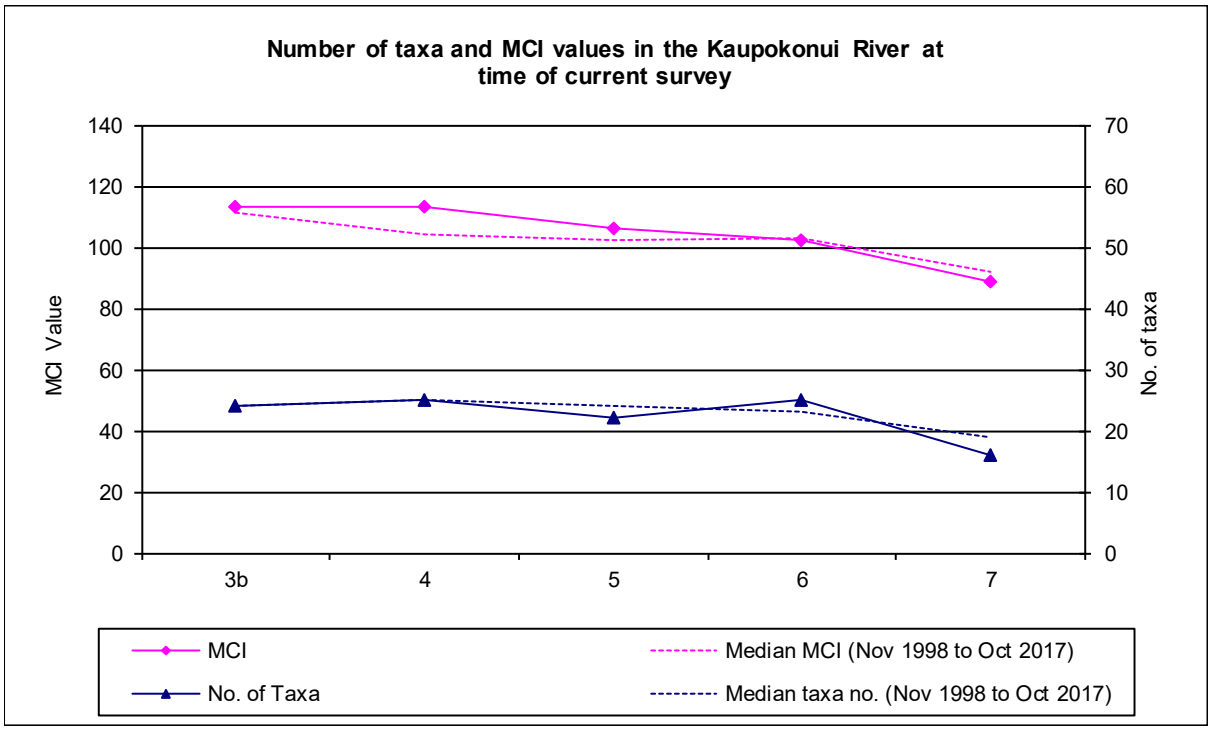

Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni samples on 1March 2018

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB18113	FWB18114	FWB18115	FWB18116	FWB18117
NEMERTEA	Nemertea	3	C	C	C	R	A
NEMATODA	Nematoda	3	-	-	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	R	R	R	R	C
	Lumbricidae	5	-	R	-	-	-
MOLLUSCA	*Latia*	5	-	-	-	-	R
	Potamopyrgus	4	C	A	C	C	A
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	C	R	C	R
	Coloburiscus	7	VA	A	A	C	-
	Deleatidium	8	XA	XA	XA	XA	C
	Nesameletus	9	A	R	R	-	-
PLECOPTERA (STONEFLIES)	*Austroperla*	9	-	R	-	R	-
	Megaleptoperla	9	R	-	-	-	-
	Zelandoperla	8	-	R	-	-	-
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA	VA	A	A
	Hydraenidae	8	R	C	C	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A	A	A	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	XA	VA	VA	VA	VA
	Costachorema	7	C	C	R	R	-
	Hydrobiosis	5	A	C	C	A	C
	Plectrocnemia	8	R	-	-	-	-
	Beraeoptera	8	A	C	R	R	-
	Olinga	9	A	C	R	R	-
	Oxyethira	2	-	-	-	R	-
	Pycnocentrodes	5	VA	C	C	A	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	A	C	A	A	C
	Eriopterini	5	R	-	-	R	-
	Maoridiamesa	3	R	R	R	R	-
	Orthocladiinae	2	VA	A	A	VA	VA
	Tanypodinae	5	-	R	-	-	-
	Tanytarsini	3	C	R	C	A	A
	Empididae	3	-	-	-	R	-
	Muscidae	3	R	-	R	R	R
	Austrosimulium	3	-	R	R	R	-
	No of taxa		24	25	22	25	16
	MCI		113	113	106	102	89
	SQMCIs		5.8	6.9	6.8	6.3	3.5
	EPT (taxa)		12	12	10	10	5
	%EPT (taxa)		50	48	45	40	31

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 3b (KPK000655)

A moderate richness of twenty-four taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was equal to both the long term median number of taxa recorded at this site to date (Table 2) and the median richness of more recent records (since 1998). It is also equal to that recorded in the previous survey.

The community had thirteen taxa present as 'abundant' or higher, of which six taxa were 'very abundant or 'extra abundant', being one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; three 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles and caddisfly (*Pycnocentrodes*)]; and two 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and orthoclad midges]. This dominance represented a slight decrease in the relative proportions of 'highly sensitive' to 'tolerant' taxa dominating the community, in comparison with the characteristic taxa found by the previous spring (2017) survey.

The moderate proportion of 'tolerant' taxa in the community (33% of taxa richness) was reflected in the MCI score (113) which was slightly higher than would be expected for a summer survey. This score was seven units lower than that recorded in the previous spring survey (Figure 3). The presence of seven 'highly sensitive' taxa indicated good preceding physicochemical water quality at this control site, above all Fonterra activities in the Kaupokonui River catchment.

The MCI score of 113 units was, two units higher than the median score for surveys since 1998 and six units higher than the median from all surveys conducted to date (Figure 2, Table 2), a statistically insignificant result (Stark, 1998). There were more 'sensitive' taxa recorded in abundance than 'tolerant' taxa, and the extreme abundance of the 'highly sensitive' *Deleatidium* mayfly and 'tolerant' net-building caddisfly *Hydropsyche* resulted in the $SQMCI_s$ value of 5.8 units, a non-significant 0.8 unit lower than the $SQMCI_s$ value found at this site by the previous spring (2017) survey.

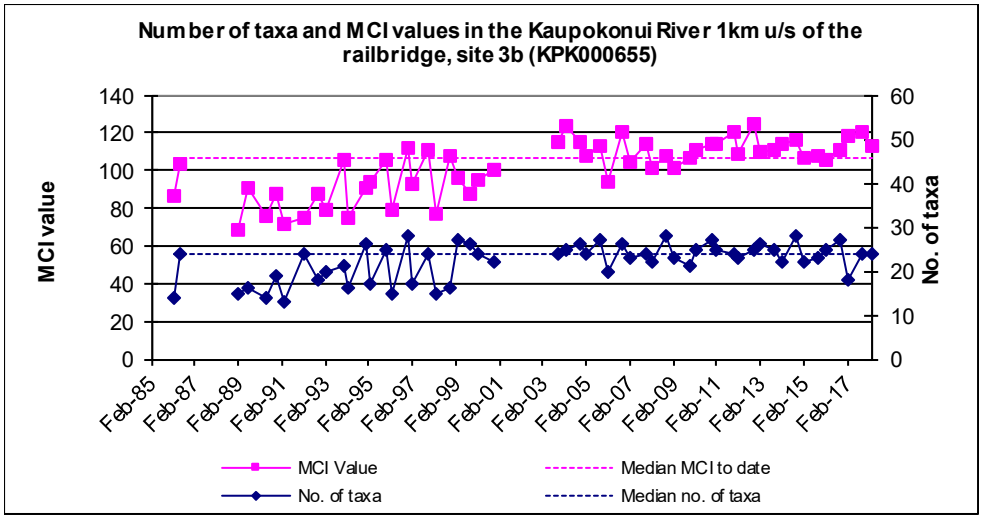

Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

Site 4 (KPK000660)

A moderate richness of 25 macroinvertebrate taxa was recorded in the community at site 4, upstream of the Fonterra Kapuni weir and rail bridge, and downstream of the area of land irrigated by wastes from Fonterra Kapuni. This taxa richness was similar to the numbers of taxa recorded in recent monitoring years (Figure 4), and one more than that recorded at site 3b by this current survey (Table 3).

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; three 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles and dobsonfly (*Archichauliodes*)}; and three 'tolerant' taxon [snail (*Potamopyrgus*), caddisfly (*Hydropsyche-Aoteapsyche*) and orthoclad midges]. There were only two significant changes in taxon abundance between sites 3b and 4, being an decrease in abundance of one 'highly sensitive' taxon and one 'moderately sensitive' taxon (Table 3).

The MCI score at site 4 was equal to the score recorded upstream at site 3b, reflecting a community composition of similar sensitivity (Table 3). The MCI score was nine units more than the median of values since 1998 and a significant fifteen units higher than the historic median recorded to date (Table 3, Figure 4), a small deterioration from that recorded in the previous survey. The current result indicated 'good' generic health (TRC, 2015) and that this site had moderate physicochemical water quality preceding this survey.

The $SQMCI_s$ value of 6.9 units was a significant 1.1 units higher than that recorded at site 3b (Table 3), reflecting a decrease in abundance of two characteristic 'tolerant' taxa and indicating that the community had not been recently adversely affected by land irrigation upstream of this site. Some prior surveys had noted that deterioration in biological 'health' between sites 3b and 4 may also be attributable to the

discharge of treated dairy shed effluent to inflowing tributary a short distance upstream of site 4. There were no such effects were evident in the current survey.

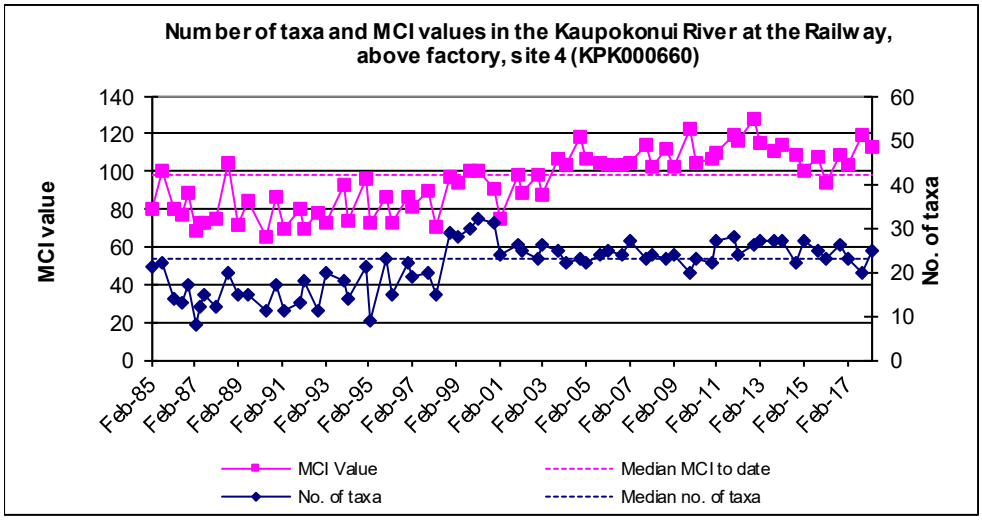

Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaupokonui River since February 1985

Site 5 (KPK000679)

A moderate richness of twenty-two macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was one taxon less than the median number of taxa recorded at this site since 1998, and two more than that recorded by the previous survey (Table 2, Figure 2)). This richness was three taxa less than that recorded at site 4, located upstream of the cooling water discharges.

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; four 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*) and cranefly (*Aphrophila*)]; and two 'tolerant' taxa [caddisflies (*Hydropsyche-Aoteapsyche*) and orthoclad midges] (Table 3).

The MCI score (106 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5). It was seven units above the median of scores from all surveys to date (Figure 2, Table 2). This MCI score was slightly lower than that recorded at site 4 upstream of the cooling water spray discharge despite the similarities in community composition, with 21 taxa common to both sites, of the 26 taxa recorded across both sites. There was no evidence of the sewage fungus recorded at this site.

The $SQMCI_S$ value (6.8 units) was 0.1 unit lower that recorded at site 4. This is a direct reflection of the fact that the communities at these sites were dominated by similar taxa, including *Deleatidium* mayflies, elmid beetles and *Hydropsyche-Aoteapsyche* caddisflies.

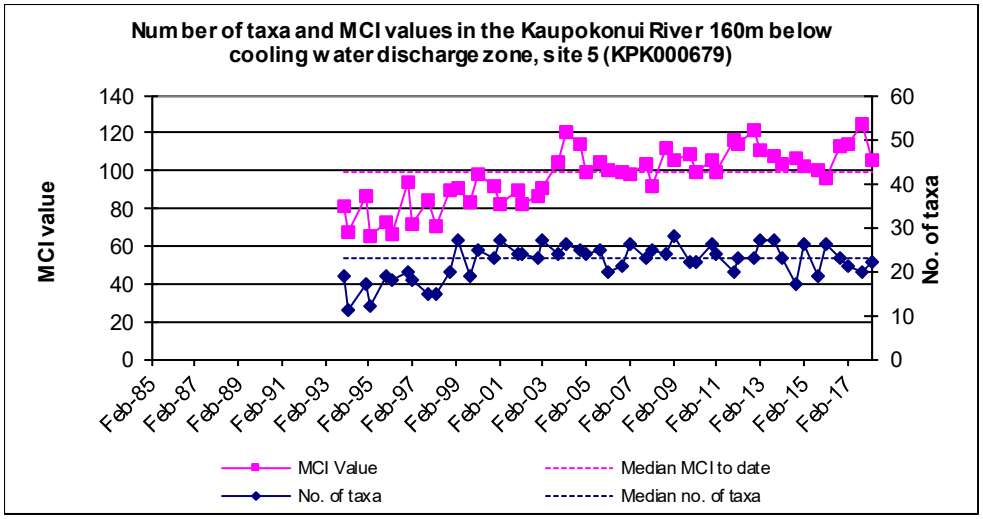

Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaupokonui River

It should be noted that the historical MCI median at this site was lowered by some poor results in the 1980s and early 1990s caused by wastes entering the river via the cooling water discharges. Most surveys in recent years had found no sign of the 'sewage fungus' growths that were recorded at site 5 in several of the 1980s and early 1990s surveys. However, an extensive 'sewage fungus' outbreak occurred in this reach of the river during the autumn-winter months of 2007. Mats of filamentous bacteria and protozoa ('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, and 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, 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. The spring 2014 survey again recorded the presence of sewage fungus, but in that case, there was no obvious impact on the macroinvertebrate communities, with bloodworm midges being absent and no decline in MCI or $SQMCI_S$ scores. 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 sewage fungus; neither did it indicate any change in macroinvertebrate communities caused by the cooling water discharge.

Site 6 (KPK000685)

A moderate richness of 25 taxa was recorded at site 6, just downstream of Skeet Road, a further 700 m below the cooling water discharges. This was two taxa more the median number of taxa since 1998 for this site, and four more than the historical median, and similar to that recorded at sites 3b, 4 and 5 upstream (Table 2, Figure 2 and Figure 6).

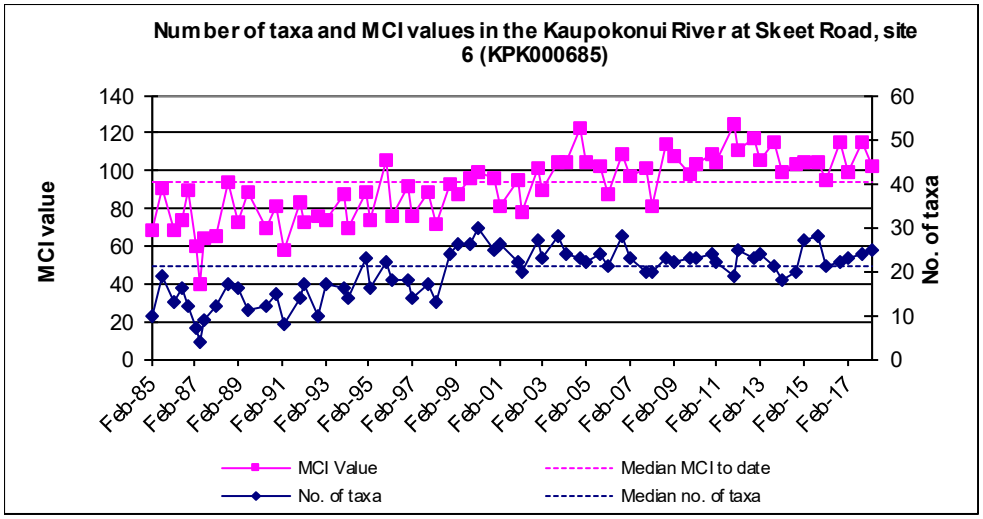

Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaupokonui River, at Skeet Road, since February 1985

This community was characterised by a similar number of taxa as at site 5 with one 'highly sensitive' taxon (*Deleatidium* mayfly), five 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*), caddisflies (*Hydrobiosis* and *Pycnocentrodes*) and cranefly (*Aphrophila*)]; and three 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and orthoclad and Tanytarsini midges] (Table 3). This represented an increase in the number of 'tolerant' taxa recorded in abundance, as Tanytarsini midges were recorded as 'common' at site 5.

The MCI score of 102 units was eight units higher than the historical median for this site but one units less than the median of scores recorded since 1998. This represents a fourteen unit drop from the previous survey, which recorded the fourth highest score at this site to date, but only a four unit drop from that recorded upstream (Figure 6, Table 2). The MCI score at this site can be variable (Figure 6) and this year the result was reflective of 'good' water quality within the range of recent scores recorded at this site. It is not considered an indication of deterioration in community health at this site at the time of the current survey.

The $SQMCI_s$ score (6.3 units) was 0.5 unit less than that recorded at site 5, suggesting little change in the health of the community structure. No taxon exhibited a significant change in abundance at this site (from site 5), reflecting relatively similar communities. This indicated that the subtle effects recorded by some past surveys were not present at the time of the current survey, with the changes in the community not considered significant in terms of impacts on the macroinvertebrate community health recorded at this site.

Site 7 (KPK000880)

A moderately low richness of 16 taxa was recorded at site 7, at Upper Glenn Road (Table 2), similar to both the long term median and the median richness of surveys since 1998. Characteristic taxa included one 'moderately sensitive' taxon [elmid beetle]; and five 'tolerant' taxa [horsehair worms (Nemertea), snail (*Potamopyrgus*), net-spinning caddisfly (*Hydropsyche-Aoteapsyche*), and midges (Tanytarsini and orthoclads)]. Of the 27 taxa recorded across sites 6 and 7, only 14 were common to both sites, reflective of a degree of natural change in macroinvertebrate communities normally found in a downstream direction, over such a distance.

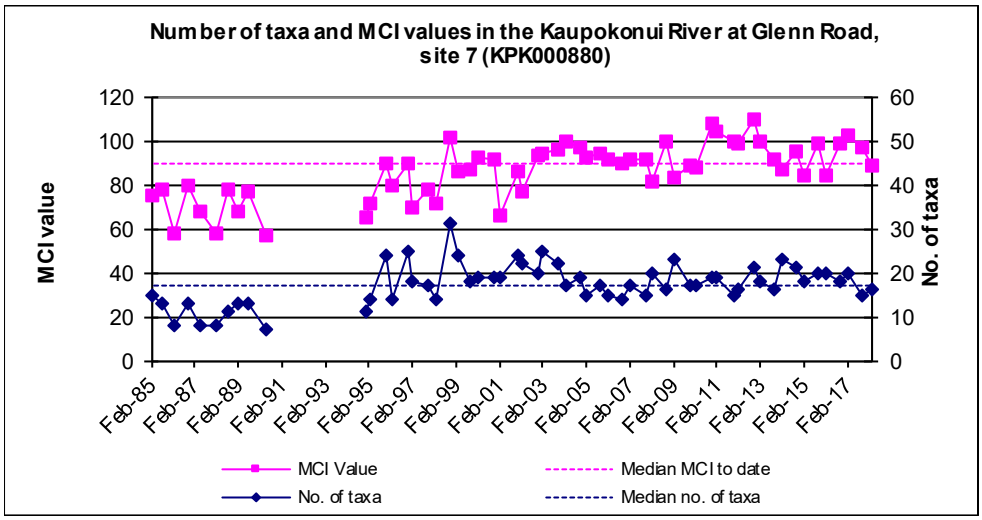

Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaupokonui River, since February 1985

The proportion of 'tolerant' taxa (50% of taxa number) increased from that recorded in the previous spring (2017) survey, resulting in a decrease in MCI score to 89 units. This score was three units below the median of scores since 1998, and one unit less than the historic median at this site (Table 2, Figure 7), neither of which is a statistically significant difference (Stark, 1998).). This is likely to be a direct reflection of the wet summer that preceded this survey, and the accompanying cooler temperatures. Just downstream of this site, water temperatures only reached 24.6˚C in the month prior to this survey, which is comparable with the maximum water temperature recorded in the month prior to the previous summer survey (24.4˚C). The current MCI score was a significant thirteen units lower than that recorded at site 6, some 9 km upstream, a statistically significant result (Stark, 1998). It is typical result is for site 7 to record a markedly lower MCI score than site 6, which is usually considered a reflection of the natural downstream deterioration typical of ringplain streams and rivers, with streams and rivers at this altitude and distance from the National Park boundary typically seeing a reduction in MCI score of approximately 0.6 MCI unit/km (Stark and Fowles, 2009).

The $SQMCI_S$ score (3.5) decreased significantly, being 2.7 units lower than the score at the nearest upstream site (Table 3). This lack of change reflects the numerical dominance of 'tolerant' taxa within the community, and the two significant changes in abundance between sites 6 and 7. This result is consistent with previous surveys, which generally have shown a decreasing trend in $SQMCI_S$ scores between sites 6 and 7, (especially in the summer surveys). This is usually attributed to the distance between the sites and the influence of the Dunns Creek tributary, which joins the river between the two sites. Occasionally, there had been little difference, due to site 6 showing impacts from the cooling water discharge. However, in the current survey, there was no significant evidence of cooling water discharge influence at site 6.

Waiokura Stream

The Waiokura Stream was included in the biological monitoring programme for the first time in the 2002-2003 monitoring year, to monitor effects from irrigation of wastewater and stormwater from the Fonterra Kapuni site onto land in the Waiokura Stream catchment. The location of the irrigation areas in relation to the biological (and water quality) monitoring sites is shown in Figure 8. This was the seventeenth biological survey related to this monitoring programme conducted at the two sites in this stream and results from this survey are summarised in Table 4, with full results provided in

Table 5 . No 'heterotrophic growths' were seen on the bed of the stream nor were any found microscopically (during sample processing) by this survey at either of the two sites.

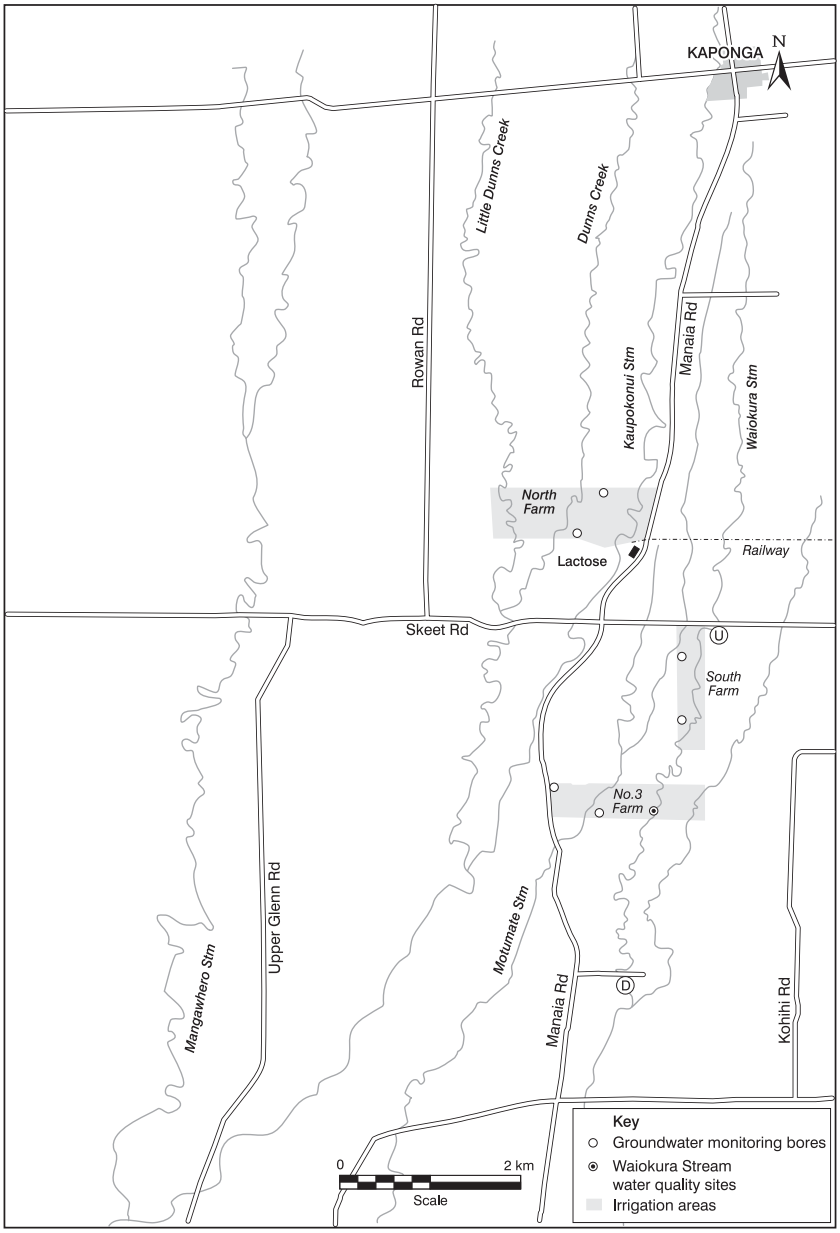

Figure 8 Waiokura Stream biomonitoring site (U and D) locations in relation to Fonterra Kapuni wastes irrigation

Table 4 Numbers of taxa, MCI values and $SQMCI_S$ values recorded previously in the Waiokura Stream, together with current results

Site	Number of previous surveys	Numbers of taxa			MCI values			$SQMCI_S$ values		
		Median	Range	Feb 2018	Median	Range	Feb 2017	Median	Range	Feb 2018
U	26	23	18-29	23	100	88-114	110	5.8	4.6-6.7	5.7
D	16	23	15-27	22	91	81-103	101	5.9	5.0-6.3	5.5

Table 5 Macroinvertebrate fauna of the Waiokura Stream in relation to Fonterra, Kapuni land irrigation of wastes, sampled on 1 March 2018

Taxa List	Site Number	MCI score	U	D
	Site Code		WKR000500	WKR000650
	Sample Number		FWB18118	FWB18119
NEMERTEA	Nemertea	3	R	R
NEMATODA	Nematoda	3	-	R
ANNELIDA (WORMS)	Oligochaeta	1	-	C
MOLLUSCA	*Potamopyrgus*	4	XA	XA
CRUSTACEA	*Paracalliope*	5	R	R
	Paraleptamphopidae	5	-	R
	Paranephrops	5	-	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	XA	XA
	Coloburiscus	7	A	C
	Deleatidium	8	A	R
	Zephlebia group	7	C	A
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	R	-
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	A	VA
	Hydrobiosis	5	R	R
	Hydropsyche (Orthopsyche)	9	R	-
	Psilochorema	6	R	R
	Beraeoptera	8	R	-
	Hudsonema	6	R	R
	Oxyethira	2	R	-
	Pycnocentria	7	VA	VA
	Pycnocentrodes	5	R	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	-
	Polypedilum	3	C	A
	Muscidae	3	-	R
	Austrosimulium	3	C	-
	Tanyderidae	4	C	R
	No of taxa		23	22
	MCI		110	101
	SQMCIs		5.7	5.5
	EPT (taxa)		13	10
	%EPT (taxa)		57	45
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa		

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site U (WKR000500)

A moderately low richness of 23 taxa was recorded at site U, upstream of the Fonterra wastes irrigation areas. This number of taxa was equal to the median richness of the previous surveys undertaken at this site (Table 4) and four taxa more than that recorded in the previous summer survey (Figure 9). The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayflies (*Austroclima* and *Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*) and stony-cased caddis (*Pycnocentria*)]; and two 'tolerant' taxa [snail (*Potamopyrgus*) and caddisfly (*Hydropsyche – Aoteapsyche*)] (

Table 5).

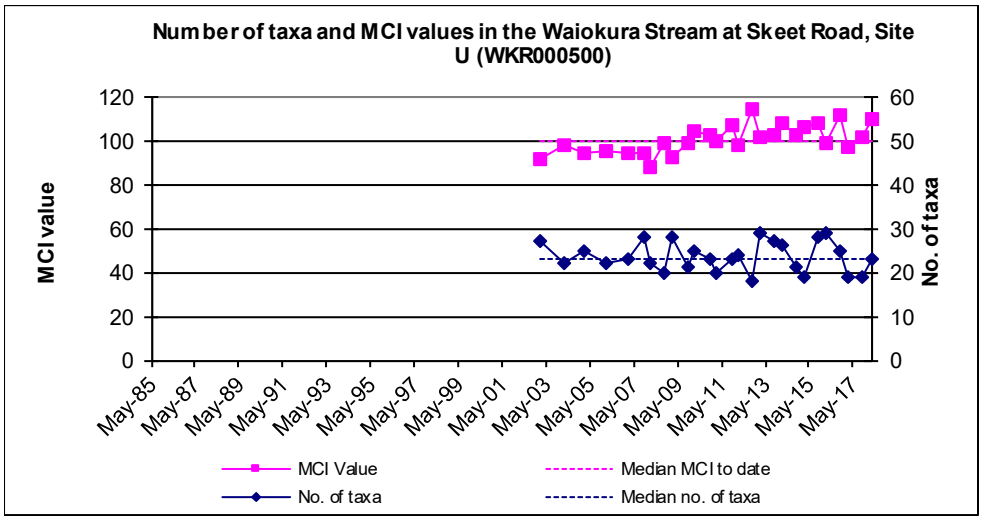

Figure 9 Numbers of taxa and MCI values recorded at site U in the Waiokura Stream since February 1985

The MCI value of 110 units was a significant thirteen units higher than that recorded by the previous summer (2017) survey (Stark, 1998), and a non-significant ten units higher than the median of previous values recorded from the twenty-six previous surveys at this site (

Table 5, Figure 9). This score reflected the moderate proportion of 'tolerant' taxa (31% of taxa richness) in the community (

Table 5). The Waiokura Stream rises below the National Park boundary and the site at Skeet Road (site U) is in the mid-reaches at an altitude of 150 masl. A relationship for ringplain streams developed between MCI and site altitude (Stark and Fowles, 2009), predicts a MCI value of 100 units for this site. The historical site median is equal to this altitude prediction, while the current result is only ten units more. The $SQMCI_S$ score of 5.7 units, which reflected the dominance of several 'sensitive' taxa and in particular *Deleatidium* mayflies, elmid beetles and *Pycnocnentria* caddisflies, was within the range of previous scores, and similar to the median score for this site (

Table 5).

Site D (WKR000650)

A moderate richness of 22 taxa was recorded at this site, downstream of the wastes irrigation areas in the Waiokura Stream catchment. This was similar to that recorded at site U but was only one taxon fewer than the median taxa number recorded at this downstream site (

Table 5). The community was characterised by no 'highly sensitive' taxa; five 'moderately sensitive' taxa [mayflies (*Austroclima* and *Zephlebia* group), elmid beetle, dobsonfly (*Archichauliodes*) and caddisfly (*Pycnocentria*)]; and three 'tolerant' taxa [snail (*Potamopyrgus*), net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and midges (*Polypedilum*)] (

Table 5). There were three significant changes in taxa abundances between site U and D, coincident with a significant change in habitat including an increase in periphyton and macrophytes at site D.

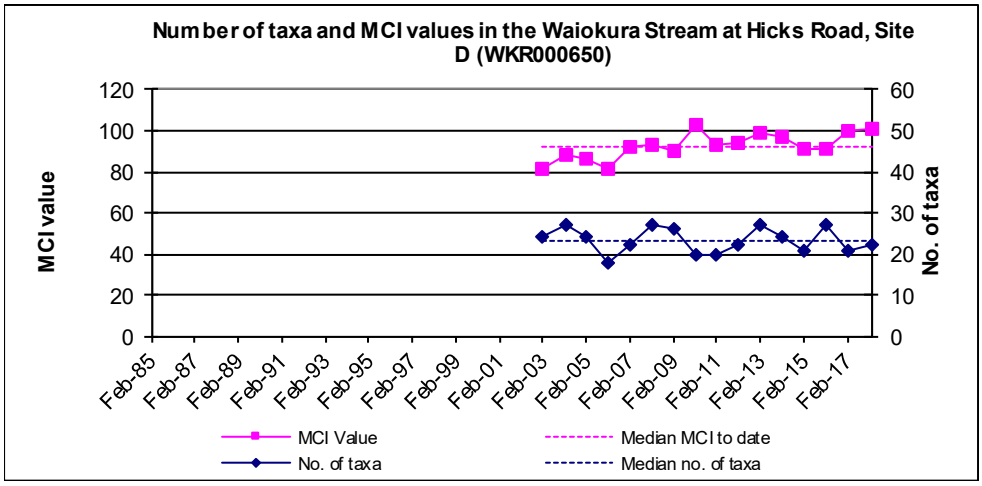

Figure 10 Numbers of taxa and MCI values recorded at site D in the Waiokura Stream since February 1985

A moderate proportion of 'tolerant' taxa (36% of taxa richness) was present at this site, which was reflected in the MCI value of 101 units. This score was only one unit higher than that recorded by the previous summer (2017) survey, and was ten units higher than the median of the fifteen previous surveys performed at this site (

Table 5 and Figure 8). The MCI score was nine units lower than that recorded upstream at site, which is an insignificant difference (Stark, 1998). This change in MCI score suggests little impact from the irrigation to land of wastes from the Fonterra factory. There is usually a reduction in MCI scores between sites U and D, with the primary drivers behind this drop likely to be the distance between sites U and D and the marked habitat differences between sites, especially the predominance of macrophytes at site D.

Despite three significant changes in individual taxon abundances between the sites, the $SQMCI_S$ score remained within 0.2 unit of the score at site U, upstream of the irrigation areas (

Table 5). Furthermore, the current score (5.5 units) was within the range of scores recorded at this site to date, and was not significantly different to that recorded at site U (Table 4). As the MCI and $SQMCI_S$ increased at site U, and much of the changes in community being attributable to differences in habitat between the two sites, there was no indication that wastes discharged from the Fonterra Kapuni site on to land in the Waiokura Stream catchment had had a recent detrimental effect on the biological health of this stream.

Summary and Conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui River and two sites in the Waiokura Stream on 1 March 2018. Samples were sorted and identified to provide the number of taxa (richness), MCI and $SQMCI_s$ scores for each site. The samples were also microscopically scanned to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ("undesirable biological growths").

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.

In the Kaupokonui River, taxa richnesses were similar to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'good' community health at all sites. MCI scores varied between sites, but generally reduced in a downstream direction. The variable MCI scores is likely a reflection of variable sampling effort, rather than of changes in water quality, as there was no clear correlation with the $SQMCI_S$ scores. There is normally a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers, which was recorded in the current survey. Although the current survey recorded this deterioration, the MCI scores were indicative of better water quality overall, probably a reflection of the wet summer that preceded this survey. The MCI scores at site 4 was significantly higher than the historical median scores, while the MCI scores at sites 3b, 5 and 6 were slightly above their historical medians. $SQMCI_S$ scores were variable between sites, with the upstream site 3b having a significantly lower score than sites 4 and 5, and site 7 having a significantly lower score than any other site. Despite this significant difference at site 3b, the results reflect the fact that the four upper sites communities were dominated by similar taxa, in particular the 'highly sensitive' mayfly *Deleatidium*, which was extremely abundant at all sites except site 7.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. As is typical, the poorest community, in 'fair' health, was found at site 7. This represents the usual influence from the Dunns Creek tributary within the reach between sites 6 and 7 as well as the natural progressive downstream deterioration which is often observed in ringplain streams and rivers.

It may be concluded that the factory's cooling water discharges had not resulted in significant adverse effects on the macroinvertebrate communities, and the communities were in average to above average condition, and in similar or slightly poorer condition than that recorded in the previous spring survey, a relatively typical result for a summer survey. Similarities in community composition, including the characteristic taxa, were generally consistent for all sites. The current survey did not record the presence of sewage fungus or bloodworm midges, also indicating a lack of impacts from the cooling water discharge.

The trend of improvement in communities noted in recent years adjacent to the factory has generally continued to be recorded by this survey, following a break in the trend recorded by the February 2008 survey, which recorded the additional presence of 'undesirable heterotrophic growths' on the streambed. The spring 2010 survey also recorded such growths at two sites, although only subtle impacts on the macroinvertebrate communities were found. Such growths were again recorded in the spring 2014 survey, but not in the current survey.

The Waiokura Stream communities indicated that conditions during this survey were fairly typical when compared with previous surveys at these two sites to date. The MCI value recorded at the downstream site was slightly lower than that recorded upstream, and exhibited the usual slight deterioration in MCI score. This is largely attributable to the distance between the sites and the marked habitat differences between sites, especially the predominance of macrophytes at site D, rather than to any effects from the application of wastes to land from the Fonterra factory. The $SQMCI_S$ scores also indicated that both sites were in average health, with the scores at both sites being similar to the historical medians, and showing no significant change between the two sites. There were some subtle changes in macroinvertebrate community compositions between the sites, which were associated with differences in habitat, principally an increase in macrophytes and periphyton at the downstream site. These community differences were insignificant and not indicative of recent impacts of wastewater irrigation within the Waiokura Stream catchment.

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