Fonterra Kapuni
Air and Water
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017–92

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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 whey and permeate from dairy product manufacture around the North Island. This report for the period July 2016 to June 2017 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 21 resource consents, which included a total of 184 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, eight 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

During the monitoring period, improvement was required in Fonterra Limited's overall level of environmental performance.

The Council's monitoring programmes for the period under review together included 12 inspections, 159 water samples collected for physicochemical analysis, two macroinvertebrate and one fish survey 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 are being addressed, and some of the data was available for evaluation at the time of writing this report. There are currently differences that remain between the manually and electronically provided data that will need to be investigated and resolved as the data provision requirements will be transitioned as part of the consent renewal process.

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 towers designed to achieve a discharge temperature of less than the maximum limit of 25°C that is allowed in the receiving water. Riparian planting was maintained on the 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 remained similar to that previously, as the addition of dairy shed effluent was approximately off-set by a reduction in loading from factory wastewater. No effect from irrigation was found from 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. The Company's wastewater and dairy shed effluent (DSE) monitoring of both the component concentrations and volumes irrigated shows that in some areas there is a continued increase in total nitrogen loading. Due to the increase in the irrigation area utilised, the nitrogen concentrations in the impact bores, although elevated in some bores, are showing no increase overall.

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

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 pond. Sample results were within those prescribed by consent conditions.

At inspection, an unauthorised discharge of effluent was found to be occurring during the cleaning of the dairy shed effluent separator pond on Farm 3. There were no significant effects from the discharge at the time of investigation. An abatement notice was issued requiring the Company to comply with the conditions of the consent and an infringement notice was also issued. The Company notified the Council that a damaged irrigation line had been discovered and that there was the potential that the resource consent conditions could be breached. The damaged line was repaired without any discharges to surface water occurring.

Particulate deposition from air emissions was, in general, similar to the previous monitoring periods. At the monitoring site east of the taker bay the lactose deposition rate was found to be almost four times the guideline value and was the highest on record for this monitoring site. No complaints were received and visual inspections found no evidence of depositions. Odour surveys continued to note low levels 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, and in the vicinity of the Pro-liq ponds.

During the year under review, an improvement was required in the Company's environmental performance and compliance and administrative performance with the resource consents as defined in Section 1.1.4. There was an abatement notice and an infringement notice issued due to the discharge of dairy effluent to the Waiokura Stream during the cleaning of the holding pond at Farm 3.

With respect to the administrative performance, there were ongoing issues with provision of accurate real time monitoring data that took some time to address and applications for the structure consents that expired on 1 June 2017, which include the weir, were not applied for until after the end of the year under review.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74 % of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21 % of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the 2017-2018 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 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Fonterra Limited (Fonterra). 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 25th combined report and 29th 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 Fonterra, 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 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% 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 whey permeate, which is the by-product of the production of cheese and casein. Whey permeate contains typically contains 78 to 88 % lactose; 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 Fonterra 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 Fonterra 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	

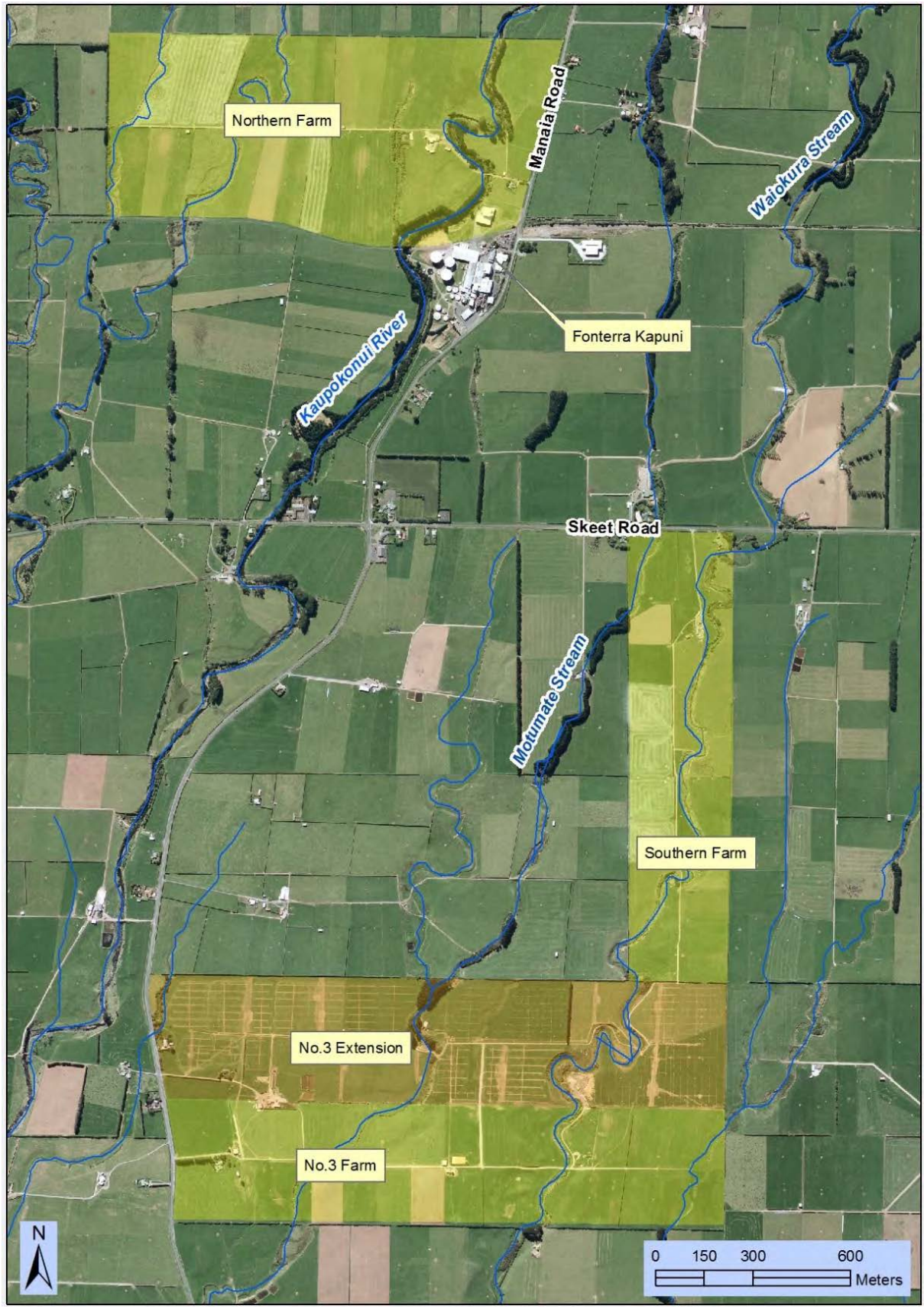

Figure 1 Fonterra Kapuni lactose factory, North, South and (extended) No 3 farms and the Kaupokonui, Motumate and Waiokura Streams

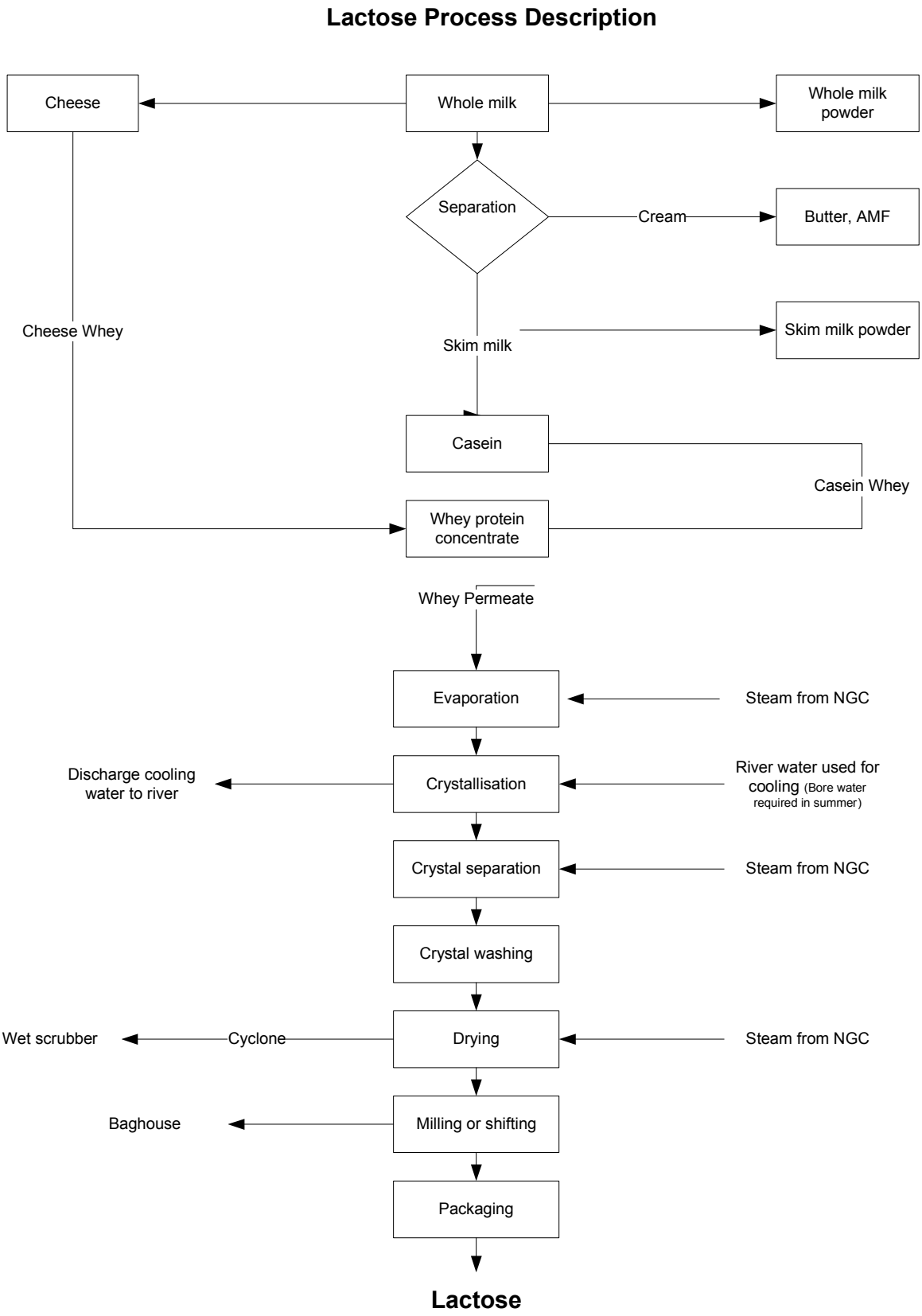

Figure 2 Lactose process diagram

1.3 Resource consents

A summary of the consents held by Fonterra 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 Limited for the lactose plant at Kapuni

Consent number	Purpose	Volume	Next review date	Expiry date	Activity's consent status at 30 June 17
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 2017. 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
5368-1	Structure over Little Dunn's Creek [Application to renew received 21 July 2017]		-	2017	Expired

Consent number	Purpose	Volume	Next review date	Expiry date	Activity's consent status at 30 June 17
6422-1	Structure for stormwater outlet (IGL plant) [Application to renew received 21 July 2017]		-	2017	Expired
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	Expired
6948-1	Structure for pipeline over Motumate and Waiokura		2017	2023	Current
9546-1	Install culvert in Waiokura Stream		2017	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 Fonterra 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

Fonterra Limited 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.

Groundwater

Fonterra Limited 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, Fonterra 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.

Fonterra Limited 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

Fonterra Limited 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.

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.

Motumate tributary

Fonterra Limited 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, Fonterra 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) storm waters

Fonterra Limited 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.

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, Fonterra 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.

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.

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.

1.3.2.2 Stormwater

Shutdown periods

Fonterra Limited held water discharge permit **4235-2** to cover the discharge of up to 240 m^3/day of stormwater from the factory site via the existing stormwater system into the Kaupokonui Stream only during factory shutdown periods. This permit was issued by the Council on 4 February 1999 under Section 87(e) of the RMA. It expired on 1 June 2017.

It was agreed by Council that, on expiry, a separate consent was no longer required for this activity, and that it could be covered under consent 0924-3.

There were five special conditions attached to the consent.

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

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

Condition 3 required 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 defined factory shut down as being when no whey is being processed.

Condition 5 dealt with review of the conditions of the consent.

Northern factory extension

Fonterra Limited holds 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 Fonterra 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

Fonterra holds 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, Fonterra 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.

Fonterra Limited 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)

Fonterra Limited 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 2,600 m^3/two consecutive days and refers to the Kaupokonui catchment, while **0923-3** covers the discharge of up to 3750 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

Fonterra Limited 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

Fonterra Limited held land use consent **4623-2** to erect, place, use and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream. This permit was issued by the Council on 4 February 1999 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 specific activities covered by this consent were:

- River sprays (1);
- Stormwater outlets (3);
- Weir (1); and
- Water intake structure (1).

There were seven special conditions attached to the consent.

Condition 1 required the consent holder to notify the Council at least 48 hours prior to undertaking significant maintenance works. Condition 5 stipulated that such works be carried out only between 1 November and 30 April.

Condition 2 stipulated that the structures are constructed generally in accordance with the application.

Condition 3 required the consent holder adopt the best practicable option to minimise adverse effects on water quality.

Condition 4 stipulated that fish passage is not obstructed.

Condition 6 required that if the structures are no longer required they are removed and the area reinstated.

Condition 7 dealt with provisions for review.

Dunn's Creek bridge

Fonterra Limited 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.

There were six conditions attached to the consent.

Condition 1 addressed notification of works.

Condition 2 stipulated that construction and maintenance be according to the documentation submitted.

Condition 3 covered measures to prevent contamination of the watercourse.

Condition 4 required that the structure is removed and the area reinstated, if and when it was no longer required.

Condition 5 prohibited the discharge of contaminated stormwater from the bridge or its approaches to the water course.

Condition 6 was a review provision.

Northern stormwater outfall

Fonterra Limited 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.

There were seven special conditions attached to the consent.

Conditions 1 to 4 dealt with construction and maintenance of the structure.

Condition 5 required that the structure is removed and the area reinstated, if and when it is no longer required.

Conditions 6 and 7 dealt with lapse and expiry of consent.

Southern stormwater outfall

Fonterra Limited 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.

There were seven special conditions attached to the consent.

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

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

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

Condition 4 stipulated that riverbed disturbance be kept to a minimum.

Condition 5 required the structure(s) be removed when no longer required.

Condition 6 and 7 dealt with expiry and review of the consent.

Motumate and Waiokura pipeline crossings

Fonterra Limited 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

Fonterra Limited 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.

Fonterra Limited 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 Fonterra Limited site consisted of five primary components.

1.4.2 Programme liaison and management

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

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

1.4.3 Site inspections

The Company's site was visited 12 times during the monitoring 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 11 occasions and of the combined stormwater/cooling water discharge on 11 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 Waiokura Stream was sampled at three sites on seven occasions. The samples were analysed for temperature, conductivity, dissolved reactive phosphorus, nitrate, pH and sodium.

Twelve samples were collected from the stormwater outfall from the factory extensions, four samples were collected from the stormwater outfall from the IGL plant and another seven were collected from the outlet of the stormwater pond. Stormwater samples were analysed for total BOD_5, conductivity, pH, turbidity, suspended solids and oil and grease. In addition, the northern factory extension samples were also analysed for free and total chlorine.

Groundwater from eight bores on the three farms was sampled on five occasions and analysed for temperature, conductivity, pH, and nitrate. In addition, filtered COD, ammonia, sodium and chloride were tested for on three of the occasions. The sixth programmed survey was undertaken on 4 July 2017 and the results of this sampling will be discussed in the 2017-2018 Annual Report.

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.

A second triennial four site fish survey was undertaken in the Kaupokonui Stream in June 2017, 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 fish communities were surveyed using the electric fishing technique, with all fish identified where possible, counted, and lengths estimated.

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. These data are assessed by Council staff to confirm compliance with consent conditions.

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. These reports cover 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 rainfall levels. 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.

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 Summary of water abstraction volumes from the Kaupokonui Stream, 2016-2017

Month	Average daily abstraction (m^3/day)	Minimum daily abstraction (m^3/day)	Maximum daily abstraction (m^3/day)	Number of days per month daily abstraction >19 500 m^3	Average abstraction rate (L/s)	Maximum abstraction rate (L/s)	Number of occasions per month abstraction rate > 225 L/s
Jul 2016	526	0	2,846	0	6.45	89.23	0
Aug 2016	5,386	1,251	9,645	0	62.24	165.5	0
Sep 2016	8,025	5,142	10,620	0	93.74	183.1	0
Oct 2016	8,654	6,043	10,834	0	99.94	176.79	0
Nov 2016	7,005	3,385	10,277	0	80.36	180.64	0
Dec 2016	9,199	6,304	12,136	0	106.47	186.49	0
Jan 2017	9,533	6,785	12,823	0	110.61	180.78	0
Feb 2017	9,813	6,366	13,095	0	113.58	179.21	0
Mar 2017	9,945	7722	12,037	0	115.03	182.28	0
Apr 2017	8,614	5,892	13,413	0	99.14	183.93	0
May 2017	4,120	0	6,572	0	47.71	117.01	0
Jun 2017	0	0	0	0	3.44	57.73	0

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 2016-2017 monitoring period.

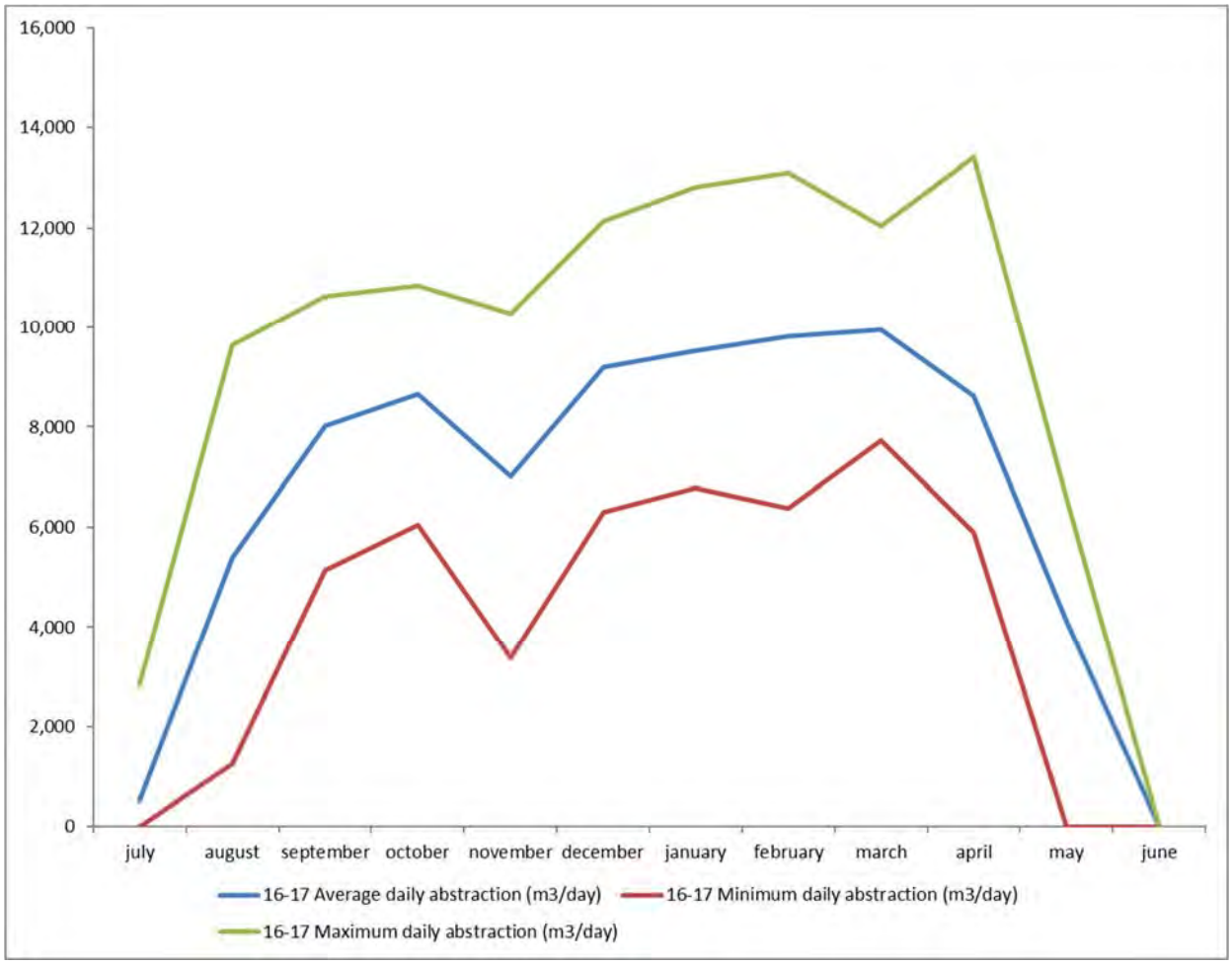

Figure 3 Monthly summary of water abstraction volumes from the Kaupokonui Stream, 2016-2017

The total volume of 2,449,491 m^3 abstracted during 2016-2017 was 14 % less than the amount taken in 2016-2017. All abstractions were within the consent limits, with the daily volume abstracted maintained well below the 19,500 m^3 daily limit. During 2016-2017, a maximum daily abstraction of 13,413 m^3 was recorded on 2 April 2017, 69 % of the consent limit. The changes in the river abstraction volumes since the 2009-2010 year are illustrated in Figure 4.

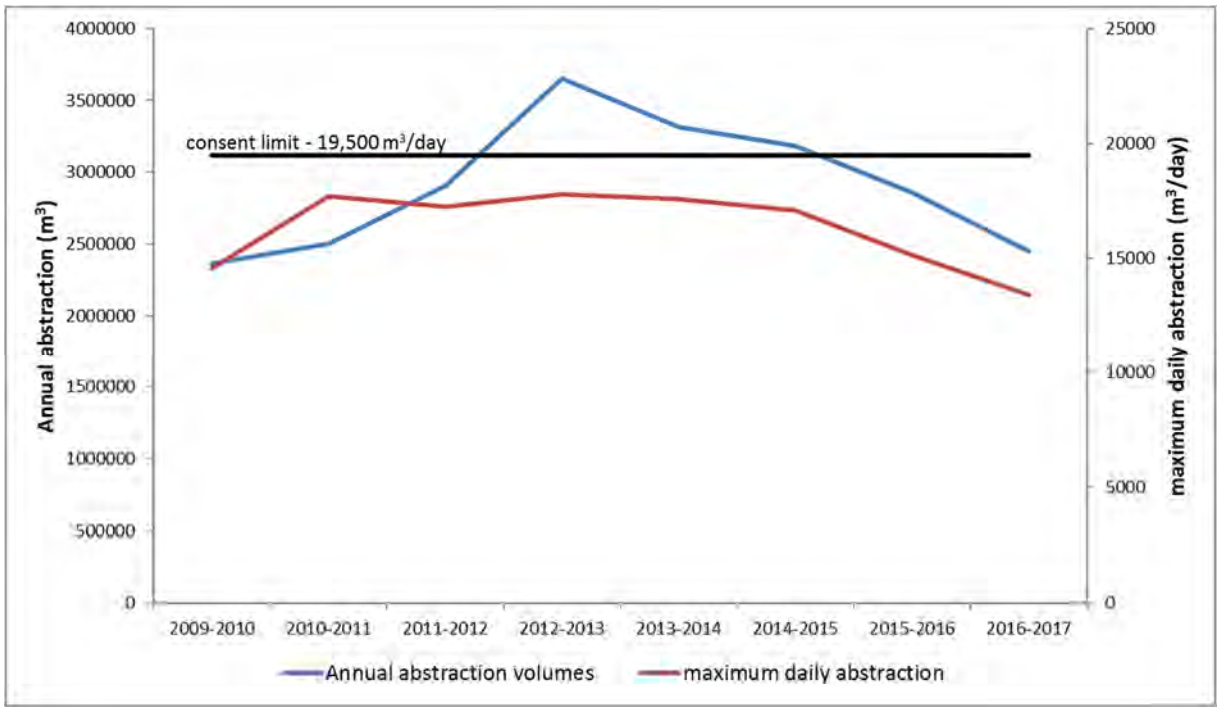

Figure 4 Daily and annual stream abstraction volumes July 2009 to June 2017

Fonterra's abstraction of water from the Kaupokonui Stream was undertaken in a satisfactory manner and there were no obvious problems. The abstraction information supplied by the Company complied with the conditions of consent **0302-1** and the Resource Management Regulations, 2010.

Electronic transmission of the abstraction data, directly to Council, was installed on 14 January 2016**.** Daily batches of data, comprising 15 minute average values, were sent electronically at 0700 NZST. Although the ongoing problems with missing data (up to about 25 %) and with scaling factors were unresolved at the end of the year under review. The 2016-2017 data was provided in January 2017 and is shown in Figure 5. This enabled compliance with the abstraction rate of 225 litres/second given on the consent to be evaluated.

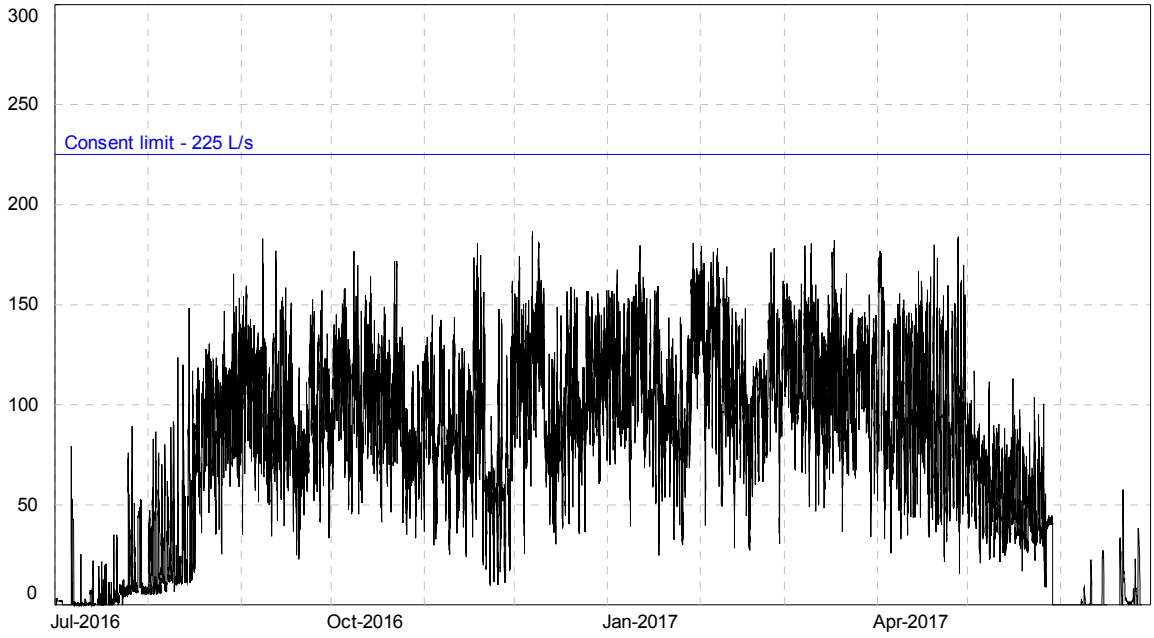

Figure 5 Abstraction rate from the Kaupokonui Stream (consent 0302-3)

It can be seen that the abstraction rate was well below the maximum permitted by consent 0302-3. The maximum abstraction rate recorded during the year under review was 186 L/s on 7 December 2016. The abstraction rate remained below 150 L/s for 96 % of the year, with a 5 days and 3 hours worth of missing records.

In comparison to the manually provided abstraction volumes, the electronic data record for the abstraction volumes (Figure 6) indicated that the total annual abstraction was 2,730,061 m^3, with a maximum daily abstraction volume of 14,664 m^3 on 1 February 2017.

The electronic record provided to Council therefore indicated that an additional 280,570 m^3 of water (11 %) was abstracted over the year.

The electronic record gave an abstraction volume of 13,619m^3 for 2 April 2017. This compares well with the manually provided value (13,413 m^3), which is collated from 06:00-06:00 rather than midnight to midnight.

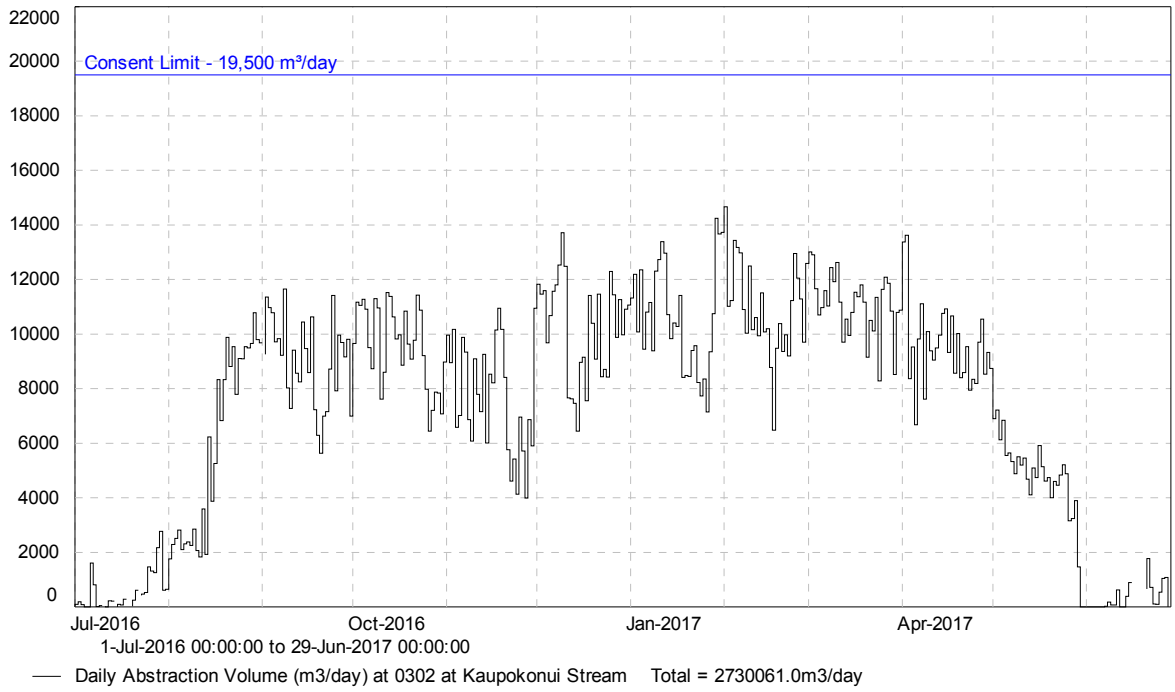

Figure 6 Daily abstraction volumes from the Kaupokonui Stream, electronic record

The differences in the manual and electronic data provided to Council will need to be investigated and resolved as the data provision requirements will be transitioned as part of the consent renewal.

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. 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, however the issue was still unresolved at the end of the period under review. This cause of this issue was identified by the Company in the 2017-2018 year and measures were put in place to limit the extent of the data gaps. This will be discussed further in the 2017-2018 Annual Report.

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 been provided to Council.

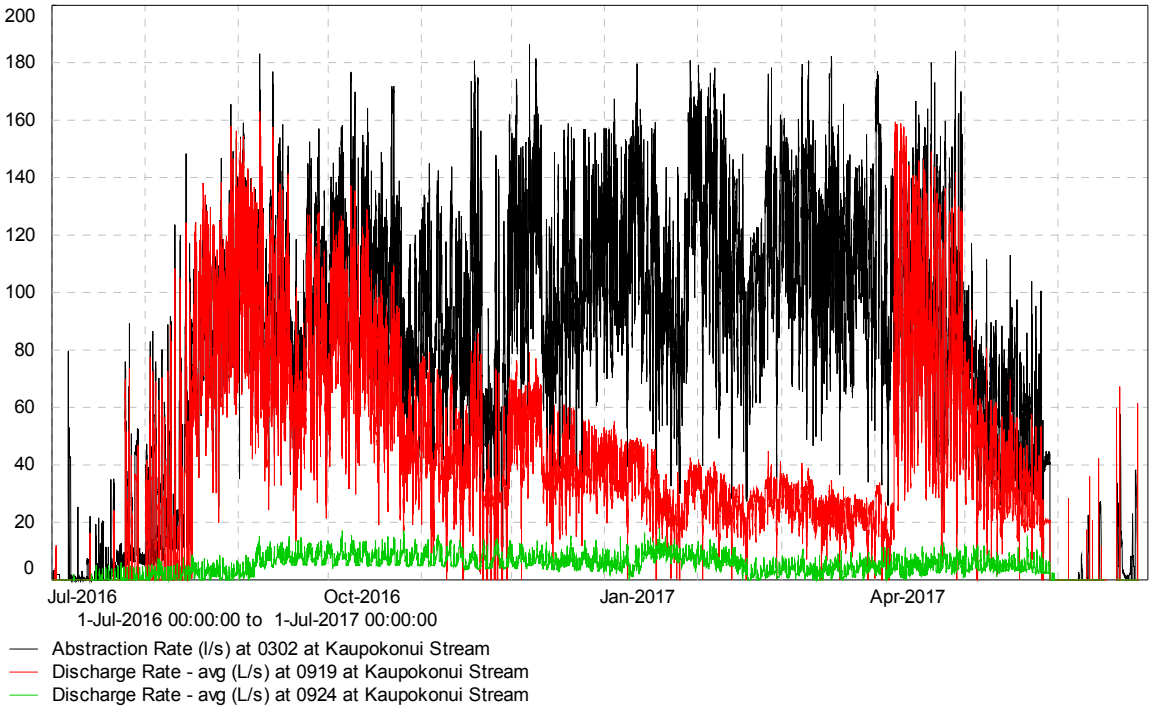

Figure 7 Discharge rates for consents 0919-3 and 0924-3, along with the abstraction rate for consent 0302-3

It is noted that the comparison between the abstraction and discharge rates could not be made during the period under review, as there were issues with the 15 minute abstraction data being reported to Council. Although these were not resolved until after the reporting period, they were resolved in time for the (corrected) 2016-2017 data to be used for comparison this report.

The data indicated that there was always some consumptive use of the abstracted water, which appeared to increase significantly at certain times during the year under review.

The Council was informed in the 2017-2018 year that Company investigation found that fouling of the flow meter recording the flow rates of the cooling water discharge permit **0919-3** was resulting in significant errors in the flow rate being recorded.

It is likely that the increase in the **0919-3** cooling water discharge rate from up to 30 L/s during the second half of March 2017 to up to 159 L/s in April 2017 would have been as a result of cleaning or replacement of the fouled flow meter.

For a number of months during the year under review the flow meter error was substantially larger than the +/- 5 % required by the agreement made between the Council and the Company that enabled the notice of consent review to be withdrawn.

Assessment of the consumptive use of the cooling water system (which was one of the purposes of the proposed review of consents 0919 and 0924) will commence once sufficient data has been gathered and provided to Council that meets the agreed standard for accuracy.

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 for the renewal of the consent.

This data has been provided to Council electronically for the year under review (Figure 8). The median monthly discharge temperatures are given in Table 11.

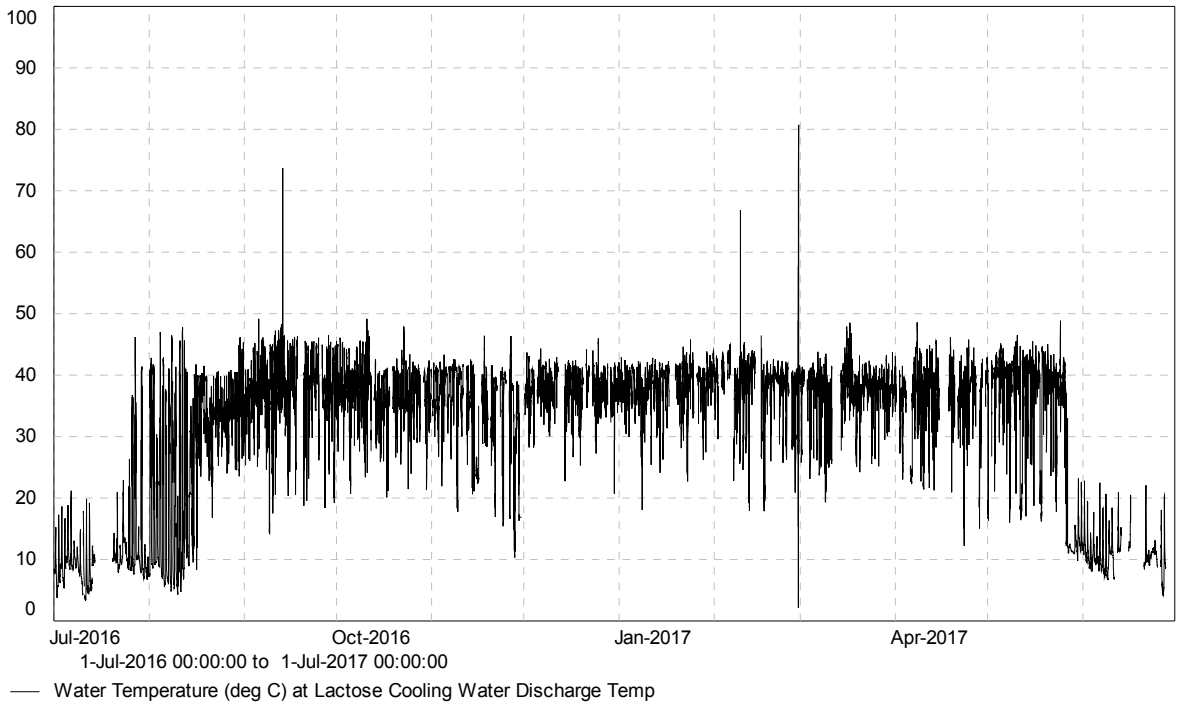

Figure 8 Temperature of the cooling water discharge permitted by consent 0919-3

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 38-39 ˚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.

September's maximum temperature was recorded on 13 September 2016, with two 15 minute average temperatures reported that were at or about 70 ˚C (at 11:15 and 11:30 am).

February's maximum temperature was recorded on 28 February 2017, a with two 15 minute average temperatures reported that were above 70 ˚C (at 10:15 and 10:30 am).

Further analysis and comparisons of performance over time will be made, as appropriate, when more data has been gathered.

Table 4 Cooling water temperature monthly statistical summary

Month	Monthly minimum (˚C)	Monthly maximum (˚C)	Monthly median (˚C)	Missing records
Jul 2016	3.3	46.2	9.5	6 days 8 hr 45 min
Aug 2016	4.3	47.8	32.4	No gaps
Sep 2016	14.1	73.7	38.4	3 days 8 hr
Oct 2016	20.1	49.2	37.5	3 days 3 hr 15 min
Nov 2016	10.3	46.4	36.8	6 days 10 hr
Dec 2016	20.7	46.0	38.1	6 days 8 hr 30 min
Jan 2017	18.1	45.8	38.8	3 days 3 hr
Feb 2017	2.1	80.7	39.3	6 days 1 hr 15 min
Mar 2017	19.4	48.5	38.2	4 days 4 hr
Apr 2017	12.2	48.6	38.0	8 days 7 hr 30 min
May 2017	9.8	48.8	39.5	1 day 15 min
Jun 2017	4.2	22.8	10.8	8 days 17 hr 45 min

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, 2016-2017

Month	Kapuni Farm 1							Farms 2 & 3						
	Factory			DSE			Total	Factory			DSE			
	Days	Volume, m/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 2016	16	243	503	0	0	0	0	30	222	693	0	0	0	0
Aug 2016	24	390	854	10	95	120	0	31	1140	1944	19	61	167	0
Sep 2016	30	521	1000	18	84	120	0	30	1462	1972	21	103	167	0
Oct 2016	31	513	823	20	81	120	0	31	1423	1887	15	54	168	0
Nov 2016	28	304	665	16	56	118	0	30	1185	1817	14	97	167	0
Dec 2016	31	461	859	26	81	119	0	31	1190	1586	11	41	167	0
Jan 2017	31	420	772	17	88	117	0	31	1349	1859	18	51	167	0
Feb 2017	28	463	673	22	95	120	0	28	1360	1683	24	117	167	0
Mar 2017	31	511	972	6	80	116	0	31	1346	1753	23	50	167	0
Apr 2017	30	444	716	24	68	115	0	30	1427	1794	18	58	78	0
May 2017	28	272	514	27	60	112	0	31	813	1349	28	101	167	0
Jun 2017	10	48	153	0	0	0	0	28	61	466	24	78	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 2016-2017 monitoring period. 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 526,626 m^3 was irrigated during 2016-2017, with a distribution between farms of 25 %, 18 % and 57 % for Farm 1, Farm 2 and Farm 3, respectively. This was a reduction of 8.3 % from the volume of 574,313 m^3 irrigated in 2015-2016. The factory wastewater irrigation distribution between the farms during the year under review was similar to the previous year.

Disposal of dairy shed effluent 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 9 August 2016. A total volume of 19,928 m^3 was discharged during the year. On Farm 1, where irrigation commenced on 16 August 2016, a total volume of 14,403 m^3 was discharged.

The record shows that the volume limits on both consents were complied with throughout the 2016-2017 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 spray

coolant water temperature (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.

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. There are currently no specific requirements on the consent regarding the accuracy of the temperature sensors to be used. In the absence of any specific consent requirements, the accuracy required needs to be as required by the Water Temperature National Environmental Monitoring Standard (NEMS standard). This standard states that the accuracy of the sensors must be within +/- 0.5˚C, with an additional off-set of 0.2˚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 +/- 0.7˚C, with a potential error of up to +/-1.4 ˚C on any calculated temperature differentials.

From 19 March 2014, the upstream and downstream temperature data were sent directly to Council by telemetry on a daily basis. As with the 2015-2016 year, there were ongoing issues during the year under review with gaps in the daily data provided to Council. However the Company was able to provide the majority of this data upon request, with a resultant gap rate of only 2.3%. The reasons for the high gap rates in the data provided to Council autonomously were investigated in the 2017-2018 year, and measures have now been put in place to limit the extent of this issue.

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 9 and Figure 10. The change in temperature is given in Figure 11.

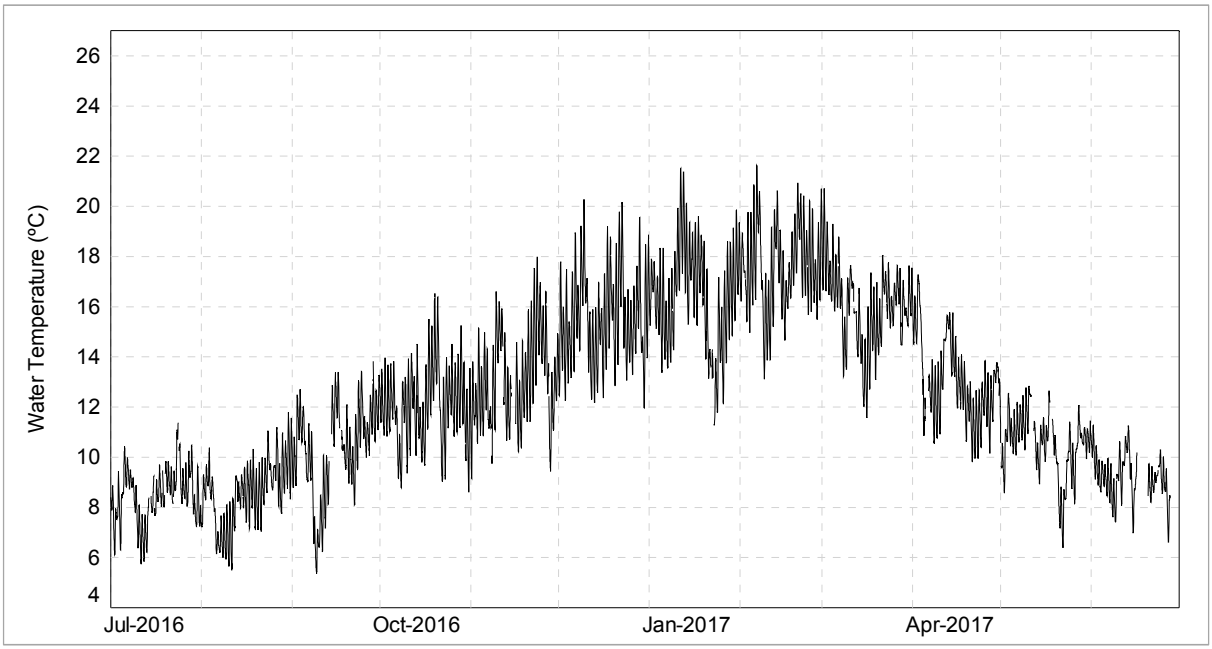

Figure 9 Water temperature (°C) records for the Kaupokonui Stream upstream of lactose plant during the period 1 July 2016 to 30 June 2017

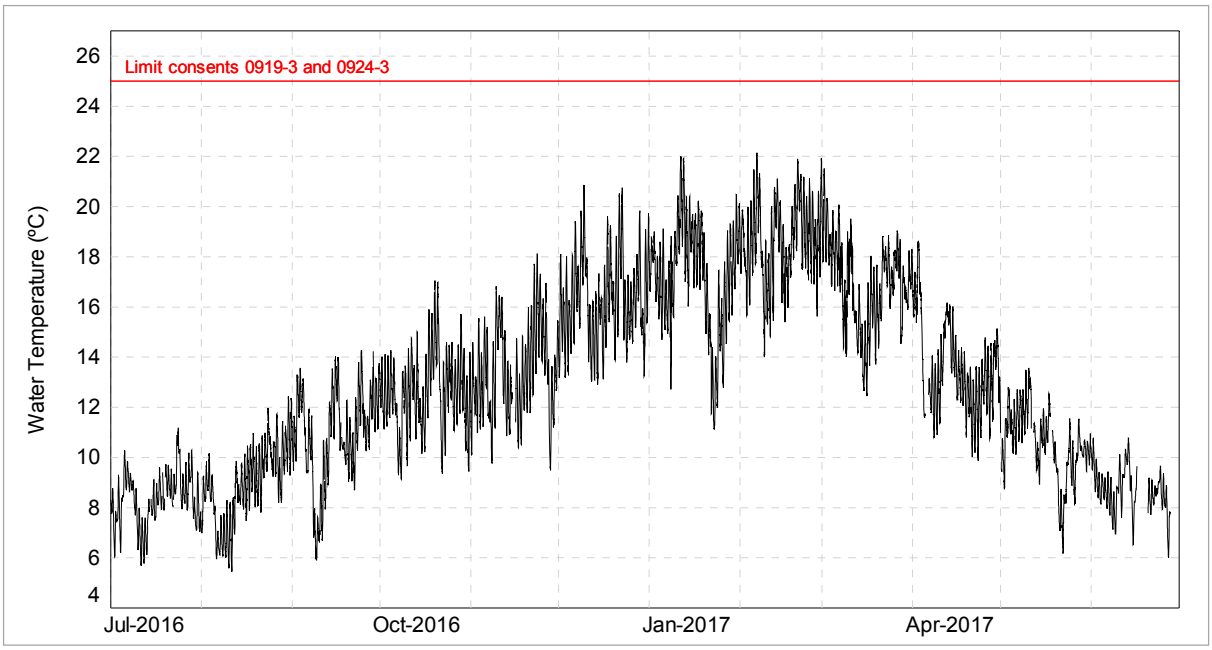

Figure 10 Water temperature (°C) records for the Kaupokonui Stream downstream of lactose plant during the period 1 July 2016 to 30 June 2017

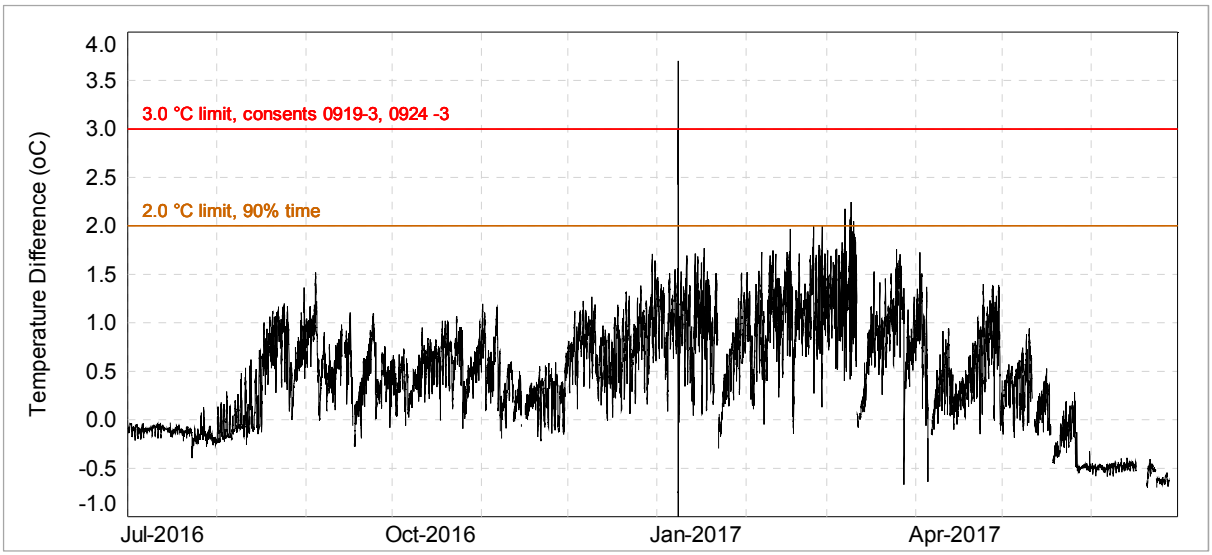

Figure 11 Kaupokonui Stream temperature increase below lactose plant for period 1 July 2016 to 30 June 2017

A summary of the reported temperature change and maximum temperature data for 2016-2017 (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 continuous water temperature records (°C) from two monitoring probes in the Kaupokonui Stream, July 2016 to June 2017

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	99	0	0	0	-0.4	0.1	0	11.2	0
Aug 2016	32	0	0	0	-0.3	1.4	0	12.5	0
Sep 2016	1.5	0	0	0	-0.3	1.5	0	14.3	0
Oct 2016	0.2	0	0	0	-0.1	1.1	0	17.1	0
Nov 2016	7.4	0	0	0	-0.2	1.2	0	18.1	0
Dec 2016	0.02	0	0	0	0.0	1.7	0	20.9	0
Jan 2017	2.3	0.08	0.05	0.03	-1.5	3.7	1	22.0	0
Feb 2017	0.5	0	0	0	-0.1	2.0	0	22.1	0
Mar 2017	0.9	0.1	0	0	-0.7	2.3	0	21.5	0
Apr 2017	4.3	0	0	0	-0.5	1.7	0	18.6	0
May 2017	49	0	0	0	-0.6	0.9	0	13.6	0
Jun 2017	100	0	0	0	-0.7	-0.4	0	10.8	0
Totals for 2016-2017	23.3	0.0	0.0	0.0	-1.5	3.7	1	22.1	0

Note:* = % of actual 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). During 2016-2017, there was only one occasion during which a temperature spike exceeded the 3°C increase limit without the null switch being activated. There was one period of less than 15 minutes on 8 January 2017, in which a maximum value of 3.7°C was recorded, and the Company advised that the temperature probe had been removed from the stream.

There were occasions when temperature differences reached or exceeded 2˚C, during periods of low flow in Kaupokonui Stream.

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. These limits were not exceeded during the 2016-2017.

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.

The data and summary provided in Figure 11 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 23 % of the time. This included a period in January when cooling water was being discharged at a temperature in excess of the upstream Kaupokonui Stream temperature.

Council is discussing options with Fonterra to improve the precision of the Company's temperature monitoring and recording, and this will be addressed during the renewal of the consents.

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 2016-2017 the pH, organic strength, major mineral components, and nutrients, including nitrogen species were determined for 47 samples collected between 4 August 2016 and 29 May 2017. The results are summarised in Table 7.

Table 7 Results of factory wastewater monitoring by Fonterra 2016-2017

Parameter	Unit	2016-2017		% change	2015-2016		% change	2014-2015	
		Median N = 43	Range		Median N = 47	Range		Median N = 46	Range
pH	pH	4.4	4.1 - 4.7	0	4.4	4.2 – 8.9	-	4.4	4.1 – 4.7
Chemical oxygen demand	g/m^3	7,370	2,790 - 11,430	-3	7,600	517 – 20,940	-10	8,435	5,150 – 14,106
Total Nitrogen	g/m^3 N	96	62 - 148	2	94	12 - 191	-12	107	41 – 176
Nitrate	g/m^3 N	41	14.8 - 94	-2	42	7 - 148	-12	48	5 – 130
Nitrite	g/m^3 N	2.1	0.31 - 7.4	-9	2.3	0.2 – 4.9	+77	1.3	0.1 – 8.8
Total Kjeldahl Nitrogen (TKN)	g/m^3 N	48	5.6 - 82	9	44	7 - 148	+7	41	5 – 130
Calcium	g/m^3	201	87 - 391	22	165	67 - 276	-16	196	137 – 352
Magnesium	g/m^3	9.5	1 - 154	-50	19	2 - 86	-10	21	5 – 183
Sodium	g/m^3	125	61 - 199	-5	131	27 - 201	+17	112	57 – 189
Potassium	g/m^3	104	52 - 480	-26	140	16 - 440	-3	145	54 – 320
Total Phosphorus	g/m^3P	73	29 - 247	-27	100	3 - 302	+8	93	25 – 278
Ash	g/m^3	1090	511 - 1799	-	-	-	-	-	-

Parameter	Unit	2016-2017		% change	2015-2016		% change	2014-2015	
		Median N = 43	Range		Median N = 47	Range		Median N = 46	Range
Sodium adsorption ratio		3.3	1.5 - 5.2	-5	3.5	1.1 – 5.1	+22	2.7	1.7 – 4.2
Lactose	%	-	Not determined		0.37	0.0 – 4.10	-35	0.57	0.32 – 14.5

The lactose plant wastewater typically has high organic strength and is acidic. A comparison can be made between results for the 2014-2015, 2015-2016 and 2016-2017 monitoring years on the basis of median values, as described in Table 7. Wastewater organic strength in 2016-2017, was, on the whole similar to the 2015-2016 year, with COD, total nitrogen, nitrate and nitrite nitrogen and total Kjeldahl nitrogen (TKN) medians all being within +/- 10 % of the 2015-2016 medians. An exception to this was the total phosphorus, the median for which decreased by 27 %. It is also noted that the total nitrogen concentration agreed reasonably well with individual nitrogen species in 2016-2017, unlike the 2013-2015 seasons. Sodium adsorption ratio was again high, though well within the safe range for soil stability. There were notable decreases in magnesium and potassium and an increase in calcium.

With respect to the mass discharge rate of wastewater components, factory wastewater volume has changed little since 2011-2012. Therefore, the estimated mass discharge rate of the wastewater components has increased or reduced by about the same proportion as their respective concentrations. Thus, it appears that the estimated total mass of nitrogen applied to the irrigation areas from the factory wastewater discharges decreased again in 2016-2017. The annual volume of factory wastewater produced since 2009-2010, together with the annual mass of factory nitrogen irrigated, is presented in Figure 12.

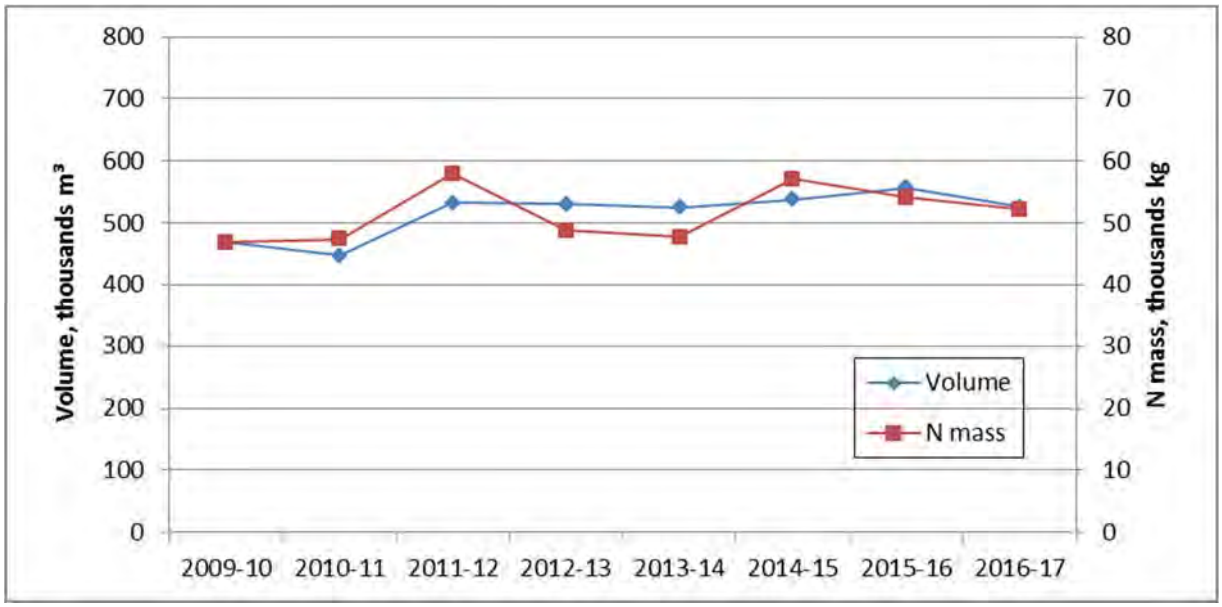

Figure 12 Annual volume of factory wastewater and estimated factory nitrogen mass irrigated, 2009 - 2017

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. Analysis is as for factory wastewater, with the exception that biochemical oxygen demand (BOD) is measured instead of chemical oxygen demand (COD). A total of 43 samples were taken between 11 August 2016 and 29 May 2017 for Kapuni Farms, and 38 samples were taken between 19 August 2016 and 29 May 2017 for Kapuni Farm 1. The results are summarised in Table 8.

Table 8 Results of dairy shed effluent monitoring by Fonterra 2016-2017

Parameter	Unit	Farm 1				Farms 2 & 3			
		Median N = 38	Range			Median N = 43	Range		
pH	pH	7.9	6.6	-	8.2	8.0	7.5	-	8.2
Biochemical oxygen demand	g/m^3	234	33	-	1,600	520.0	139	-	2,400
Total Nitrogen	g/m^3N	115	50	-	162	190	58	-	310
Nitrate	g/m^3N	0.43	0.01	-	3.16	0.20	0.01	-	1.00
Nitrite	g/m^3N	0.08	0.01	-	6.00	0.04	0.01	-	0.20
Total Kjeldahl Nitrogen (TKN)	g/m^3N	113	49	-	162	190	57	-	310
Calcium	g/m^3	85	51	-	129	98	59	-	165
Magnesium	g/m^3	20	2	-	79	12	2	-	84
Sodium	g/m^3	49	30	-	93	62	38	-	198
Potassium	g/m^3	370	220	-	550	620	225	-	1260
Total Phosphorus	g/m^3P	50	31	-	72	80	37	-	151
Ash	g/m^3	941	500	-	1,370	1,315	607	-	2,856
Sodium adsorption ratio		1.9	1.1	-	3.5	2.5	1.0	-	6.4

Comparison of contaminant loadings from the factory wastewater and DSE

The DSE has lower organic (BOD compared to COD) and higher mineral strength than factory wastewater, and is slightly alkaline (Figure 13 and Figure 14). 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 (190 g/m^3), was about double the Farm 1 effluent (115 g/m^3), and about double that of factory wastewater (96 g/m^3). The predominant nitrogen species present in the dairy shed effluent are ammoniacal nitrogen and organically bound nitrogen, whereas the factory wastewater contains much higher concentrations of nitrate and nitrite nitrogen. The additional nitrogen load applied to the paddocks during the year under review from the Farm 1 and the Farm 2 and 3 DSE was about 5,400 Kg, that is, about anther 10 % when compared to the nitrogen applied in the factory wastewater.

Within the production season, measured wastewater strength was significantly higher from September to April, in terms of total nitrogen (Figure 15) and minerals (for example potassium as shown in Figure 17). Total phosphorus on the other hand was higher in the factory wastewater on the shoulders of the season between late August to the end of September and February to April.

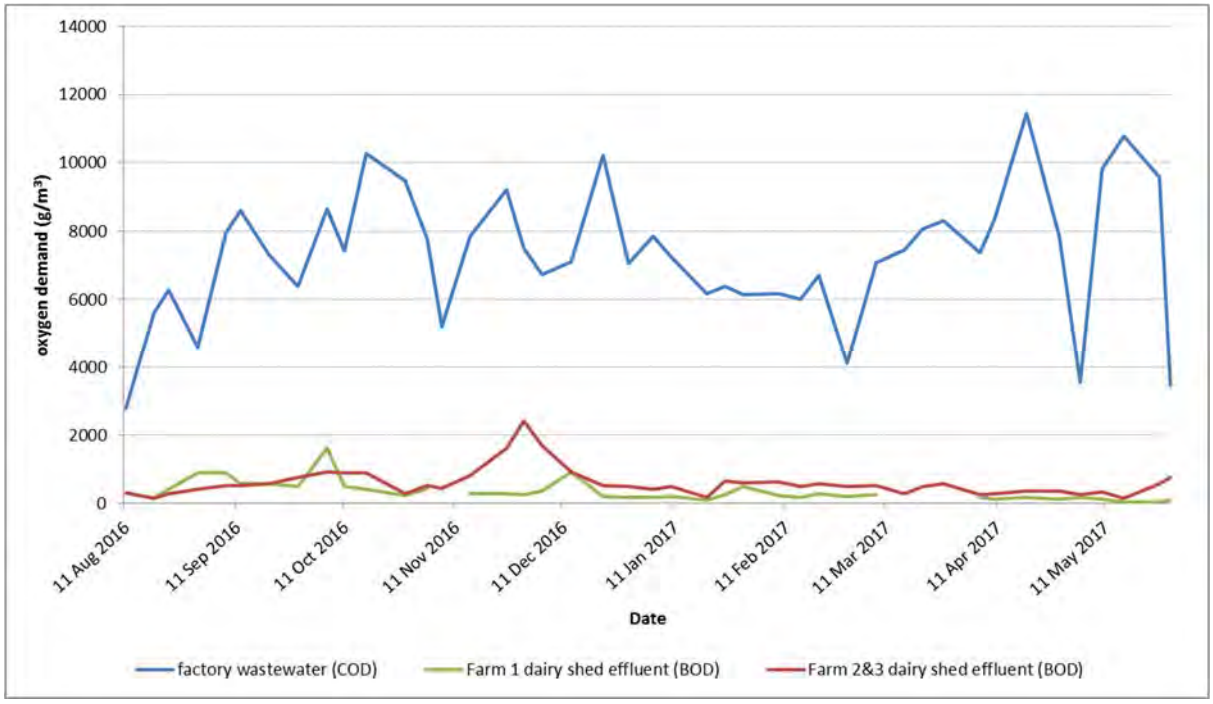

Figure 13 Oxygen demand of the factory wastewater and dairy shed effluents

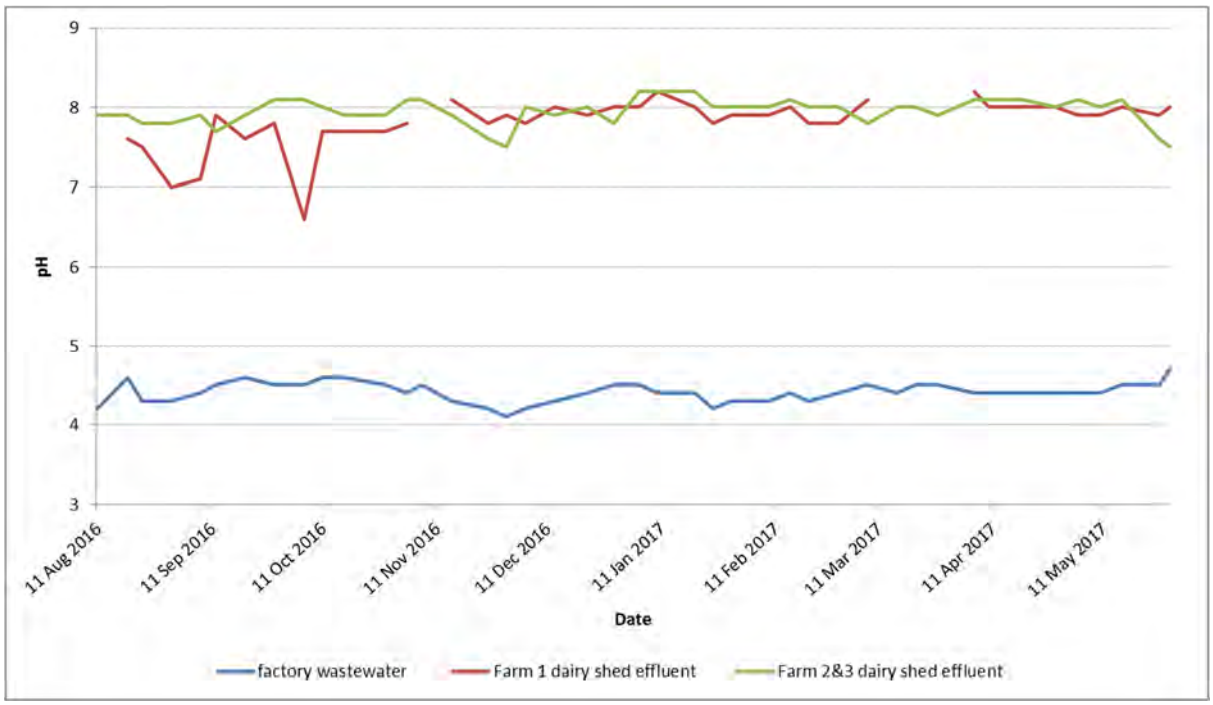

Figure 14 pH of the factory wastewater and dairy shed effluents

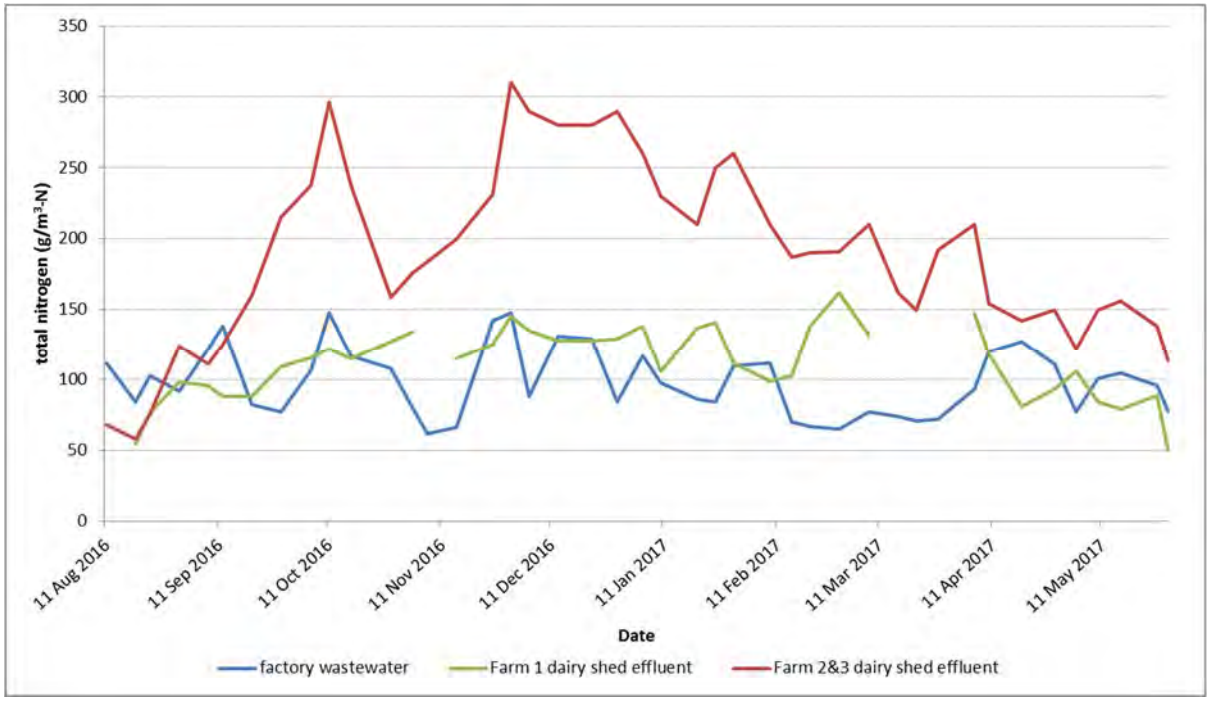

Figure 15 Total nitrogen of the factory wastewater and dairy shed effluents

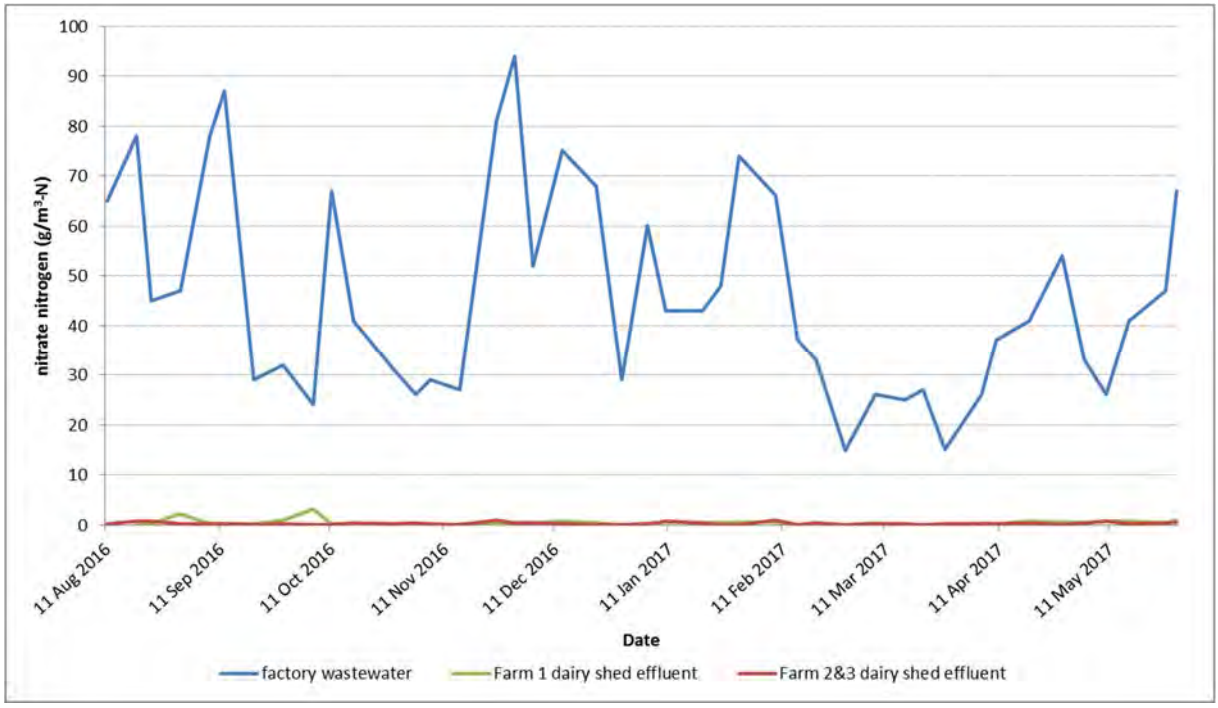

Figure 16 Nitrate nitrogen of the factory wastewater and dairy shed effluents

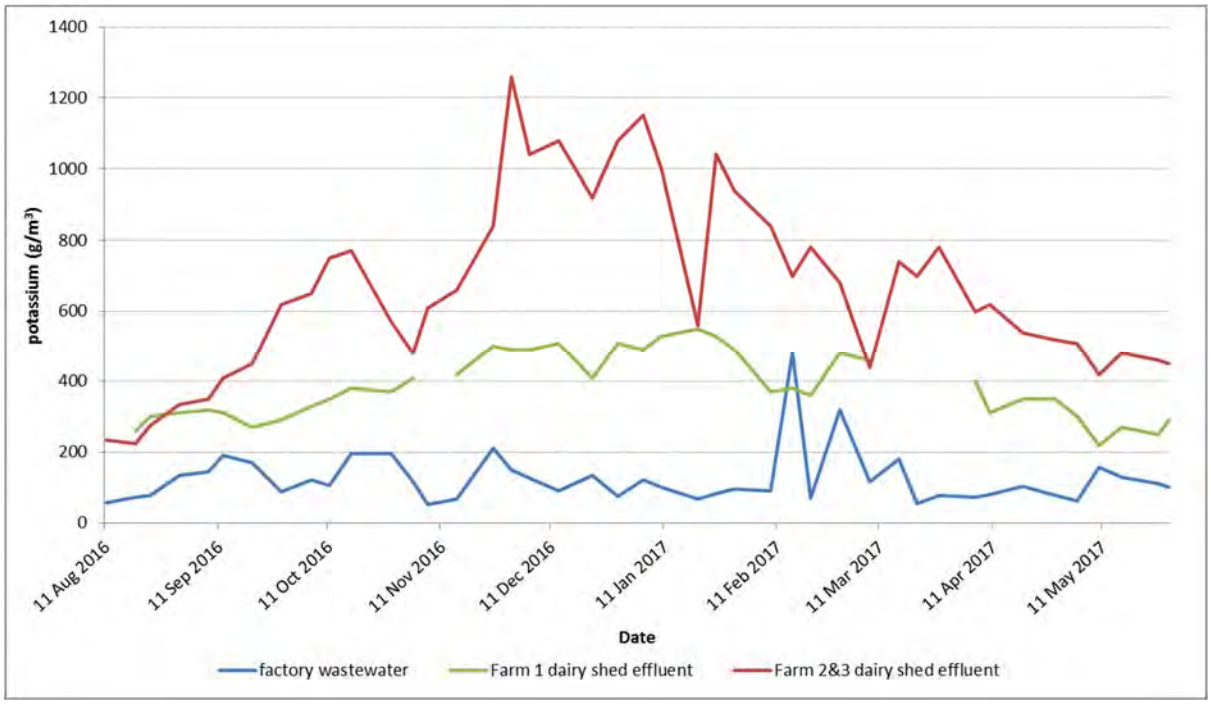

Figure 17 Potassium concentration of the factory wastewater and dairy shed effluents

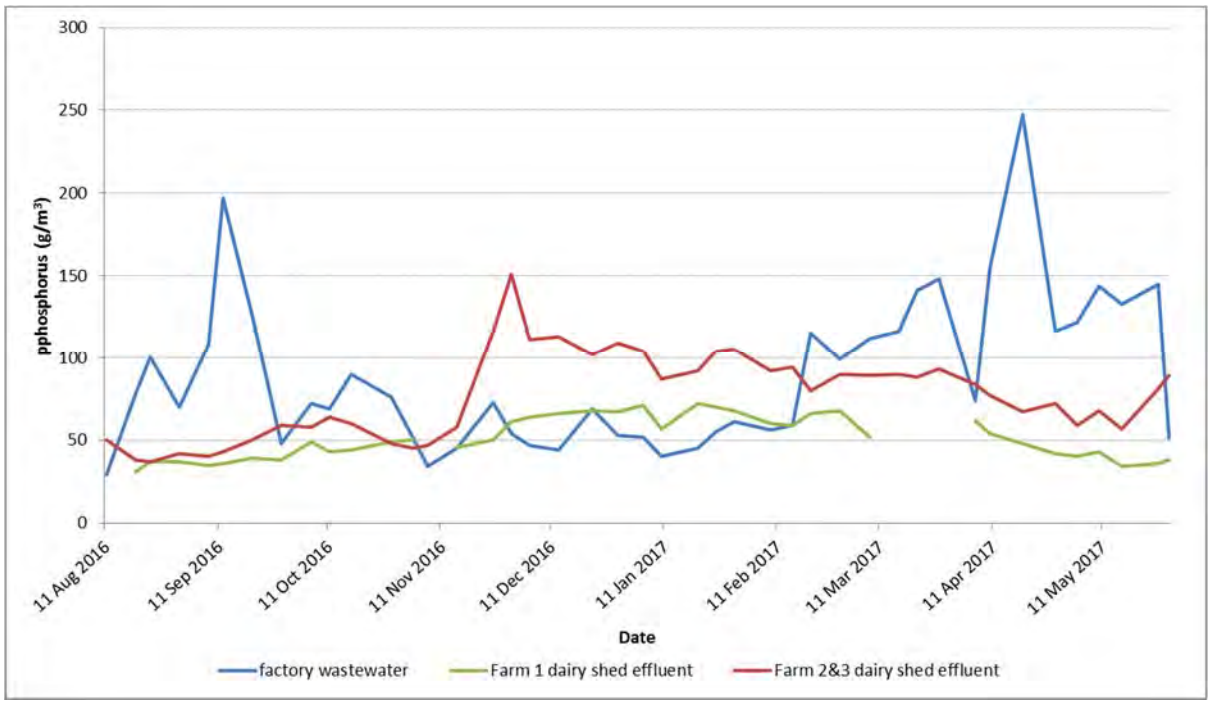

Figure 18 Phosphorus concentration of the factory wastewater and dairy shed effluents

Interlaboratory comparison

An interlaboratory comparison exercise was carried out on 28 September 2016 on 24-hour composite samples taken by Fonterra of factory wastewater and farms DSE. The results are given in Table 9.

Table 9 Results of interlaboratory comparison on factory and dairy effluents, 28 September 2016

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/m^3 $CaCO_3$	-	<1	-	-	-	-
Biochemical oxygen demand (BOD)	g/m^3	-	3430	480	407	760	590
Calcium	g/m^3	172	67.7	86	48.8	102	174
Chloride	g/m^3	-	69.1	-	-	-	-
Chemical oxygen demand (COD)	g/m^3	6,380	6100	-	-	-	-
Conductivity, 20°C	mS/m	-	130	-	143	-	240
Bicarbonate	g/m^3 HCO_3	-	0.6	-	-	-	-
Potassium	g/m^3	88	102	290	184	620	347
Potassium adsorption ratio		-	1.74	-	3.17	-	3.93
Magnesium	g/m^3	14	13.2	57	24	43	18.7
Sodium	g/m^3	104	108	46	46.6	57	54.7
Ammoniacal nitrogen	g/m^{3}N	-	4.68	-	62.1	-	128
Nitrate + nitrite	g/m^{3}N	34.75	27.0	-	<0.01	0.2	0.02
Oil and grease	g/m^3	-	3.1	-	-	-	-
pH	pH	4.5	4.5	7.8	7.8	8.1	8.2
Sodium adsorption ratio		2.9	3.14	1.3	1.37	1.7	1.05
Sulphate	g/m^3	-	44.7	-	-	-	-
Suspended solids	g/m^3	-	360	-	360	-	880
Total Kjeldahl Nitrogen (TKN)	g/m^{3}N	42	45.8	108	94.4	215	189
Total Nitrogen	g/m^{3}N	77	72.8	109	94.4	215	189
Total Phosphorus	g/m^{3}P	48	53	38	39.4	59	61.2
Ash	g/m^3	862	-	689	-	1179	-
Nitrate	g/m^{3}N	32	-	0.9	-	0.16	-
Nitrite	g/m^{3}N	2.75	-	0.02	-	0.04	-

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 it was found that there was good agreement (within +/- 5 %) for the pH and sodium on all three wastewater streams, and for COD in the factory wastewater and total phosphorus on the DSE's. There was reasonable

agreement (within +/- 10 %) on most of the other factory wastewater components, with the exception of calcium, potassium and, nitrate-nitrite nitrogen. The parameters showing particularly poor agreement across all wastewater streams were calcium and potassium. This is only the second series of interlaboratory comparisons that have been undertaken, which are scheduled to continue.

A wide range of parameters were tested by Council, for future reference. For nitrogen species, it was determined that nitrate was the major single component in factory wastewater, whereas the DSE was almost exclusively ammonia and organics (which are the components that are measured by TKN analysis).

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 2016-2017 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 installation of a bund wall on the western side of the site to prevent any spills from reaching the stream. This included the stretch between the wastewater tank and the stream. Repairs were also undertaken on the wastewater overflow pipe. The waste oil bunds were replaced and covered to prevent stormwater entering the bunds.

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 cleaned regularly during the year under review and the intake structure was cleaned of silt in July 2016, without incident. During the exercise, the diverted water flooded the adjacent bund causing staff to note that the cable pipelines running through the bund wall provided conduits for liquid to escape the bund when it reached a certain level. This discovery enabled the proactive step of using expanding foam to fill the pipe cavities to be undertaken, mitigating the risk of this happening if there was to have been a spillage.

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 upstream of the weir on five of the 12 inspections undertaken during the period under review.

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 a temperature of less than 25°C for water entering Kaupokonui Stream after going through the towers and existing spray system, that is, below the maximum temperature allowed in the receiving water under consent 0919-3. Flow and temperature meters were installed on the inflow line to the towers. A flow meter was also placed on the line through which combined recovery condenser cooling water and stormwater is discharged directly to the stream under consent 0924-3. The installation of telemetry for the monitoring data from these meters was 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 2.1.1.3 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.

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 is installed on this stormwater outfall, in case of accidental spillage of chemicals, and Reno mattresses for erosion control are laid below both northern stormwater outlets, as shown in Photo 1. The valve was not required to be used in the 2016-2017 review period.

There were a number of discussions held regarding the southern stormwater pond. Approval was given for the sediment/sludge from the pond to be discharged onto land in the vicinity of the pond to allow works to occur on the concrete liner to reduce losses. It was also found that the pond outlet was not closing. Although works were undertaken to clear the blockage, minor discharges were still occurring when the valve was closed. This was thought to be groundwater ingress into the discharge pipes. At the inspection on 18 May 2017 the inspecting officer was advised that the pond was to be cleaned out and relined during the winter 2017 shutdown period.

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.

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, is also discharged back to the Motumate catchment via a tributary immediately opposite the factory across Manaia Road.

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 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.

There was one instance of leakage of wastewater/stormwater from the underground transfer and distribution pipelines reported to Council during the period under review. This is discussed in section 2.3. Although there was a discharge onto land, none of this wastewater reached surface water. A dead patch of pasture approximately 1 m^2 was found to be present on 19 January 2017 from the break in the irrigation line. This is considered to be only a minor, short term effect. A set of standard operating procedures is in place for monitoring of the system. Pumping is stopped automatically, and restarts must be made manually, when the pressure set point is exceeded.

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. Most inspections found that there was no ponding present and that buffer distances were being maintained. In addition to the normal factory wastewaters and DSE, other wastes such as solids from the effluent holding ponds, cleanings from the Pro-liq ponds (May 2017) and wastewater from the fighting of an on-site fire were irrigated onto land during the year under review. Matters noted during the 2016-2017 year are outlined below.

A fire at the plant in November 2016 due to machine friction setting light to dried lactose powder resulted in firefighting liquid being directed to the wastewater tank. This was the irrigated onto land. At the December inspection it was found that there was minor pasture die off in an area where this had been applied due to the high lactose concentration of the wastewater. In October 2016 it was found that effluent was tracking to the Waiokura Stream during the spreading of solids from the Farm 3 effluent pond. This was logged as an unauthorised incident and is discussed in section 2.3. It was noted that some works were to occur on the stationary irrigator systems in paddock 26 on Farm 1 to ensure that the 20 m buffer zone to the bank of a watercourse is maintained at all times (16 February 2017). Pods were being trialled on this farm to replace the travelling irrigators. A gate valve and non-return valve were installed in the Farm 1 irrigation line, above the stream crossing, to ensure if the pipe was broken the wastewater would not backflow and discharge into the stream. A gate valve was also installed by paddock 13 on Farm 1 to allow irrigation to be continued on one quarter of the farm, whilst three quarters of it can be isolated for repairs if there was a failure to the mainline.

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 2017 monitoring period.

The Company is currently investing around $20,000 a year in planting and fencing of waterways around the factory and Company farms, and a further $2,000 a year on maintenance of these areas, such as spraying. This 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 $4,327.18 paid to the Council in the 2016-2017 year.

At the end of the 2016-2017 year, the Council had prepared 65 Riparian Management Plans (RMP's) fully or partially located in the Kaupokonui Stream catchment. Of these, 37 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 19.

The riparian plantings recommended in the plans that have received funding to the end of June 2017 covered a stream bank distance of 13 Km, of which 44 % were plans 100 % completed, with 29 % of all plans above the plant now 100 % completed.

This compares to a total of 159 plans covering 341 Km, of which 15 % were 100 % completed in the wider Kaupokonui parent catchment.

During the 2016-2017 year four farms received rebates under this scheme totalling $3,111.00, which equated to 2,165 plants.

An example of riparian planting is given in Photo 2, 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.

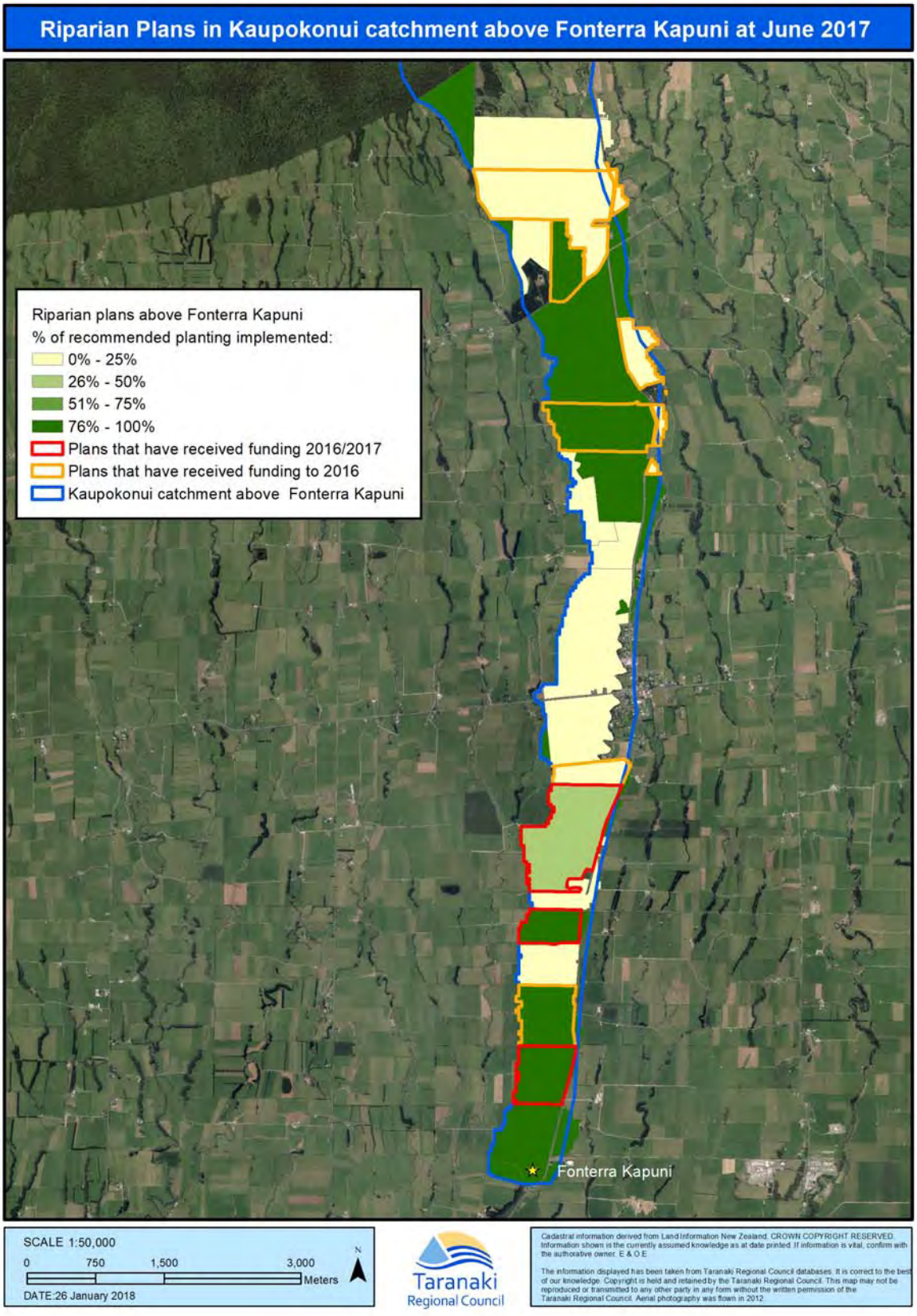

Figure 19 Riparian planting progress in the |Kaupokonui Stream catchment above the lactose plant

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. All plantings were maintained in 2017.

More recently, at the inspection undertaken on 17 November 2016 it was noted that riparian plantings on the Kaupokonui Stream were to be extended up the catchment to increase shading. 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.

Photo 2 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.

On 15 September 2016 it was noted that a Trommel (solids separator) had been 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. It was noted that the Trommel was not operating at the time of inspection. The inspecting officer was informed that at the time, the separated solids were being discharged into a receiving pit on the farm. It was outlined that approximately 1 m^3 of waste was being generated per day. In October the Company advised that the current carbon burial pit was to be filled in shortly. Going forward the carbon filter wastes were to be removed from the site by a waste contractor, due to operational and health and safety constraints surrounding the regular on going presence and use of open pits on the farm. At the November inspection the inspecting officer was informed that the carbon filter wastes were now being disposed of off site, via a waste contractor. At this inspection it was noted that the existing burial pit had been partially filled in, but that the water contained in the pit had a turbid green-blue appearance with whey permeates present on the surface. In January 2017 it was noted that the Trommel had been reinstated and 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. At the May 2017 inspection it was reported that a hole was being dug adjacent to the old Skeet Road cowshed was located, and that the carbon from the wastewater tank would be buried there during the cleaning operations programmed for the upcoming shutdown period. Previous carbon waste burial areas had good grass growth.

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 2016-2017 are presented in Table 10.

Composite samples of the stormwater/cooling water discharge were either not collected or of insufficient volume on only one out of 11 monitoring occasions in 2016-2017, because the samplers had either not been set up properly or failed, in which case a grab sample was taken. On one occasion, no sample was taken as the main plant was not operating. For the spray cooling water, all of the samples collected during the year under review were composite samples.

Table 10 Results of the analysis of stormwater/cooling water and spray cooling water discharge, 2016-2017

Waste	Spray cooling water					Stormwater/cooling water						
Site code	STW 002017					STW 002018						
Date	BOD5		Condy @ 20˚C	pH	Turbid-ity	BOD5		Condy @ 20˚C	Oil and grease	pH	Susp-ended solids	Turbid-ity
	Total	Filtered				Total	Filtered					
	g/m^3	g/m^3	mS/m	pH	NTU	g/m^3	g/m^3	mS/m	g/m^3	pH	g/m^3	NTU
28 Jul 2016	<0.5	<0.5	9.6	7.4	5.2	>24	16	22.0	<0.5	6.7	7	5.2
18 Aug 2016	0.6	<0.5	10.5	7.6	2.1	-	-	-	-	-	-	-
18 Aug 2016^	-	-	-	-	-	0.6	0.5	11.9	<0.5	7.1	3	0.66

Waste	Spray cooling water					Stormwater/cooling water						
Site code	STW 002017					STW 002018						
Date	BOD5		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
15 Sep 2016	0.7	<0.5	9.9	7.5	1.5	5.4	3.9	10.5	0.7	7.4	7	1.3
20 Oct 2016	<0.5	<0.5	10.5	7.6	0.56	1.0	1.0	11.2	<0.5	7.5	3	0.62
17 Nov 2016	0.5	<0.5	5.9	7.2	2.5	4.8	4.5	6.9	<0.5	7.1	7	1.7
14 Dec 2016	<0.5	<0.5	8.7	7.7	0.54	4.2	3.5	9.1	<0.5	7.2	<2	0.99
19 Jan 2017	0.6	0.6	9.6	7.6	0.52	2.9	2.4	9.5	<0.5	7.6	3	0.83
16 Feb 2017	0.5	<0.5	9.7	7.8	2.2	0.8	0.7	9.7	<0.5	7.7	8	3.5
16 Mar 2017	0.6	<0.5	8.1	7.5	10	72	27	9.8	<0.5	6.8	16	4.3
27 Apr 2017	<0.5	<0.5	10.5	7.6	1.5	1.2	0.7	11.1	<0.5	7.4	<2	0.83
18 May 2017	1.1	<0.5	6.6	7.4	8.5	2.1	0.9	9.6	<0.5	7.1	4	3.4
22 June 17°	-	-	-	-	-	-	-	-	-	-	-	-
Range	<0.5-1.1	<0.5-0.6	5.9–10.5	7.2–7.8	0.52-10.0	0.6-72	0.5-27	6.9–22.0	<0.5-0.7	6.7–7.7	<2-16	0.62-5.2
Median	0.5	0.25	9.6	7.6	2.1	2.9	2.4	9.8	<0.5	7.2	4	1.3

°No spray cooling water discharge, as plant not operating

* Grab sample of spray cooling water collected due to absent or insufficient composite

^ Grab sample of stormwater/cooling water collected due to absent or insufficient composite

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 11.

Table 11 Summary of cooling water discharge quality from the Council surveys during the period March 1992 to June 2016

Waste	Spray cooling water				'Stormwater/cooling' water		
Parameter	Unit	No. of samples	Range	Median	No. of samples	Range	Median
BOD_5	g/m³	198	<0.5 - 460	2.4	217	<0.5 - 1100	2.5
BOD_5 (filtered)	g/m³	187	<0.5 - 91	1.21	200	<0.5 - 1100	1.4
Conductivity at 20˚C	mS/m	204	3.1 - 46.8	9.8	224	5.4 - 132	10.8
Oil and grease	g/m	2	<0.5	<0.5	94	<0.5 - 4.3	<0.5
pH	pH	85	5.8 - 8.2	7.4	128	4.6 - 10.6	7.2
Turbidity	NTU	92	0.51 - 120	4.0	109	0.26 - 110	16.2

For the spray cooling water, the seasonal increase in total and filtered BOD in spring/summer that was noted in the 2012-2015 years was not repeated in 2016-2017. Median total BOD decreased significantly, for the third successive year, to the 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) reduced from 4.7 g/m^3 in the 2015-2016 year to 2.9 g/m^3 for the year under review. The filtered BOD and conductivity (minerals) values were similar to those for the previous four seasons. An elevated total BOD of above 24 g/m^3 was found in the composite sample taken on 28 July 2016, while conductivity and turbidity were normal. A further elevated BOD of 72 g/m^3 was found in the composite sample taken on 16 March 2017, which was accompanied by a reduced pH and elevated suspended solids. 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 21), or as visible biological growth.

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

In comparison with historical data, the 'stormwater/cooling water' discharge results were within ranges previously recorded.

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 stormwater pond (STW002078), as shown in Figure 6. The discharge from the southern area of the lactose plant is combined with cooling water and has been addressed in section 2.1.3.1.1 above.

Discharges were found to be occurring on most inspections, however 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 12 occasions during 2016-2017 and analysed by the Council's laboratory. These results are presented in Table 12 below. Rain was falling or had recently occurred on six occasions. There was typically a small discharge.

Table 12 Results of the analysis of monthly grab samples of the stormwater from the northern factory extensions outfall discharge during the 2016-2017 monitoring period

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
28 Jul 2016	<0.5	-	-	8.3	<0.5	7.2	<2	0.3
18 Aug 2016	4.2	<0.1	<0.1	16.6	<0.5	6.9	<2	0.42
15 Sep 2016	<0.5	<0.1	<0.1	16.3	0.5	7.0	<2	0.39
20 Oct 2016	3.7	<0.1	<0.1	12.7	<0.5	7.1	<2	1.4
17 Nov 2016	2.4	<0.1	<0.1	5.5	<0.5	6.8	10	12
14 Dec 2016	2.4	<0.1	<0.1	11.3	<0.5	6.9	<2	1.0
19 Jan 2017	45	<0.1	<0.1	3.4	<0.5	6.3	23	6.9
16 Feb 2017	1.5	<0.1	<0.1	10.7	<0.5	7.4	<2	0.91
16 Mar 2017	9.1	<0.1	<0.1	10.5	<0.5	7.2	<2	1.3
27 Apr 2017	3.4	<0.1	<0.1	10.6	<0.5	7.3	3	1.5
18 May 2017	2.5	<0.1	<0.1	10.3	<0.5	6.6	10	3.0

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
22 Jun 2017	8.7	<0.1	<0.1	18.1	<0.5	6.9	3	4.1
Consent limit	-	-	-	-	15	6.0 – 8.5	100	-
1995-2016								
No of samples	110	14	14	114	73	103	85	77
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	5.8	0	0	10.8	0.2	7.0	3	3.0

BOD_5 was elevated nine of the twelve occasions monitored, indicating some organic contamination. This may have been a result of lactose powder deposition within the stormwater catchment. A slight organic odour was noted on four occasions and slight chlorine odour was noted on two occasions. However, there was no chlorine detectable in the samples collected, which is as to be expected following the introduction of de-chlorination post July 2016.

The highest BOD recorded during the year under review was in the sample collected on 19 January 2017. This sample was collected during a rainfall event after a prolonged dry period. Although the BOD of the receiving water was found to be elevated downstream of the discharge point, it was noted at the time of sampling that there was dairy effluent entering the stream from the cattle crossing at the upstream monitoring site. This would have made a significant contribution to the increase in BOD observed at the two receiving water sites downstream of the northern outfall discharge point (Figure 21).

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 four inspections in 2016-2017. The results of the grab samples collected are presented in Table 13 below.

Table 13 Results of the analysis of grab sample of the stormwater from the IGL outfall discharge during the 2016-2017 monitoring period

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 Nov 2016	2.0	5.2	0.5	6.6	9	7.8
19 Jan 2017	1.3	3.6	<0.5	6.7	7	2.0
18 May 2017	0.5	12.7	<0.5	6.6	12	2.4
22 Jun 2017	5.2	16.5	<0.5	7.2	<2	3.5
Consent limit	-	-	**15 (hydrocarbons)**	**6.0 – 8.5**	**100**	-
2005-2016						
No of samples	22	24	15	24	22	22

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
Minimum	<0.5	0.6	<0.5	6.5	<2	6.3
Maximum	41	22.6	0.8	8.0	62	16.7
Median	4	7.2	0.2	7.0	6	13.2

The sample collected on 22 June 2017 exerted a slightly elevated biochemical oxygen demand, and it was noted that this sample had a slight "chemical" odour. There was no sign of undesirable biological growths noted in the receiving waters below the discharge point.

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

2.1.3.1.2.3 Stormwater pond outfall

Samples were also collected from the outlet of the stormwater pond (Site STW002078, Table 14 and Photo 3) on seven occasions during 2016-2017. The results of the grab samples collected are presented in Table 14. There had been a recent rainfall event prior to the collection of five of the seven samples, with the stormwater pond outlet valve reported to have been closed on two of these sampling occasions, suggesting groundwater seepage. On 28 July 2017, the stormwater pond contents were being discharged; there was an organic pipe odour, and on 18 May 2017 there was a pungent odour reported.

Photo 3 Outfall from stormwater pond to Kaupokonui Stream

Table 14 Results of the analysis of grab samples of the stormwater pond during the 2016-2017 monitoring period

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
28 Jul 2016	4	<0.5	34.0	<0.5	7.6	3	1.0
18 Aug 2016	1	4.8	48.6	<0.5	7.3	6	6.6
15 Sep 2016	<0.1	1.8	48.7	0.5	7.5	7	5.0
20 Oct 2016		<0.5	29.9	<0.5	7.6	2	0.88
16 Mar 2017	0.1	3.2	8.0	<0.5	7.2	10	3.9
27 Apr 2017		1.5	44.0	<0.5	7.9	2	1.3
18 May 2017	<0.5	1.1	29.7	<0.5	7.6	5	3.9
Consent limit	**-**	**-**	**-**	**15 (hydrocarbons)**	**6.5 – 8.5**	**100**	
2008-2015							
No of samples		22	24	19	23	20	23
Minimum		<0.5	4.6	<0.5	6.6	<2	0.05
Maximum		28	48.8	<0.5	7.6	150	31
Median		1.0	39.4	0.2	7.4	1	0.69

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 (Table 15and Figure 20) as follows:

Table 15 Location of water quality sampling sites

Site code	Site	Location	Map reference, NZTM	
			Easting	Northing
KPK000655	Kaupokonui Stream	1km upstream of rail bridge	1697963	5630770
KPK000660	Kaupokonui Stream	Immediately upstream of rail bridge	1697613	5629791
KPK000679	Kaupokonui Stream	150m downstream of spray cool discharge zone	1697607	5629399

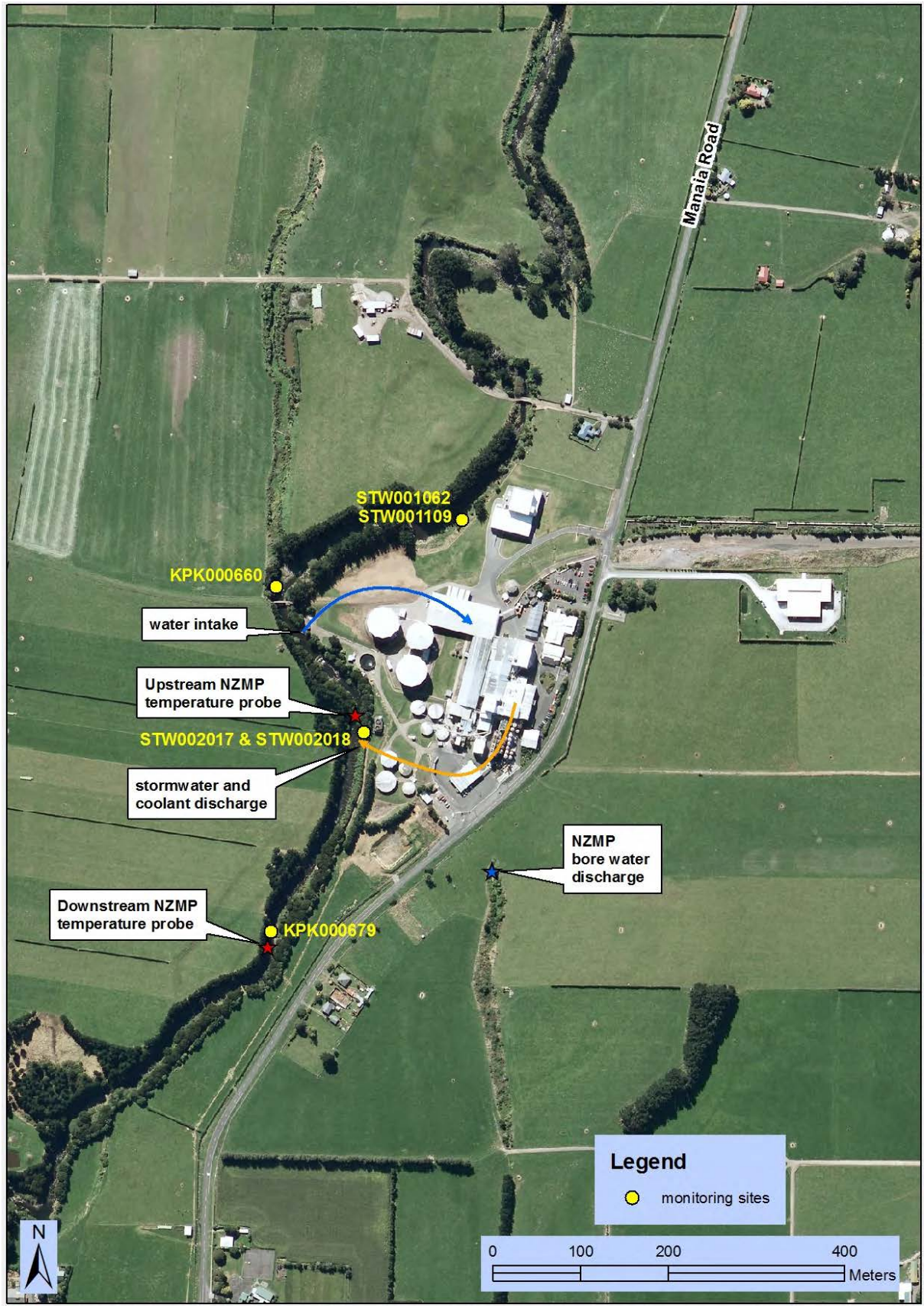

Figure 20 Section of Kaupokonui Stream for physicochemical monitoring in relation to Fonterra Kapuni's waste discharges to water

Sampling was performed under varying flow conditions ranging from 0.91 m^3/s to about 30 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 0.75 m^3/s. A record of flows (hydrograph) over the reporting period is presented in Figure 42 . Samples were taken in the mornings. The results of this monitoring are contained in Appendix II and summarised in Table 16. Past Council sampling results from these sites are presented in summary form in Table 17.

Table 16 Summary of Kaupokonui Stream water quality data (ranges) from monthly monitoring for the period July 2016 to June 2017 (N=11 samples)

Parameter	Unit	KPK000655		KPK000660		KPK000679	
		Range	Median	Range	Median	Range	Median
Total BOD_5	g/m^3	<0.5 - 1.3	0.8	<0.5 - 2.6	1.4	<0.5 - 2.5	1.4
Filtered BOD_5	g/m^3	<0.5 - 0.7	0.5	<0.5 - 2.4	1.3	<0.5 - 2.2	1.2
Conductivity @ 20˚C	mS/m	3.9 - 10.3	7.1	3.8 - 10.9	7.35	3.8 - 11.4	7.6
DRP	g/m^3 P	0.009 - 0.038	0.024	0.008 - 0.029	0.019	0.009 - 0.029	0.019
Ammonia-N	g/m^3 N	0.004 - 0.055	0.030	0.005 - 0.048	0.027	0.006 - 0.061	0.034
Nitrate+Nitrite	g/m^3 N	0.15 - 0.93	0.54	0.16 - 1.05	0.61	0.16 - 1.08	0.62
pH	pH	7.3 - 7.9	7.6	7.2 - 8.0	7.6	7.2 - 8.3	7.8
Temperature	˚C	8.5 - 16	12.3	8.3 - 16.1	12.2	9.0 - 17.3	13.2
Turbidity	NTU	0.58 - 14	7.29	0.62 - 25	12.8	0.51 - 27	13.8

Table 17 Summary of Kaupokonui Stream water quality data from the Council surveys during the period August 1994 to June 2016

Parameter	Unit	KPK000655			KPK000660			KPK000679		
		No.	Range	Median	No.	Range	Median	No.	Range	Median
Total BOD_5	g/m^3	210	<0.5 - >8.3	0.6	231	<0.5 - 7.5	0.6	213	<0.5 - >8	0.7
Filtered BOD_5	g/m^3	210	<0.5 - 1.8	<0.5	212	<0.5 - 1.7	<0.5	212	<0.5 - >8	0.5
Conductivity @ 20˚C	mS/m	213	3.3 - 11.1	9.1	223	3.3 - 11.8	9.6	215	3.2 - 11.9	9.7
DRP	g/m^3 P	24	0.006 - 0.097	0.014	24	0.007 - 0.101	0.018	24	0.007 - 0.103	0.02
Ammonia-N	g/m^3 N	212	<0.003 - 0.869	0.022	212	0.003 - 0.147	0.017	212	<0.003 - 0.248	0.018
Nitrate+Nitrite	g/m^3 N	81	0.12 - 1.26	0.39	81	0.12 - 1.36	0.45	81	0.11 - 1.40	0.5
pH	pH	210	6.8 - 8.5	7.7	219	6.6 - 9.0	7.7	211	7.0 - 8.6	7.8
Temperature	˚C	211	4.9 - 19.1	12.1	229	5.1 - 19.5	12.5	214	5.2 - 21.7	13.7
Turbidity	NTU	110	0.39 - 120	1.0	113	0.4 - 130	1.0	112	0.43 - 160	1.05

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 a progressive increase from 7.9 to 8.3 pH units on 16 February 2017. At the time of this sampling run, the

three discharges flowing were sampled and had pH's in the range 7.4 to 7.8. The change of pH observed in the stream was therefore unlikely to be as a result of activities at the Fonterra site.

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 19 January, the BOD of the stream at the control site was already elevated at 1.3 g/m^3 (filtered; 0.7 g/m^3). The BOD of the sample collected at the stream site below the lactose plants stormwater discharges had increased by a further 1.3 g/m^3 (filtered; 1.4 g/m^3) to 2.6 g/m^3 (2.4 g/m^3). The BOD was found to have changed little, if at all, at the monitoring site downstream of the cooling water discharges. With the changes in the total and filtered BODs being similar, this shows that the increase in BOD was due to dissolved organic contaminants. On this sampling occasion it was noted that there was dairy effluent discharging to the stream from the bridge crossing the stream immediately upstream of site KPK000655. It is possible that due to the discrete nature of grab sampling, both in terms of location with respect to the width of the stream, and in time, the effects of this discharge on BOD could have been more apparent further downstream. It is proposed that during the 2017-2018 year that the upstream control site for monitoring of the Fonterra site discharges is moved further downstream, to ensure that is downstream of the mixing zone of any potential discharges from the bridge or farm dairy shed on the true left bank above the lactose plant.

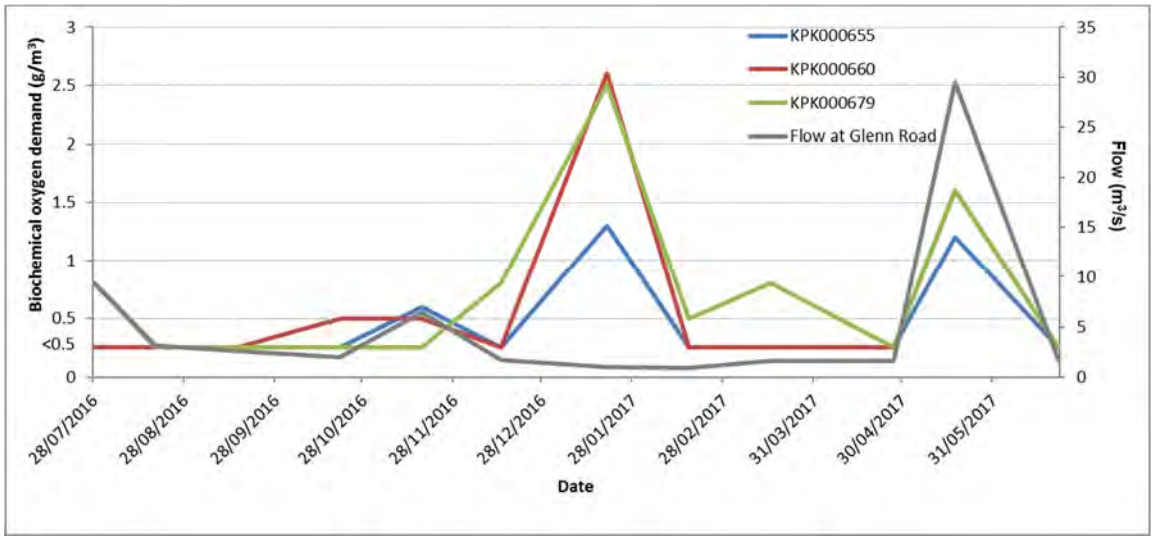

Figure 21 Downstream biochemical oxygen demand changes in the Kaupokonui Stream from the monthly stream surveys

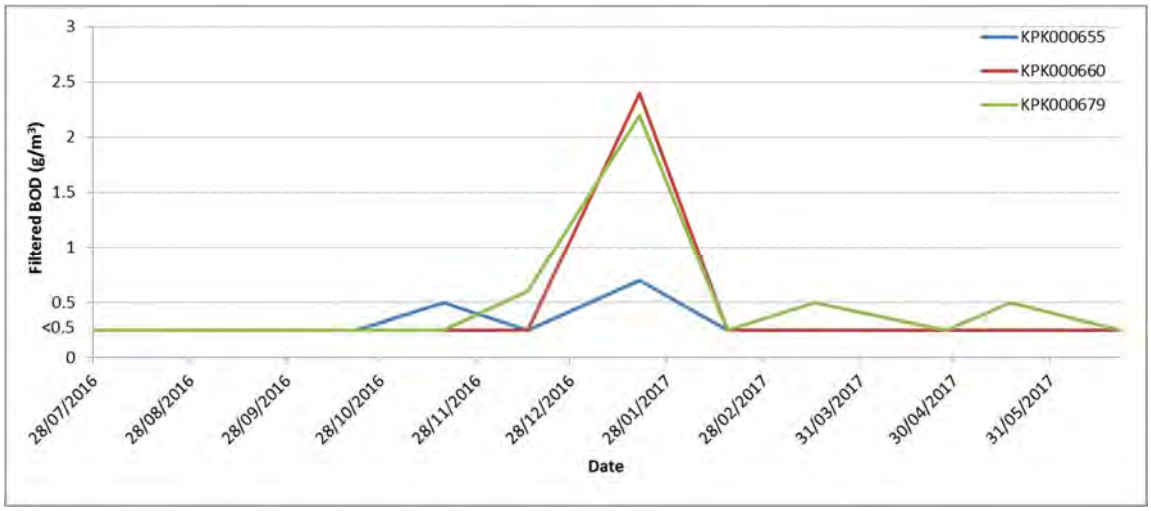

Figure 22 Downstream filtered biochemical oxygen demand changes in the Kaupokonui Stream from the monthly stream surveys

Ammoniacal nitrogen generally decreased in a downstream direction, as one would expect where there are no additional ammoniacal nitrogen inputs.

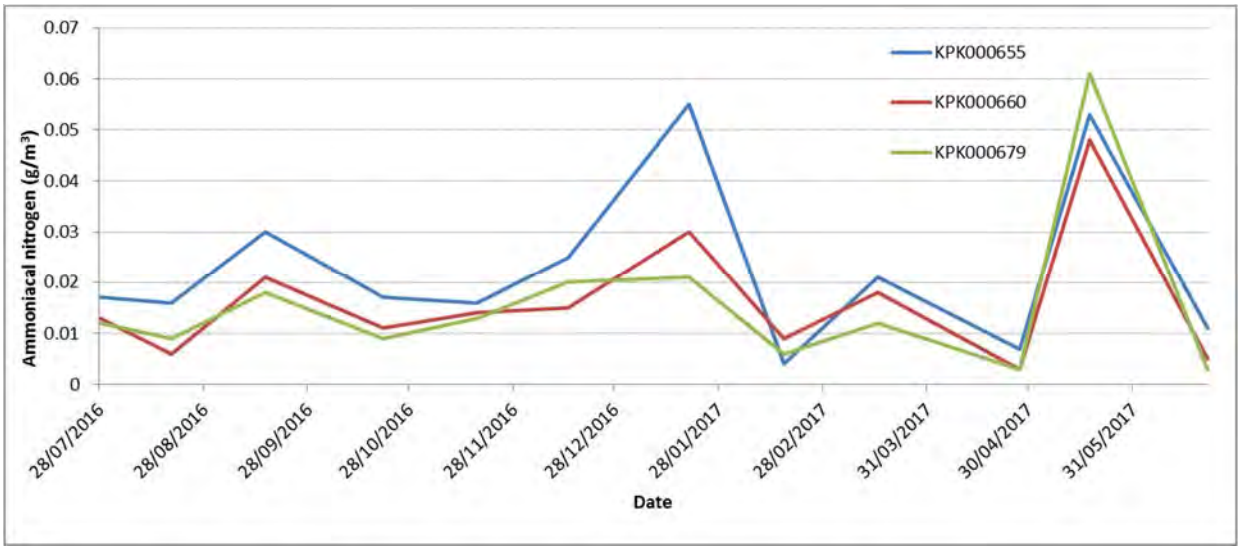

Figure 23 Downstream ammoniacal nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys

Conductivity and nitrate-nitrite nitrogen both increase slightly in a downstream direction, whilst ammoniacal nitrogen appears to decrease. Whilst 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 recommended that total nitrogen is included in the analysis suite 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.

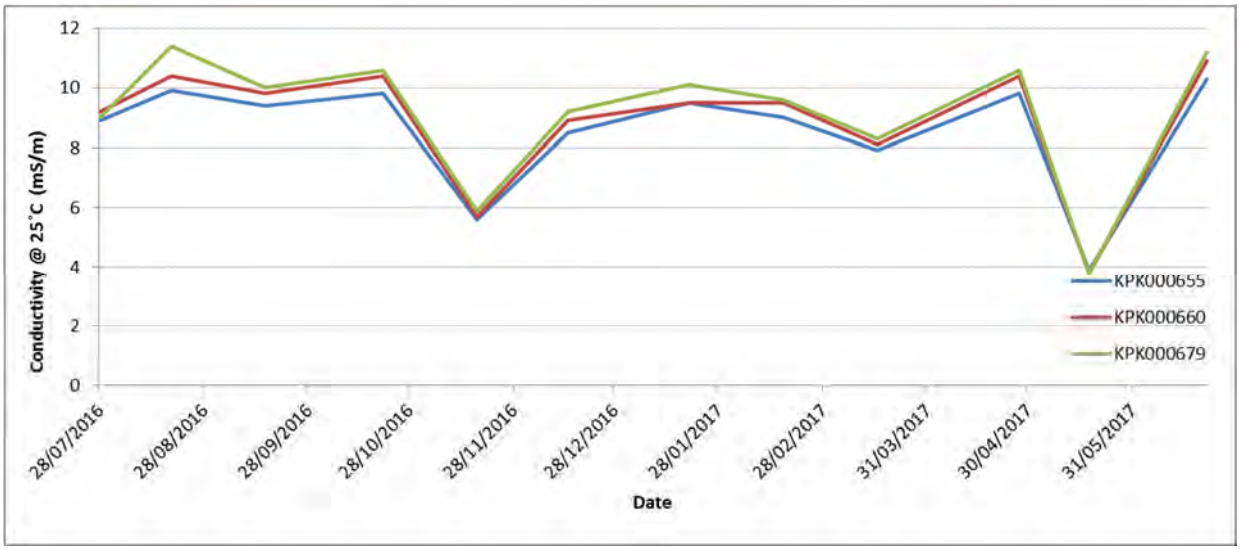

Figure 24 Downstream conductivity changes in the Kaupokonui Stream from the monthly stream surveys

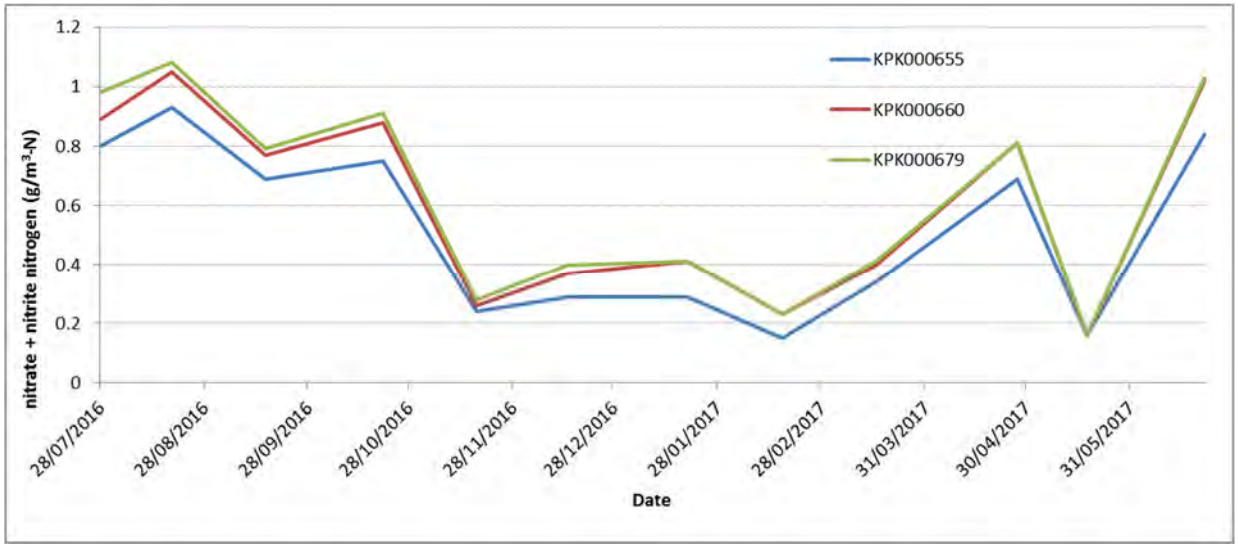

Figure 25 Downstream nitrate-nitrite nitrogen concentration changes in the Kaupokonui Stream from the monthly stream surveys

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 26).

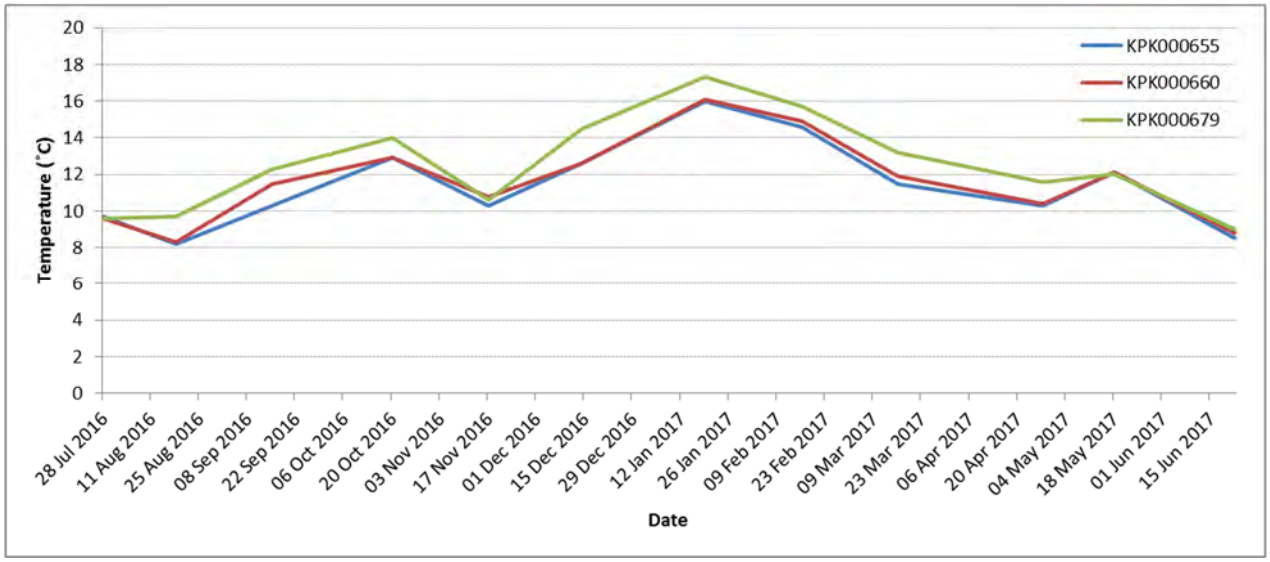

Figure 26 Downstream temperature changes in the Kaupokonui Stream from the monthly stream surveys

No conspicuous changes in clarity, as indicated by turbidity measurements and field comments, were attributed to discharges of cooling or storm water. Natural variation in clarity was observed, in relation to rainfall.

The summary of Kaupokonui Stream water quality data for the upstream (control) site recorded over the 21 year period prior to the 2016-2017 monitoring period (Table 17) and during this period (Table 16), 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. Eleven bores were sampled on the three wastewater spray irrigation farm properties, as described in Table 18 and depicted in Figure 27. 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 18 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 19 for comparison with data collected during the recent monitoring period. The shaded bores are those no longer monitored.

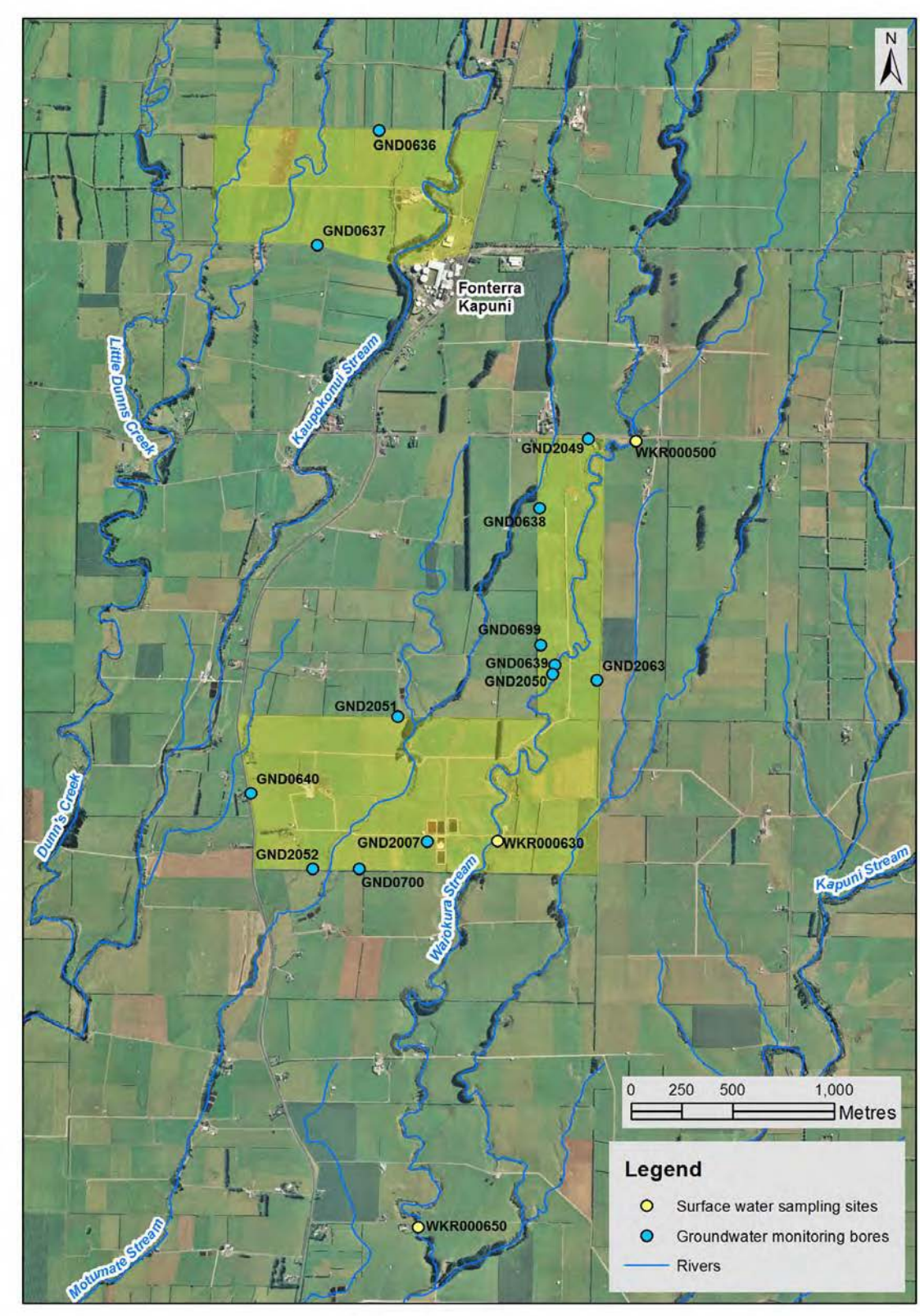

Figure 27 Groundwater monitoring bores and Waiokura Stream sampling site locations on the three Company farms

Table 19 Summary of previous Council groundwater quality sampling performed during the period October 1991 to June 2016

Parameter		Level		pH		Conductivity @ 20˚C		Sodium		Nitrate-N		COD*	
Unit		m		pH		mS/m		g/m^3		g/m^{3}N		g/m^3	
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	77	1.55-4.83 (2.91)	123	6.2-7.1 (6.5)	122	26.4 -57.7 (29.9)	80	12.0-56 (25.7)	124	3.7-19.5 (8.0)	69	<5-27 (<5)
	Impact GND0637	82	2.77-6.15 (4.16)	119	6.1-7.8 (6.5)	117	34.0-82.4 (58.0)	77	40-179 (78)	118	1.5-33 (13.2)	65	<5-50 (7)
Farm 2	Control ('new') GND2049	54	1.73-3.80 (2.59)	55	6.2-7.2 (6.4)	55	21.2-48.3 (38.1)	26	26-36 (31)	55	2.4-23 (14.4)	26	<5-7 (<5)
	Impact ('central') GND0638	82	1.08-3.68 (2.58)	117	4.7-6.9 (6.5)	116	54.4-149 (73.9)	75	67-136 (91)	116	<0.01-49 (8.3)	69	<5-1600 (13)
	Impact ('original') GND0639	50	1.90-4.22 (2.89)	68	6.5-7.5 (6.9)	68	43.7-82.6 (64.3)	46	73-157 (119)	68	3.8-29 (11.1)	41	<5-57 (12)
	Impact ('new') GND2050	55	1.60-3.20 (2.66)	55	6.5-7.0 (6.8)	55	13.7-71.1 (54.4)	26	49-102 (69)	55	0.01-13.0 (2.0)	26	<5-21 (<5)
	Impact GND2063	52	1.55-5.00 (3.46)	52	6.3-6.9 (6.5)	52	25.2-49.1 (29.3)	25	35-59 (40)	52	0.4-18.6 (2.9)	25	<5-24 (6)
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	55	1.86-4.46 (3.13)	55	6.4-7.2 (6.5)	55	25.4-56.9 (31.6)	26	24-37 (28)	55	0.03-22 (6.9)	26	<5-31 (<5)
	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	79	0.40-4.60 (2.21)	91	5.6-7.2 (6.7)	91	30.3-154 (60.5)	53	39-188 (81)	92	0.02-47 (7.8)	53	<5-33 (6)
	Impact ('new') GND2052	55	1.30-4.38 (2.51)	55	6.4-7.3 (6.6)	55	18.9-42.6 (31.8)	26	35-55 (42)	55	<0.01-12.9 (1.9)	26	<5-29 (<5)
	Impact ('deep') GND2007	0	-	43	6.9-8.0 (7.7)	43	32.4-34.6 (33.3)	23	35-39 (37)	43	<0.01-0.10 (<0.01)	20	<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 2016-2017 period are summarised in Table 20. The full set of results is given in Appendix III.

Table 20 Results of groundwater quality sampling on Farm 1, 2016-2017

Waste		Control (GND0636)			Impact (GND0637)		
Parameter	**Unit**	**No.**	**Range**	**Median**	**No.**	**Range**	**Median**
Chloride	g/m^3	3	34.6 - 55.2	35.5	3	39.3 - 45.8	41.2
COD	g/m^3	3	<5 - 6	5	3	<5 - 6	5
Conductivity @20 ˚C	mS/m	5	27.8 - 36.6	28.1	5	48 - 57.3	54
Water level	m	5	2.51 - 3.56	2.79	5	3.63 - 5.23	4.04
Sodium	g/m^3	3	24.2 - 30.3	24.3	3	55.2 - 58.4	55.8
Ammoniacal nitrogen	g/m^{3}N	3	<0.003 - 0.004	0.004	3	<0.003 - <0.003	<0.003
Nitrate+nitrite	g/m^{3}N	5	6.43 - 6.93	6.61	5	10.4 - 17.5	13.2
pH		5	6.4 - 6.6	6.6	5	6.6 - 6.7	6.7
Temperature	˚C	5	13.6 - 14.1	13.9	5	13.9 - 14.6	14.1

The water quality of the control bore GND0636 groundwater appears to be improving slightly in terms of nitrate. The median nitrate-N concentration of 6.6 g/m^3 was lower than the 2015-2016 median of 7.2 g/m^3, and lower than the historical median of 8.0 g/m^3. The highest concentration recorded in this bore during the year under review was 6.9 g/m^3 compared to the peak concentration of 11.2 g/m^3 recorded in June 2015, when groundwater level was high. 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 Table 19). The COD of both bores was found to be low at each of the sampling surveys.

Figure 28 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 spring 2016 and autumn 2017, with the concentrations found to be above the drinking water standard (11.3 g/m^3) at all surveys during these periods. Only one impact bore sample was found to contain a nitrate concentration below the drinking water standard. This was the 2016-2017 minimum of 10.4 g/m^3 recorded for the sample collected on 15 February 2017. When looking at the changes in groundwater level and nitrate concentration between the May and June surveys (Figure 29), it is likely that the effects of irrigation are evident. The groundwater level increased to a greater extent at the impact bore than at the control bore, as did the nitrate nitrogen concentration, which showed very little seasonal variation 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.

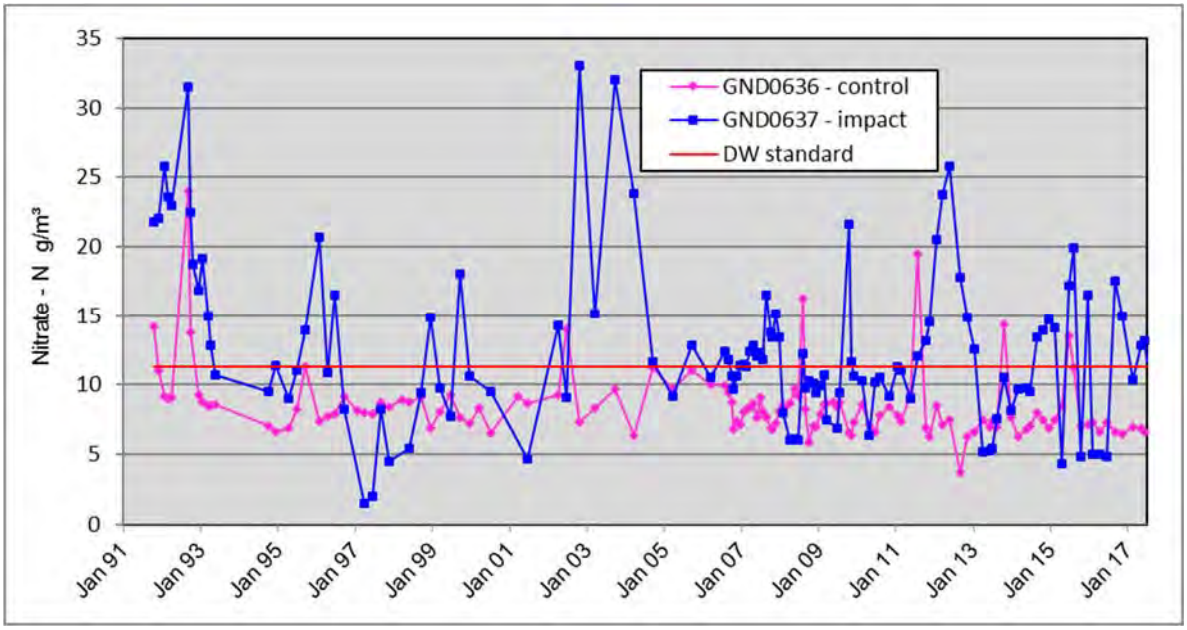

Figure 28 Long term trends in groundwater Nitrate-N concentration at Farm 1

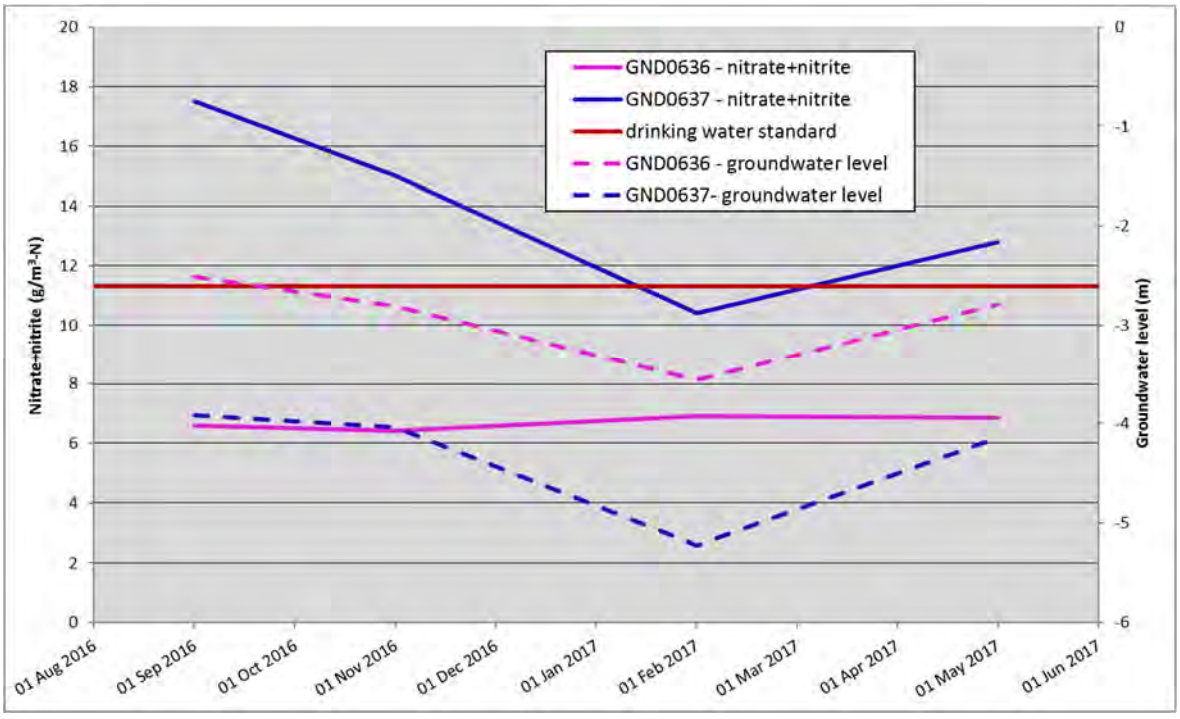

Figure 29 Farm 1 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.2 Farm 2 groundwater

The results of groundwater monitoring on this farm during the 2015-2016 period are summarised in Table 21. The full set of results is given in Appendix III.

Table 21 Results of groundwater quality sampling on Farm 2, 2016-2017

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	33.3 - 34.7	33.8	3	50.1 - 65.2	61.1	3	55.4 - 72.3	58.9	3	50.1 - 51.7	50.9	3	41.4 - 44.0	42.6
COD	g/m^3	3	<5 - 5	<5	3	<5 - 6	5	3	6 - 14	8	3	<5 - 13	8	3	<5 - 6	6
Conductivity @20 ˚C	mS/m	5	35.7 - 37.2	36.8	5	67.6 - 76.2	73.5	5	50.1 - 64.3	61.3	5	52.4 - 62.6	55.8	5	29.9 - 34.9	32.7
Water level	m	5	2.08 - 3.22	2.12	5	1.69 - 2.88	2.03	5	2.08 - 3.65	2.46	5	2.04 - 2.92	2.43	5	2.79 - 4.52	3.05
Sodium	g/m^3	3	30.0 - 31.9	30.1	3	68.2 - 71.0	70.7	3	84.3 - 95.3	95	3	56.1 - 80.6	72.7	3	44.6 - 48.1	46.9
Ammoniacal nitrogen	g/m^{3}N	3	<0.003 - 0.143	0.007	3	<0.003 - 0.005	<0.003	3	<0.003 - 0.047	0.021	3	<0.003 - 0.317	0.030	3	<0.003 - 0.007	<0.003
Nitrate+nitrite	g/m^{3}N	5	13.7 - 18.5	14.4	5	6.79 - 8.22	7.5	5	7.59 - 10.9	10.7	5	0.02 - 10.1	0.05	5	4.80 - 7.03	5.48
pH		5	6.3 - 6.6	6.4	5	6.6 - 6.7	6.6	5	6.9 - 6.9	6.9	5	6.6 - 6.8	6.8	5	6.4 - 6.8	6.6
Temperature	˚C	5	13.9 - 14.8	14.6	5	14.6 - 15.4	15.1	5	13.8 - 14.9	14.3	5	14.0 - 15.3	14.4	5	14.1 - 14.7	14.5

The control bore for Farm 2, GND2049, was drilled in March 2008, on the northern boundary beside Skeet Road. (Refer to Figure 27). 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 30 compares the long term trends in groundwater nitrate-N levels at the newer impact bores (GND2063 and GND2050), the previous two impact bores (GND0639 and GND0699), and the original control bore (GND0638) with the new control bore (GND2049).

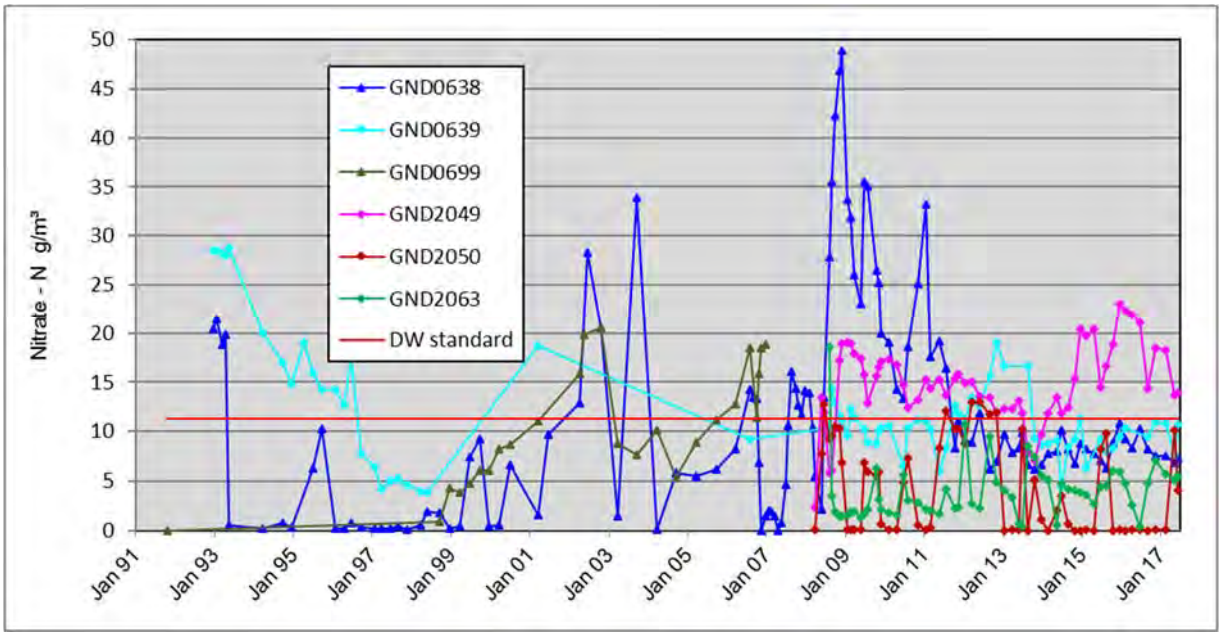

Figure 30 Long term trends in groundwater Nitrate-N concentration at Farm 2

The control bore, GND2049, showed the influence of an unknown source, with the nitrate-N concentration ranging from 13.7 to 18.5 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. 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, is being investigated by the Company. 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 has reduced from the peak of 49 g/m^3 recorded during 2008-2009 down to 8 g/m^3 in 2012. For the last five years to June 2017 it has been fluctuating between 6 to 11 g/m^3, remaining just below the drinking water standard of 11.3 g/m^3. 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 newer impact bore beside the Waiokura Stream, GND2050, nitrate-N concentration appears to fluctuate with groundwater level (shown in Figure 31), being in the range 3 to 13 g/m^3 during winter and spring over the total record, and 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 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 (4 to 10 g/m^3) when the groundwater levels were at the highest. It is noted that the mineral levels were significantly higher at GND2050 than at the control bore.

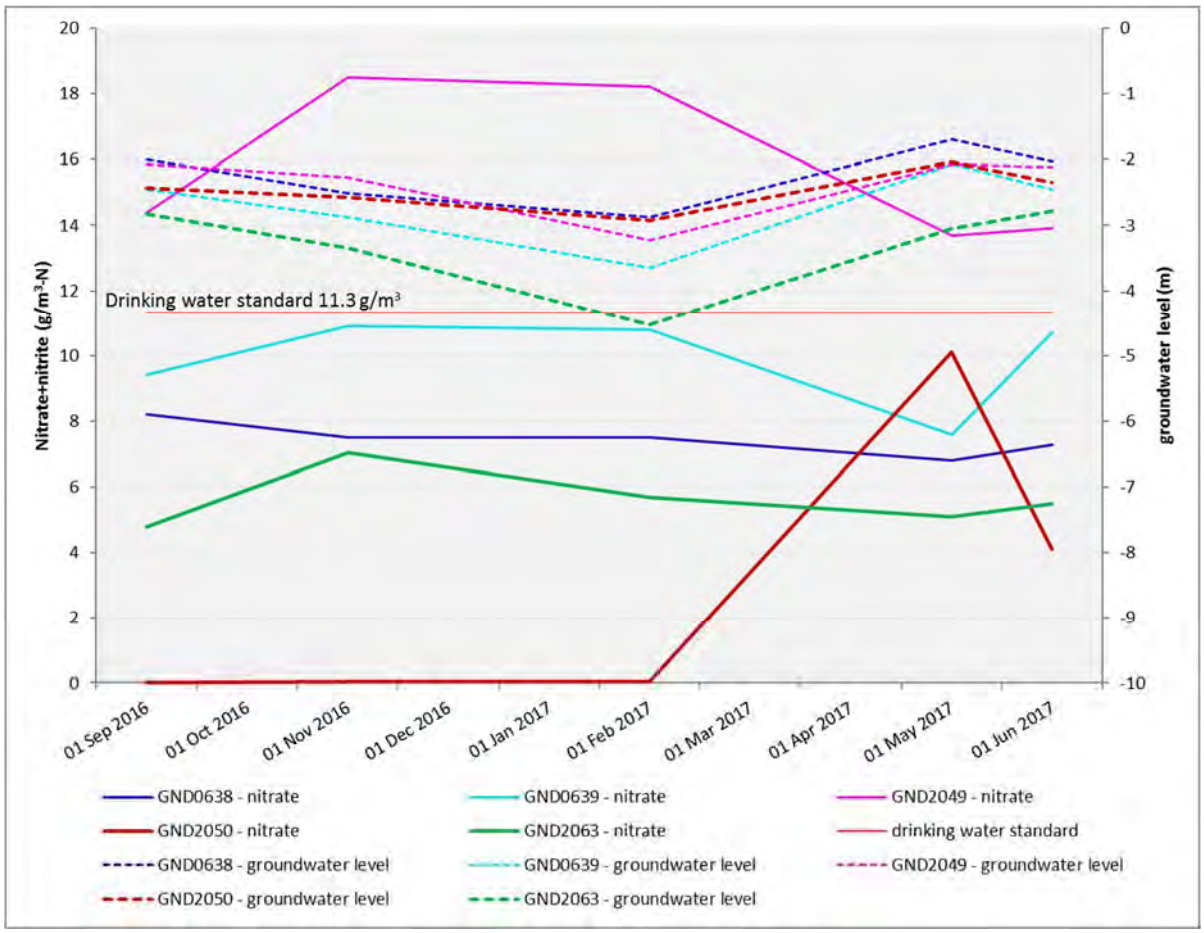

Figure 31 Farm 2 groundwater levels and nitrate + nitrite nitrogen concentrations and groundwater levels during the year under review

The relative concentrations of selected parameters, conductivity, pH, sodium and chloride, are shown in Figure 32 to Figure 35.

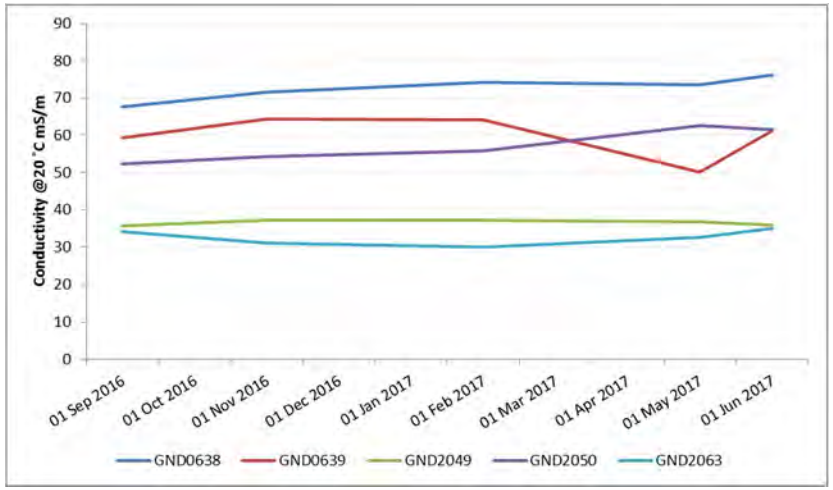

Figure 32 Groundwater conductivity at Farm 2 bores during the year under review

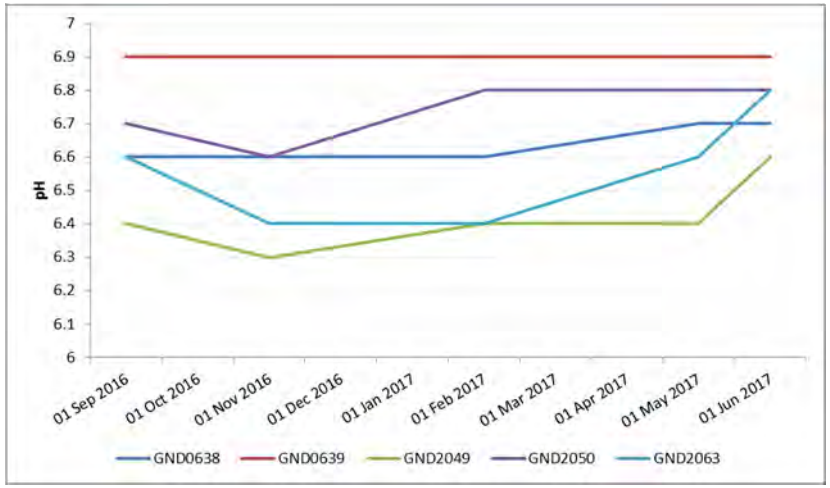

Figure 33 Groundwater pH at Farm 2 bores during the year under review

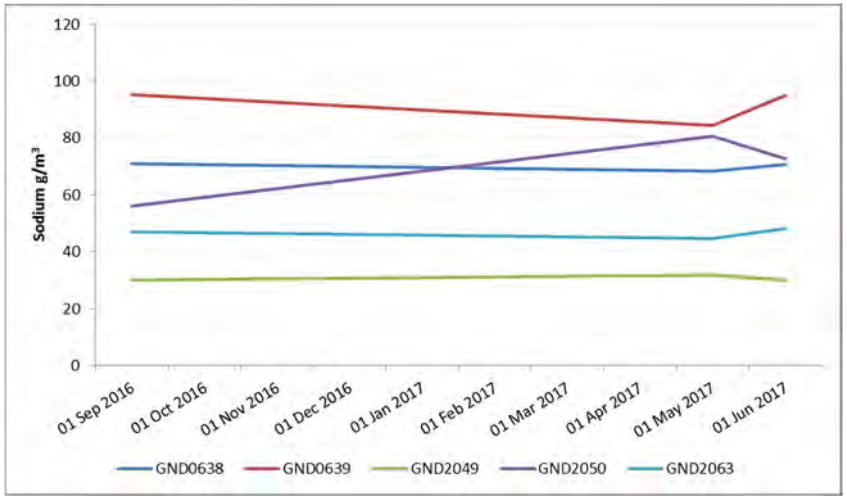

Figure 34 Groundwater sodium concentration at Farm 2 bores during the year under review

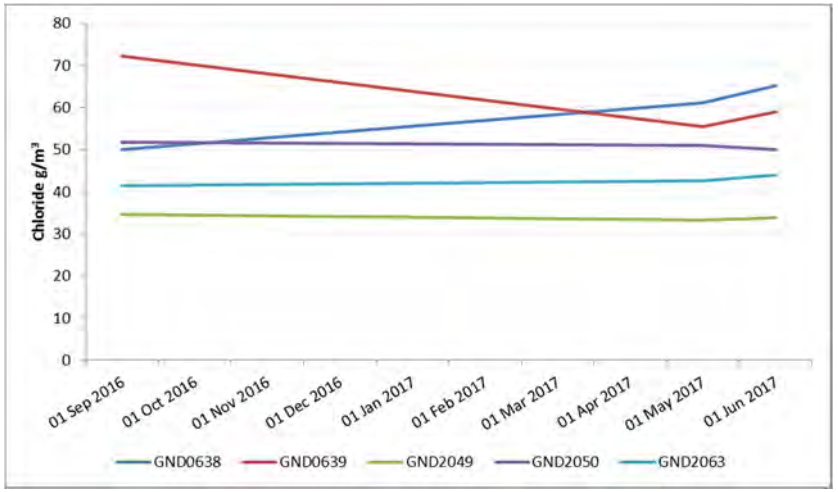

Figure 35 Groundwater chloride concentration at Farm 2 bores during the year under review

2.1.5.3 Farm 3 groundwater

The results of groundwater monitoring on this farm during the 2016-2017 period are summarised in Table 22. 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 2016-2017 period due to the bailer becoming stuck inside the bore in May 2013. The bore was not able to be unblocked and is no longer 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),

consideration needs to be given as to whether 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, will be undertaken to monitor for potential effects on the stream from irrigation activities.

Table 22 Results of groundwater quality sampling on Farm 3, 2016-2017

Parameter	Unit	Control (GND2051)			Impact (GND0700)			Impact (GND2052)			Deep bore (GND2007)		
		No.	Range	Median	No.	Range	Median	No.	Range	median	No.	Range	median
Chloride	g/m^3	3	57.1 - 77.6	62.9	3	45.0 - 51.8	46.3	3	90.6 - 119	107	3	16.1 - 16.5	16.2
COD	g/m^3	3	<5 - 7	<5	3	<5 - 11	6	3	5 - 7	6	3	8 - 20	10
Conductivity @20 ˚C	mS/m	5	29.6 - 61.1	43.0	5	29.1 - 38.7	36.8	5	48.8 - 74.9	67.2	5	33.5 - 35.3	33.6
Water level	m	5	2.08 - 3.70	2.69	5	1.69 - 3.10	2.03	5	1.12 - 2.76	1.29	3	-	-
Sodium	g/m^3	3	29.0 - 31.8	30.8	3	44.1 - 50.0	46.3	3	93.6 - 98.8	94.4	3	36.4 - 37.4	36.8
Ammoniacal nitrogen	g/m^3N	3	<0.003 - 0.004	<0.003	3	<0.003 - 0.006	<0.003	3	<0.003 - <0.003	<0.003	5	1.08 - 1.36	1.3
Nitrate+nitrite	g/m^3N	5	3.18 - 29.8	14.6	5	0.03 - 3.69	3.27	5	2.61 - 8.40	6.94	5	<0.01 - <0.01	<0.01
pH		5	6.3 - 6.5	6.4	5	6.5 - 6.7	6.7	5	6.7 - 6.9	6.8	5	6.7 - 7.7	7.7
Temperature	˚C	5	13.9 - 15.3	14.3	5	13.9 - 15.0	14.6	5	14.2 - 14.9	14.8	3	12.8 - 17.6	16.9

The impact of wastewater irrigation upon the old impact bore (GND0700) was reflected in elevated sodium, chloride, and conductivity levels (Figure 36, Figure 37, and Figure 38).

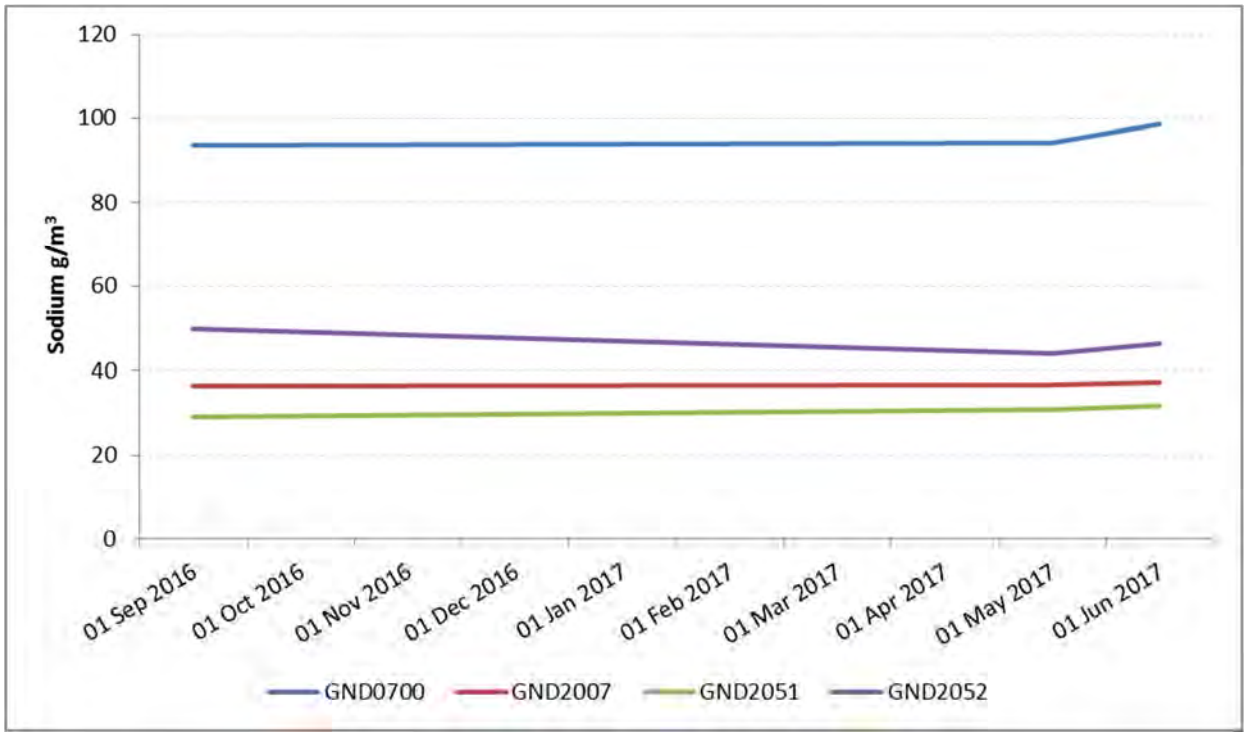

Figure 36 Groundwater sodium concentration at Farm 3 bores during the year under review

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

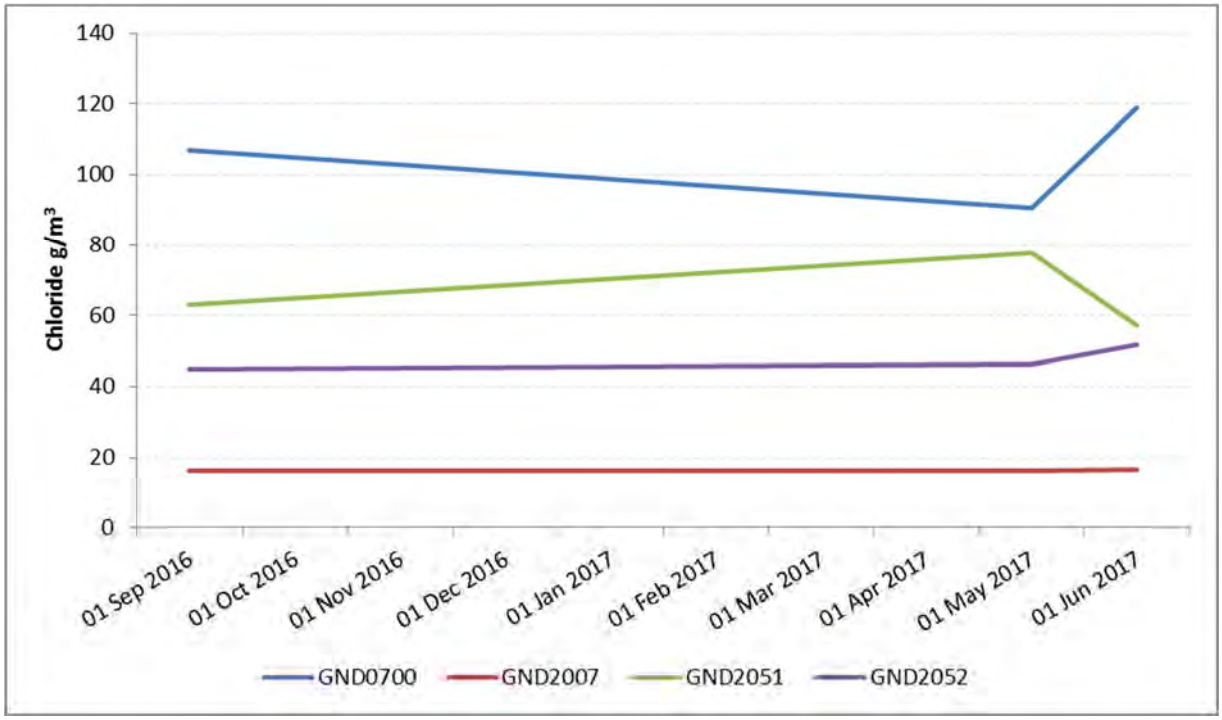

Figure 37 Groundwater chloride concentration at Farm 3 bores during the year under review

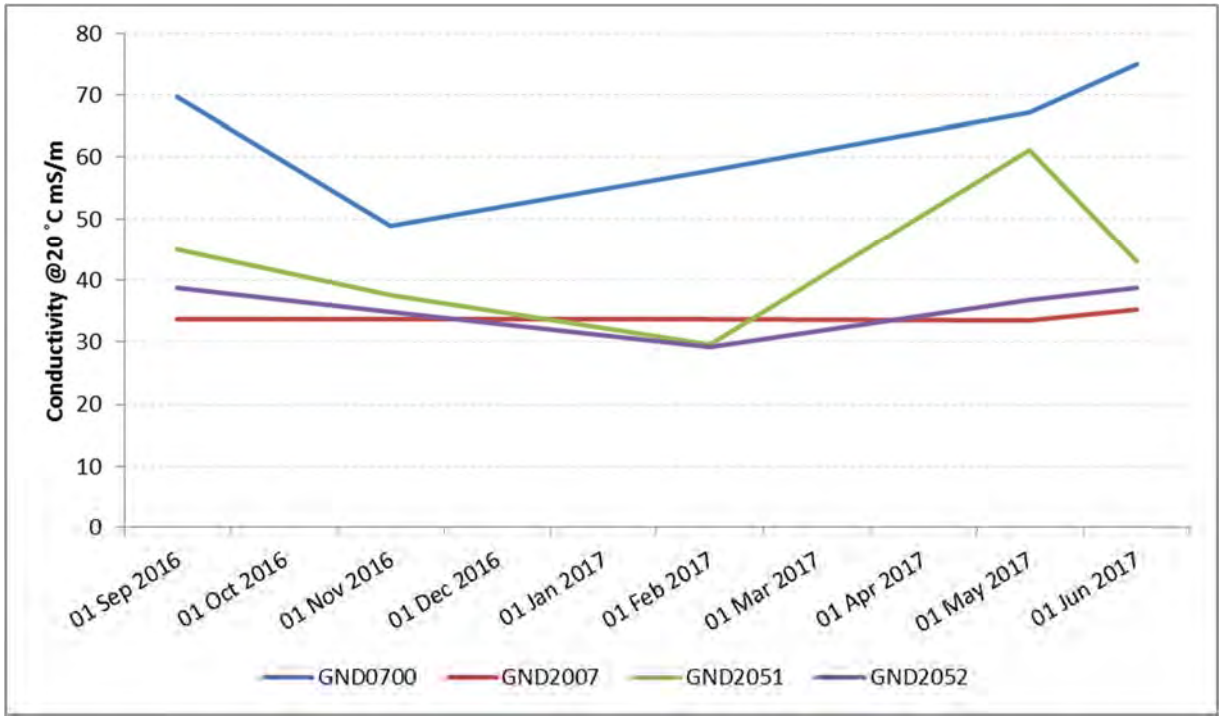

Figure 38 Groundwater conductivity at Farm 3 bores during the year under review

Figure 39 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.

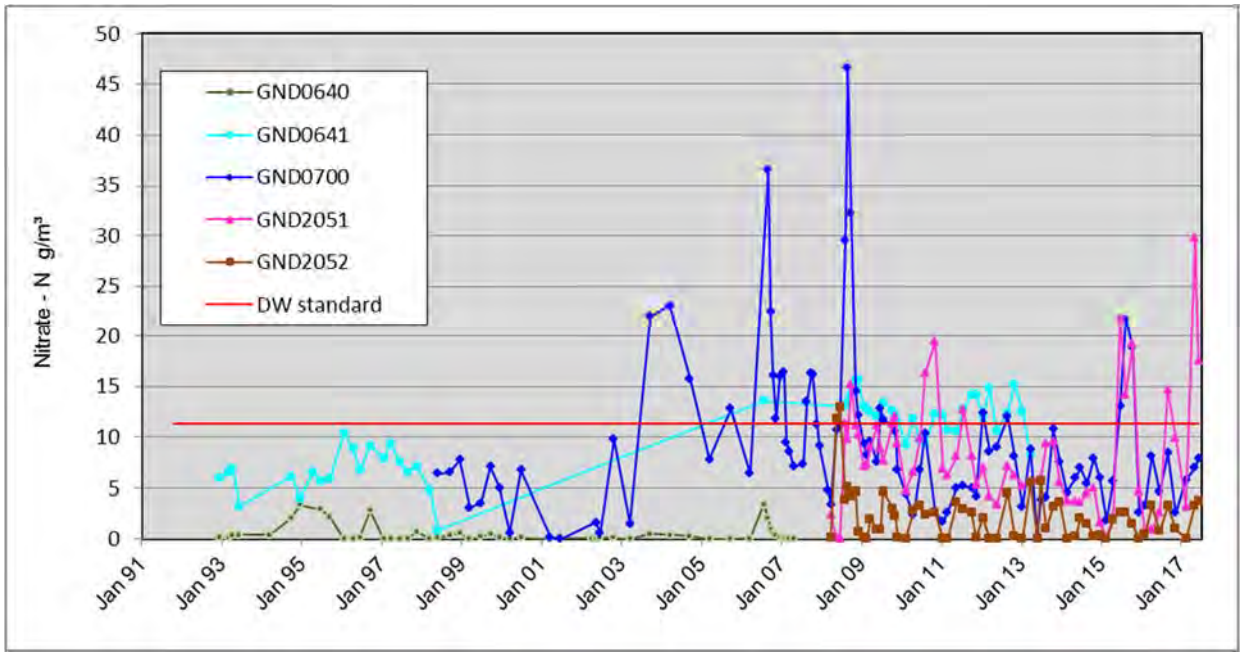

Figure 39 Trends in groundwater Nitrate-N concentration at Farm 3

At the new control bore (GND20501), nitrate-N values were elevated, with a median value of 14.6 g/m^3 (compared to 3.6 g/m^3 in 2015-2016); and a spike to 29.8 g/m^3 coinciding with higher groundwater levels found at the sampling survey on 5 May 2017 (. The older impact bore GND0700 yielded lower levels of nitrate-N, with a median value of 3.27 g/m^3; and showed no spike in concentration with the increased groundwater level.

The new impact bore GND2052 had a moderate median nitrate-N value of 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, whether the nitrate comes from farming activities up-gradient, or from "mounding" of factory effluent applied down (the ground surface) gradient, or by some other mechanism, is being investigated by the Company.

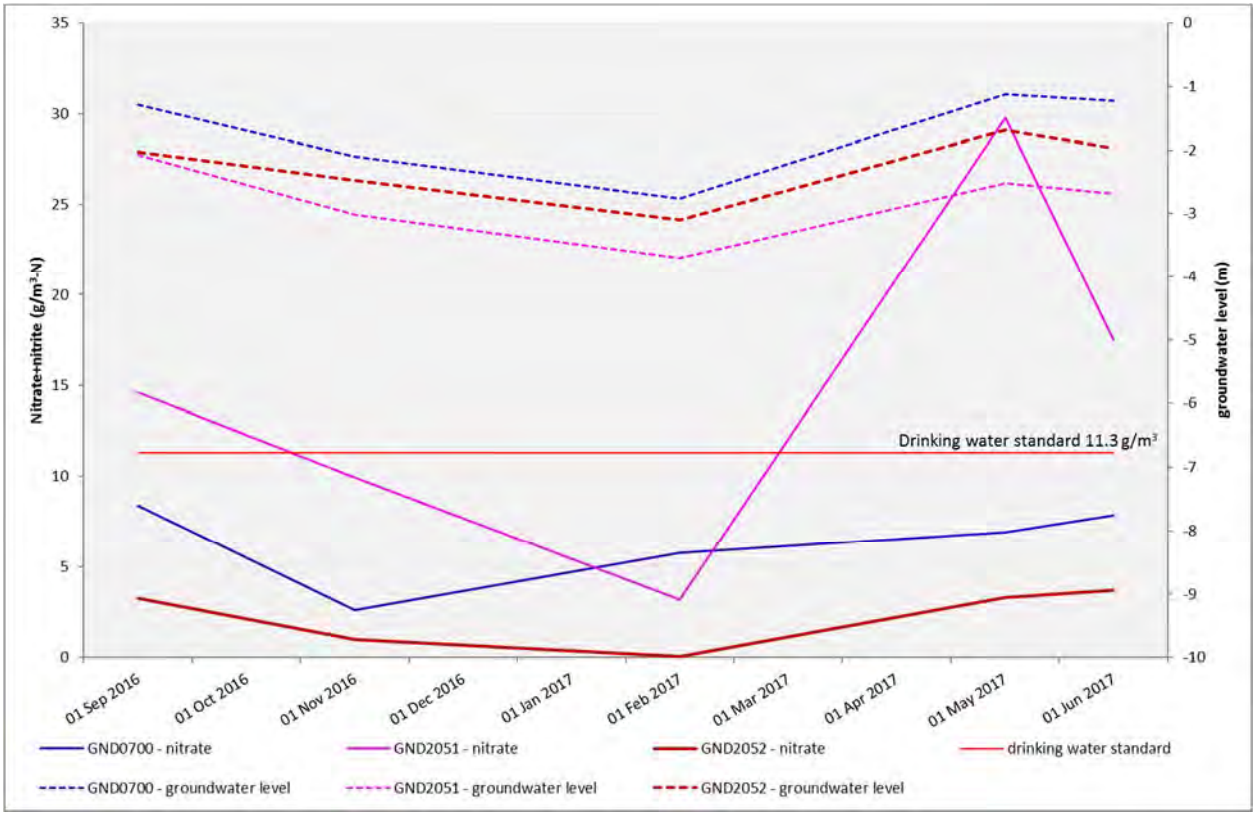

Figure 40 Farm 3 groundwater levels and nitrate + nitrite nitrogen concentrations during the year under review

2.1.5.4 General

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

The main parameter of concern is nitrate level, given the NZ Drinking Water Standard of 11.3 g/m^3 (as nitrate-N) has been exceeded frequently during this and previous monitoring periods. There are no 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 23.

Table 23 Summary of groundwater nitrate concentrations at monitoring bores, 2016-2017

Property	Site code	Bore location	Designation	Nitrate & Nitrite-N, g/m³		No. samples
				Median	Range	
Farm 1	GND0636	North	Control	6.61	6.43 - 6.93	5
	GND0637	South	Impact	**13.2**	10.4 - 17.5	5
Farm 2	GND2049	North	Control (new)	**14.4**	13.7 - 18.5	5
	GND0638	West	Impact	7.5	6.79 - 8.22	5
	GND0639	South-west	Impact	10.7	7.59 - 10.9	5
	GND2050	South-west	Impact (new)	0.05	0.02 - 10.1	5
	GND2063	South-east	Impact	5.48	4.80 - 7.03	5
Farm 3	GND2051	North	Control (new)	**14.6**	3.18 - 29.8	5
	GND2052	South-west	Impact (new)	6.94	2.61 - 8.40	5
	GND0700	South-east	Impact	3.27	0.03 - 3.69	5
	GND2007	South	Impact (deep)	<0.01	<0.01 - <0.01	5
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 has been 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 2016-2017, a total metered volume of 526,626 m^3 of factory effluent was generated, which had a (time-based) average total nitrogen concentration of 98.4 g/m^3 (43 samples, range 62 - 148 g/m^3), giving a total nitrogen mass of 52,177 kg. When applied to 164 ha, at an average depth of 321 mm, this amounted to an overall annual nitrogen application rate of 318 kg/ha. The calculated annual nitrogen application rates for Farm 1 (51 ha), Farm 2 (26 ha) and Farm 3 (87 ha) are 256, 357 and 342 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 345 kg/ha.

For dairy shed effluent, on Farm 1, a total metered volume of 14,403 m^3 was irrigated over 10 months, which had an average total nitrogen concentration of 113 g/m^3 (38 samples, range 50 – 162 g/m^3), giving a total mass of 1,624 kg. When applied to 51 ha, at an average depth of 0.8 mm, this amounted to an overall annual nitrogen application rate of 32 kg/ha.

For dairy shed effluent, on Farms 2 and 3, a total metered volume of 19,928 m^3 was irrigated over 11 months, which had an average total nitrogen concentration of 189 g/m^3 (43 samples, range 58 – 310 g/m^3), giving a total mass of 3,761 kg. When applied to 113 ha, at an average depth of 18 mm, this amounted to an overall annual nitrogen application rate of 33 kg/ha.

The change in the total mass of nitrogen from DSE irrigated from 3,360 Kg in 2015-2016 to 5,384 kg in 2016-2017 (an increase of 2,024 kg), was approximately the same as the reduction in factory wastewater nitrogen mass from 2015-2016, at 1,992 kg. DSE total nitrogen amounted to 9.4 % of nitrogen mass irrigated.

The combined nitrogen loading rate for 2016-2017 from irrigation of factory wastewater and DSE was 288 kg/ha on Farm 1 and 379 kg/ha on Farms 2 and 3. A comparison of the nitrogen application rates in recent years are given in Table 24.

Table 24 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	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 have increased since the 2013-2014 year, the addition of the DSE has no 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 7 and Table 8), along with relying on the assumption that the waste has been irrigated uniformly across all paddocks.

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.

Overall, on Farm 1 it appears that the base nitrate levels under the irrigation areas may have increased during the 2016-2017 year. 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.

On Farm 2, it appears that the nitrogen loadings have been better managed since the beginning of the 2013-2014 year, with only 2 of the impact bore samples being at, or above, the drinking water standard.

However, the elevated concentrations at the control bore (GND2049) continued, with all samples being above the drinking water standard.

On Farm 3, it appears that nitrate levels under the irrigation areas have decreased and are stabilising in response to the increase in irrigated area. However, it is noted that GND0641, which generally fluctuated around the drinking water standard, has not been sampled since the bore became blocked in 2013, and that the nitrate levels in the control bore (GND2049) appear to be increasing, with a new maximum value of 29.8 g/m^3 recorded during the year under review, over 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 was again a spike in nitrate level observed during the year under review. However, in contrast to the 2015-2016 monitoring year, this did not occur at most monitoring bores, both impact and control, most likely as the result of a heavy rainfall event. The increase only occurred at the May sampling survey at the Farm 2 impact bore (GND0637) and to a lesser extent the Farm 2 impact bore (GND2050). This did not coincide with a single heavy rainfall event, but did coincide with an increase in groundwater level.

In general, the groundwater contained the highest concentrations of nitrate nitrogen at a time when the groundwater levels were also elevated. Exceptions to this were GND2049, GND0639, and GND2063, although there is little seasonal variation at GND2063 when compared to the other two aforementioned bores.

The results for the two relatively new control bores, at the upslope boundaries of Farm 2 and Farm 3, 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. It has been signalled to Fonterra 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 Waiokura Stream surface water quality

In combination with groundwater monitoring, 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 27, Table 25). This was carried out approximately monthly.

Table 25 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 2016-2017 monitoring period are presented in Table 26, and a summary of the monitoring previously performed is presented in Table 27.

Table 26 Results of Waiokura Stream quality sampling for the 2016-2017 monitoring period

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	7	20.2 - 22.4	21.0	7	21.1 - 22.6	22.0	7	20.7 - 23.8	22.3
Dissolved reactive phosphorus	g/m^3	7	0.024 - 0.088	0.035	7	<0.003 - 0.095	0.034	7	0.030 - 0.117	0.038
Sodium	g/m^3	7	18.4 - 20.2	19.2	7	19.9 - 22.3	20.9	7	20.4 - 24.4	20.7
Nitrate + nitrite	g/m^3 N	7	1.51 - 4.28	2.82	7	1.46 - 6.51	3.03	7	1.50 - 3.68	3.00
pH		7	7.4 - 8.0	7.7	7	7.5 - 8.1	7.7	7	7.5 - 8.1	7.7
Temperature	°C	7	8.3 - 15.4	11.8	7	8.3 - 15.9	12.0	7	8.4 - 16.3	12.4

Table 27 Summary of Waiokura Stream water quality data from the Council surveys during the period March 2001 to June 2016

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	113	16.6 - 30.4	21.1	112	17.0 - 25.3	22.4	112	15.0 - 27.4	23.2
Dissolved reactive phosphorus	g/m^3	58	0.012 - 0.065	0.032	57	0.013 - 0.072	0.032	57	0.016 - 0.066	0.034
Sodium	g/m^3	111	14.8 - 25.4	19.5	110	9.4 - 24.9	21.4	110	13.9 - 62.4	23.1
Nitrate + nitrite	g/m^3 N	100	1.27 - 4.08	2.68	98	1.03 - 4.03	2.88	99	1.03 - 4.25	2.85
pH		79	6.6 - 8.0	7.6	78	6.9 - 8.2	7.6	77	7.0 - 8.1	7.7
Temperature	°C	114	7.1 - 18.0	12.3	113	8.4 - 20.2	12.7	113	8.1 - 19.6	12.6

The results for the 2016-2017 monitoring period again indicate a slight increase in conductivity and the sodium levels in the samples downstream of the control site (site 1) on all survey occasions (Table 26), but not significant enough to be considered an environmental effect. Nitrate-N concentration showed a large seasonal fluctuation, varying from about 2.0 g/m^3 in summer to 6.5 g/m^3 in winter. Median nitrate concentration for 2016-2017 was higher at all three sites than the long-term median value, with new maximum values being recorded for both the upstream site (WKR000500) and WKR000630. The high of 6.51 g/m^3 at WKR000630 on 1 August 2016 is unlikely to be due to the Company's discharges. There was no DSE being irrigated on Farms 2 and 3 on the day of (or week prior to) sampling; although factory wastewater was being irrigated, there was no concurrent change in sodium levels as would be expected if this were the source; and if it were as a result of shallow groundwater discharges, during dry weather conditions of this survey, the elevation would have been evident at the monitoring sites further downstream. The ranges of all the other parameters were generally similar to those recorded in previous monitoring periods (Table 27), however it is noted that the dissolved reactive phosphorus levels were elevated above the historical maximums at all sites during the May 2017 survey. 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.

2.1.7 Biomonitoring

2.1.7.1 Fish passage temperature compliance in mixing zone

The Taranaki Regional 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 41. 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)

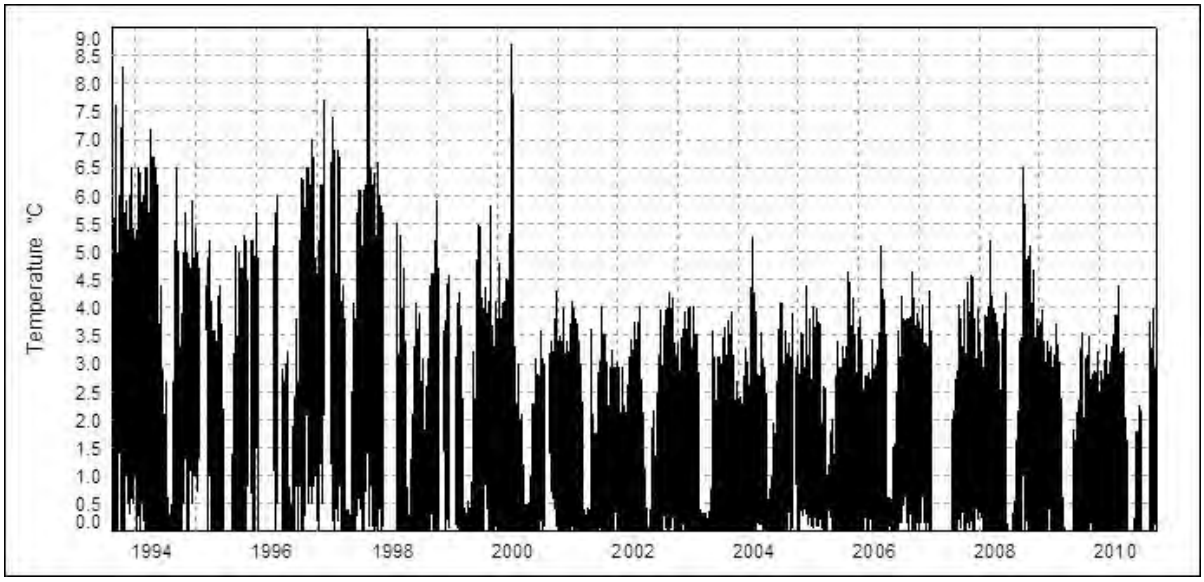

Figure 41 Kaupokonui Stream water temperature differential (LB-RB) records at the periphery of the Fonterra Kapuni spray cooling water discharge zone, 1993-2010

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 2.1.7.3.

Kaupokonui Stream flow records for the monitoring period for the Glenn Road recording station are presented in Figure 42.

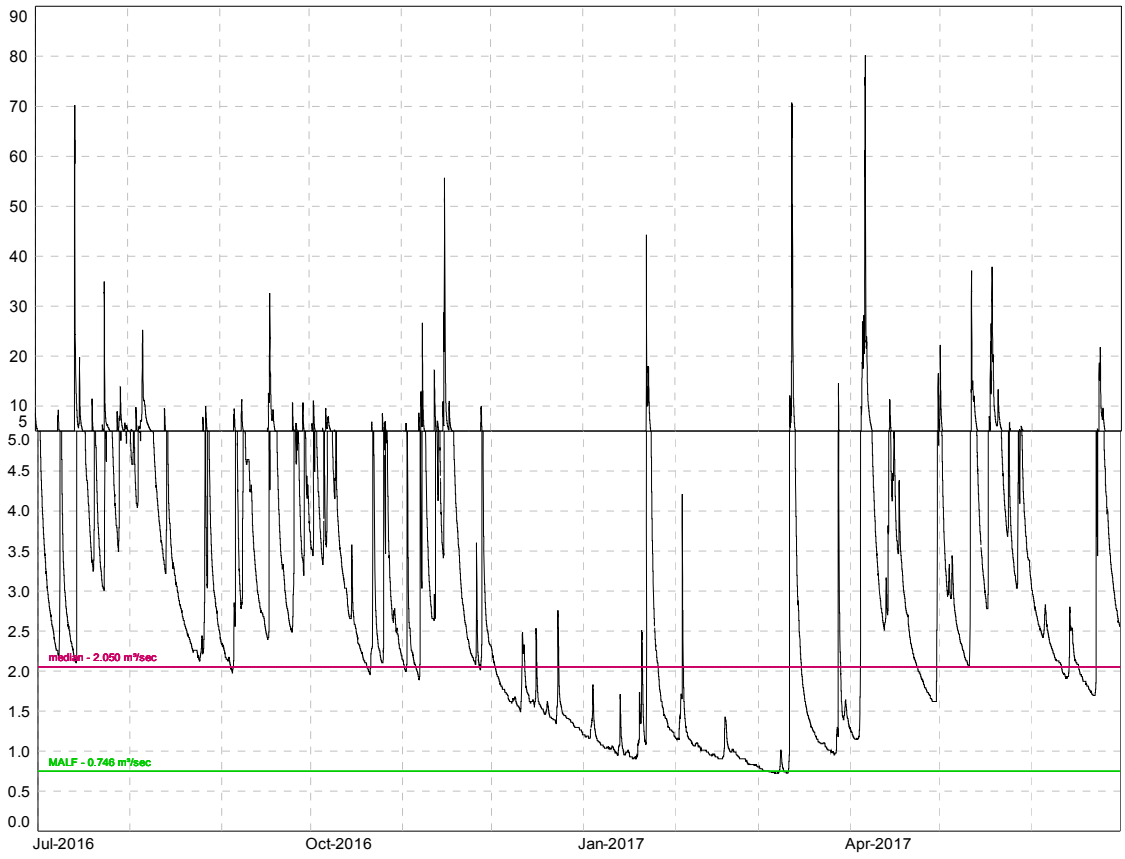

Figure 42 Kaupokonui Stream at Glenn Road flow record (m^3/s) for period 1 July 2016 to 30 June 2017

2.1.7.2 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 2016-2017 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 43 and Figure 44.

A monthly summary of these data is included in Table 28.

In 2016-2017, stream temperatures reached an instantaneous maximum of 24.4˚C on 11 January 2017 at 1600 NZST and from 1600 to 1630 on 28 February 2017 at Glenn Road.

On 11 January at 1600 NZST the temperature of the Kaupokonui Stream upstream of Fonterra was 21.7˚C and the temperature downstream of the sprayers was 21.7 ˚C. The highest temperature recorded downstream of the sprayers on this day was 22.0˚C at 1815 NZST. Fonterra's reported cooling water discharge rates totalled about 55 L/s at 42˚C

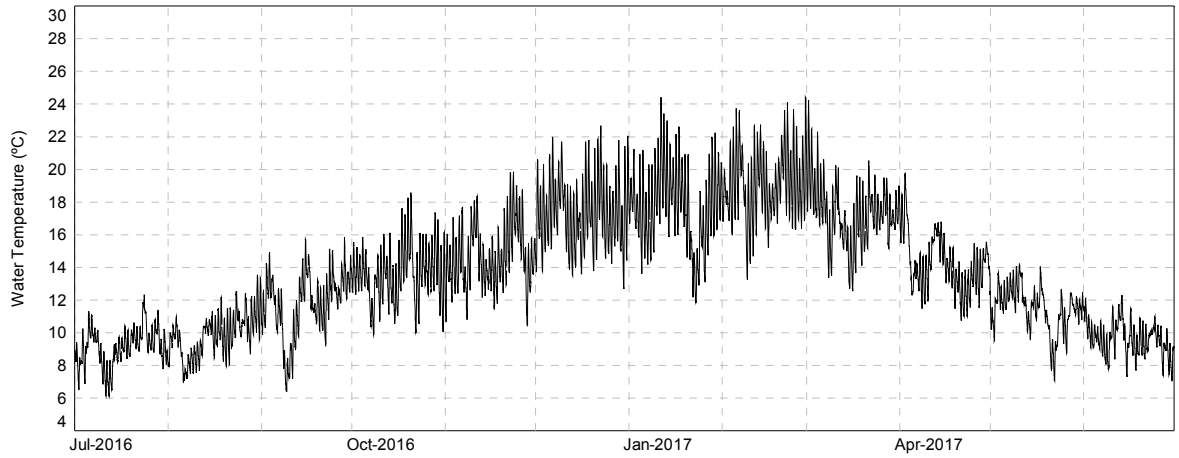

Figure 43 Water temperature (°C) records for the Kaupokonui Stream at Glenn Rd during the period 1 July 2016 to 30 June 2017

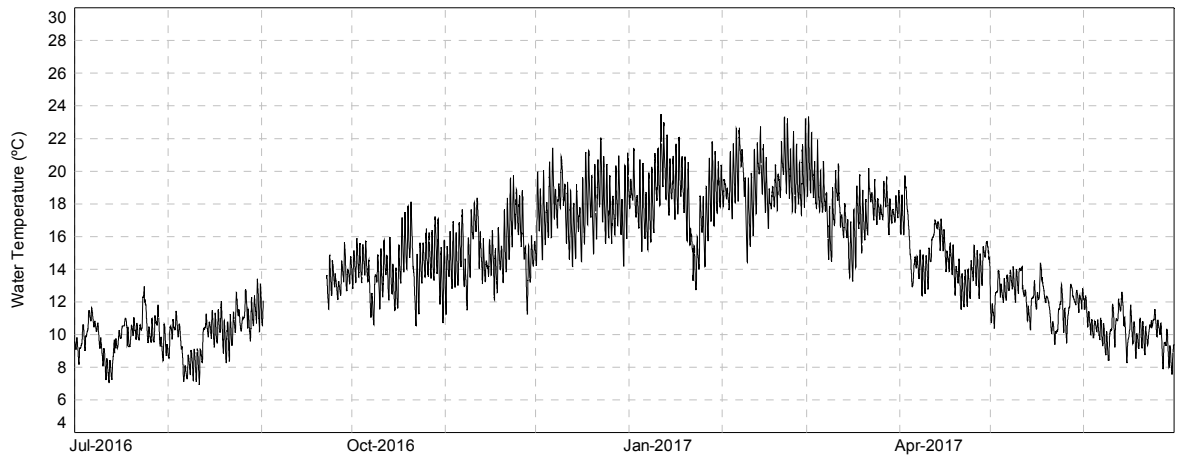

Figure 44 Water temperature (°C) records for the Kaupokonui Stream at beach during the period 1 July 2016 to 30 June 2017

On 28 February between 1600 and 1630 NZST the temperature of the Kaupokonui Stream upstream of Fonterra reached a maximum of 21.2 ˚C and the temperatures downstream of the sprayers reached a maximum of 21.1˚C. The highest temperature recorded downstream of the sprayers on this day was 21.9˚C between 1830 and 1945 NZST. Fonterra's reported cooling water discharge rates totalled about 34 L/s at 38˚C.

Table 28 Monthly Kaupokonui Stream water temperature data for two sites from July 2016 to June 2017

Site	Upper Glenn Road			Near Coast		
	Min	Max	Mean	Min	Max	Mean
July 2016	6.1	12.3	9.1	7.1	12.9	9.9
August 2016	6.9	13.6	9.8	6.9	13.4	10.1
September 2016	6.4	15.9	11.8	-	-	-
October 2016	9.9	18.6	13.7	10.5	18.1	14.1
November 2016	10.4	19.9	14.7	11.2	19.8	15.2
December 2016	12.7	22.7	17.4	14.1	22.1	17.8
January 2017	11.9	24.4	17.7	12.7	23.5	18.2
February 2017	13.2	24.4	19.1	14.4	23.3	19.3
March 2017	12.6	24.2	17.3	13.3	23.4	17.7
April 2017	10.7	19.8	14.2	11.5	19.8	14.7
May 2017	7.1	14.2	11.5	9.4	14.4	12.2
June 2017	7.1	12.3	9.7	7.6	12.6	10.2

An analysis of the stream water temperature data for each site indicated that 20˚C, above which trout start to become stressed, was exceeded for approximately 6% of the year at both Glenn Road and near the mouth, while the median water temperatures were 13.5˚C at Glenn Road and 14.3˚C near the mouth.

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).

2.1.7.3 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.

2.1.7.3.1 Fish survey

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 29 and shown in Figure 45.

Table 29 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

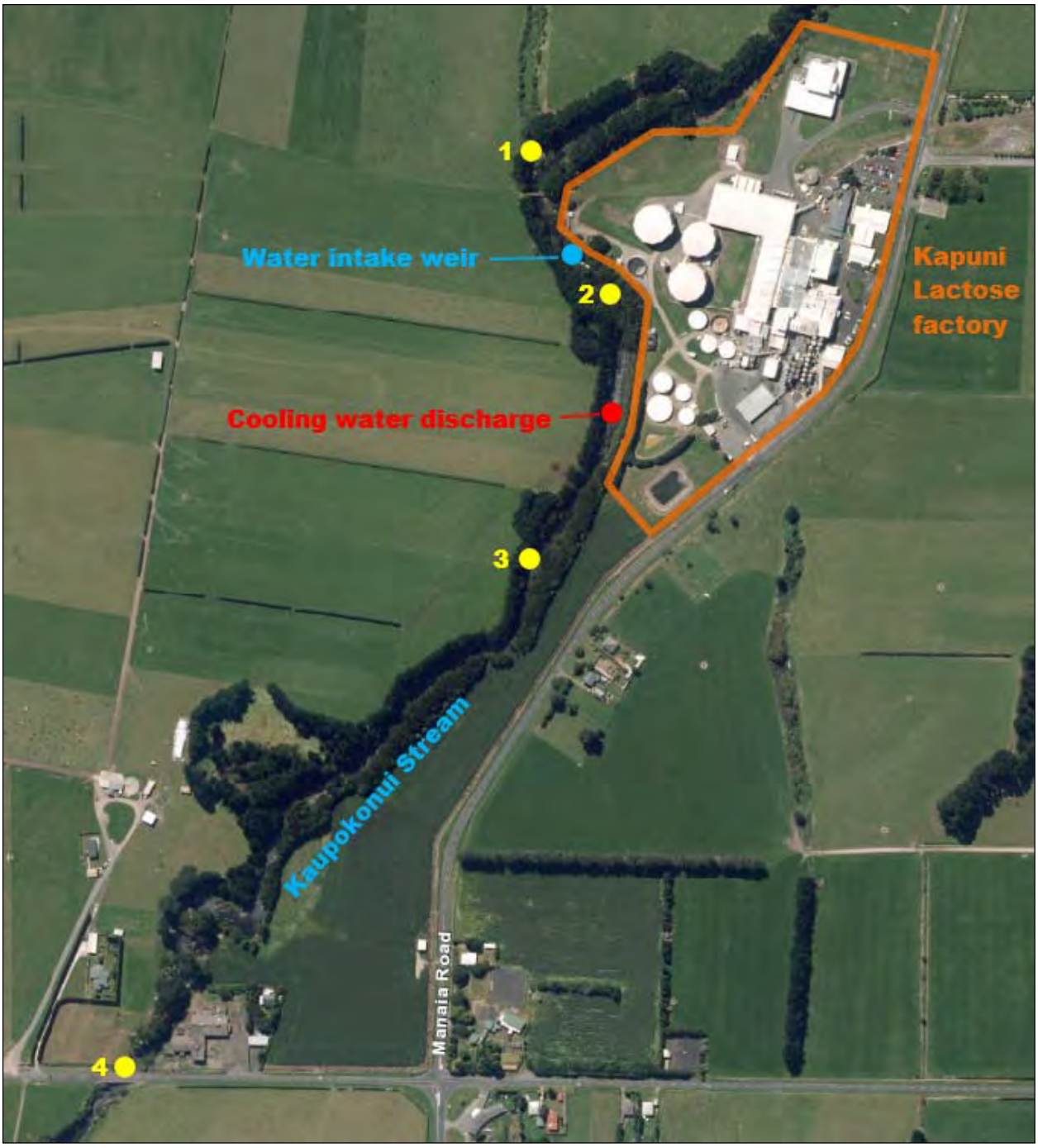

Figure 45 Fish monitoring sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory

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 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.

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.

2.1.7.4 Macroinvertebrate surveys

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from five sites in the Kaupokonui Stream on 19 October 2016 and 10 February 2017. Two sites in the Waiokura Stream were sampled in February 2017. The sites monitored are described in Table 30 and shown in Figure 46. 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 30 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.

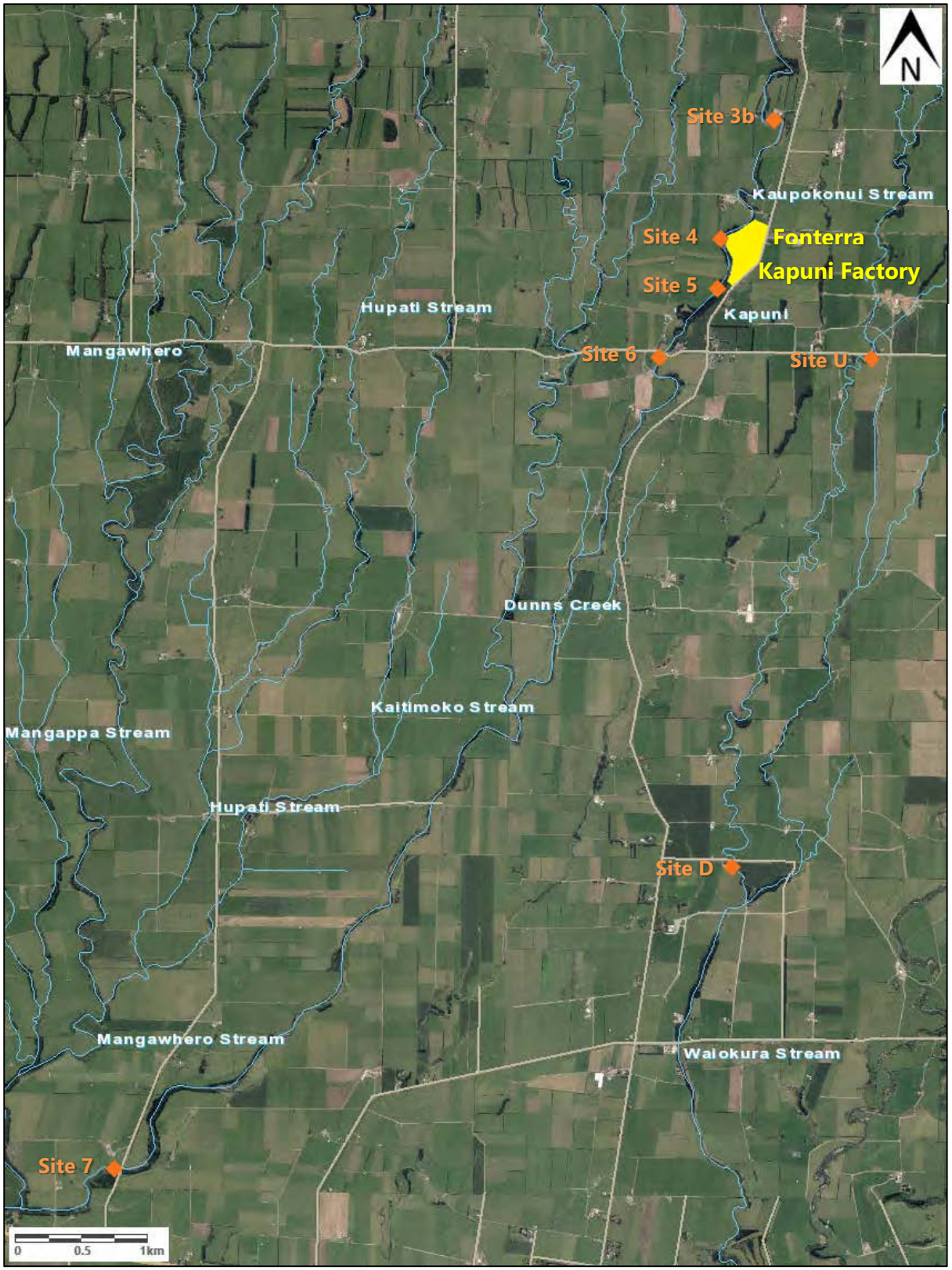

Figure 46 Biomonitoring sites in the Kaupokonui River sampled in relation to Fonterra Kapuni factory discharges

19 October 2016

At the time of this morning survey, water temperatures in the Kaupokonui River ranged from 14.1°C to 15.0°C. Periphyton mats and algal filaments were patchy at all sites, despite the relatively recent occurrence of scouring flows. Cobbles, gravel and boulders were the predominant substrate at all sites in the river.

In the Kaupokonui River, taxa richnesses were all equal to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'good' community health at all sites. MCI scores remained generally stable in a downstream direction, with the exception of the furthest downstream site, which recorded a large reduction. This is an atypical result for this survey, which normally records a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. In the case of the current survey however, this lack of a progressive deterioration indicates that water quality in the mid survey sites was better than would be expected. The MCI score at the upper site 3b was slightly higher than the historical median score, while the MCI scores at sites 4, 5 and 6 were well above their historical medians. The significant decrease in $SQMCI_S$ scores recorded between sites 3b and 4 was primarily due to a reduced abundance of the 'highly sensitive' mayfly *Deleatidium*. This is a relatively subtle change when the communities at sites 3b and 4 are considered overall, and not necessarily an indication that the community had been recently adversely affected by land irrigation upstream of this site.

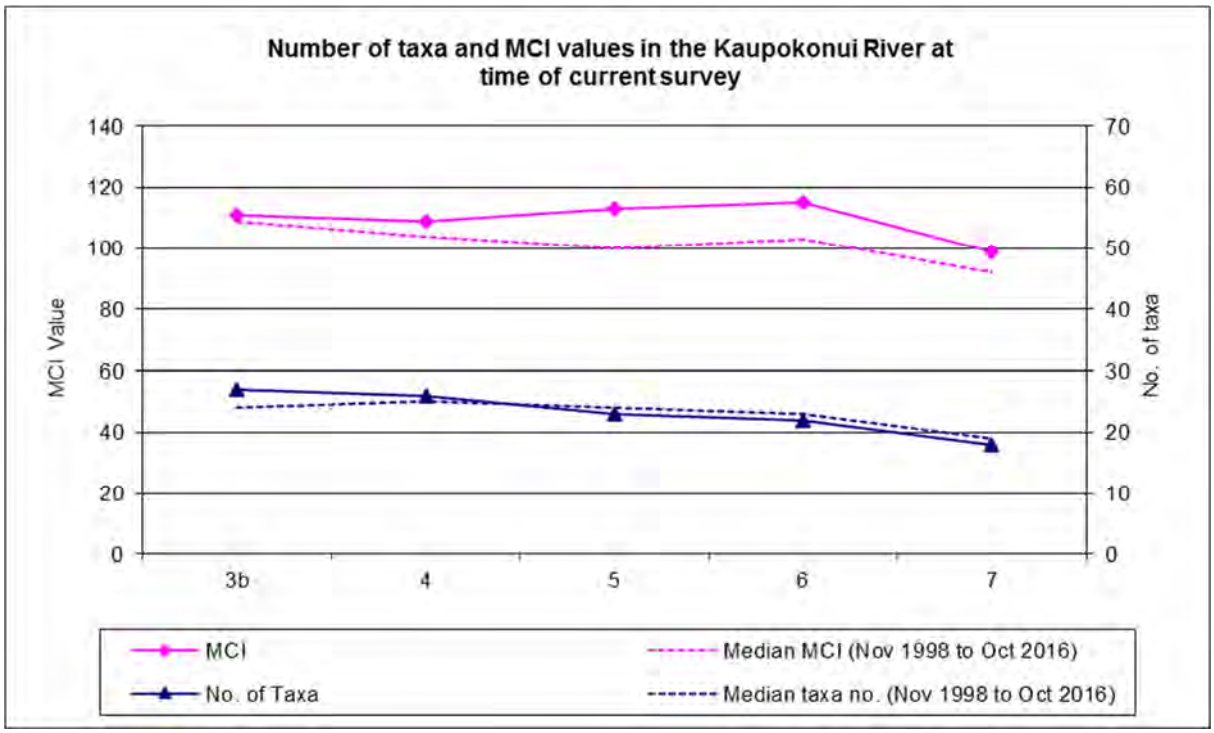

Figure 47 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of a possible influence from the Dunns Creek tributary within the reach between sites 6 and 7. However, this is also a reflection of a natural progressive downstream deterioration that was exacerbated by low flows, although the rate of deterioration recorded in the current survey is particularly high, primarily due to the above average MCI score recorded at site 6.

It can 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 better condition than that recorded in the previous summer survey, a relatively typical spring result. 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.

10 February 2017

This survey was undertaken following a moderate period of receding flows in the Kaupokonui River, and followed 18 days after flow events in excess of three and 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 1.011 m^3/sec, less than half the median flow (2.032 m^3/sec), and just 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 14.6°C to 20.6°C. No periphyton mats were noted at site 3b, where the rocks supported a slippery film and patchy growths of filamentous algae. Sites 4, 5 and 6 all supported patchy growths of algal mats and filaments, while at site 7, these growths were widespread, 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. 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 site U, while site D supported patches of algal filaments and slippery algal mats. Water temperatures ranged from 13.4˚C to 14.8˚C at the time of this mid-morning component of the survey.

The Waiokura Stream had experienced an extended period of stable flows prior, with this survey performed 182 and 188 days after flow events in excess of three and seven times median flow respectively. 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.

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. 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 the sites 3b, 5 and 7 were significantly higher than their historical median scores, while the MCI scores at sites 4 and 6 were slightly above their historical medians. There were no significant differences in $SQMCI_S$ scores between any sites, reflecting the fact that the communities were dominated by similar taxa, in particular the 'highly sensitive' mayfly *Deleatidium*, which was extremely abundant at all sites. This lack of change suggests that there is no indication that the community had been recently adversely affected by land irrigation upstream of this site.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 6, was still in above average health. The usual influence from the Dunns Creek tributary within the reach between sites 6 and 7 was not apparent in the current survey, and the natural progressive downstream deterioration was less obvious, with the primary factor behind this being the wet summer that preceded the survey.

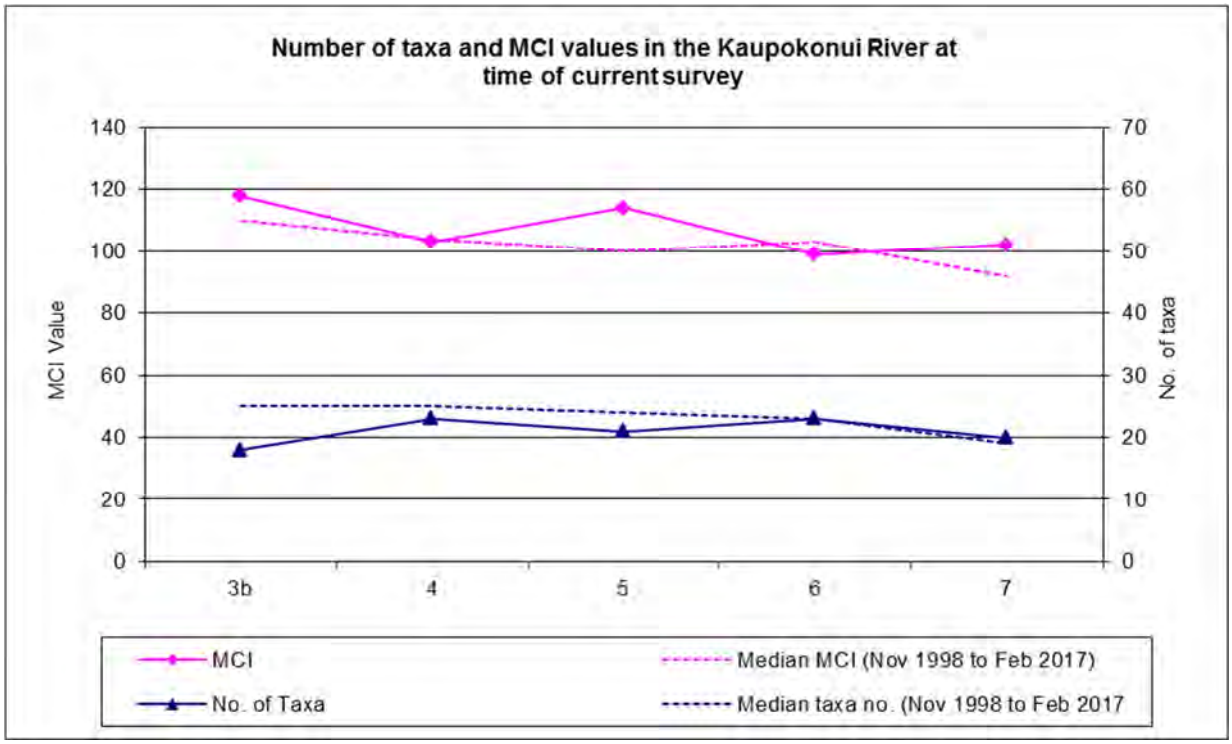

Figure 48 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

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 spring survey, a relatively a-typical but positive 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 higher than that recorded upstream, indicating that community health at the downstream site was better than would be expected. Usually this site exhibits some deterioration in MCI score, which 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 the downstream site was in above average health, with the score at this site being the highest recorded to date, and higher than that recorded upstream. 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 2016-2017 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.

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. On-site odours were noted during inspections, particularly in the vicinity of the effluent tank, and in the vicinity of the Pro-liq ponds. No off site odours were noted during the year under review.

The plant appeared to be well managed and well maintained, with a high standard of housekeeping observed at the time of each inspection. Any on-site spills were responded to and cleaned up promptly.

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

Table 31 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 21st September 2016 by CRL Energy, using USEPA Method 201A over three 60 minute periods. Average production rate was 5.4 t/hr. These averaged results are presented in Table 32 below, along with previous CRL and Council results since 1998.

Table 32 Summary of isokinetic stack analysis of the flash drier for 1998-2016

Date	Emission (mg/dsm^3)*	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	

Date	Emission (mg/dsm^3)*	Comments
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	17	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.

Emissions monitoring was also performed on the "small dryer" according the USEPA Method 201A on the 21 September 2016. The three samples were all collected, each over a period of 60 minutes at a production rate of 2.5 t/hr. The average total particulate emission rate was 66 mg/dsm^3 and 1.8 kg/hr.

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 September 2016 were below consent limits.

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 2016-2017, 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 33 and Figure 50.

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 2016-2017 deployment period are compared with previous results since 1997 in Figure 49 and Table 34.

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 33 Description of the Fonterra 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

Westerly winds predominated (over 30 % of the time) during the gauge deployment, with south easterly, southerly, northerly and north westerly components each also in the range of about10-20% of the time.

The deposition rates obtained during the periods under review were generally similar to the most recent monitoring periods, with the exception of site AIR02302. The lactose deposition rate recorded at this site was the highest on record for this monitoring location and about four times higher than the guideline value. However, it was noted that this gauge contained a green mould, and there were no complaints received regarding particulate deposition during the deployment period of the gauges.

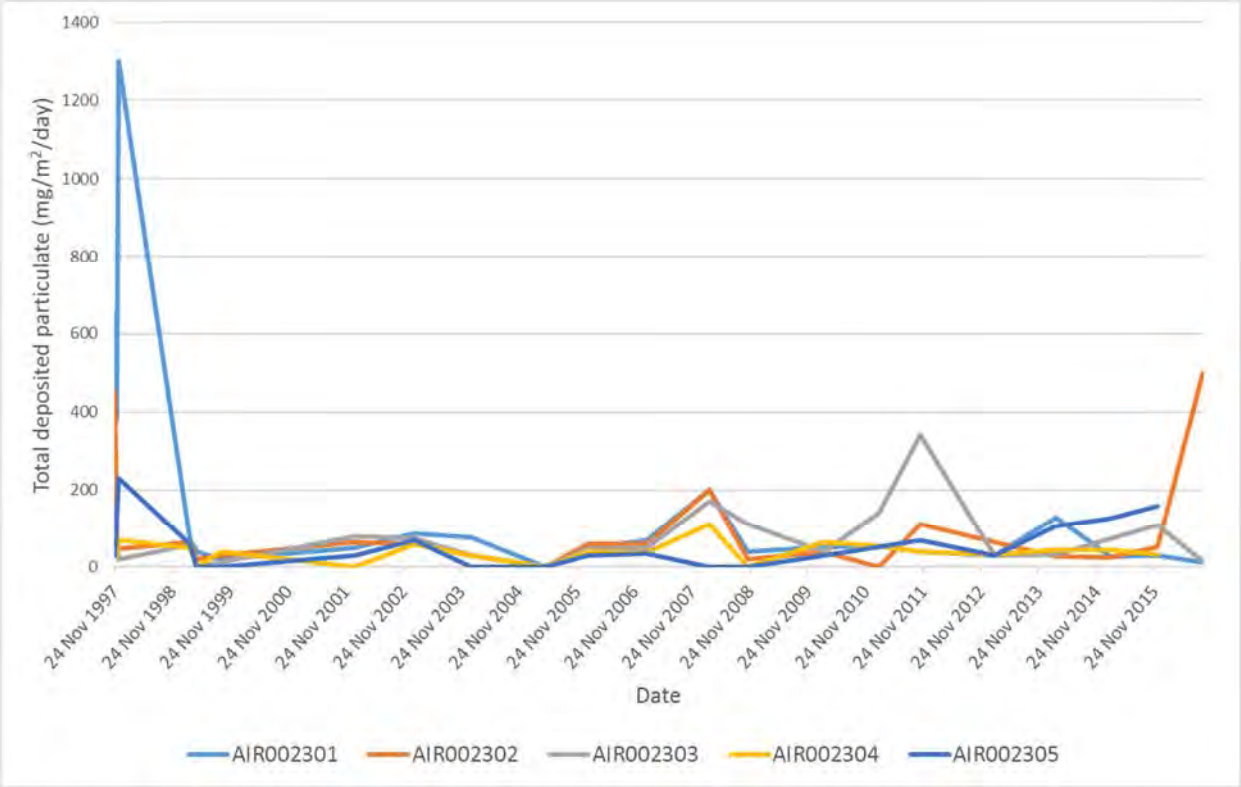

Figure 49 Deposition gauge results from 1997-2017 monitoring periods

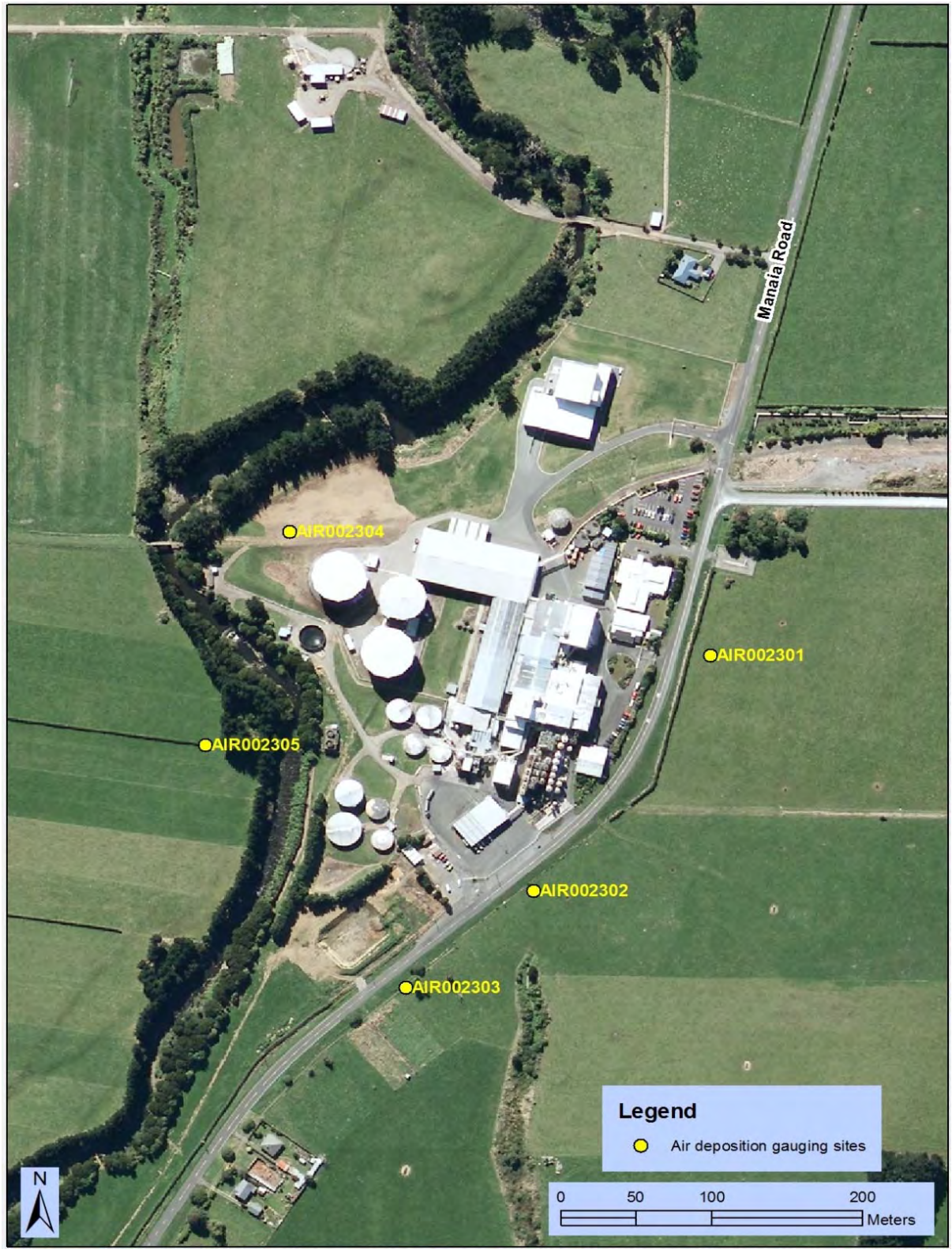

Figure 50 Location of air deposition gauging sites

Table 34 Deposition gauge results from 1997-2017 monitoring periods

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	*	*

* 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 2016-2017 period, the Council was required to undertake additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans on one occasion, in relation to a self-notified odour complaint.

20 October 2016

During a routine monitoring inspection it was found that the effluent disposal system at the Fonterra Lactose Plant at Kapuni was not operating within resource consent conditions. Inspection found that effluent solids removal was occurring from the southern farm dairy shed holding pond. The liquid portion of the effluent had been applied to land using a vacuum truck. It was observed that effluent was running off and entering the Waiokura Stream. Samples (Table 35) and photographs were taken.

Table 35 Unauthorised discharge sampling, 20 October 2016

Parameter	Unit	Waiokura Stream upstream E1698147-N5626965	Discharge sample E1698153-N5626957	Waiokura Stream downstream E1698136-N5626940
Carbonaceous BOD_5	g/m^3	1800	-	-
Filtered carbonaceous BOD_5	g/m^3	-	1.4	1.5
Conductivity @ 20˚C	mS/m	410	22.0	22.2
Ammonia-N	g/m^3 N	229	0.010	0.020
Unionised ammonia	g/m^3 N	-	0.00024	0.00047
pH	pH	7.5	7.9	7.9
Suspended solids	g/m^3	7090	20	23
Turbidity	NTU	5760	12	-
Temperature	˚C	19.7	14.1	13.8

An abatement notice (EAC-21356) was issued requiring the Company to ensure that the special conditions of resource consent 0923-3 are complied with at all times, and an explanation from the Company was sought by Council. A letter of explanation was received and accepted. The letter outlined the changes that would be made to the system and the standard operating procedures for this activity to prevent a reoccurrence. An infringement notice was subsequently issued for the contravention of Section 15(1)(b) of the RMA.

3 January 2017

Notification was received from the Company advising of a damaged irrigation line and the potential that resource consent conditions could be breached. It was found that a PVC flange was split where it met a valve. The Company's shift engineer attempted in-situ repairs, however these gave out under the pressure when the system was restarted. The Council was advised that contractors would be engaged to dig up the line to cut out and replace the damaged section(s). The Company advised that the irrigation volumes at the time were only about 17-1800 m^3/day, so there was only a small chance of a consent breach occurring. It was determined that under section 341(b)(i)(ii) the alleged offender would have had a credible defence, however it was found that no consent conditions were breached during the course of this event. Modifications were also made to the system to minimise the risk of a reoccurrence. A gate valve was

installed outside paddock 13 so that three quarters of the farm can be isolated for repairs while still allowing irrigation the front quarter of the farm.

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.

A number of improvements were made at the site during the year under review, which included the installation of a bund wall on the western side of the site above the Kaupokonui Stream to protect the stream from accidental spillage, replacement and covering of the waste oil bunds, and the installation of a gate valve and non-return valve in a Farm 1 irrigation line at a stream crossing.

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 August 2015. Council has been advised that a revision to this plan is currently being drafted due to the significant 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. A Spray Irrigation Plan is required by consents 0922-3.2 and 09023-3.2, and is to be updated annually with the updated plan to be provided to Council by 1 July each year. The most recent edition on Council record was issued in August 2015. Council has been informed that the irrigation practices at the site have not changed, and that the operator training is being maintained as required. Operator training records were provided to Council.

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. 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, 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.

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 in order to get the information for water allocation purposes. 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. Electronic transmission of abstraction data 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 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. This was investigated in the 2017-2018 year, allowing most of the missing data to be backfilled, and corrupt data to be corrected for the 2016-2017 year. However, there remained an issue with the accuracy of the discharge flow meter for the discharge covered by consent 0919-3 during the year under review, which has now been rectified.

The main cooling system was replaced in August 2015, with Council advised that the towers were designed to achieve a temperature of less than 25°C for water entering Kaupokonui Stream after going through the

towers and existing spray system. The monthly median cooling water temperature upstream of the spray discharge system during the year under review was 37 to 39 °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 and a degree of further cooling is expected due to the discharge mechanism. This appears to have addressed the issue of increasing water temperature upstream of the plant.

Two incidents were recorded; an unauthorised discharge of effluent to the Waiokura Stream during the cleaning of the DSE separator ponds on Farm 3; and a self notification of damage to an irrigation line that had the potential to result in a breach of consent. An abatement notice and an infringement fine were issued in relation to the unauthorised discharge of dairy effluent. The irrigation line was repaired without a consent breach occurring.

Recorded annual abstraction volume from Kaupokonui Stream decreased in 2016-2017, by a factor of 14 % over 2015-2016, which follows the reduction by a factor of about 10 % in 2015-2016 over 2014-2015. The lactose concentration of the wastewater was not ascertained during the year under review. The measured strength and volume of wastewater irrigated onto land remained similar to the previous year. As the volume abstracted decreased while the volume discharged to land changed little, it is assumed that the volume returned to Kaupokonui Stream as cooling water decreased correspondingly.

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 total mass of nitrogen from DSE irrigated in 2016-2017 was approximately equivalent to the decrease in nitrogen irrigated in factory wastewater.

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. In 2016-2017, the Company continued two further projects in relation to stormwater control, to divert all stormwater from the factory site through a continuously monitored system which will enable detection of contaminants for storage in the detention pond and/or diversion to wastewater irrigation. Planning for the implementation of these projects continued 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. The Company also purchased additional shading varieties of plants for planting on 11 upstream farms.

3.2 Environmental effects of exercise of consents

Ecological monitoring did not note any problems in regard to the abstraction of water from the Kaupokonui Stream for cooling water and general purposes. The assumption had previously been made that the abstraction for the cooling water was close to being non-consumptive. Cooling water discharge rates provided for the year under review indicated that about 70 % or more of the abstracted water was not being returned to the stream. However, this was later found to be as a result of the "stab" flow meter becoming fouled, and that the data for the period of at least about November 2016 to March 2017 was not

representative of the real situation. Assessment of the consumptive nature of the abstraction, and the impact this may be having on the flow of the Kaupokonui Stream will be made once sufficient data is available. It must also be noted that any losses due to evaporation or wind drift at the point of discharge is additional to any measured water consumption through the plant.

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. Biological monitoring of the Kaupokonui Stream during spring 2016 and summer 2017 did not show any significant adverse effect of the cooling and storm water 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 five of the site inspections during the year under review. It is noted 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 23 % of the time, with a maximum temperature drop of 1.5 ˚C reported to Council.

Irrigation onto the dairy farms was, in general, well managed. At inspection it was found that a 20 m buffer was maintained to the bank of water courses, although it was noted on one inspection that work was to be undertaken on Farm 1 stationary irrigator to ensure that the 20 m buffer zone was maintained. A break in an irrigation line was notified to Council and repaired without a discharge to the Waiokura Stream. A small patch of dead grass was noted at a following inspection, which 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 has remained relatively stable. 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, with the estimated 2016-2017 nitrogen application rates increased by about 18 % over the 2012-2013 application rates on both Farm 1 and Farms 2 and 3. It is noted that the nitrate concentration in the groundwater bore at the southern boundary of Farm 1 was above the drinking water standard in all but one sample collected during the year under review. The control bore for Farm 2 (GND2049) was consistently above the drinking water standard and for Farm 3 (GND2051) was above the standard in three of the five samples collected. The reason for this elevation in the control bores is to be investigated by Fonterra and presented in the AEE for the consent renewal.

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

Stormwater discharged from the northern outfall complied with the conditions of consent **4604-2**.

Results from monitoring of the stormwater discharged from the IGL plant showed that the discharge was complying with conditions of consent **6423-1.**

Results from monitoring of the stormwater discharged from the southern stormwater outlet showed that the discharge was complying with the conditions of consent **0924-3.**

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 AIR002302, east of the site opposite the tanker bay, which was almost four times the guideline level and the highest result on record. Mould was found to have grown in the gauge and no complaints were received by Council in relation to deposited particulates. Visual inspections found no evidence of depositions, and odour surveys continued to note 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, and in the vicinity of the Pro-liq ponds.

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Table 36 to Table 56.

Table 36 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 37 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	Collection of samples and provision of cooling water discharge temperatures	**No. See Table 38**
2. Prohibited effects on receiving water	Site inspections, collection of samples, biological surveys	Yes
3. BOD level	Collection of samples	Yes
4. Limits on temperature increase of receiving water	Temperature information supplied by Fonterra	Yes
5. Limit on temperature of receiving water	Temperature data supplied by the Company	Yes
6. Monitoring of temperature of receiving water	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

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?**
8. No thermal barrier or growths as a result of discharge	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
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 38 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 was out by an unknown factor	**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, but was out by an unknown factor	**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		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 39 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		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

Table 40 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 41 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		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. Review and provision or reviewed spray irrigation plan by 1 July each year and upon two months notice by Council	Check of Council records. Latest document issued July 2015. 2016-2017 training records provided	**Updates not provided, but advised no changes in methodology have occurred**
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		**Good**

Table 42 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	Yes
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. Review and provision or reviewed spray irrigation plan by 1 July each year and upon two months notice by Council	Check of Council records. Latest document issued July 2015. 2016-2017 training records provided	**Updates not provided, but advised no changes in methodology have occurred**
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	**Discharge of dairy effluent to Waiokura Stream. Abatement and infringement notices issued**
10. No ponding	Farm inspections	Yes. Ponding due to pipe break and repairs, therefore credible defence
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

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?**
14. Records provided to Council of effluent produced, volume irrigated, area and hours pumped	Records received	Yes
15. Change of consent conditions	Not sought	N/A
16. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Improvement required**
Overall assessment of administrative performance in respect of this consent		**Improvement required**

Table 43 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	**No. See Table 44**
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	Yes
9. Discharge not to create barrier for fish, or undesirable growths	Temperature monitoring and site inspections	Yes

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?**
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 August 2015.	Yes
12. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Improvement required**

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

Table 44 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, but was out by an unknown factor	**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, but was out by an unknown factor	**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		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 (corrected in 17-18)**
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 45 Summary of performance for Consent 4032-5

Purpose: ***To discharge emissions to the air from the manufacture, drying, packaging and storage of lactose and associated processes and from the inhalation grade lactose plant***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt BPO to prevent or minimise emissions	Site inspections	Yes
2. Consent holder to fulfil obligations under the RMA	Site inspections	Yes
3. Limits of particulate from wet scrubber	Stack testing in September 2016	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

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?**
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 46 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	Approved August 2015	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 47 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	Yes
3. Contingency planning	Approved August 2015	Yes

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?**
4. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 48 Summary of performance for Consent 4623-2 (to 1 June 2017, thereafter unconsented)

Purpose: *To erect, place and maintain various spray, stormwater, irrigation and intake structures in the bed of the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification of maintenance works	Receipt of notification of works in July 2016	Yes
2. Construction in accordance with application		N/A
3. Best practicable option to minimise environmental effects	Consent holder monitored maintenance activity	Yes
4. Structures not to restrict fish passage	Site inspections	Yes
5. Works to be undertaken between November and April, unless waiver received from Council	Waiver granted for works outside date restrictions .Works did not result in downstream discolouration	Yes
6. Structure to be removed and area reinstated when no longer required		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		**Improvement required**

Table 49 Summary of performance for Consent 5368-1 (to 1 June 2017, thereafter unconsented)

Purpose: *To erect, place, use and maintain a bridge over Little Dunn's Creek a tributary of Dunns Creek in the Kaupokonui catchment for access purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification of works	No maintenance carried out during period under review	N/A

Purpose: *To erect, place, use and maintain a bridge over Little Dunn's Creek a tributary of Dunns Creek in the Kaupokonui catchment for access purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
2. Construction and maintenance in accordance with application	No maintenance carried out during period under review	N/A
3. Practicable measures to prevent contamination of watercourse	No maintenance carried out during period under review	N/A
4. Removal and reinstatement when no longer required		N/A
5. No discharge of contaminated stormwater	No maintenance carried out during period under review	N/A
6. 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		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

Table 50 Summary of performance for Consent 6422-1 (to 1 June 2017, thereafter unconsented)

Purpose: *To erect, place and maintain a stormwater outlet structure in the bed of the Kaupokonui Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification prior to maintenance	No maintenance undertaken	N/A
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental effects		N/A
4. Disturbance to be minimised		N/A
5. Structure to be removed and area reinstated if no longer required		N/A
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		**Improvement required**

Table 51 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	Approved August 2015	Yes
2. Exercise of consent in accordance with application	Site inspections	Yes
3. Best practicable option to minimise environmental impacts	Site inspections	Yes
4. Limits on pH, suspended solids and hydrocarbons in the discharge	Sample collection	Yes
5. Effects which must not arise below the 50 mixing zone	Site inspections, stream sample collection, biomonitoring	Yes
6. Lapse of consent		N/A
7. Review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 52 Summary of performance for Consent 6885-1 (to 1 June 2017, thereafter unconsented)

Purpose: *To erect, place and maintain an outlet structure in the Kaupokonui Stream for stormwater discharge purposes*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option		N/A
2. Exercise of consent in accordance with application		N/A
3. Notification prior to installation		N/A
4. Minimise disturbance of stream bed		N/A
5. Reinstatement when structure no longer needed		N/A
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		**N/A**
Overall assessment of administrative performance in respect of this consent		**Improvement required**

Table 53 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		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 54 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 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

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?**
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
20. Removal of structure when no longer required		N/A
21. Lapse of consent if not 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 55 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	Checking of records and information provided to Council	Yes
3. Notification upon volume exceedance	Checking of records and information provided to Council	Yes
4. Best practicable option on adverse effects	General observation and checking of records	**Discharge of dairy effluent to Waiokura Stream. Abatement and infringement notices issued**
5. Diversion of stormwater	Assessment by Council Officers	Yes
6. Maintenance of buffer distances	Monitoring by Council Officers	**Discharge of dairy effluent to Waiokura Stream. Abatement and infringement notices issued**
7. Limit on Nitrogen application rate	Not assessed	N/A
8. Keeping of records	Not assessed	N/A
9. Actions following unauthorised discharge	Unauthorised discharge found at inspection with no prior notification	**Discharge of dairy effluent to Waiokura Stream. Abatement and infringement notices issued**
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 Overall assessment of administrative performance in respect of this consent		**Improvement required** **Improvement required**

Table 56 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 and information provided to Council	Yes
3. Notification upon volume exceedance	Checking of records and information provided to Council	N/A
4. Best practicable option on adverse effects	General observation and checking of records	Yes
5. Diversion of stormwater	Assessment by Council Officers	Yes
6. Maintenance of buffer distances	Monitoring by Council Officers	Yes
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	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**

During the year under review, an improvement was required in the Company's environmental performance and compliance and administrative performance with the resource consents as defined in Section 1.1.4. There was an abatement notice and an infringement notice issued due to the discharge of dairy effluent to the Waiokura Stream during the cleaning of the DSE separator pond at Farm 3.

With respect to the administrative performance, there were ongoing issues with provision of accurate real time monitoring data that took some time to address, and applications for the structure consents that expired on 1 June 2017, which include the weir, were not applied for until after the end of the year under review.

3.4 Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT monitoring of air emissions from the Fonterra Kapuni site in the 2016-2017 year continue at the same level as in 2015-2016.
2. THAT monitoring of abstractions and discharges at the Fonterra Kapuni site in the 2016-2017 year continue to be exercised as in 2015-2016.

3. THAT the option for a review of resource consent **6948-1** (pipeline structure) in June 2017, as set out in condition 9 on consent **6948-1** not be exercised, on the ground that the current conditions are adequate to deal with any potential adverse effects.
4. THAT the option for a review of resource consent **9546-1** (culvert) in June 2017, as set out in condition 22 on consent **9546-1** not be exercised, on the ground that the current conditions are adequate to deal with any potential adverse effects.

These recommendations were implemented.

3.5 Alterations to monitoring programmes for 2017-2018

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 2016-2017 was essentially the same as that for 2015-2016. In 2015-2016, some additional sampling of discharges to Kaupokonui Stream, for nutrients, trace metals and faecal indicator bacteria, was carried out at the request of the Company, in preparation for an AEE when applications are made for consent replacement. It is now proposed that for 2017-2018, the programme remains unchanged.

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 2017-2018.

4 Recommendations

1. THAT in the first instance, monitoring of air emissions from the Fonterra 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 Fonterra 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.

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, normally expressed in terms of the mass of nitrogen (N).
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 the Council's laboratory.

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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)

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 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

Discharge Permit

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

Name of Consent Holder:	Origin Energy Resources (Kupe) Limited 12 Waione Street Petone WELLINGTON
Consent Granted Date:	21 June 2005

Conditions of Consent

Consent Granted:	To discharge emissions to air as products of combustion from the Kupe Production Station involving equipment burning natural gas as fuel where the maximum heat release is in excess of 10 megawatts, together with miscellaneous emissions at or about GR: P21:098-802
Expiry Date:	1 June 2039
Review Date(s):	June 2007, June 2009, June 2011, June 2017, June 2023, June 2029, June 2034
Site Location:	Kupe Production Station, west of Inaha Road, east of Kapuni Road [being a paper road] and south of Siggs Road [being a paper road], Inaha, Manaia
Legal Description:	Secs 55 56 Pt Secs 53 54 Sbdn 1 of Pt Sec 53 Sbdn 1 of Pt Sec 54 DP 2201 Blk VII Waimate SD Sec 17 Blk VIII Waimate SD

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

General conditions

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

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

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

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

Special conditions

1. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 3516. In the case of any contradiction between the documentation submitted in support of application 3516 and the conditions of this consent, the conditions of this consent shall prevail.

2. 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 actual or likely adverse effects on the environment associated with the discharge of contaminants into the environment arising from the emissions to air from the site.

3. The consent holder shall minimise the emissions and impacts of air contaminants discharged from the site by the selection of the most appropriate process equipment, process control equipment, emission control equipment, methods of control, supervision and operation, and the proper and effective operation, supervision, control and maintenance of all equipment and processes.

4. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request an analysis of a typical gas and/or condensate stream from the Kupe field, covering sulphur compound content and the content of compounds containing six or more carbon atoms in their molecular structure.

5. The consent holder shall provide to the Taranaki Regional Council during May of each year, for the duration of this consent, a report:

   a) detailing gas combustion at the production station;
   b) detailing any measures that have been undertaken by the consent holder to improve the energy efficiency of the production station;
   c) detailing any measures to reduce smoke emissions;
   d) detailing any measures to reduce flaring;
   e) addressing any other issue relevant to the minimisation or mitigation of emissions from the production station; and
   f) detailing any complaints received and any measures undertaken to address complaints.

6. Prior to undertaking any alterations to the plant, processes or operations, which may significantly change the nature or quantity of contaminants emitted to air from the site, the consent holder shall first consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

7. Prior to the commencement of production, the consent holder shall supply to the Chief Executive, Taranaki Regional Council, a final site lay-out plan, demonstrating configuration of the facilities and equipment so as to avoid or mitigate the potential effects of air emissions.

8. Any incident having an environmental impact or potential environmental impact which has caused or is liable to cause substantiated complaint or a hazardous situation beyond the boundary of the property on which the production station is located, shall be notified to the Taranaki Regional Council, as soon as possible, followed by a written report to the Chief Executive, Taranaki Regional Council, within one week of the incident, with comment about the measures taken to minimise the impact of the incident and to prevent re-occurrence.

9. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, a record of all smoke emitting incidents and all relief valve releases, noting time, duration and cause. The consent holder shall also keep, and make available to the Chief Executive, upon request, a record of all complaints received as a result of the exercise of this consent.

10. The discharges authorised by this consent shall not, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, give rise to any dangerous levels of airborne contaminants at or beyond the boundary of the property including but not limited to any risk of fire or explosion.

11. The discharges authorised by this consent shall not, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, give rise to any levels of odour or dust or smoke that are offensive or obnoxious or objectionable at or beyond the boundary of the property on which the production station is located in the opinion of an enforcement officer of the Taranaki Regional Council.

12. The consent holder shall not discharge any contaminant to air from the site at a rate or a quantity such that the contaminant, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the property where the production station is located, or at any dwellinghouse.

13. The consent holder shall control all discharges of carbon monoxide to the atmosphere from the site, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 milligrams per cubic metre [eight-hour average exposure], or 30 milligrams per cubic metre [one-hour average exposure] at or beyond the boundary of the property on which the production station is located.

14. The consent holder shall control all discharges of nitrogen dioxide or its precursors to the atmosphere from the site, whether alone or in conjunction with any other discharges to the atmosphere from the site arising through the exercise of any other consent, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 200 micrograms per cubic metre [one hour average exposure], or 100 micrograms per cubic metre [twenty-four hour average exposure], at or beyond the boundary of the property on which the production station is located.

15. The consent holder shall control discharges to the atmosphere from the site of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent, measured at or beyond the boundary of the property on which the production station is located, is not increased above background levels:

    a) by more than 1/30th of the relevant Workplace Exposure Standard-Time Weighted Average [exposure averaged over a duration as specified for the Workplace Exposure Standard-Time Weighted Average], or by more than 1/10th of the Workplace Exposure Standard-Short Term Exposure Limit over any short period of time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or

    b) if no Short Term Exposure Limit is set, by more than the General Excursion Limit at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

16. This consent shall lapse on the expiry of five [5] years after the date of commencement 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.

17. 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 within six months of receiving a report prepared by the consent holder pursuant to condition 5 of this consent, or by giving notice of review during the month of June 2007 and/or June 2009 and/or June 2011 and/or June 2017 and/or June 2023 and/or June 2029 and/or June 2034, for the purposes of:

    a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
    b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or

c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant or contaminants; and/or
d) taking into account any Act of Parliament, regulation, national policy statement or national environmental standard which relates to limiting, recording, or mitigating emissions of carbon dioxide and/or nitrogen dioxide, and which is relevant to the air discharge from the Kupe Production Station.

Signed at Stratford on 21 June 2005

For and on behalf of
Taranaki Regional Council

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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

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

Monthly analytical monitoring results for the Kaupokonui Stream (sites KPK000655, KPK000660, KPK000679)

Sample date: 28 July 2016 (flow at Glenn Road – 9.4 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:49	09:37	10:06	The stream was in high flow, and appeared turbid.
Total BOD	g/m^3	0.8	<0.5	0.8	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	8.9	9.2	9.0	
DRP	g/m^3P	0.014	0.015	0.013	
Ammonia-N	g/m^3N	0.017	0.013	0.012	
Nitrate-N	g/m^3N	0.8	0.89	0.98	
pH	pH	7.6	7.7	7.7	
Temperature	°C	9.7	9.6	9.6	
Turbidity	NTU	5.0	7.9	5.3	

Sample date: 18 August 2016 (flow at Glenn Road – 3.1 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:35	10:13	11:00	The stream was at moderate flow and of clear appearance
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	9.9	10.4	11.4	
DRP	g/m^3P	0.009	0.008	0.009	
Ammonia-N	g/m^3N	0.016	0.006	0.009	
Nitrate-N	g/m^3N	0.93	1.05	1.08	
pH	pH	7.6	7.6	7.5	
Temperature	°C	8.2	8.3	9.7	
Turbidity	NTU	1.0	0.94	1.3	

Sample date: 15 September 2016 (flow at Glenn Road – 2.6 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:53	10:48	11:35	The stream appeared clear at the time of sampling
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	9.4	9.8	10.0	
DRP	g/m^3P	0.021	0.021	0.021	
Ammonia-N	g/m^3N	0.030	0.021	0.018	
Nitrate-N	g/m^3N	0.69	0.77	0.79	
pH	pH	7.7	7.8	7.8	
Temperature	°C	10.3	11.5	12.3	
Turbidity	NTU	1.7	0.84	0.83	

Sample date: 20 October 2016 (flow at Glenn Road – 2.0 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:45	09:25	10:07	The stream was at moderate flow and of clear appearance
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	10.4	10.6	
DRP	g/m^3P	0.014	0.015	0.015	
Ammonia-N	g/m^3N	0.017	0.011	0.009	
Nitrate-N	g/m^3N	0.75	0.88	0.91	
pH	pH	7.8	7.8	7.9	
Temperature	°C	12.9	12.9	14.0	
Turbidity	NTU	0.88	1.1	0.88	

Sample date: 17 November 2016 (flow at Glenn Road – 6.4 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:10	09:48	10:27	The stream was at high flow and of clear appearance
Total BOD	g/m^3	0.6	0.5	<0.5	
Filtered BOD	g/m^3	0.5	<0.5	<0.5	
Conductivity	mS/m	5.6	5.7	5.9	
DRP	g/m^3P	0.010	0.011	0.011	
Ammonia-N	g/m^3N	0.016	0.014	0.013	
Nitrate-N	g/m^3N	0.24	0.26	0.28	
pH	pH	7.4	7.4	7.4	
Temperature	°C	10.3	10.8	10.6	
Turbidity	NTU	1.8	1.9	1.8	

Sample date: 14 December 2016 (flow at Glenn Road – 1.7 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	10:00	10:51	11:33	The stream appeared clear at the time of sampling
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	8.9	9.2	
DRP	g/m^3P	0.01	0.008	0.012	
Ammonia-N	g/m^3N	0.025	0.015	0.02	
Nitrate-N	g/m^3N	0.29	0.37	0.4	
pH	pH	7.7	7.8	7.8	
Temperature	°C	12.6	12.6	14.5	
Turbidity	NTU	0.66	0.64	0.62	

Sample date: 19 January 2017 (flow at Glenn Road – 1.04 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:05	10:04	10:39	There had been 10 mm or rain recorded at Glenn Road in the morning prior to sampling. It was noted that there was some cattle effluent running off the bridge upstream of KPK000655. In general, the stream appeared clear, although slightly turbid in deeper pools
Total BOD	g/m^3	1.3	2.6	2.5	
Filtered BOD	g/m^3	0.7	2.4	2.2	
Conductivity	mS/m	9.5	9.5	10.1	
DRP	g/m^3P	0.021	0.022	0.025	
Ammonia-N	g/m^3N	0.055	0.03	0.021	
Nitrate-N	g/m^3N	0.29	0.41	0.41	
pH	pH	7.8	7.8	7.8	
Temperature	°C	16.0	16.1	17.3	
Turbidity	NTU	3.0	3.5	4.0	

Sample date: 16 February 2016 (flow at Glenn Road – 0.91 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	-	-	-	
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	9.0	9.5	9.6	
DRP	g/m^3P	0.023	0.021	0.019	
Ammonia-N	g/m^3N	0.004	0.009	0.006	
Nitrate-N	g/m^3N	0.15	0.23	0.23	
pH	pH	7.9	8.0	8.3	
Temperature	°C	14.6	14.9	15.7	
Turbidity	NTU	1.1	0.73	5.8	

Sample date: 16 March 2017 (flow at Glenn Road – 1.67 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:40	10:15	10:54	The stream was at moderate flow and of clear appearance. There were no dairy effluent discharges occurring from the bridge at the time of sampling
Total BOD	g/m^3	<0.5	<0.5	0.8	
Filtered BOD	g/m^3	<0.5	<0.5	0.5	
Conductivity	mS/m	7.9	8.1	8.3	
DRP	g/m^3P	0.038	0.022	0.029	
Ammonia-N	g/m^3N	0.021	0.018	0.012	
Nitrate-N	g/m^3N	0.34	0.40	0.41	
pH	pH	7.6	7.6	7.6	
Temperature	°C	11.5	11.9	13.2	
Turbidity	NTU	1.1	1.1	1.3	

Sample date: 27 April 2017 (flow at Glenn Road – 1.6 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	09:10	09:53	-	The stream appeared clear at the time of sampling
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	10.4	10.6	
DRP	g/m^3P	0.012	0.012	0.012	
Ammonia-N	g/m^3N	0.007	<0.003	<0.003	
Nitrate-N	g/m^3N	0.69	0.81	0.81	
pH	pH	7.7	7.8	7.8	
Temperature	°C	10.3	10.4	11.6	
Turbidity	NTU	0.58	0.68	0.51	

Sample date: 18 May 2017 (flow at Glenn Road – 29.5 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:36	09:35	09:56	The stream was in flood, with swift, brown turbid flow. There was also flotsam present in the flow. It was noted that the temperature probes had been removed for their protection
Total BOD	g/m^3	1.2	1.6	1.6	
Filtered BOD	g/m^3	<0.5	<0.5	<0.5	
Conductivity	mS/m	3.9	3.8	3.8	
DRP	g/m^3P	0.017	0.029	0.025	
Ammonia-N	g/m^3N	0.053	0.048	0.061	
Nitrate-N	g/m^3N	0.16	0.16	0.16	
pH	pH	7.3	7.2	7.2	
Temperature	°C	12.1	12.1	12.0	
Turbidity	NTU	14	25	27	

Sample date: 22 June 2017 (flow at Glenn Road – 1.69 m^3/s)

Parameter	Unit	Site			Conditions
		KPK000655	KPK000660	KPK000679	
Time	NZST	08:36	09:35	09:56	The stream appeared clear at the time of sampling
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	10.3	10.9	11.2	
DRP	g/m^3P	0.015	0.015	0.011	
Ammonia-N	g/m^3N	0.011	0.005	<0.003	
Nitrate-N	g/m^3N	0.84	1.02	1.03	
pH	pH	7.6	7.7	7.6	
Temperature	°C	8.5	8.8	9.0	
Turbidity	NTU	1.0	0.62	0.51	

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	01-Sep-16	12:45	2.5	13.6	27.9	6.6	6.6	35.5	24.2	0.004	<5
	08-Nov-16	12:10	2.8	13.7	27.8	6.4	6.4				
	15-Feb-17	13:00	3.6	13.9	28.6	6.5	6.9				
	05-May-17	13:30	2.8	14.1	28.1	6.6	6.9	34.6	24.3	0.004	6
	07-Jun-17	14:00	2.6	14.1	36.6	6.6	6.6	55.2	30.3	0.003	<5
GND0637	01-Sep-16	12:25	3.9	14.0	57.2	6.7	17.5	45.8	58.4	0.003	<5
	08-Nov-16	11:40	4.0	14.1	57.3	6.6	15.0				
	15-Feb-17	12:30	5.2	14.3	48.0	6.6	10.4				
	05-May-17	12:50	4.1	14.6	54.0	6.7	12.8	39.3	55.2	0.003	6
	07-Jun-17	13:20	3.6	13.9	53.0	6.7	13.2	41.2	55.8	0.003	5
Farm 2											
GND2049	01-Sep-16	9:40	2.1	14.2	35.7	6.4	14.4	34.7	30.0	0.007	5
	08-Nov-16	8:45	2.3	13.9	37.2	6.3	18.5				
	15-Feb-17	9:00	3.2	14.8	37.1	6.4	18.2				
	05-May-17	10:00	2.1	14.6	36.8	6.4	13.7	33.3	31.9	0.143	5
	07-Jun-17	10:45	2.1	14.7	35.9	6.6	13.9	33.8	30.1	0.003	<5
GND0638	01-Sep-16	9:55	2.0	14.6	67.6	6.6	8.2	50.1	71.0	0.005	<5
	08-Nov-16	9:05	2.5	14.6	71.6	6.6	7.5				
	15-Feb-17	9:20	2.9	15.1	74.2	6.6	7.5				
	05-May-17	10:15	1.7	15.2	73.5	6.7	6.8	61.1	68.2	0.003	6
	07-Jun-17	11:05	2.0	15.4	76.2	6.7	7.3	65.2	70.7	0.003	5
GND2050	01-Sep-16	10:40	2.4	14.0	52.4	6.7	0.0	51.7	56.1	0.317	<5
	08-Nov-16	9:30	2.6	14.1	54.3	6.6	0.0				
	15-Feb-17	10:30	2.9	14.5	55.8	6.8	0.1				
	05-May-17	10:40	2.0	15.3	62.6	6.8	10.1	50.9	80.6	0.030	8
	07-Jun-17	11:30	2.4	14.4	61.6	6.8	4.1	50.1	72.7	0.003	13

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 3											
GND2051	01-Sep-16	11:15	2.1	13.9	44.9	6.4	14.6	62.9	29.0	0.004	5
	08-Nov-16	10:15	3.0	14.2	37.6	6.3	9.9				
	15-Feb-17	11:15	3.7	14.3	29.6	6.5	3.2				
	05-May-17	11:20	2.5	15.3	61.1	6.4	29.8	77.6	30.8	0.003	<5
	07-Jun-17	12:10	2.7	14.6	43.0	6.5	17.5	57.1	31.8	0.003	7
GND0639	01-Sep-16	10:35	2.5	13.8	59.4	6.9	9.4	72.3	95.3	0.021	14
	08-Nov-16	9:15	2.9	13.9	64.3	6.9	10.9				
	15-Feb-17	10:15	3.7	14.3	64.1	6.9	10.8				
	05-May-17	10:30	2.1	14.9	50.1	6.9	7.6	55.4	84.3	0.047	8
	07-Jun-17	11:20	2.5	14.5	61.3	6.9	10.7	58.9	95.0	0.003	6
GND2052	01-Sep-16	11:30	2.0	13.9	38.7	6.6	3.3	45.0	50.0	0.006	<5
	08-Nov-16	10:40	2.5	14.3	34.8	6.5	1.0				
	15-Feb-17	11:30	3.1	14.7	29.1	6.7	0.0				
	05-May-17	11:40	1.7	15.0	36.8	6.7	3.3	46.3	44.1	0.003	11
	07-Jun-17	12:35	2.0	14.6	38.7	6.7	3.7	51.8	46.3	0.003	6
GND0700	01-Sep-16	11:45	1.3	14.2	69.7	6.8	8.4	107.0	93.6	0.003	6
	08-Nov-16	11:00	2.1	14.2	48.8	6.8	2.6				
	15-Feb-17	11:50	2.8	14.8	57.8	6.7	5.8				
	05-May-17	12:05	1.1	14.8	67.2	6.9	6.9	90.6	94.4	0.003	5
	07-Jun-17	12:50	1.2	14.9	74.9	6.9	7.9	119.0	98.8	0.003	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

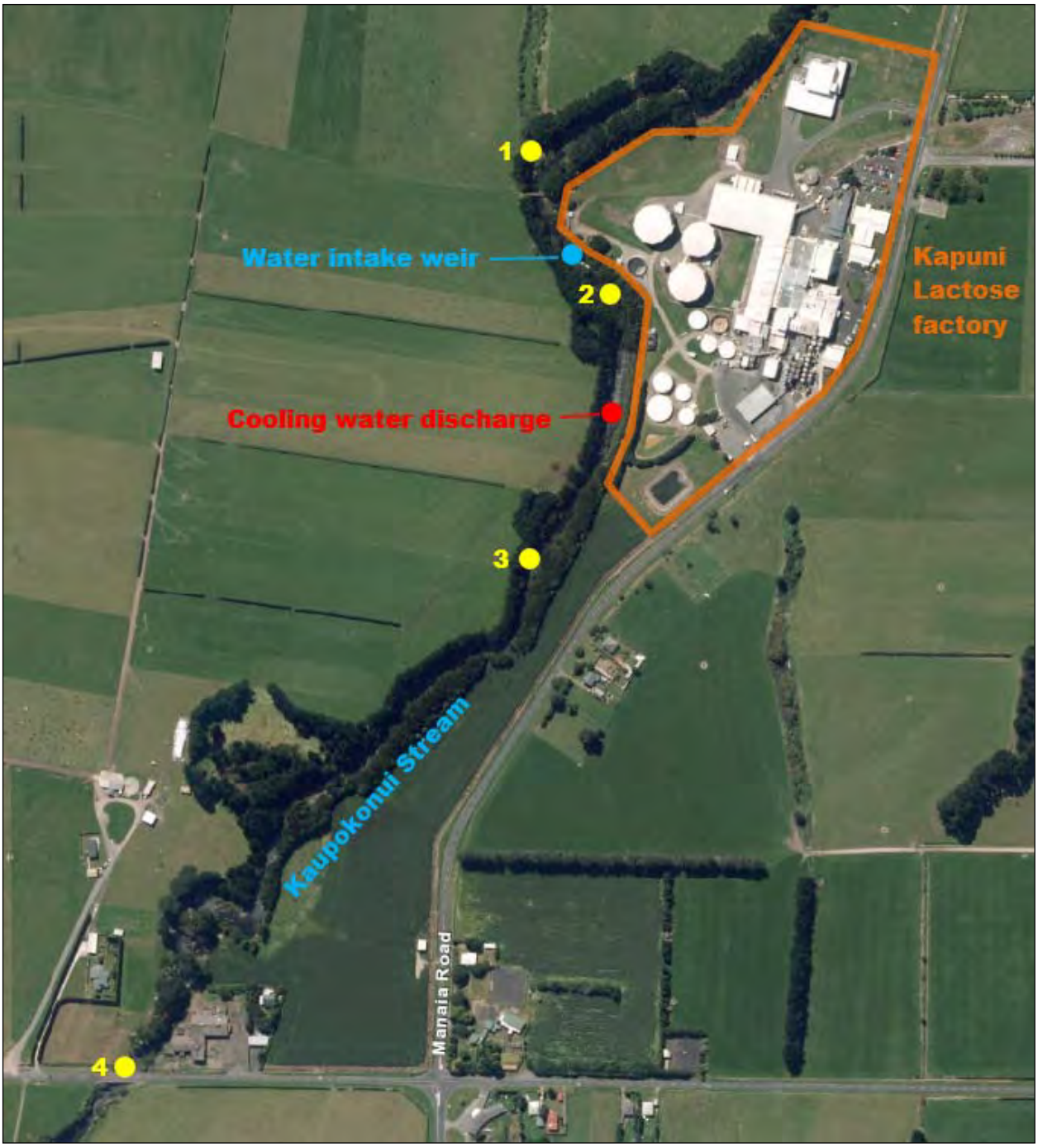

Figure 2 Sites sampled in the Kaupokonui River, in relation to the Kapuni Lactose factory

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

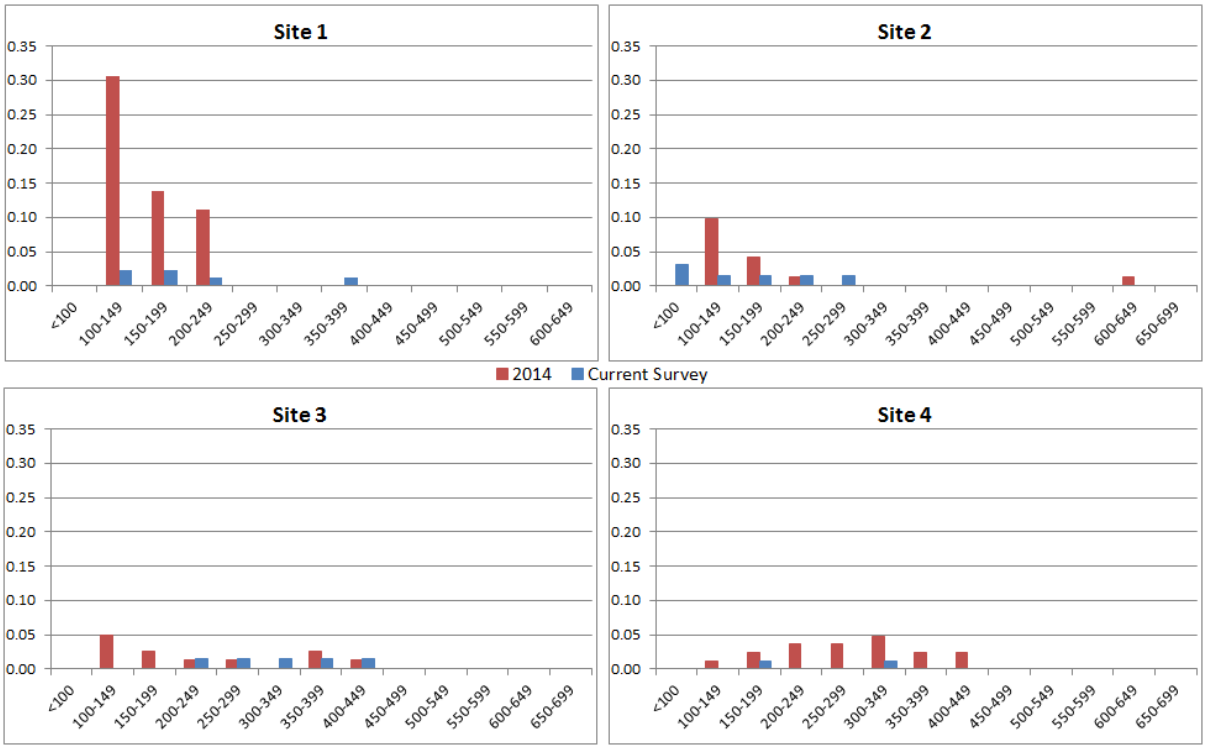

Figure 3 The size of range of eels recorded at each site, compared with the results from the 2014 survey. The data is displayed as number of eels/m^2 surveyed.

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

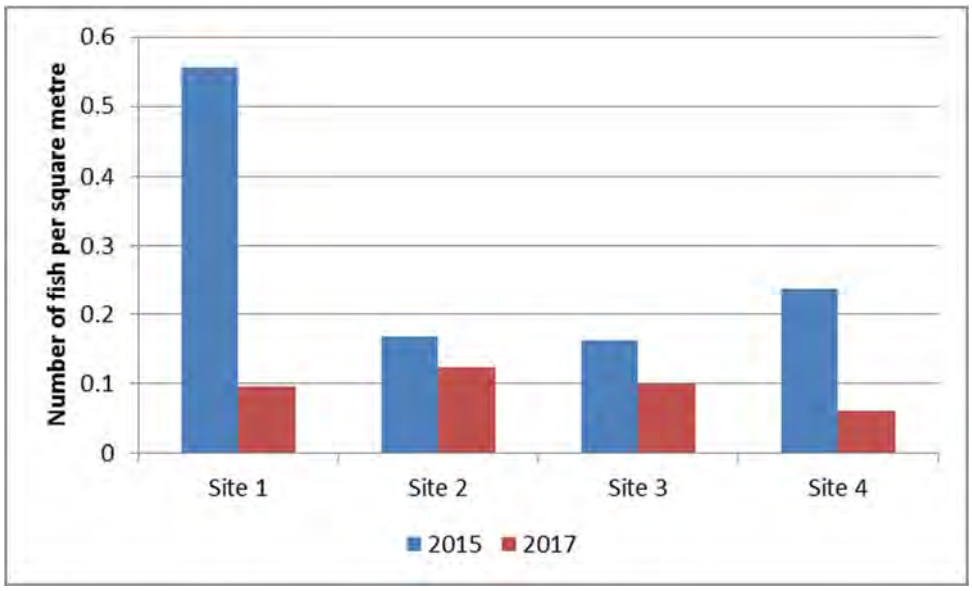

Figure 4 The average number of fish recorded per square metre sampled at each site

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	Scientific Officer, Bart Jansma
Report No	BJ298
Doc No	1920360
Date	22 August 2017

Biomonitoring of the Kaupokonui River in relation to the Fonterra Kapuni farm and factory, October 2016

Introduction

This biological survey was the first of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2016-2017 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 19 October 2016 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). 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.

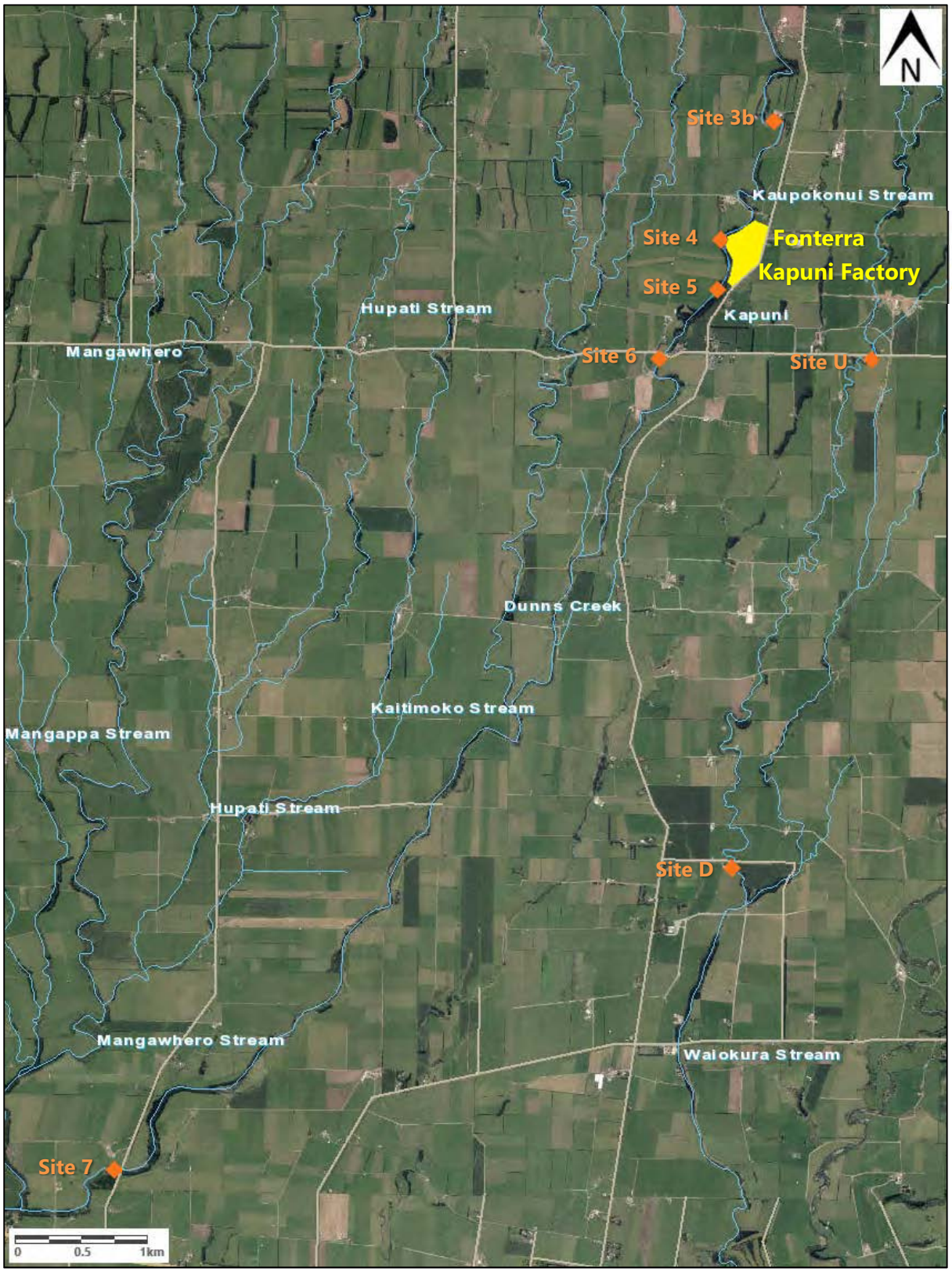

Figure 1 Biomonitoring sites in the Kaupokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a moderate period of receding flows in the Kaupokonui River, and followed 12 and 31 days after flow events in excess of three and seven times median flow respectively. The Kaupokonui River had a moderate, clear, uncoloured, and swift flow at all sampling sites. River flow at the Glenn Road recorder site was 2.104 m^3/sec, just above the median flow (2.032 m^3/sec), and well 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 14.1°C to 15.0°C. Periphyton mats and algal filaments were patchy at all sites, despite the relatively recent occurrence of scouring flows. 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	51	24	13-28	*24*	27	106	68-125	*109*	111
4	65	22	8-32	*25*	26	96	65-128	*104*	109
5	46	23	11-28	*24*	23	99	65-121	*100*	113
6	65	20	4-30	*23*	22	92	40-125	*103*	115
7	56	17	7-31	*19*	18	90	57-110	*92*	99

In this October 2016 survey, all sampling sites supported between 18 and 27 taxa. These results were all within three 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 5 and 6 (Stark, 1998), and their respective median values for surveys since 1985 (

Table 2, Figure 2). Taxa richness was relatively similar between sites with the highest number (27) recorded at site 3b and the lowest number (18) recorded at site 7. MCI scores were relatively stable in a downstream direction, with the only exception being between site 6, which recorded the highest score (115 units) and site 7, which recorded the lowest score (99 units). MCI scores ranged from 99 to 115 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 16 unit decrease in scores between sites 6 and 7, similar to that recorded the previous summer (2016) survey, which recorded an 11 unit decrease. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural 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.

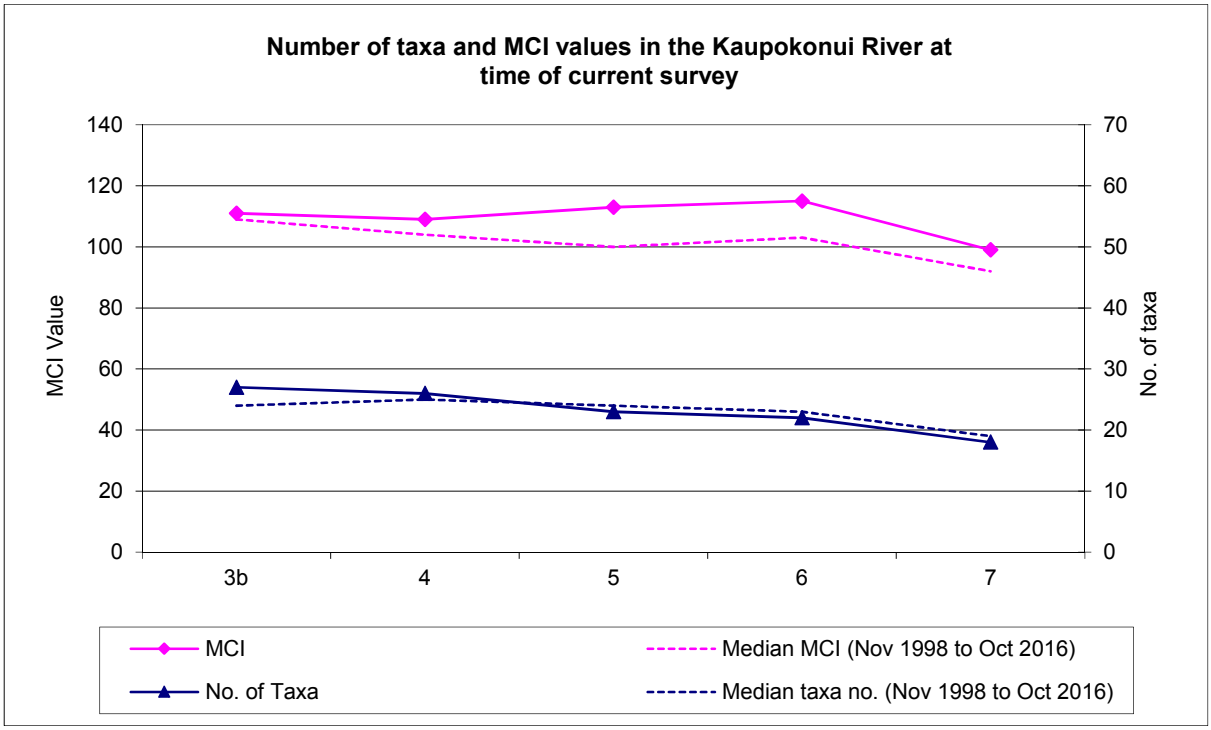

Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni samples on 19 October 2016

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB16247	FWB16248	FWB16249	FWB16250	FWB16251
NEMATODA	Nematoda	3	R	-	R	-	R
ANNELIDA	Oligochaeta	1	R	R	C	A	A
	Lumbricidae	5	-	-	-	-	R
MOLLUSCA	*Potamopyrgus*	4	-	C	R	R	R
EPHEMEROPTERA	*Austroclima*	7	C	R	R	R	-
	Coloburiscus	7	VA	VA	VA	A	C
	Deleatidium	8	XA	VA	XA	XA	XA
	Nesameletus	9	C	C	C	R	-
	Zephlebia group	7	-	-	-	R	-
PLECOPTERA	*Acroperla*	5	R	C	C	R	-
	Austroperla	9	-	-	R	-	-
	Megaleptoperla	9	-	-	-	R	-
	Stenoperla	10	-	-	R	-	-
	Zelandobius	5	R	R	-	R	R
COLEOPTERA	Elmidae	6	C	A	R	C	A
	Hydraenidae	8	R	R	-	-	R
	Ptilodactylidae	8	R	-	-	-	-
MEGALOPTERA	*Archichauliodes*	7	C	A	A	C	R
TRICHOPTERA	*Hydropsyche (Aoteapsyche)*	4	A	A	C	A	R
	Costachorema	7	A	C	C	R	-
	Hydrobiosis	5	A	C	C	A	A
	Neurochorema	6	R	R	-	-	-
	Plectrocnemia	8	R	-	-	-	-
	Beraeoptera	8	A	C	C	C	R
	Confluens	5	-	R	-	-	-
	Olinga	9	C	C	R	R	-
	Pycnocentrodes	5	VA	VA	C	A	VA
DIPTERA	*Aphrophila*	5	C	A	C	A	C
	Eriopterini	5	R	R	-	-	-
	Maoridiamesa	3	VA	VA	VA	VA	VA
	Orthocladiinae	2	VA	VA	A	A	A
	Tanypodinae	5	-	R	-	-	-
	Tanytarsini	3	C	A	C	R	A
	Empididae	3	R	-	-	-	-
	Austrosimulium	3	-	R	R	-	-
	Tabanidae	3	R	-	-	-	-
	No of taxa		27	26	23	22	18
	MCI		111	109	113	115	99
	SQMCIs		6.3	5.1	6.9	6.6	6.4
	EPT (taxa)		14	14	13	14	7
	%EPT (taxa)		52	54	57	64	39
'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-seven taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was three more than 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). The community was characterised by nine taxa including two 'highly sensitive' taxa [mayfly (*Deleatidium*) and caddisfly (*Beraeoptera*)]; four 'moderately sensitive' taxa [mayflies (*Coloburiscus*), and caddisfly (*Costachorema*, *Hydrobiosis* and

Pycnocentrodes)]; and three 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and *Maoridiamesa* and orthoclad midges]. This dominance represented a slight 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 (2016) survey.

The moderate proportion of 'tolerant' taxa in the community (30% of taxa richness) was reflected in the MCI score (111) which was similar to the most recent surveys, and reflective of the moderate period of stable flows and patchy periphyton growths observed. This score was five units higher than that recorded in the previous summer 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 111 units was well within the range recorded in recent surveys (Figure 3). It was two units higher than the median score for surveys since 1998 and five units higher than the median from all surveys conducted to date (Figure 2,Table 2). There were 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 6.3 units, a significant 1.5 units higher than the $SQMCI_s$ value found at this site by the previous summer (2016) survey.

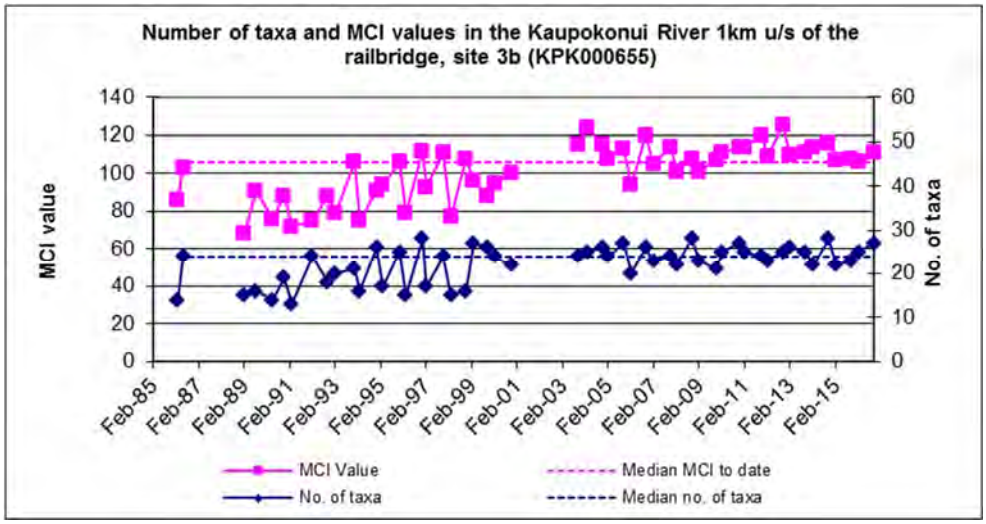

Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

Site 4 (KPK000660)

A moderate richness of 26 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 less than that recorded at site 3b by this current survey (Table 3).

The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), caddisfly (*Pycnocentrodes*) and cranefly (*Aphrophila*)}; and four 'tolerant' taxa [caddisflies (*Hydropsyche-Aoteapsyche*) and midges (*Maoridiamesa*, orthoclads and tanytarsids)]. There was only one significant change in taxon abundance between sites 3b and 4, being an increase of one 'tolerant' taxon (Table 3).

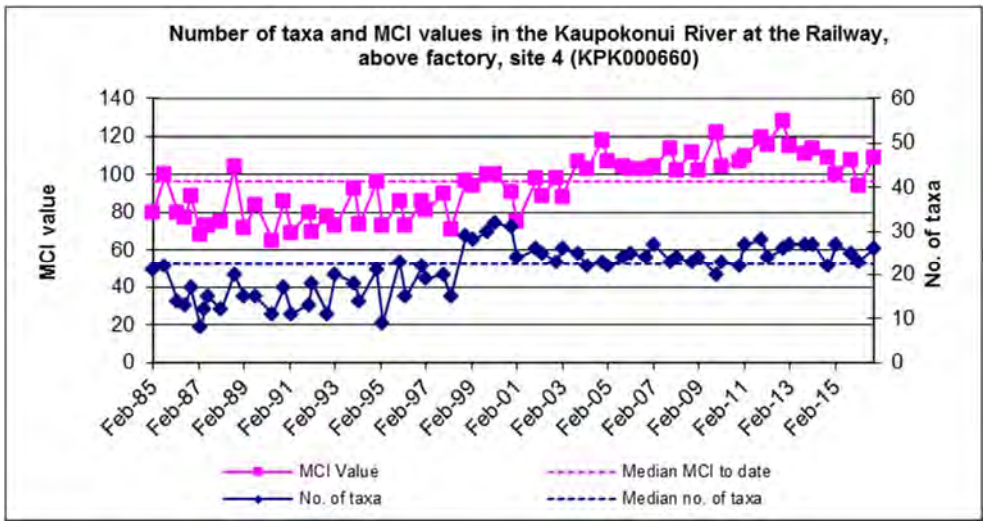

Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaupokonui River since February 1985

The MCI score at site 4 was a non-significant (Stark, 1998) two units less than the score recorded upstream at site 3b, reflecting a community composition of similar sensitivity (Table 3). The MCI score was five units higher than the median of values since 1998 and significantly higher (by thirteen units) than the historic median recorded to date (Table 3, Figure 4), a recovery from that recorded in the previous survey, which was the first survey to record a below median MCI score since 2003. 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 5.1 units was 1.2 units lower than that recorded at site 3b (Table 3), primarily due to a reduced abundance of the 'highly sensitive' mayfly *Deleatidium*. This is a relatively subtle change when the communities at sites 3b and 4 are considered overall, and not necessarily an indication that the community had 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. No such effects were evident in the current survey.

Site 5 (KPK000679)

A moderate richness of twenty-three 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 three less than that recorded by the previous survey (Table 2,, Figure 2)). This richness was also 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*)]; two 'moderately sensitive' taxa [mayfly (*Coloburiscus*) and dobsonfly (*Archichauliodes*)]; and two 'tolerant' taxa [*Maoridiamesa* and orthoclad midges] (Table 3). This represents a decrease in the number of abundant taxa from that recorded in the previous (summer 2016) survey.

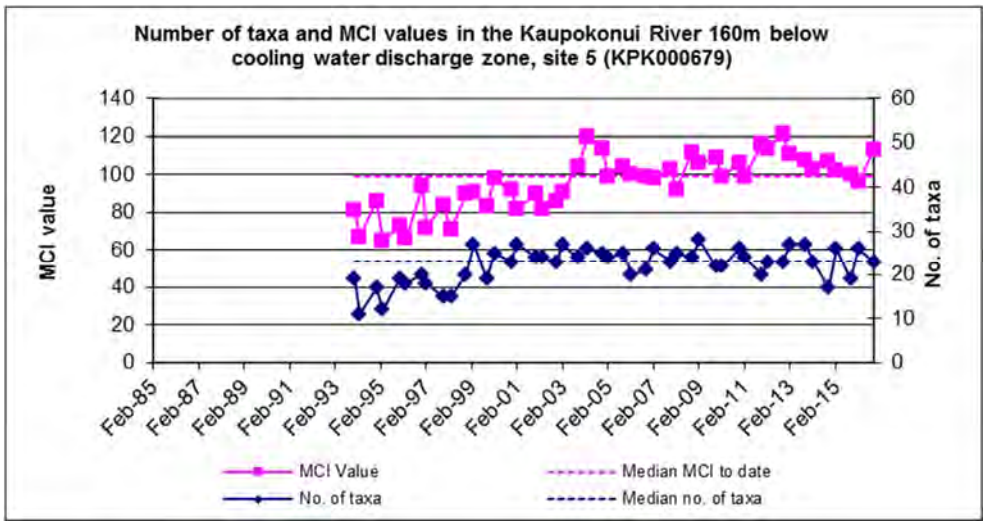

Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaupokonui River

The MCI score (113 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5) and fourteen units above the median of scores from all surveys to date (Figure 2,Table 2). This MCI score was similar to that recorded at site 4 upstream of the cooling water spray discharge despite the differences in community composition, with only 20 taxa common to both sites, of the 29 taxa recorded across both sites. There was no evidence of the sewage fungus recorded at this site.

The $SQMCI_S$ value (6.9 units) was significantly higher than that recorded at site 4 (Stark, 1998), and 0.6 unit higher than that recorded at site 3b. The communities at sites 3b, 4 and 5 were dominated by similar taxa, including *Deleatidium* and *Coloburiscus* mayflies, and *Maoridiamesa* and orthoclad midge larvae.

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 22 taxa was recorded at site 6, just downstream of Skeet Road, a further 700 m below the cooling water discharges. This was one taxon less than the median number of taxa since 1998 for this site,

but two more than the historical median, and slightly less than that recorded at sites 4 and 5 upstream (Table 2, Figure 2 and Figure 6).

This community was characterised by more taxa than at site 5 with one 'highly sensitive' taxon (*Deleatidium* mayfly), four 'moderately sensitive' taxa [*Coloburiscus* mayfly, free-living caddisfly (*Hydrobiosis*) and stony cased caddisfly (*Pycnocentrodes*) and *Aphrophila* cranefly larvae]; and four 'tolerant' taxa [oligochaete worms, net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and midges (orthoclads and *Maoridiamesa*)] (Table 3). Like all upstream sites, there was one 'highly sensitive' taxon recorded in abundance at this site. This represented an increase in the number of abundant taxa from that recorded at site 5, although this increase was spread between 'tolerant' and 'sensitive' taxa.

The MCI score of 115 units was 23 units higher than the historical median for this site and 12 units higher than the median of scores recorded since 1998. This is the fourth highest score recorded at this site to date, and represents a strong improvement from that recorded in the previous survey, which recorded a score of 95 (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, and higher than that recorded at the other sites surveyed in this survey, indicating no deterioration in community health at this site at the time of the current survey.

The $SQMCI_s$ score (6.6 units) was 0.3 unit less than that recorded at site 5, suggesting no change in the health of the community structure. No taxa changed significantly 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.

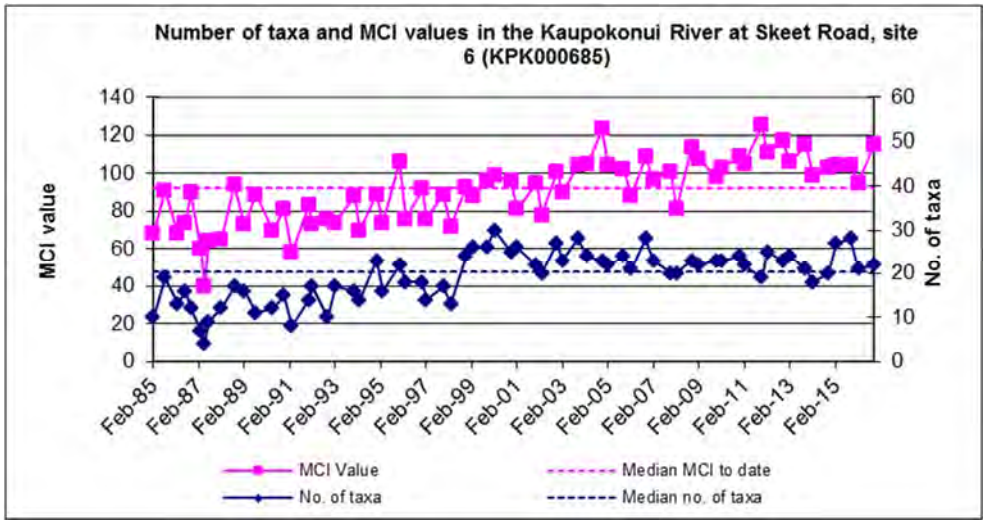

Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaupokonui River, at Skeet Road, since February 1985

Site 7 (KPK000880)

A moderate richness of 18 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 'highly sensitive' taxon [mayfly (*Deleatidium*)]; three 'moderately sensitive' taxa [elmid beetles, free-living caddisfly (*Hydrobiosis*) and stony-cased caddisfly (*Pycnocentrodes*)]; and four 'tolerant' taxa [oligochaete worms, and midges (*Maoridiamesa,* orthoclads and tanytarsids)]. Of the 25 taxa recorded across sites 6 and 7, only 15 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.

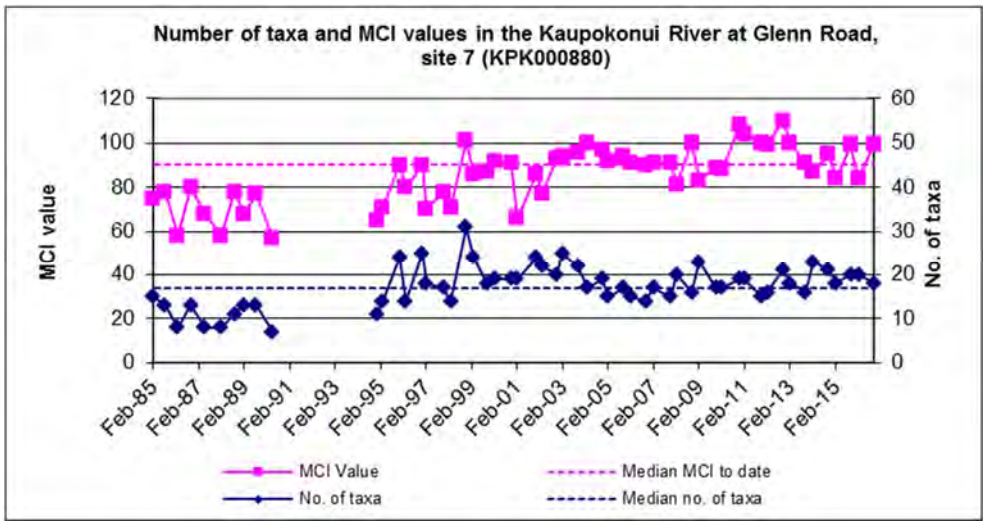

Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaupokonui River, since February 1985

The proportion of 'tolerant' taxa (39% of taxa number) reduced from that recorded in the previous summer (2016) survey and resulted in an increased MCI score of 99 units. This score was seven units above the median of scores since 1998, and nine units higher than the historic median at this site (Table 2, Figure 7), neither of which was a statistically significant difference (Stark, 1998). This indicates some improvement in community health, but also suggests that there appears to be a seasonal pattern developing since 2013 (Figure 7). This is likely to be a direct reflection of flows that preceded each survey, coupled with warmer water temperatures in the summer and cooler temperatures in the spring. Just downstream of this site, water temperatures did not exceed 19˚C 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 (27.9˚C). The current MCI score was sixteen units less than that recorded at site 6, some 9 km upstream, a statistically significant result (Stark, 1998). This is a greater deterioration than that recorded in the previous survey and in part reflects 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). However, the rate of deterioration recorded in the current survey is particularly high, primarily due to the well above average MCI score recorded at site 6.

The $SQMCI_S$ score (6.4) showed little change, being 0.2 unit lower than the score at the nearest upstream site (Table 3). This lack of change reflects the similarities within the communities, with only two significant changes in abundance between sites 6 and 7, with one 'tolerant' taxon increasing in abundance and another 'tolerant' taxon reducing in abundance. Unlike in the current survey, there has generally been 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 above 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 19 October 2016. 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 all equal to or higher than historical median richnesses, while MCI scores indicated 'fair' to 'good' community health at all sites. MCI scores remained generally stable in a downstream direction, with the exception of the furtherest downstream site, which recorded a large reduction. This is an a-typical result for this survey, which normally records a steady decline in MCI score in a downstream direction, likely related to the progressive deterioration typical of Taranaki's ringplain streams and rivers. In the case of the current survey however, this lack of a progressive deterioration indicates that water quality in the mid survey sites was better than would be expected. The MCI score at the upper site 3b was slightly higher than the historical median score, while the MCI scores at sites 4, 5 and 6 were well above their historical medians. The significant decrease in $SQMCI_s$ scores recorded between sites 3b and 4 was primarily due to a reduced abundance of the 'highly sensitive' mayfly *Deleatidium*. This is a relatively subtle change when the communities at sites 3b and 4 are considered overall, and not necessarily an indication that the community had been recently adversely affected by land irrigation upstream of this site.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 7, was indicative of a possible influence from the Dunns Creek tributary within the reach between sites 6 and 7. However, this is also a reflection of a natural progressive downstream deterioration that was exacerbated by low flows, although the rate of deterioration recorded in the current survey is particularly high, primarily due to the above average MCI score recorded at site 6.

It can 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 better condition than that recorded in the previous summer survey, a relatively typical spring result. 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.

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To	Job Manager, Lorraine Smith
From	Scientific Officers, Bart Jansma
Report No	BJ299
Doc No	1923395
Date	29 August 2017

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

Introduction

This biological survey was the second of two scheduled in relation to the Fonterra Kapuni (formerly Lactose) factory in the 2016-2017 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 10 February 2017 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.

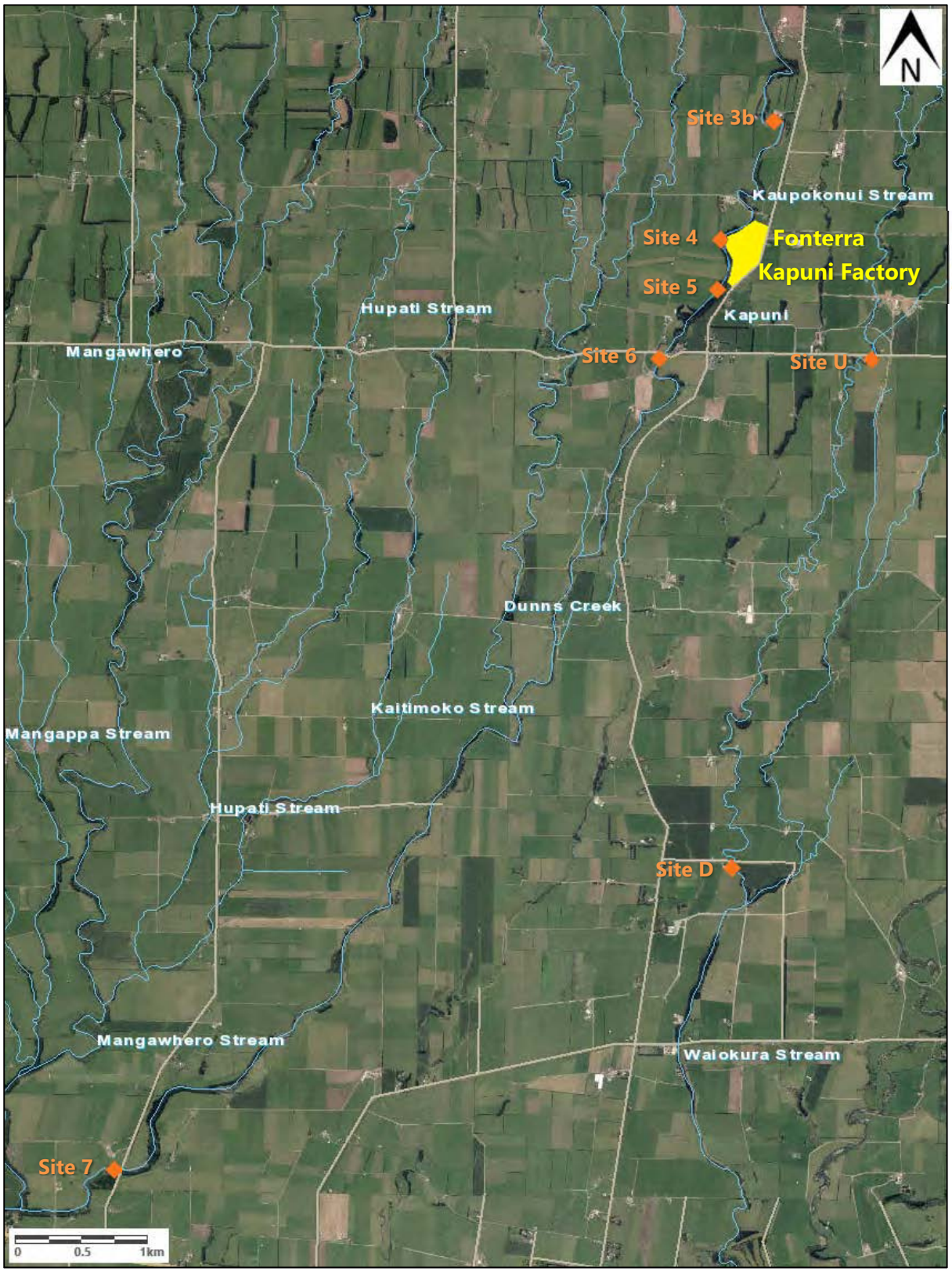

Figure 1 Biomonitoring sites in the Kaupokonui River sampled in relation to Fonterra Kapuni factory discharges

Results and discussion

This survey was undertaken following a moderate period of receding flows in the Kaupokonui River, and followed 18 days after flow events in excess of three and 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 1.011 m^3/sec, less than half the median flow (2.032 m^3/sec), and just 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 14.6°C to 20.6°C. No periphyton mats were noted at site 3b, where the rocks supported a slippery film and patchy growths of filamentous algae. Sites 4, 5 and 6 all supported patchy growths of algal mats and filaments, while at site 7, these growths were widespread, 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. 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 site U, while site D supported patches of algal filaments and slippery algal mats. Water temperatures ranged from 13.4˚C to 14.8˚C at the time of this mid-morning component of the survey. The Waiokura Stream had experienced an extended period of stable flows prior, with this survey performed 182 and 188 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	52	24	13-28	*25*	18	106	68-125	*110*	118
4	66	23	8-32	*25*	23	97	65-128	*104*	103
5	47	23	11-28	*24*	21	99	65-121	*100*	114
6	66	21	4-30	*23*	23	93	40-125	*103*	99
7	57	17	7-31	*19*	20	90	57-110	*92*	102

In this February 2017 survey, all sampling sites supported between 18 and 23 taxa. These results were all within seven taxa of the site medians from data since 1998. MCI scores at all sites were similar to or higher than their respective median values for surveys since November 1998, significantly so at sites 5 and 7 (Stark, 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 (23) recorded at sites 4 and 6 and the lowest number (18) recorded at site 3b. MCI scores were somewhat variable stable in a downstream direction, but overall decreased in a downstream direction with the highest score (118 units) recorded at site 3b and site 6 recording the lowest score (99 units). MCI scores ranged from 99 to 118 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 three unit increase in scores between sites 6 and 7, dissimilar to that recorded in the previous spring (2016) survey which recorded a 16 unit decrease. In most previous surveys, the inflow from Dunns Creek in this reach was likely to have contributed to this recorded deterioration, although the natural 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 increase recorded in the current site is due to a reduced MCI score at site 6, couple with an above average MCI score at site 7, suggesting less of a deleterious impact from the Dunns Creek inflow.

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.

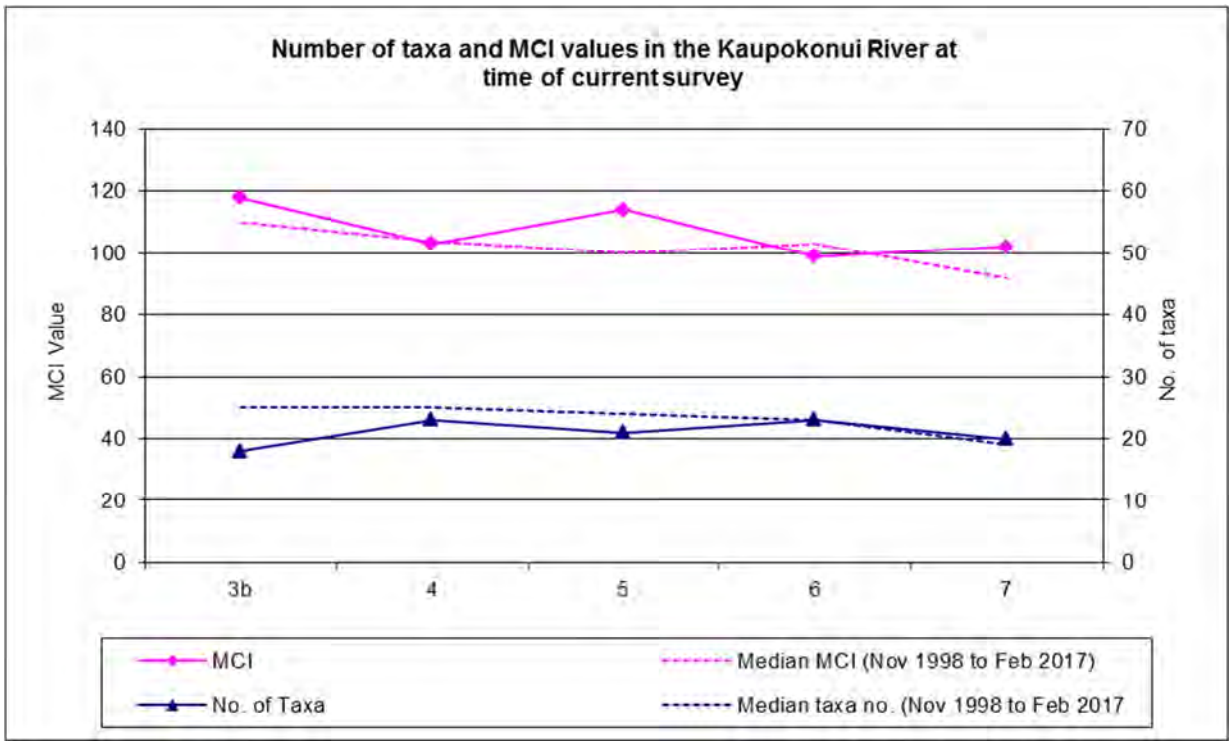

Figure 2 Numbers of taxa and MCI values recorded in the Kaupokonui River in this survey, together with median values from previous surveys (November 1998 to date)

Table 3 Macroinvertebrate fauna of the Kaupokonui River in relation to Fonterra Kapuni samples on 10 February 2017

Taxa List	Site Number	MCI score	3b	4	5	6	7
	Site Code		KPK000655	KPK000660	KPK000679	KPK000685	KPK000880
	Sample Number		FWB17035	FWB17036	FWB17037	FWB17038	FWB17039
NEMATODA	Nematoda	3	-	-	-	R	-
ANNELIDA	Oligochaeta	1	R	R	-	C	C
MOLLUSCA	*Potamopyrgus*	4	-	R	R	C	C
EPHEMEROPTERA	*Austroclima*	7	-	C	-	R	R
	Coloburiscus	7	A	A	C	R	-
	Deleatidium	8	XA	XA	XA	XA	XA
	Nesameletus	9	C	C	C	C	R
PLECOPTERA	*Megaleptoperla*	9	R	-	R	-	-
COLEOPTERA	Elmidae	6	A	VA	A	A	C
	Hydraenidae	8	A	A	C	R	R
	Hydrophilidae	5	-	-	R	-	-
MEGALOPTERA	*Archichauliodes*	7	C	A	A	A	R
TRICHOPTERA	*Hydropsyche (Aoteapsyche)*	4	VA	VA	VA	VA	VA
	Costachorema	7	C	C	C	C	R
	Hydrobiosis	5	C	C	A	C	C
	Plectrocnemia	8	R	-	-	-	-
	Beraeoptera	8	-	R	R	-	-
	Olinga	9	R	C	R	-	R
	Pycnocentrodes	5	R	C	C	A	C
DIPTERA	*Aphrophila*	5	R	R	R	R	R
	Eriopterini	5	-	-	-	R	-
	Hexatomini	5	-	-	-	R	-
	Chironomus	1	-	R	-	-	-
	Maoridiamesa	3	A	R	C	C	A
	Orthocladiinae	2	A	R	C	VA	VA
	Tanytarsini	3	-	C	C	C	C
	Empididae	3	-	R	-	R	R
	Muscidae	3	R	R	R	-	R
	Austrosimulium	3	-	C	C	R	R
	Tanyderidae	4	-	-	-	R	-
	No of taxa		18	23	21	23	20
	MCI		118	103	114	99	102
	SQMCIs		7.0	7.1	7.1	6.4	6.4
	EPT (taxa)		10	10	10	8	8
	%EPT (taxa)		56	43	48	35	40

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

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

Site 3b (KPK000655)

A relatively low richness of eighteen taxa was recorded at site 3b, upstream of the Fonterra Kapuni farm. This was six less than the long term median number of taxa recorded at this site to date (Table 2) and seven less than the median richness of more recent records (since 1998). It is also nine taxa less than that recorded in the previous survey, and the lowest richness recorded at this site since 1998. The community was characterised by seven taxa including two 'highly sensitive' taxa [mayfly (*Deleatidium*) and hydraenid beetles)]; two 'moderately sensitive' taxa [mayflies (*Coloburiscus*), and elmid beetles)]; and three 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and *Maoridiamesa* 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 (2016) survey.

The moderate proportion of 'tolerant' taxa in the community (28% of taxa richness) was reflected in the MCI score (118) which was slightly higher than would be expected for a summer survey. This is likely a reflection of the relatively wet summer that preceded this survey, resulting in a more spring-like community. This score was seven units higher than that recorded in the previous spring survey (Figure 3). The presence of six '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 118 units was the fifth highest recorded at this site to date, (Figure 3), being eight units higher than the median score for surveys since 1998 and twelve units higher than the median from all surveys conducted to date (Figure 2, Table 2), a statistically significant result (Stark, 1998). There were 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 7.0 units, a non-significant 0.6 units higher than the $SQMCI_s$ value found at this site by the previous spring (2016) survey.

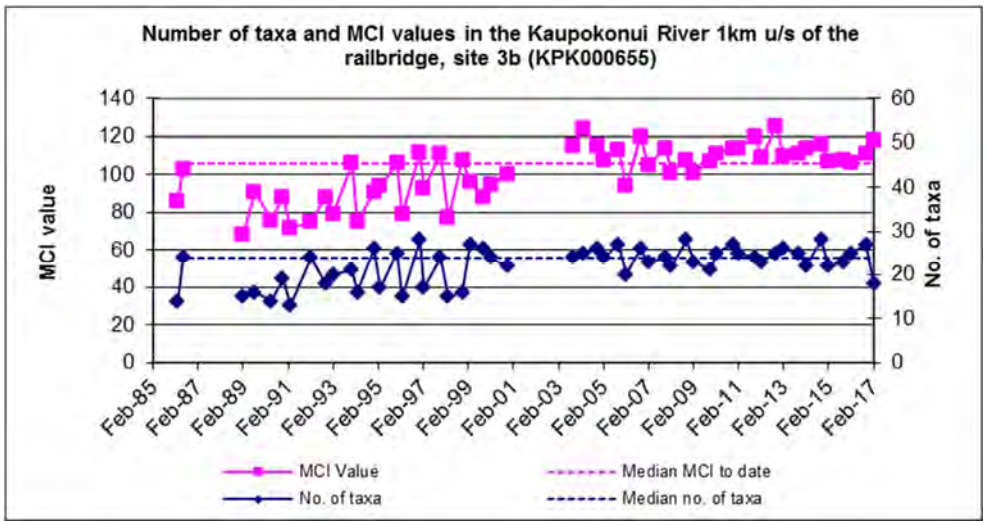

Figure 3 Numbers of taxa and MCI values recorded at site 3b in the Kaupokonui River since 1985

Site 4 (KPK000660)

A moderate richness of 23 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 five more than that recorded at site 3b by this current survey (Table 3).

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

The MCI score at site 4 was a significant (Stark, 1998) fifteen units less than the score recorded upstream at site 3b, reflecting a community composition of differing sensitivity (Table 3). The MCI score was one unit less than the median of values since 1998 but six 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 7.1 units was 0.1 unit higher than 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. Although there was some deterioration in MCI score between sites, this is likely to be due to differing sampling effort at the time, a conclusion supported by the similar $SQMCI_s$ scores. Therefore, there were no such effects were evident in the current survey.

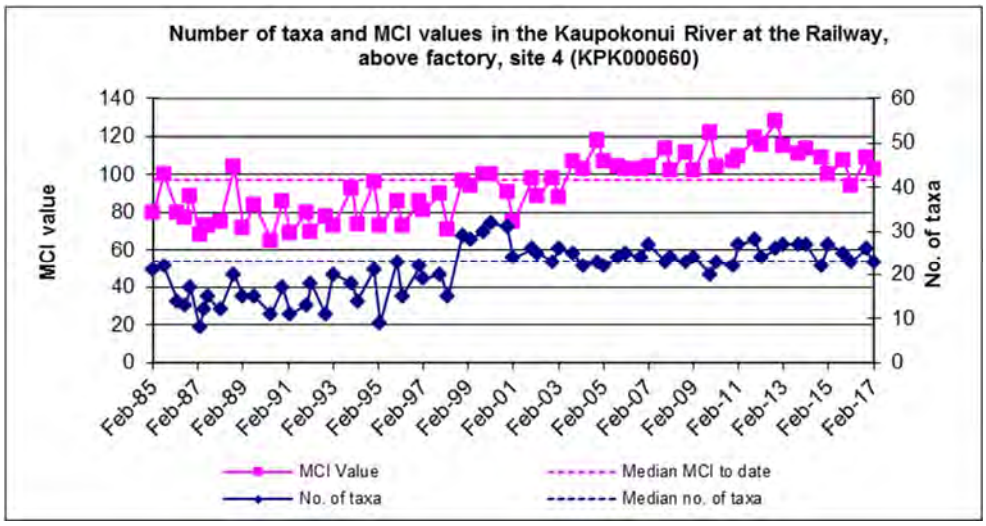

Figure 4 Numbers of taxa and MCI value recorded at site 4 in the Kaupokonui River since February 1985

Site 5 (KPK000679)

A moderate richness of twenty-one macroinvertebrate taxa was found at site 5, downstream of the cooling water discharges from Fonterra Kapuni. This was three taxa less than the median number of taxa recorded at this site since 1998, and two less than that recorded by the previous survey (Table 2, Figure 2)). This richness was also two 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*)]; three 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*) and free-living caddisfly (*Hydrobiosis*)]; and one 'tolerant' taxon [caddisflies (*Hydropsyche-Aoteapsyche*)] (Table 3). This represents a decrease in the number of abundant taxa from that recorded in the previous (spring 2016) survey.

The MCI score (114 units) was higher than most of the earlier surveys' scores, especially those prior to 2003 (Figure 5), being the fourth highest (equal) MCI score recorded at this site to date. It was fifteen units above the median of scores from all surveys to date (Figure 2, Table 2). This MCI score was significantly higher than that recorded at site 4 upstream of the cooling water spray discharge despite the similarities in community composition, with 19 taxa common to both sites, of the 25 taxa recorded across both sites. There was no evidence of the sewage fungus recorded at this site.

The $SQMCI_s$ value (7.1 units) was equal to that recorded at site 4, and 0.1 unit higher than that recorded at site 3b. This is a direct reflection of the fact that the communities at sites 3b, 4 and 5 were dominated by similar taxa, including *Deleatidium* mayflies, elmid beetles and *Hydropsyche-Aoteapsyche* caddisflies.

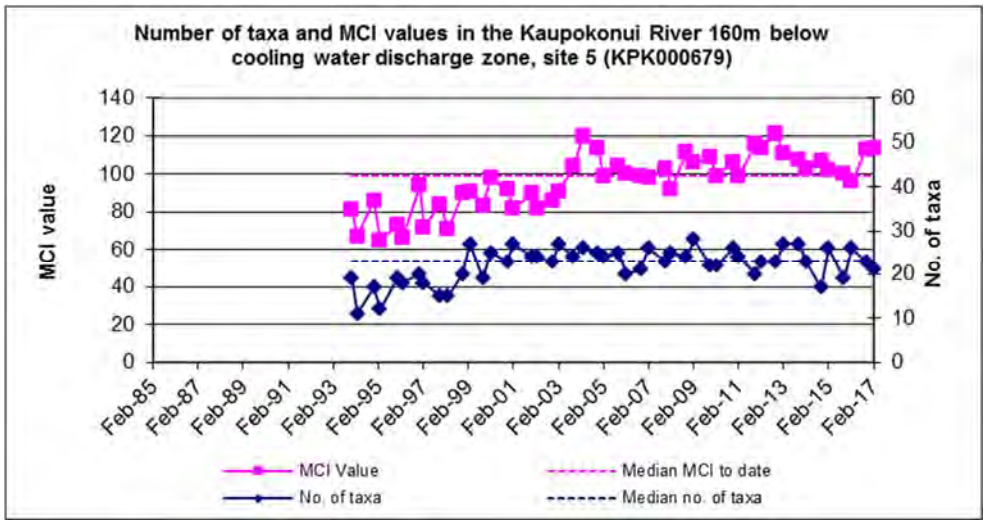

Figure 5 Numbers of taxa and MCI values recorded since December 1993 at site 5 in the Kaupokonui River

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 richness of 23 taxa was recorded at site 6, just downstream of Skeet Road, a further 700 m below the cooling water discharges. This was equal to the median number of taxa since 1998 for this site, but two more than the historical median, and similar to that recorded at sites 4 and 5 upstream (Table 2, Figure 2 and Figure 6).

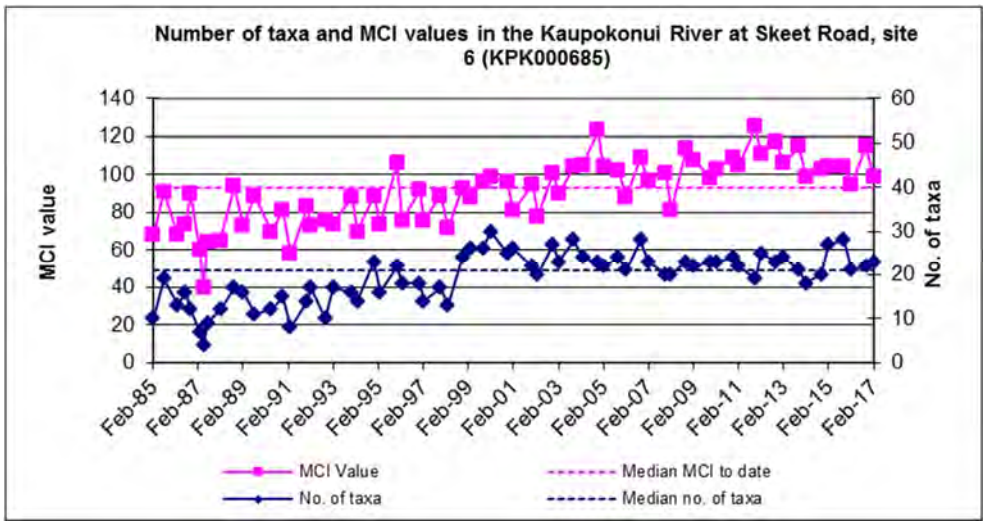

Figure 6 Numbers of taxa and MCI values recorded at site 6 in the Kaupokonui River, at Skeet Road, since February 1985

This community was characterised by a similar number of taxa as at site 5 with one 'highly sensitive' taxon (*Deleatidium* mayfly), three 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*) and stony cased caddisfly (*Pycnocentrodes*)]; and two 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*) and orthoclad midges] (Table 3). This represented an increase in the number of 'tolerant' taxa recorded in abundance, as orthoclad midges were recorded as 'common' 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 drop from the spring (2016) survey, which recorded the fourth highest score at this site to date, and a 15 unit drop from that recorded upstream, where an above average score was recorded (Figure 6, Table 2). The MCI score at this site can be variable (Figure 6) and this year the result was reflective of 'fair' water quality, lower than that recorded at the other sites surveyed in this survey, but 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 (6.4 units) was 0.7 unit less than that recorded at site 5, suggesting little change in the health of the community structure. One 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 moderate richness of 20 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 'highly sensitive' taxon [mayfly (*Deleatidium*)]; and three 'tolerant' taxa [net-spinning caddisfly (*Hydropsyche-Aoteapsyche*), and midges (*Maoridiamesa* and orthoclads)]. Of the 25 taxa recorded across sites 6 and 7, only 18 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.

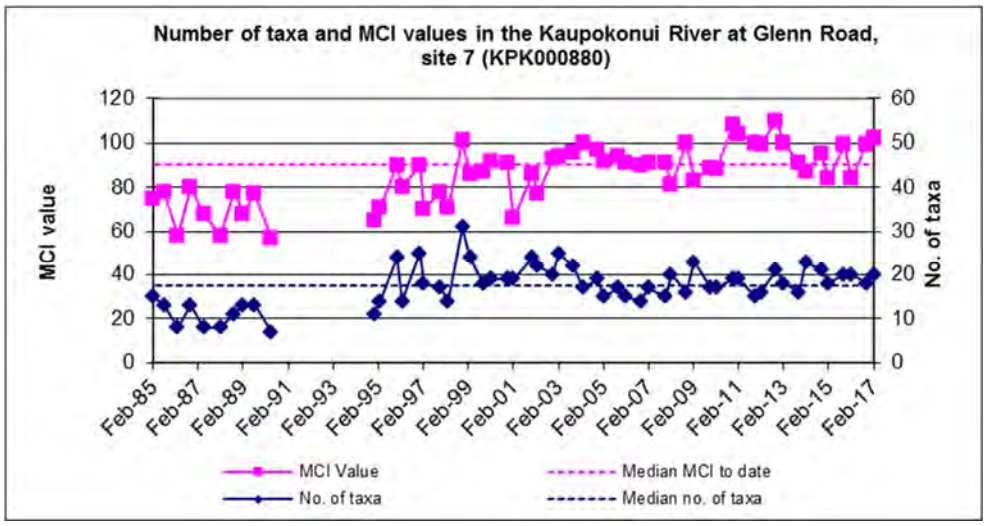

Figure 7 Numbers of taxa and MCI values recorded at site 7 in the Kaupokonui River, since February 1985

The proportion of 'tolerant' taxa (45% of taxa number) increased from that recorded in the previous spring (2016) survey, but despite this, the MCI score increased to 102 units. This score was ten units above the median of scores since 1998, and twelve units higher than the historic median at this site (Table 2, Figure 7), the latter being a statistically significant difference (Stark, 1998). This indicates some improvement in community health, but also suggests a break from the seasonal pattern that had developed since 2013 (Figure 7). 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 exceeded 25˚C 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 (27.9˚C). The current MCI score was three units higher than that recorded at site 6, some 9 km upstream, a statistically insignificant result (Stark, 1998). This is the first time since 2006 that site 7 has recorded an MCI score that was higher than that recorded at site 6 upstream. The more typical result is for site 7 to record a markedly lower MCI score, 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 current result is a product of site 7 recording an above average score, coupled with site 6 recording an average score.

The $SQMCI_S$ score (6.4) showed little change, being equal to the score at the nearest upstream site (Table 3). This lack of change reflects the similarities within the communities, with no significant changes in abundance between sites 6 and 7. Unlike in the current survey, there has generally been 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 above average health.

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 sixteenth 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.

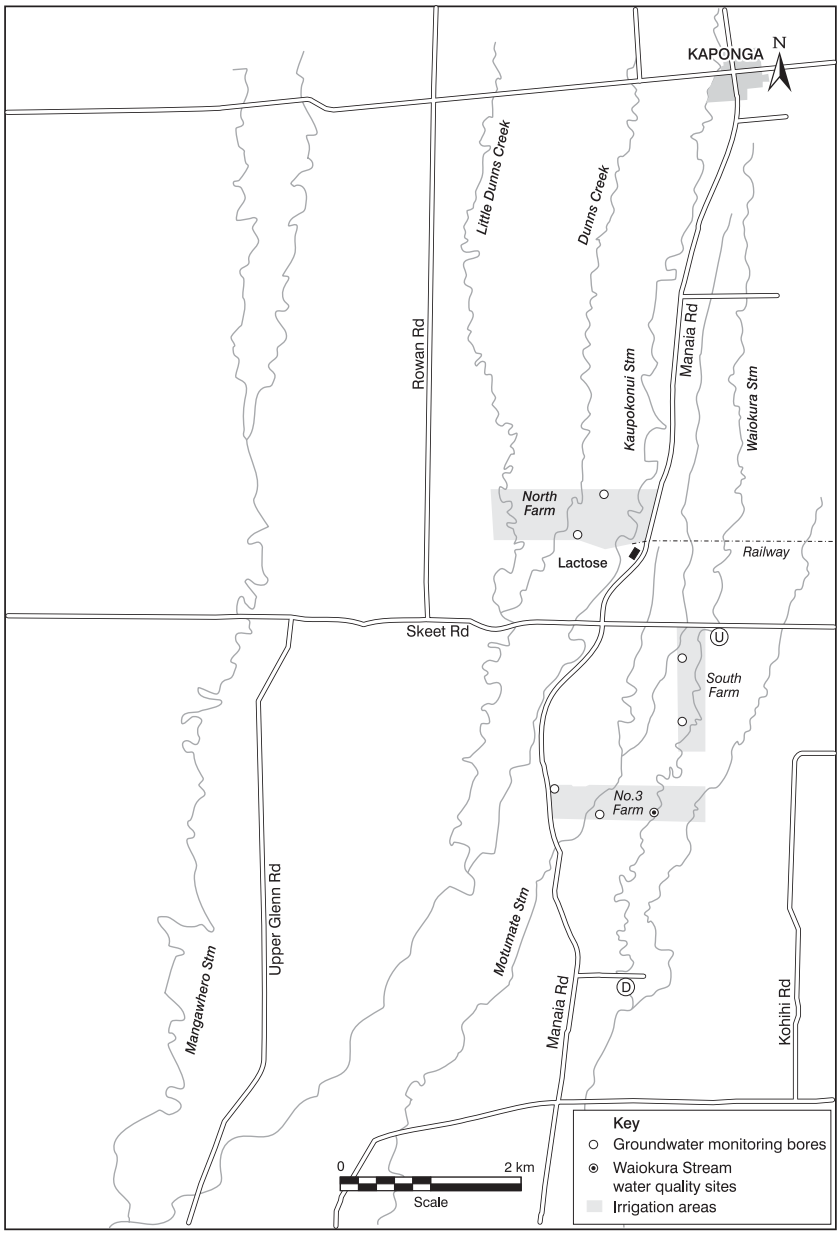

Figure 8
Waiokura Stream biomonitoring site (U and D) locations in relation to Fonterra Kapuni wastes irrigation

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 2017	Median	Range	Feb 2017	Median	Range	Feb 2017
U	24	24	18-29	19	100	88-114	97	5.8	4.6-6.7	5.5
D	15	24	15-27	21	91	81-103	100	5.9	5.0-6.2	6.3

Table 5 Macroinvertebrate fauna of the Waiokura Stream in relation to Fonterra, Kapuni land irrigation of wastes, sampled on 10 February 2017

Taxa List	Site Number	MCI score	U	D
	Site Code		WKR000500	WKR000650
	Sample Number		FWB17032	FWB17033
ANNELIDA (WORMS)	Oligochaeta	1	A	-
MOLLUSCA	*Potamopyrgus*	4	C	A
CRUSTACEA	Ostracoda	1	A	R
	Paracalliope	5	A	C
	Paraleptamphopidae	5	R	-
	Paranephrops	5	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	VA	XA
	Coloburiscus	7	C	R
	Zephlebia group	7	A	C
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	VA
	Hydraenidae	8	-	R
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	A
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	C	VA
	Hydrobiosis	5	-	R
	Psilochorema	6	R	R
	Hudsonema	6	-	R
	Pycnocentria	7	-	C
	Pycnocentrodes	5	R	C
	Triplectides	5	C	-
DIPTERA (TRUE FLIES)	*Chironomus*	1	R	-
	Harrisius	6	R	-
	Maoridiamesa	3	-	R
	Orthocladiinae	2	-	R
	Muscidae	3	-	R
	Austrosimulium	3	-	C
	Tanyderidae	4	-	R
ACARINA (MITES)	Acarina	5	C	C
		No of taxa	19	21
		MCI	97	100
		SQMCIs	5.5	6.3
		EPT (taxa)	8	9
		%EPT (taxa)	42	43

'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 19 taxa was recorded at site U, upstream of the Fonterra wastes irrigation areas. This number of taxa was five taxa fewer than the median richness of the previous surveys undertaken at this site (Table 4) and ten taxa fewer than that recorded in the previous summer survey (Figure 9). The community was characterised by no 'highly sensitive' taxa; four 'moderately sensitive' taxa [mayflies (*Austroclima* and *Zephlebia* group), elmid beetles and amphipod (*Paracalliope*)]; and two 'tolerant' taxa [oligochaete worms and ostracod seed shrimp] (Table 5).

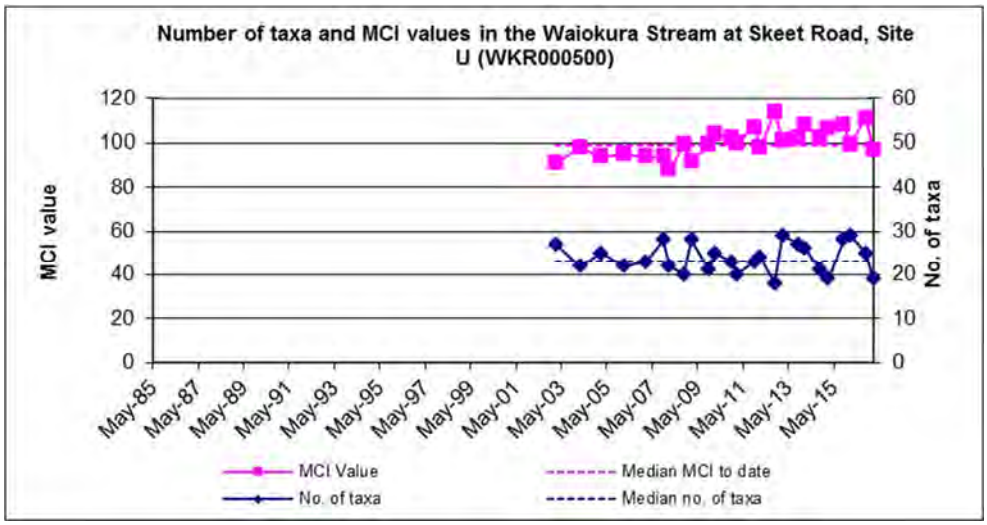

Figure 9 Numbers of taxa and MCI values recorded at site U in the Waiokura Stream since February 1985

The MCI value of 97 units was similar to that recorded by the previous summer (2016) survey, and the median of previous values recorded from the twenty-four previous surveys at this site (Table 5, Figure 9). This score reflected the moderate proportion of 'tolerant' taxa (26% 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 three units less. The $SQMCI_S$ score of 5.5 units, which reflected the dominance of several 'sensitive' taxa and two mayflies in particular, 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 21 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 three taxa fewer than the median taxa number recorded at this downstream site (Table 5). The community was characterised by no 'highly sensitive' taxa; three 'moderately sensitive' taxa [mayflies (*Austroclima*), elmid beetles, and dobsonfly (*Archichauliodes*)]; and two 'tolerant' taxa [snail (*Potamopyrgus*) and net-spinning caddisfly (*Hydropsyche-Aoteapsyche*)] (Table 5). There were six 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.

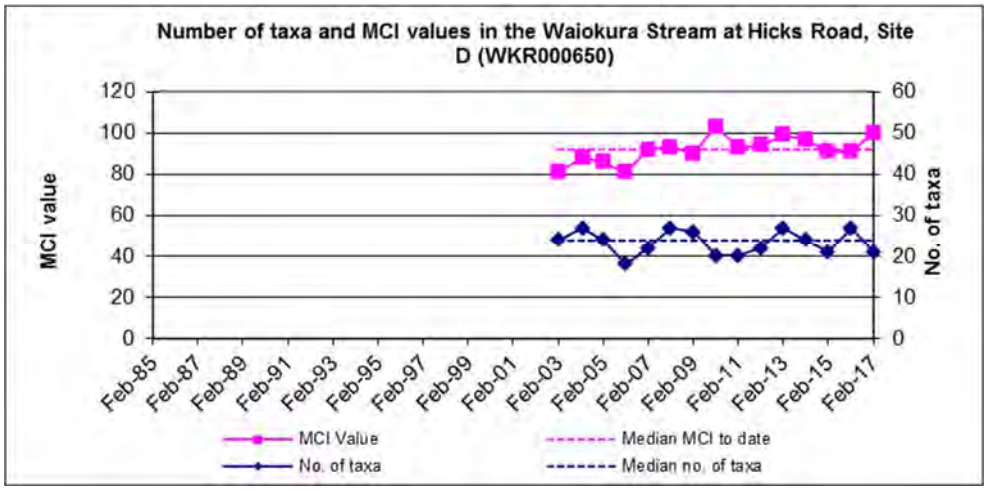

Figure 10 Numbers of taxa and MCI values recorded at site D in the Waiokura Stream since February 1985

A moderate proportion of 'tolerant' taxa (38% of taxa richness) was present at this site, which was reflected in the MCI value of 100 units. This score was the higher than that recorded by the previous summer (2016) survey, and was nine units higher than the median of the fifteen previous surveys performed at this site (Table 5 and Figure 8). The MCI score was three units higher 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 six significant changes in individual taxon abundances between the sites, the $SQMCI_S$ score remained within 0.8 unit of the score at site U, upstream of the irrigation areas (Table 5). Furthermore, the current score (6.3 units) was the highest recorded at this site to date, and was higher than that recorded at site U. 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 10 February 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 '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. 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 the sites 3b, 5 and 7 were significantly higher than their historical median scores, while the MCI scores at sites 4 and 6 were slightly above their historical medians. There were no significant differences in $SQMCI_S$ scores between any sites, reflecting the fact that the communities were dominated by similar taxa, in particular the 'highly sensitive' mayfly *Deleatidium*, which was extremely abundant at all sites. This lack of change suggests that there is no indication that the community had been recently adversely affected by land irrigation upstream of this site.

The current survey showed that the Kaupokonui River generally had macroinvertebrate communities of 'good' health throughout most of the reach surveyed. The poorest community, found at site 6, was still in above average health. The usual influence from the Dunns Creek tributary within the reach between sites 6 and 7 was not apparent in the current survey, and the natural progressive downstream deterioration was less obvious, with the primary factor behind this being the wet summer that preceded the survey.

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 spring survey, a relatively a-typical but positive 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 higher than that recorded upstream, indicating that community health at the downstream site was better than would be expected. Usually this site exhibits some deterioration in MCI score, which 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 the downstream site was in above average health, with the score at this site being the highest recorded to date, and higher than that recorded upstream. 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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