TARANAKI BY-PRODUCTS

OKAIAWA RENDERING PLANT

RESOURCE CONSENT RENEWAL
11 AUGUST 2020

traverse ENVIRONMENTAL

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Report Information

Report Status	Draft
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PART A

Resource Consent Application

APPLICATION FOR RESOURCE CONSENT

Sections 88, Resource Management Act 1991

To Taranaki District Council

1. Taranaki By-Products apply for the following type(s) of resource consent:

    a. Water Permit for the taking and use of surface water which does not meet the conditions of Rule 15 (Rule 16 of the Regional Fresh Water Plan for Taranaki);

    b. Discharge Permit for the discharge of stormwater into or onto land or into water that is not provided for by Rules 25-27 and that does not comply with the conditions of Rule 23 (Rule 24 of the Regional Fresh Water Plan for Taranaki);

    c. Discharge Permit for the discharge of contaminants or water into surface water which is not provided for in Rules 21-42 or which is provided but does not meet the standards, terms or conditions (Rule 43 of the Regional Fresh Water Plan for Taranaki);

    d. Discharge Permit for the discharge of contaminants onto or into land restricted by s15(1)(b) (where contaminants may reach water) and s15(d) (where the discharge is from industrial or trade premises) of the Resource Management Act 1991 which is not expressly provided for in Rules 21-42 or does not meet the standards, terms or conditions and any other discharge of contaminants to land which is provided for in Rules 21-42 but which does not meet the standards, terms or conditions of those rules (irrespective of whether the discharges are from industrial or trade premises or are likely to reach water) (Rule 44 of the Regional Fresh Water Plan for Taranaki);

    e. Discharge Permit for any discharge of contaminants to the air from any industrial or trade premises not listed in any other rule or where the activity is listed in a rule but the conditions for that rule cannot be met OR any discharge from production land, waste management processes, site development, earthworks, the application of soil conditioners, aquaculture or intensive farming processes where the activity is listed in a rule but the conditions for that rule cannot be met (Rule 55 of the Regional Air Quality Plan for Taranaki);

    f. Discharge Permit of the discharge of solid waste into land restricted by s15(1)(b) (where contaminants may reach water) and s15(d) (where the discharge is from industrial or trade premises) of the Resource Management Act 1991 which is not expressly provided for in Rules 21-42 (Rule 44 of the Regional Fresh Water Plan for Taranaki);

2. The activity to which the application relates (the proposed activity) is as follows:

   The operation of the Okaiawa Rendering Plant, the discharge of treated wastewater to land and any ancillary emission of odour, the discharge of treated wastewater, stormwater and cooling/backwash water from the plant to the Inaha Stream, the burial of waste material in the event of emergency, and the take of water for non-consumptive uses.

3. The site at which the proposed activity is to occur is as follows:

   The Taranaki By-Products site is located on Kohiti Road, Okaiawa.

   The legal description is Lot 3 DP 378038 Lot 2 DP 410593 Lots 2-3 DP 6457, Lot 1 DP 6457 Blk IV Waimate SD, Lot 1 DP 410593 [TBE], Lot 1 DP 10174 Lot 1 DP 11864 Sec 88 Pt Sec 90 Blk IV Waimate SD, SBDN 1 Sec 149 SURD WAIMATE IV.

   The land is owned by Taranaki By-Products Limited.

4. No additional resource consents are needed for the proposal to which this application relates.

5. Attached is an assessment of the proposed activity's effect on the environment that—

   a) includes the information required by clause 6 of Schedule 4 of the Resource Management Act 1991; and

   b) addresses the matters specified in clause 7 of Schedule 4 of the Resource Management Act 1991; and

   c) includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

6. Attached is an assessment of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991.

7. Attached is an assessment of the proposed activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act.

Date: 11 August 2020

Signature:

Deborah Kissick

On behalf of Paul Drake
Plant Manager, Taranaki By-Products Ltd

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PART B

Assessment of Environmental Effects

Executive Summary

Taranaki By-Products Limited ("TBP") (the applicant) owns and operates the Okaiawa rendering plant ("ORP") on Kohiti Road, Okaiawa.

Six of the thirteen resource consents held to enable the ongoing operation of the ORP expire on the 1st June 2019. Pursuant to s.124 of the Resource Management Act 1991 ("RMA"), in order for TBP to continue to exercise these resource consents while replacement consents are sought, new consents need to be applied for by 1st December 2018.

The six consents that require renewal are:

- Discharge of treated wastewater to land (spray irrigation) and associated discharge to air resulting from this activity
- Discharge of treated wastewater to the Inaha Stream (used when land option not available e.g. wet winter conditions)
- Take of water from the Inaha Stream (non-consumptive take used for cooling)
- Discharge of cooling water to the Inaha Stream
- Discharge of storm water to the Inaha Stream
- Burial of waste to land (used when plant in emergency shutdown)

Technical assessments have indicated that there are several significant environmental effects associated with the current operation of the ORP.

TBP is currently seeking to improve environmental outcomes associated with the ORP. To do so, TBP are proposing three main upgrades which include:

- The commissioning of the recently installed VSEP filtration at the plant to reduce the volume of stick water being discharged;
- Improved stormwater management.; and
- Improved management of the burial of solid waste.

The proposed upgrades were developed in response to pre-application consultation and technical assessments which were carried out in order to assess the environmental effects of the ORP as it is currently operating.

Public notification has been requested for four of the consent renewal applications, and limited notification is deemed appropriate for the two remaining applications.

An application was lodged with Taranaki Regional Council ("TRC") on 30 November 2018 and a request for further information in relation to this application was received from TRC on 15 February 2019. The request for further information was responded to on 19 December 2019. This application has been updated in 2020 to incorporate the following developments since the original application was lodged:

- Incorporate the information collected in response to the request for further information from TRC, dated 15 February 2019.
- Provide for an expanded irrigation area to include land recently purchased by TBP for that purpose
- Update the proposed approach to emergency burial of solid waste,
- Remove the proposal to line the emergency burial pits, and
- Update the application to document the plant upgrades that have occurred since the original application was compiled in 2018.

1 Introduction

1.1 Background

Taranaki By-products (TBP) owns and operates the Okaiawa rendering plant on Kohiti Road, Okaiawa.

Established in 1936, TBP is the main animal rendering plant in the Taranaki region. Raw material comes from meat and poultry processing plants in central and lower North Island, and from dead stock collected within the Taranaki and broader regions. Inedible products are manufactured at the site, including meat, bone, poultry, feather and blood meals, tallow and chicken oil.

TBP operates under a total of 13 resource consents, six of which are due to expire on 1 June 2019. These consents also support the operation of the Taranaki Bio-Extracts (TBE) which sits alongside TBP. The consents due for renewal include five discharge permits and one water take permit.

The activities covered by the consents that require replacement are:

- Discharge of treated wastewater to land (spray irrigation) (Existing Consent Reference 3941-2)
- Discharge of treated wastewater to the Inaha Stream (used when land option not available e.g. wet winter conditions) (Existing Consent Reference 2049-4)
- Take of water from the Inaha Stream (non-consumptive take used for cooling) (Existing Consent Reference 2051-4)
- Discharge of cooling water to the Inaha Stream (Existing Consent Reference 2050-4)
- Discharge of storm water to the Inaha Stream (Existing Consent Reference 5426-1)
- Burial of waste to land (used when plant in emergency shutdown) (Existing Consent Reference 5495-1)

Over recent years, TBP have taken measures to improve the quality of discharges to the Inaha Stream. These improvements include:

- dissolved air flotation unit installed October 2004 and enlarged in October 2008;
- new cooling equipment installed in 2014;
- new monitoring bore installed in May 2015;
- improvements to reduce the temperature of the cooling water prior to discharge in 2010;

- a new pond 5A was built in 2015 so that pond 6 could be bypassed and solids removed (providing the ability to swap between these ponds and remove solids); and
- continual reduction in spills within the plant through automation and process improvements to eliminate leaks, which has improved the quality of the wastewater entering the pond system.
- VSEP systems installed at TBE in late 2018 used to recycle concentrated stickwater and TBP installation began October 2019 with full commissioning anticipated in 2021 for treatment as part of the plant wastewater system.
- Installation of the stormwater collection sump adjacent to the fire pond for first flush diversion in 2019.

1.2 Report Structure

This document has been prepared to describe the nature of the activities and provide an Assessment of Environmental Effects ("AEE") for the activities as required under section 88 of the Resource Management Act 1991 ("RMA"). Specifically:

- Section 2 provides a description of the existing environment.
- Section 3 describes the proposed activity.
- Section 4 identifies the status of the proposed activity under the RMA.
- Section 5 provides an assessment of the effects on the environment associated with the proposed activity.
- Section 6 provides an analysis of the proposed activity in relation to the provisions of the relevant policy and planning documents.
- Section 7 analyses the activity under Part 2 of the RMA.
- Section 8 addresses consultation and notification.
- Section 9 sets out the key conclusions.

2 Existing Environment

The subject site is located on Kohiti Road, Okaiawa. The ORP is located beside the Inaha Stream, 13 kilometres from the sea. The location of the site is shown in Figure 1.

Figure 1: Location of the Okaiawa Rendering Plant (ORP)

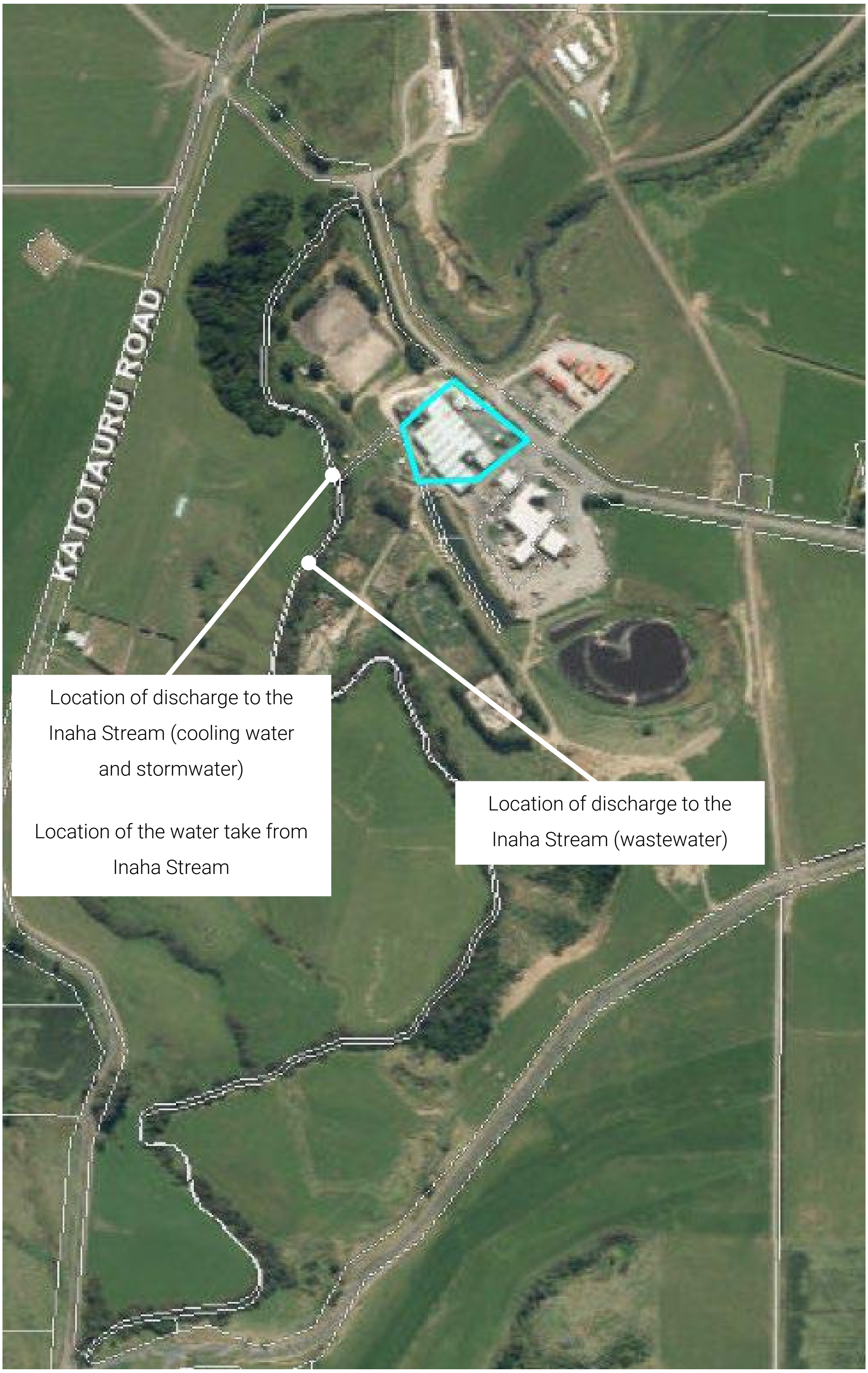

Figure 2: Location of the point-source discharges and water take location

The ORP provides an essential service by receiving waste streams from meat and poultry processing plants in central and lower North Island and deceased stock from farmers in Taranaki.

There are three separate processing lines at ORP which process up to 26 tonnes per hour of raw material. The ORP operates 24 hours per day, 7 days per week, throughout the year. Sixty people are employed at the plant.

The ORP carries out a rendering processing where fat is separated from the raw material using continuous low temperature drying (under 100°C). The resulting material is dewatered using mechanical dewatering screw press and further dried using thermal de-watering.

The plant operates three processing lines as follows:

- A mixed abattoir material line processing beef and mutton, hard and soft offal, and fallen stock; and
- A poultry line processing soft poultry offal and feathers; and
- A blood line.

The plant operates 24 hours/day, 7 days/week throughout the year, and is able to process up to 26 t/h of raw material, which includes 18 t/h mixed abattoir material, 6-8 t/hr poultry line and up to 100,000 L/day of blood. The plant is generally shutdown weekly on Sundays and Mondays for maintenance.

Seasonal variations in processing are largely due to processing of mixed abattoir material, with peak of beef offal processing during January to May and fallen stocks during the dairy calving season of July and August. Poultry processing is relatively steady through the year.

The TBE plant operates adjacent to the TBP plant and conducts low temperature rendering to produces edible rendered products (food grade tallow and gelatine bone chip).

Wastewater generated from the plant is characterised into two main waste streams:

- Process Wastewater: consisting of floor drains, raw material bin drains some stickwater and condensates from Taranaki By-Products and wastewater generated from Taranaki Bio-extracts Ltd;
- Zeal Grow: Rendering stickwater

Process wastewater is treated on site in a dissolved air flotation tank ("DAF") and lagoon-based treatment system, prior to discharge to either the Inaha Stream (sometimes during winter months) or irrigated to land (year-round). The treatment plant process is described in detail in Section 2 of the PDP Report (**Appendix 1**).

Following a recent upgrade, a portion of the wastewater is diverted through a Vibratory Shear Enhanced Processing (VSEP) system which generates water for use in the site boiler and concentrate for product recovery, reducing the organic load on the wastewater treatment system. Concentrate from the system is sent to the DAF dewatering unit and permeate is processed through a reverse osmosis unit and used in the plant boilers. The VSEP system at the TBP plant, at the time of writing this report, was undergoing commissioning (See Technical Memo from PDP dated 17 December 2019 (**Appendix 6**) for further detail).

Low temperature rendering ("LTR") which is utilised at the ORP generates a highly concentrated liquid by-product, commonly referred to as stickwater, which is the remaining liquid following removal of protein solids and tallow. While some of the stickwater can be treated in the wastewater treatment system, a portion of the stickwater is spread to land to avoid overloading of the wastewater treatment plant.

TBP has had the stickwater classified as a fertiliser (under a trading name Zeal Grow) with the intention that it could be spread to land on a district wide basis as a nutrient source for pasture growth.

Utilisation of the Zeal Grow by farmers in the district has been limited and as such, a large portion of the Zeal Grow has been spread to land that is also utilised for wastewater irrigation.

2.1 Additional land for irrigation

Since the preparation of the application 2018, TBP acquired additional land in April 2019 for use in the discharge of treated wastewater to land via spray irrigation. The land is some 16.39ha and is legally described as SBDN 1 Sec 149 SURD WAIMATE IV and is shown in relation to the TBP plant in Figure 3 below. This revised application seeks to include this additional land area in the application to enable spray irrigation of treated wastewater.

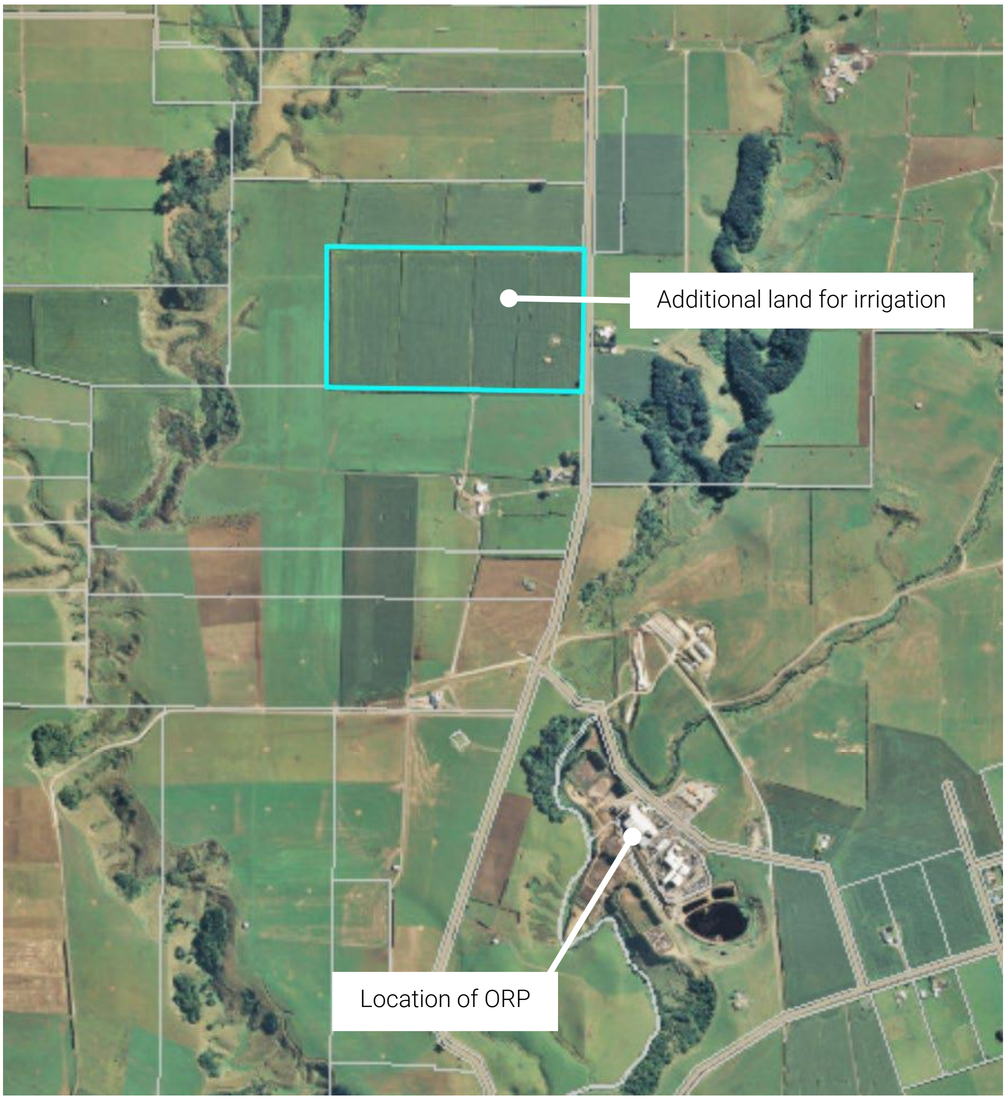

Figure 3: Additional land for the discharge of treated wastewater via spray irrigation

2.2 Receiving Environment

The site is bisected by two surface water bodies, the Inaha Stream, which enters the site at the north-eastern corner before flowing southwest, past the plant, to the middle of the southern site boundary, and an un-named tributary that flows in a southerly direction across the western half of the site, feeding into the Inaha stream just to the south of the site boundary.

The Inaha Stream and its tributaries have a catchment area of 62km^2. The source of the small stream lies just outside of the Egmont National Park. The stream and its tributaries meander through farmland on the upper and lower ring plain and enter the Tasman Sea just east of Manaia [1].

It is understood that the total consumptive use in the Inaha catchment is 92 l/s. There are two consents which total 85 l/s, one of which is for the ORP (50 l/s) and the other is for pasture irrigation (35 l/s). Both takes are in the lower reaches of the catchment and approximately 7 l/s of surface water is taken for permitted uses involving small takes of water.

The Inaha Stream is also recognised as a water body of known regional significance for their native fishery habitat value [2]. It is said to be a habitat of threatened or regionally distinctive (aquatic) species including Lamprey, Freshwater mussel and Longfin eels.

The discharge point for the discharge of treated wastewater, cooling water and backwash water is at approximate map reference Q21: 118-858. The discharge point for the discharge of stormwater into an unnamed tributary of the Inaha Stream is at approximate map reference Q21:119-858, Q21:120-858 and Q21:121-858. The discharge of wastes from meat rendering operations by burial into land is at approximate map reference Q21:121-859.

The surrounding country is of flat to undulating topography and is mainly dedicated to rural activities such as dairying. The site is situated on the ring plain of the Mt Taranaki stratovolcano and is underlain by variable Quaternary lahar deposits. In addition, there are localised alluvial deposits along the banks of the Inaha Stream.

2.3 Plant Process

The TBP process is largely continuous low temperature (below 100 degrees) dry rendering with mechanical de-watering by screw press, and some thermal de-watering. Indirect (rota disc) steam-heated driers are employed. The dried product is milled, sieved and stored in bulk. The following process lines are operated at the ORP:

- Bovine by-products rendering line (nominally processing 500 tonnes/day of raw material) including pre-breaker (for fallen stock), hogger, surge bin, pre-cooker, press, 2 decanters, tallow recovery plant (liquid phase tank and tallow separators), three indirect steam dryers and dedicated meal processing plant.

[1] A Guide to Surface Water Availability and Allocation in Taranaki, Taranaki Regional Council (August 2005)

[2] Freshwater bodies of outstanding or significant value in the Taranaki region: Review of the Regional Fresh Water Plan for Taranaki (January 2016)

- Blood processing line (nominally processing 150 tonnes/day blood) including a steam coagulator, decanter and indirect steam dryer.
- A poultry rendering line (nominally processing 60 to 120 tonnes/day of raw material) including continuous cook, decanter, indirect steam dryer, milling line and tallow recovery.
- Pressurised feather hyrdolyser co-sharing the poultry line's dryer and milling line.

The mechanical de-watering of the raw material creates large quantities of stickwater, which is essentially the pressed-out meat juices. Three waste heat evaporators concentrate the stick liquor streams that are produced from the tallow recovery plants. This gets the stickwater to a stage where it can be incorporated back into the meal product. At present, some stickwater is discharged to land however TBP are in the process of incorporating plant upgrades to fully recycle this waste stream back into the rendering process. Washings and waste products from the stick water system have been registered as a fertiliser and are applied to an adjacent dairy farm owned by TBP. Solid wastes (as may be generated during a plant shut-down) are buried in a designated area on the farm.

2.4 Existing consents

Six resource consents are currently held by TBP for the operation of the ORP, expiring on 1st June 2019. These consents are set out in Table 1.

Table 2-1: Consents held by RDC that will expire in 2019

Consent types and number	Description of Activity	Expiry
Water Discharge Permit 2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream at or about GR: Q21:118-858	1 Jun 2019
Water Discharge Permit 2050-4 / TRK992050	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream at or about GR: Q21:118-858	1 Jun 2019
Water Permit 2051-4	To take up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation	1 Jun 2019
Discharge Permit 3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries	1 Jun 2019

Water Discharge Permit 5426-1 / TRK995426	To discharge up to 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha stream at or about GR: Q21:119-858, Q21:120-858 AND Q21:121-858	1 Jun 2019
Discharge Permit 5495-1	To discharge up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-859	1 Jun 2019

Full copies of the resource consents are attached as **Appendix 2**.

Under s124 of the RMA, TBP must lodge a replacement consent application for the expiring consents 6 months prior to the expiration date of the 1st June 2019 in order to continue operation of the plant while the replacement resource consents are being processed. A replacement application was lodged on 30 November 2018, securing s124 rights to continue operations at the plant. This application replaces the November 2018 application with updated information but does not change the activities for which consent is sought.

A further seven consents are held by TPB with expiry dates between 2023 and 2029, as shown in Table 2.

Table 2-2: Consents held by TBP with expiry dates between 2023-2029

Consent types and number	Description of Activity	Expiry
Land Use Permit 6431-1	To erect, place and maintain two culverts in the Inaha Stream for farm access purposes at or about GR:Q21:121-860 and Q21:125-863	1 Jun 2023
Land Use Permit 7234-1	To realign a section of approximately 350 metres of the Inaha Stream for land improvement purposes at or about 2612637E-6186381N	1 Jun 2023
Water Discharge Permit 7329-1	To discharge stormwater and sediment from earthworks associated with the re-contouring of the land and the realigning of a section of the Inaha Stream onto and into land and into the Inaha Stream at or about (NZTM) 1702455E-5624812N	1 Jun 2023
Discharge Permit 2446-2	To discharge untreated dairy farm effluent by honey wagon onto and into land (no longer exercised but retained in case needed in future)	1 Dec 2023

Discharge Permit 3117-2	To discharge untreated dairy farm effluent by spray irrigation onto and into land (only used for a small shed for sick cows)	1 Dec 2023
Air Discharge Permit 4058-4	To discharge to air emissions from rendering operations and associated processes including wastewater treatment at or about (NZTM) 1701965E-5624119N and burial of material at or about (NZTM) 1702416E-5624339N	1 Jun 2024
Water Permit 9756-1	To take up to 1,970m3 /day (22.8L/s) of groundwater for industrial water supply purposes	1 Jun 2029
Air Discharge Permit 10054-1	To discharge emissions to air from burning of pallets, paper and cardboard	1 Jun 2029

No changes are required to the consents as listed in Table 2. TBP also held a consent for the burial of waste cheese and associated packaging by burial into land, which expired on 1 June 2017 (R2/5560-1). TBP no longer require consent for this activity.

2.4.1 Water Discharge Permit 2049-4

Water Discharge Permit 2049-4 provides for the discharge of up to 940 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream at or about GR: Q21:118-858. The key operational requirements imposed by the conditions of this consent are summarised in Table 3.

Table 2-3: Key operational requirements stipulated by Discharge Permit 2049-4

Consent types and number	Description of Activity
Condition 1 and 2	Relate to the location and area of the mixing zone
Condition 3	Relates to the point of discharge into the Inaha Stream.
Condition 4	Requires the consent holder to give notice of changes in process which may affect the nature of the discharge.
Condition 5	Requires the consent holder to monitor consent conditions as deemed reasonably necessary by Council.

Condition 6	Sets a minimum dilution rate on the discharge.
Condition 7	Prohibits the discharge of stickwater and deals with increase in dairy herd size.
Condition 8	Requires cessation of discharge into the stream at the specified minimum flow rate.
Condition 9	Prohibits the discharge from giving rise to specific adverse effects in the receiving waters.
Condition 10	Sets a limit on the level of ammonia in the receiving waters.
Condition 11	Requires controls on discharge and records of discharge rate.
Condition 12	Requires the consent holder to maintain a stream flow gauge.
Condition 13 and 14	Relate to the requirement for a wastewater disposal management plan.
Condition 15 and 16	Require notice of changes to the management plan, provide for review of the plan, and require a designated manager of the wastewater system.
Condition 17	Requires the wastewater management plan be adhered to, and that site staff are trained in implementation and advised of any changes to the plan.
Condition 18	Relates to a consent holder donation to Taranaki Tree Trust and commitment to riparian planting.
Condition 19	Is a provision for review of consent conditions.

2.4.1.1 Compliance with Resource Consent 2049-4

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March 2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to be good. It was noted that in regard to Condition 6, there were two occasions where the dilution rate dipped to below 1:300, with the lowest found 1:276.

In addition, Aquanet Consulting Limited has completed a report on the Assessment of Effects on Freshwater Quality and Ecology (Aquanet, 2018) which includes an analysis of some conditions of the current resource consent 2049-4. The following limits were checked for compliance:

- Condition 9: Aquanet found that the consent limit of no more than a 0.5pH unit reduction between sites was complied with on all sampling occasions between 1997-2017. Water temperatures in the Inaha Stream were found to be generally compliant with the no more than 3-degree temperature rise (with breaches on only 6 sampling occasions). Dissolved oxygen in the Inaha Stream was generally compliant with the consent limit of 80% both upstream and downstream of the ORP (only above on one sampling occasion upstream, and above on six sampling occasions at the downstream site).
- Condition 9(b): Aquanet found that ScBOD5 concentrations in the Inaha Stream upstream and downstream of the ORP were compliant with the RFP guideline and the consent limit on all sampling occasions.
- Condition 10: Aquanet found that NH4-N concentrations in the Inaha Stream were compliant upstream of the ORP and generally compliant downstream of the ORP (noting that the beaches of the limits were all prior to 2005).

The full Aquanet 2018 Report is included as Appendix 3.

As stated earlier, Taranaki Regional Council have undertaken compliance monitoring of the conditions of consent 2049-4 and the monitoring data collected. The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 4.

Table 2-4: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 2049-4 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	**Period covered** 2015-2016	**Period covered** 2016-2017
1	Compliant	Compliant	Compliant
2	N/A	N/A	N/A
3	Compliant	Compliant	Compliant
4	Compliant	Compliant	Compliant

Consent 2049-4 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
5	Compliant	Compliant	Compliant
6	No. Breach on 30 April 2014. Infringement Notice ($750 fine).	Yes, although on a few occasions it dipped to below 300 to dilution rate of 295.	Mostly. On two occasions it dipped to below 1:300. Lowest found was 1:276.
7	Compliant	Compliant	Compliant
8	Compliant	Compliant	Compliant
9	Compliant	Compliant	Compliant
10	Compliant	Compliant	Compliant
11	Compliant	Compliant	Compliant
12	Compliant	Compliant	Compliant
13	Compliant	Compliant	Compliant
14	Some reports late	Some reports late	Compliant
15	Compliant	Compliant	Compliant
16	Compliant	Compliant	Compliant
17	Compliant	Compliant	Compliant
18	Compliant	Compliant	Compliant
19	N/A	N/A	N/A

2.4.2 Water Discharge Permit 2050-4

Water Discharge Permit 2050-4 permits the discharge of up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream at or about GR: Q21:118-858. The key operational requirements imposed by the conditions of this consent are summarised in Table 5.

Table 2-5: Key operational requirements stipulated by Water Discharge Permit 2050-4

Consent condition	Key operational requirement
Condition 1	Requires the consent holder to monitor consent conditions as deemed reasonable and necessary by Council.
Condition 2	Prohibits the increase in concentration of pollutants in the discharge.
Conditions 3 and 4	Place a temperature and suspended solids limit on the cooling water discharge.
Condition 5	Prohibits specific adverse effects in the receiving waters of the Inaha Stream.
Condition 6	Requires the consent holder to measure and keep record of discharge temperature, to make available on request.
Condition 7	Sets out provision for review of the consent.

2.4.2.1 Compliance with Resource Consent 2050-4

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March 2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to be highly compliant.

In addition, Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (Appendix 3), it is noted that the frequency at which treated wastewater is discharged to the Inaha Stream has been reduced to meet Condition 6 of the Consent and that this appears to have led to an improvement in downstream NH4-N and DRP concentrations.

The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 6.

Table 2-6: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 2050-4 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
1	Compliant	Compliant	Compliant

Consent 2050-4 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
2	Compliant	Compliant	Compliant
3	Compliant	Compliant	Compliant
4	Compliant	Compliant	Compliant
5	No. Maximum temperature increase breach 3-6 April 2014, while new cooling equipment installed.	Compliant	Compliant
6	Compliant	Compliant	Compliant
7	N/A	N/A	N/A

2.4.3 Water Take Permit 2051-4.1

Water Take Permit 2051-4.1 provides for the take of up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation. The key operational requirements imposed by the conditions of this consent are summarised in Table 7.

Table 2-7: Key operational requirements stipulated by Water Take 2051-4.1

Consent condition	Key operational requirement
Condition 1	Requires the means of taking water to be satisfactory to Council.
Condition 2	Imposes a minimum flow of 25 L/s be maintained in the stream
Condition 3	Requires installation of a measuring device and records to be kept of daily abstraction and condition 4 requires the flow of Inaha Stream to be measured and recorded.
Condition 4	Was changed on 21 January 2015 to remove the requirement to install a flow recorder but preserve the requirement to visually record the stream height daily, and keep records of the flows within Inaha Stream.

Consent condition	Key operational requirement
Condition 5	Required the consent holder to investigate and report on the use of wastewater for cooling water.
Condition 6	Sets out provision for review of the consent.

2.4.3.1 Compliance with Resource Consent 2051-4.1

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March 2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to be high.

The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 8.

Table 2-8: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 2051-4.1 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	**Period covered** 2015-2016	**Period covered** 2016-2017
1	Compliant	Compliant	Compliant
2	Compliant	Compliant	Compliant
3	No – Fixed rate pumps and meters installed September 2012. Large gaps in data provided in 2013-2014.	Data provided though one month lost	Compliant
4	Compliant	Compliant	Compliant
5	N/A	N/A	N/A
6	N/A	N/A	N/A

2.4.4 Discharge Permit 3941-2

Discharge Permit 3941-2 permits the discharge of up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries. The key operational requirements imposed by the conditions of this consent are summarised in Table 9

Table 2-9: Key operational requirements stipulated by Discharge Permit 3941-2

Consent condition	Key operational requirement
Condition 1	Outlines the authorised area for the discharge.
Condition 2	Outlines the requirement to provide a spray irrigation management plan and specific matters it must address.
Conditions 3	Requires adherence to the plan and states that consent conditions prevail over any contradictory aspects.
Condition 4	Provides for review of the management plan
Condition 5	Requires a designated manager to implement the management plan.
Condition 6	Requires adoption of the best practicable option to deal with adverse effects, with particular reference to minimisation of nitrogen in the effluent.
Condition 7	Requires notification to Council when irrigation is not possible and discharge to the stream will cause dilution limits to be exceeded.
Condition 8	Places a minimum limit on the level of dissolved oxygen in the discharge.
Condition 9 and 10	Stipulate there shall be no objectionable odour or spray drift as a result of irrigation.
Condition 11	Limits the sodium adsorption ratio in the wastewater.
Condition 12	Prohibits ponding of wastewater or direct discharge.
Condition 13 and 14	Specify the area of the irrigation spray zone and limit the rate of nitrogen loading.
Condition 15	Requires the consent holder to investigate and report on options for reducing ammonia concentrations in wastewater prior to discharge.

Consent condition	Key operational requirement
Conditions 16 and 17	Restrict the average application rate and specify the return period between effluent applications.
Conditions 18 and 19	Require the consent holder to monitor groundwater bores and to monitor consent activities deemed necessary by Council.
Condition 20	Relates to liaison meetings with interested submitters to the consent
Condition 21	Addresses notification of Ngāti Manuhiakai hapu of discharge to Inaha Stream.
Condition 22	Relates to mitigating effects in the case of contamination of groundwater.
Condition 23	Allows for the consent holder to apply for change of conditions.
Condition 24, 25 and 26	All set out provisions for review of specific conditions and the consent in general.

2.4.4.1 Compliance with Resource Consent 3941-2

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March 2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to require improvement. It is noted that the engagement of a suitably qualified environmental consultant will seek to mitigate the elevated nitrogen in groundwater.

In addition, PDP's report on the Land Treatment of Wastewater – Technical Assessment of Environmental Effects (Appendix 1) provides further detail on the nitrogen loading. The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 10.

Table 2-10: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 3941-2 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
1	Compliant	Compliant	Compliant
2	Compliant	Compliant	Compliant
3	Compliant	Compliant	Compliant
4	Compliant	Compliant	Compliant
5	Compliant	Compliant	Compliant
6	Upgraded system still being assessed	No, high application rates of nitrogen have continued despite apparent trends of increasing nitrate in groundwater	Significant reduction in nitrogen loading undertaken by TBP this period
7	N/A	N/A	N/A
8	No, though no adverse effect	No, on three occasions of five, though no adverse effect considered likely	Compliant
9	Compliant	Compliant	Compliant
10	Compliant	Compliant	Compliant
11	Compliant	Compliant	Compliant
12	Compliant	Compliant	Compliant
13	Compliant	Compliant	Compliant
14	No. Limit exceeded or 11% of the area irrigated	No: one exceedance in 300kgN/ha and one exceedance in 200 kgN/ha	No, exceedance in nitrogen loading
15	N/A	N/A	N/A

Consent 3941-2 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
16	Compliant	Compliant	Compliant
17	Compliant	Compliant	Compliant
18	Compliant	Compliant	Compliant
19	Compliant	Compliant	Compliant
20	Compliant	Compliant	Compliant
21	No. Breach on 28 April 2014. Infringement Notice ($750 fine)	Compliant	Compliant
22	N/A	Significant nitrate impacts in groundwater	Remedial actions implemented and under development

2.4.5 Water Discharge Permit 5426-1

Water Discharge Permit 5426-1 permits the discharge of up to 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream at or about GR: Q21:119-858. The key operational requirements imposed by the conditions of this consent are summarised in Table 11.

Table 2-11: Key operational requirements stipulated by Water Discharge Permit 5426-1

Consent condition	Key operational requirement
Condition 1	Requires the consent holder to give notice of changes in process which may alter the nature of the discharge.
Condition 2	Sets chemical limits on the discharge.
Conditions 3	Prohibits specific adverse effects in the receiving waters of the Inaha Stream.
Condition 4	Requires the consent holder to provide Council with a contingency plan.

Consent condition	Key operational requirement
Condition 5	Sets out provision for review of the consent.

2.4.5.1 Compliance with Resource Consent 5426-1

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March 2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to be good.

The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 12.

Table 2-12: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 5426-1 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	Period covered 2015-2016	Period covered 2016-2017
1	Compliant	Compliant	Compliant
2	Three breaches of suspended solids limit and one breach of oil and grease limits	Compliant	Minor exceedance in suspended solid concentration
3	Compliant	Compliant	Compliant
4	N/A	N/A	N/A
5	N/A	N/A	No review required

2.4.6 Discharge Permit 5495-1

Discharge Permit 5495-1 permits the discharge of up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-

859. The key operational requirements imposed by the conditions of this consent are summarised in Table 13.

Table 2-13: Key operational requirements stipulated by Discharge Permit 5495-1

Consent condition	Key operational requirement
Condition 1	Requires the Consent holder to provide a waste burial management plan addressing specific matters.
Condition 2, 3, 4	Relate to the implementation and exercise of the management plan and provide for a review with notice from either party.
Conditions 5	Relate to the implementation and exercise of the management plan and provide for a review with notice from either party.
Condition 6 and 7	Relate to the construction of the disposal pits
Condition 8	Requires inspection by Council prior to disposal.
Condition 9	Relates to the timing of conditions 1-4.
Condition 10	Imposes a time limit on the covering of discharged material.
Condition 11 and 12	Impose a certain quality of cover material and suitable stormwater contouring.
Condition 13	Requires the disposal site be reinstated satisfactorily.
Condition 14 and 15	Prohibit irrigation of effluent onto disposal area or direct discharge of contaminants to surface water.
Condition 16	Requires a minimum of eight monitoring bores to monitor groundwater quality.
Condition 17	Allows the consent holder to apply for change to consent conditions.
Condition 18	Sets out provision for review of the consent.

2.4.6.1 Compliance with Resource Consent 5495-1

Taranaki By-Products monitor their compliance through reference to the annual report prepared by Taranaki Regional Council. In the most recent annual report (Annual Report 2016-2017, dated March

2018), the overall assessment of consent compliance and environmental performance in respect of this consent was considered to be high.

In addition, PDP's report on the Land Treatment of Wastewater – Technical Assessment of Environmental Effects (Appendix 1) provides further detail on groundwater quality.

The compliance assessment outcomes from the three most recent reports from Taranaki Regional Council have been summarised below in Table 14.

Table 2-14: Compliance Monitoring results from Taranaki Regional Council monitoring (three most recent monitoring reports).

Consent 5495-1 Condition No.	**Compliance Reporting completed**		
	Period covered 2013-2015	**Period covered** 2015-2016	**Period covered** 2016-2017
1	N/A	N/A	N/A
2	Compliant	Compliant	Compliant
3	N/A	N/A	N/A
4	Compliant	Compliant	Compliant
5	Compliant	Compliant	Compliant
6	Compliant	Compliant	Compliant
7	N/A	N/A	N/A
8	Compliant	Compliant	Compliant
9	Compliant	Compliant	Compliant
10	Compliant	Compliant	Compliant
11	Compliant	Compliant	Compliant
12	Compliant	Compliant	Compliant
13	N/A	N/A	Compliant
14	Compliant	Compliant	Compliant
15	Compliant	Compliant	Compliant

Consent 5495-1 Condition No.	Compliance Reporting completed		
	Period covered 2013-2015	**Period covered** 2015-2016	**Period covered** 2016-2017
16	Compliant	Compliant	Compliant
17	N/A	N/A	N/A
18	N/A	N/A	Not required

3 Proposed Activities

TBP seek to provide for the ongoing operation of the ORP on a "roll over" basis. TBP is, however, looking to improve environmental outcomes associated with the ongoing operation of the ORP.

The process and function of the current ORP is proposed to remain broadly unchanged, while investment is directed into focused mitigation measures that have been recommended by the technical experts from Aquanet and PDP, in response to feedback from consultation undertaken by TBP.

3.1 Proposed Upgrades

There are three key mitigation areas that TBP are seeking to update in order to reduce the contaminants arising from their activities at the site:

1. Vibratory Shear Enhanced Process ("VSEP") membrane
2. Stormwater Management
3. Management of solid waste burial
4. Expansion of land irrigation area

3.1.1 Vibratory Shear Enhanced Process ("VSEP") membrane

TBP acknowledges that the management of stickwater, or Zeal Grow, has been challenging for the site with limited uptake by farmers outside of the main irrigation area. This has resulted in heavy nitrogen loads on the irrigated areas of the farm. PDP's report on the Land Treatment of Wastewater – Technical Assessment of Environmental Effects (Appendix 1) describes the issue in detail in Section 2.5, and Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (Appendix 3) also demonstrates that these diffuse discharges are having an adverse effect on the water quality in the stream and notes that nitrate-nitrate nitrogen ("NNN") have been increasingly rapidly since 2011.

TBP have been undergoing internal reviews of its processes and have committed to upgrading their systems to aim towards a model to 100% recycle stickwater. An operational building ~~will~~ was constructed on site in 2019 which will use VSEP membrane system to resolve the leachate treatment problems at the site. This building will filter half the amount of wastewater going to the ponds and use that to fuel the boiler systems. Taranaki Bio Extracts ("TBE") have had their equivalent operational building installed (in late 2018) and this example has proven that it is possible to significantly reduce the amount of stickwater that needs to be discharged to land.

Details of the VSEP system are discussed further in the PDP (2018) report and in the technical memo prepared in response to questions from TRC on the design details of the VSEP system dated 17 December 2019 and attached as **Appendix 6**.

Close~~ly~~ monitoring of the improvements at the ORP indicates that the volumes of stickwater being spread to land have significantly reduced, from an average of around 300 m^3/week to an average of around 100m^3/week [3] It is anticipated that the environmental effects should revert back to the pre-2011 environmental conditions. The eventual goal of TBP is to be in a position to filter all of the wastewater and have only one final pond as their wastewater system.

3.1.2 Stormwater management

Due to the findings of Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (**Appendix 3**), TBP have prepared an updated stormwater management plan (**Appendix 7**).

In the past, the cooling water / stormwater discharge has been presenting high contaminant concentrations (NH_4-N, NNN, SIN, DRP and $ScBOD_5$ concentrations) and it appears as though the stormwater is picking up nutrients before it is being discharged with the cooling water. As the cooling water runs through a closed loop system, this would indicate that it is primarily the stormwater that is presenting the environmental effect. The stormwater is discharged into and diluted by the firewater pond, however, it is likely that the stormwater is contaminated.

Table 3-1 below summarises the Stormwater and Cooling Water Characteristics.

Table 3-1 Stormwater and Cooling Water Characteristics

Location	**Parameter**								
	Temp (°C)	pH	TSS (mg/L)	BOD (mg/L)	DRP (mg/L)	NH_4-N (mg/L)	TON (mg/L)	O&G (mg/L)	*E. coli* (cfu/100ml)
Cooling Water to Fire Pond	28 [9 – 63]	7.5 [7.1-8.0]	N/A	1.6 [0.25- 4]	N/A	0.7 [0.02- 2]	N/A	N/A	N/A
Stormwater to Fire Pond	16 [11 - 25]	7.2 [6.8-8.7]	99 [1-200]	101 [0.5-1400]	N/A	3.4 [0.1-24]	N/A	13.9 [0- 110]	110700 [21400-200000]
Fire Pond to Inaha Stm	18 [6 - 31]	7.4	12 [5- 24]	8	0.15	2.3	2.6	1.1 [0-3.6]	22018

[3] Section 2.2.2 PDP Report January 2020

	[6-8.1]	[0.6-120]	[0.004-0.74]	[0.5-6.8]	[1.5-3.8]	[1170 - 72700]

Notes:

Based on quarterly monitoring results from 2012 to 2018.

TSS = total suspended solids, BOD = biochemical oxygen demand, DRP = dissolved reactive phosphorus, NH_4-N = ammonical nitrogen, TON = total oxidised nitrogen (NO_2-N + NO_3-N), O&G = oil and grease.

[ ] indicates monitoring results range.

N/A = not assessed.

TBP has installed a stormwater collection sump adjacent to the fire pond for first flush diversion (refer Appendix 6 for drawings and photos of installed system). Operation of the first flush diversion system is summarised as follows:

- Stormwater collected from potentially contaminated areas, including from the raw material area and meal load out area, is diverted to the chamber rather than to the fire pond.
- Diverted stormwater is settled out in the chamber, with float and settled solids removed. The collected stormwater is then pumped to the anaerobic lagoon, for treatment through them 'existing' wastewater treatment system.
- During more intense, prolonged, rainfall events and following the initial flush, a manual gate valve is be opened by site staff to divert additional collected stormwater to the Fire Pond.
- Collected solids are regularly removed from the chamber to maintain optimum performance.

TBP plant Manager Paul Drake advises that the stormwater management system is working well and automation of the system will be installed before the end of 2020. This automation will replace the current manual opening of the gate valve by site staff and will ensure that following the first 10mm flush of the site, into the stormwater chamber, stormwater will then be diverted to the Fire Pond.

3.1.3 Management of solid waste burial

TBP have an existing resource consent (5495-1) which provides for the burial of waste material to land at a maximum rate of 200 tonnes/day. The site has historically buried solid waste material during emergency situations, such as plant breakdown, or when the material is unable to be processed through the plant due to the nature of the material received.

TBP propose to continue this activity on an emergency only basis. Evaluation of the past burial of waste has been undertaken to understand the rates of burial activity for the past 20 years and to assess the effects of this activity on ground and surface water. As outlined in the report by PDP, attached as Appendix 1, future burial of waste material is proposed to occur only in the event of an emergency and will be limited to 500 tonnes/year which aligns with the estimated average historic disposal rate. This significantly reduced limit in the burial of waste material is proposed to retain the current slow rate of nitrogen release from the burial pits and further monitoring of surface water is also proposed.

TBP propose to contain the burial of waste activities to the south and west of the current burial location as indicated on Figure 4.

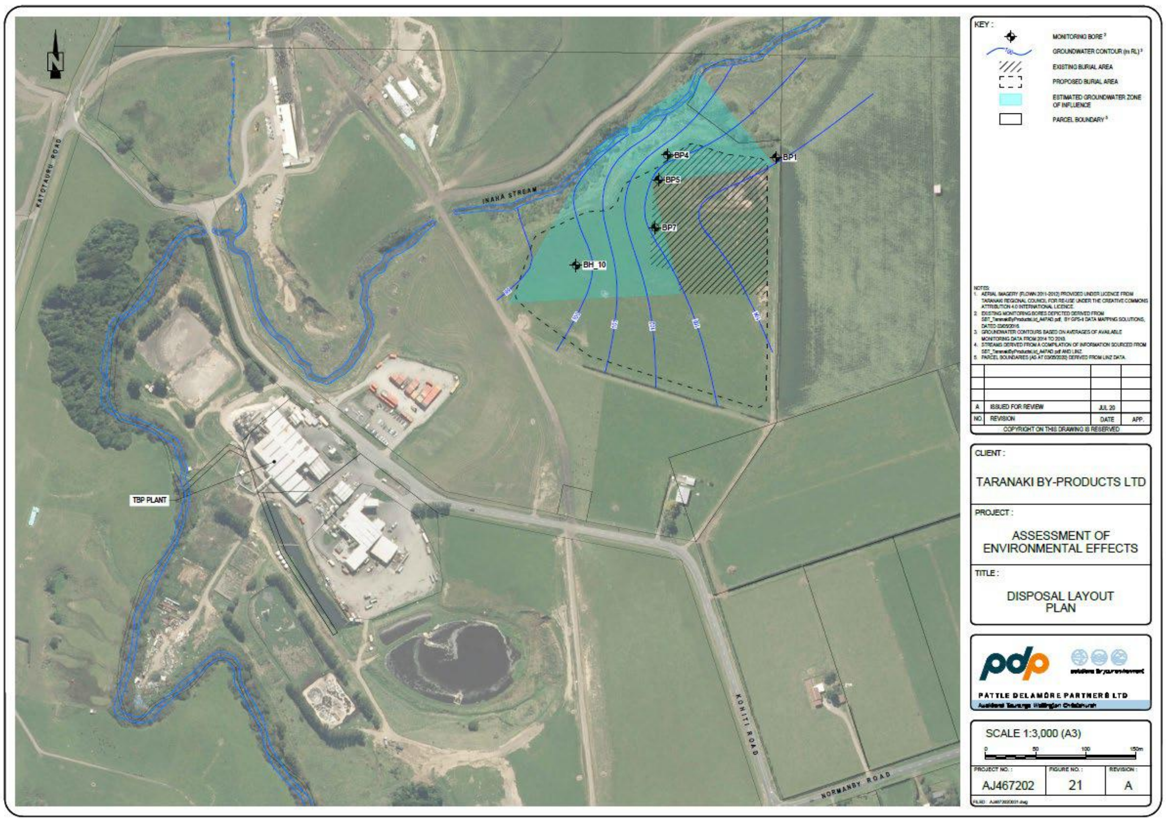

Figure 4 Proposed future burial activity location map

3.1.4 Expansion of irrigation area

An additional 16.39ha of land purchased in April 2019 by TBP to enable the expansion of land-based disposal of treated wastewater from the Plant. Figure 3 illustrates the location of this land.

3.2 Term of Consent Sought

TBP seek the following terms for the consents applied for:

- A term of 35 years for the new consent for the discharge of up to 940 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream at or about GR: Q21:118-858.
- A term of 35 years for the new consent for the discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream at or about GR: Q21: 118-858.
- A term of 35 years for the new consent to take up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation.
- A term of 35 years for the new consent to discharge up to 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream at or about GR: Q21:119-858, Q21: 120-858 and Q21:121-858.
- A term of 35 years for the new consent for the emergency discharge up to of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-859.
- A term of 35 years for the new consent to discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries.

TBP have sought the above terms to provide operational certainty for a business that provides an essential service and is a significant employer and contributor to the local economy. A longer term also supports the investments necessary to implement the mitigations proposed in this application; for example, the VSEP system has cost a combined total estimated at $8.5 million across the TBE and TBP sites.

3.3 Alternatives Considered

The primary method TBP have adopted for minimising the environmental effects of their activities is to discharge treated wastewater to land. To that end, TBP have, over the years, progressively increased their landholdings, allowing irrigation to occur across larger areas including the 2019 purchase of land which this application seeks consent to utilise for wastewater irrigation. In this way, the primary alternative method to discharging treated wastewater to the Inaha stream is to discharge treated wastewater to land.

This renewal application seeks to build on that approach, and so has not considered alternatives to the irrigation of treated wastewater to land. Some form of discharge to the Inaha Stream over winter months is necessary, when the land is too wet to receive further irrigation.

Paul Drake, Plant Manager of TBP, outlines that in general, wastewater is preferentially irrigated to land over being discharged to surface water. During summer months, the majority of wastewater is irrigated to land, however, during winter it is more difficult to irrigate all wastewater to land and the ability to discharge to surface water must be utilised. During the middle of winter and wetter periods, when the river flow increases to a level where discharge to surface water can occur, operation of the underlying dairy farming activity becomes difficult and TBP tend to utilise the full capacity available for discharge to surface water, depending on the river flow and dilution ratio limit. The remaining wastewater is irrigated to land, following stock rotation. It is during the shoulder seasons (spring and autumn) or prolonged dry periods in winter, that a judgement call is made as to whether to prioritise irrigation to land and reduce discharge to surface water. During this period, the extent of irrigation that is applied to land is discussed with the dairy farmer and a qualitative decision is made based on stock rotation, risk of runoff and pugging risk.

There were initially several options discussed around how to improve the ORP's environmental performance, however, the focus was given to measures which would directly improve the environmental indicators that had been performing poorly.

PDP prepared a technical memo, dated 16 December 2019, which discusses the three alternative options that were considered for the current wastewater management system on the site. The alternative options considered were:

- Storage of wastewater to avoid discharge to surface water with increased irrigation to land;
- Piping and discharge to Hawera wastewater treatment facility; and
- Piping and discharge to marine environment.

The additional Technical Memo attached as Appendix 8, evaluates each of the above options as alternatives to the current system. The memo concludes that due to significant existing investment, and the need for large additional capital investment for the alternative options including land purchase and the uncertainty associated with some of the alternatives, the existing system is considered by PDP, as the most practicable for the site.

The best practicable option is considered to be to continue operations with an aim towards focusing on improvements which would lessen the significant environmental effects occurring at the ORP.

The three proposed upgrades outlined in Section 3.1 above, are a direct response to the~~se~~ issues identified in the options report.

3.4 Emergency Burial Pits

Historically, TBP have buried waste into unlined pits on an almost weekly basis as a result of plant shut down, equipment failure or other emergency events which has meant material arriving at the plant has not been able to be processed.

Over recent years, upgrades and improvements at the TBP plant have meant that equipment and plant issues are rare and as a result, TBP advise that burial of waste material has not occurred since early 2015 when there was a fire in the TBP plant which disrupted processing.

These plant improvements, together with the improved opportunity to access spare capacity at other processing plants in the North Island in the event of an emergency at TBP mean that the need for solid waste burial is greatly reduced.

TBP originally proposed to implement the burial of waste material into lined burial pits but has since revisited the logistics of such an approach and have deemed that lined pits are no longer a feasible option for waste disposal. This change in approach relates to the significant cost, practicality and storage requirements associated with having the lining materials on site at all times in case of emergency. This is considered by TBP to be particularly excessive when this option for waste disposal would only be utilised in the event that all other options for disposal had been exhausted.

It is proposed that provision for 500 tonnes/year of waste be provided for, calculated on a 5-year rolling average. This is based on recommendations in the PDP report (Appendix 1) for the mitigation of effects on ground water and to recognise the operational requirements of the plant in the event of an emergency. This amendment has resulted in the revision of the conditions on the replacement consent in relation to the emergency burial of waste to ensure that:

- Burial activities only occur in the case of an emergency and in the instance where all possible options have been explored prior to any disposal of waste material to land;
- A restriction on the volume of material that is buried of 500 tonnes /year calculating on a 5-yearly rolling average to provide for the fact that more than 500 tonnes may need to be disposed of from the factory in response to a single emergency event.
- Restriction on the location of where burial pits can be located, identified on the map attached as Appendix 4.

- Removal of the existing condition 7 that provides for burial of waste to occur outside of the disposal area identified on the map in Appendix 4..

Amendments to the conditions proposed for the emergency solid waste burial consent have been included in a revised Appendix 5.

3.5 Proposed Consent Conditions

TBP have included a 'tracked changes' version of the existing conditions with proposed changes to be considered as part of this consent renewal (refer to Appendix 5).

The changes to the existing conditions largely relate to:

- Conditions that need to be updated to reflect the current planning and regulatory environment
- Conditions that have been added or modified in response to feedback during pre-application consultation; and
- Conditions that have been added or modified to reflect the general approach and mitigation measures proposed as part of this application.

Appendix 5 includes a comparison of the original conditions with the proposed conditions and an explanation / rationale for the proposed changes. This includes a revision of the conditions relating to the consent for the emergency burial of solid waste into unlined pits.

4 RMA Status of Proposed Activities

Activity status of the consents required to replace the expiring consents can be determined with reference to the Regional Freshwater Plan, and in the case of air quality matters, the Regional Air Quality Plan.

The following consents are sought to replace the existing consents held for the ORP.

The type and activity status of the consents required for each activity is presented in Table 15.

Table 4-1: Assessment of Activities under the Operative Plans

Consent to be replaced	Activity	Rule	Compliance Standard	Compliance Status
Water Permit 2051-4	Taking and use of surface water which does not meet the conditions of Rule 15 (permitted activity)	Rule 16 Regional Fresh Water Plan		Discretionary – TBP are looking to renew their existing consent which granted consent to take up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation.
Water Discharge Permit 5426-1	Discharge of stormwater into or onto land or into water that is not provided for by Rules 25-27 and that does not comply with the conditions of Rule 23	Rule 24 Regional Fresh Water Plan	A stormwater management plan shall be submitted to the Taranaki Regional Council; The discharger shall at all times adopt the best practicable option to prevent or minimise any adverse effects of the discharge or discharges on any water body.	Controlled – the stormwater discharge is not provided for by Rule 23. A contingency plan was prepared and approved by Taranaki Regional Council as part of the existing consent 5426-1. As stated earlier, TBP are proposing to prepare an updated stormwater management plan as a condition of this consent.
Water Discharge Permit 2050-4 Water Discharge Permit 2049-4	Discharge of contaminants or water into surface water which is not provided for in Rules 21-42 or which is provided but does not meet the standards, terms or condition	Rule 43 Regional Fresh Water Plan		Discretionary – the discharge of cooling water and backwash water, and the discharge of treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream, both are not provided for in Rules 21-42.
Discharge Permit 3941-2 Water Discharge Permit 5495-1	Discharge of contaminants onto or into land restricted by s15(1)(b) (where contaminants may reach water) and s15(d) (where the discharge is from industrial or trade premises) of the Resource Management Act 1991	Rule 44 Regional Fresh Water Plan		Discretionary – the discharge of treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and to discharge emissions into the air, and the discharge of wastes from meant rendering operations by burial into land in the vicinity of the Inaha Stream, both are not expressly provided for in Rules

Consent to be replaced	Activity	Rule	Compliance Standard	Compliance Status
	which is not expressly provided for in Rules 21-42 or does not meet the standards, terms or conditions and any other discharge of contaminants to land which is provided for in Rules 21-42 but which does not meet the standards, terms or conditions of those rules (irrespective of whether the discharges are from industrial or trade premises or are likely to reach water).			21-42 and are restricted by S15 of the RMA.
Discharge Permit 3941-2	Any discharge of contaminants to the air from any industrial or trade premises not listed in any other rule or where the activity is listed in a rule but the conditions for that rule cannot be met OR any discharge from production land, waste management processes, site development, earthworks, the application of soil conditioners, aquaculture or intensive farming processes where the activity is listed in a rule but the conditions for that rule cannot be met.	Rule 55 Regional Air Quality Plan		Discretionary – odour is discharged into the air from the industrial premises which is not provided for in any other rule in the Regional Air Quality Plan.

4.1 Summary of Activity Status

In summary, the proposed activities do not comply with the following permitted rules:

- Rule 15 in relation to water take (Regional Fresh Water Plan)
- Rule 23 in relation to stormwater discharge (Regional Fresh Water Plan)
- Rule 29 in relation to discharge to land (Regional Fresh Water Plan)

Therefore, resource consent is required in regard to the following rules

- Rule 16 in relation to water take – Discretionary Activity (Regional Fresh Water Plan);
- Rule 24 in relation to stormwater discharge to water – Controlled Activity (Regional Fresh Water Plan);
- Rule 43 in relation to the discharge of cooling water and backwash water, AND in relation to the discharge of treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream – Discretionary (Regional Fresh Water Plan);
- Rule 44 in relation to the discharge of treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and in relation to discharge emissions into the air, AND the discharge of wastes from meant rendering operations by burial into land in the vicinity of the Inaha Stream – Discretionary (Regional Fresh Water Plan);
- Rule 55 in relation to odour discharge (Regional Air Quality Plan).

4.1.1 Renewal of Applications

As there are existing consents for the current operation of the ORP, it is considered that the RMA status of the proposed activities is related back to the specific existing consents that are up for renewal (shown in Table 16 below).

Table 4-2: Table of consents to be renewed and their activity status

Expiring Consent No.	Purpose	Application form No.	Activity status
2049-4	To discharge treated wastewater from a rendering operation and from a dairy farm into the Inaha Stream	110	Discretionary (Rule 43 of the Regional Fresh Water Plan)

Expiring Consent No.	Purpose	Application form No.	Activity status
2050-4	To discharge cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream	110	Discretionary (Rule 43 of the Regional Fresh Water Plan)
2051-4	To take water from the Inaha Stream for a rendering operation	300	Discretionary (Rule 16 of the Regional Fresh Water Plan)
3941-2	To discharge treated wastewater from a rendering operation and from a dairy farm via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries	110	Discretionary (Rule 44 of the Regional Fresh Water Plan and Rule 55 of the Regional Air Quality Plan)
5426-1	To discharge up 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha Stream	110	Controlled (Rule 24 of the Regional Fresh Water Plan)
5495-1	The~~o~~ emergency discharge of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream.	110	Discretionary (Rule 44 of the Regional Fresh Water Plan)

The necessary application forms are provided in Appendix 2.

5 Assessment of Environmental Effects

The following section outlines the actual and potential effects on the environment of the proposed continuation of the operation of the ORP, which involves the discharge of treated wastewater, stormwater and cooling/backwash water from the plant to the Inaha Stream, the take of water for non-consumptive uses and the ancillary emission of odour.

In accordance with section 88 of, and the Fourth Schedule to, the Resource Management Act 1991, this assessment corresponds with the scale and significance of the effects that the proposed activity may have on the environment.

5.1 Positive Effects

The ORP has been in operation since 1936. The plant currently employs a number of people and operates 24 hours a day, seven days a week. It services a large area, receiving and rendering protein-based material from supermarkets, butchers, farmers, meat and poultry processors. The low temperature rendering process used by the plant essentially recycles material that would otherwise require disposal as a waste product into stable, value-added products including tallow, meat and bone meal and blood meal. The rendering process is an essential function of the agricultural, poultry, fish, meat and related industries, and these industries could not function effectively at scale without it. Rendering is essentially a recycling service; large volumes of by-product material that would otherwise require disposal as waste are collected and processed. The cost and environmental impact of alterative disposal methods for this material (e.g. incineration, landfill) can be significant, and do not provide any recoverable value. The operation therefore provides significant social and economic benefits to the communities of the Okaiawa area and, more generally, the mid-upper North Island. The operation also helps support the New Zealand economy as much of the site's product is exported. Furthermore, the operation supports the Taranaki Region's and New Zealand's waste minimisation strategy, by helping to avoid the deposition of meat processing by-products into landfills, and other less environmentally friendly disposal methods.

5.2 Effects on Soils and Groundwater

The potential effects of the activities on soils and groundwater have been assessed in the report *Land Treatment of Wastewater – Technical Assessment of Environmental Effects* (Appendix 1) by PDP (updated January 2020) in sections 4.2 and 4.3.

The updated report outlines that previous estimates of the nitrogen concentrations used in modelling underestimated the nitrogen load associated with the application of Zeal Grow and the concentration of Zeal Grow being applied. Section 2.5.3 of the report outlines the nutrient loading rates averaged across the irrigation area including past loading and future loading rates

The following is an excerpt of the executive summary of the report highlighting its key findings.

Context

The aim of this report is to provide a technical assessment of environmental effects of the wastewater irrigation to assist with the renewal of the discharge to land consent (No. 3941-2).

Potential Environmental Effects

The potential environmental effects from the irrigation of wastewater and Zeal Grow (stickwater) to land include:

- *Potential effects on soils, including impacts on soil structure through pugging and cation imbalances and potential accumulation of heavy metals;*
- *Potential effects on groundwater and groundwater users as a result of nutrient migration, particularly nitrate;*
- *Potential effects on surface water in terms of effects on water quality through nutrient migration from either direct runoff or nutrient migration via groundwater;*
- *Potential effects on human and stock health as a result of exposure to microorganisms; and*
- *Potential nuisance effects on neighbours, such as odour and spray drift, as result of system operation.*

Assessment undertaken

To assess the effects that the current irrigation system has had on soils as an indication of potential effects going forward, PDP conducted a soil investigation in June 2018 to investigate soil nutrient levels, infiltration rates and heavy metal levels in comparison to a selected background monitoring site.

TBP has conducted regular monitoring of irrigated wastewater and stickwater since 2015 and TRC has conducted regular groundwater monitoring within the irrigation area. Utilising the irrigation loading rate data, an Overseer nutrient model was developed to estimate the rate of nutrient loss to surface water via runoff, or to groundwater via leaching.

Modelled nutrient leaching rates were then compared with groundwater and surface water monitoring data to estimate the flux rate of nitrogen to surface water. Based on the surface water monitoring results and assessment of effects on the fresh water aquatic environment, conducted by Aquanet Consulting Ltd, the subsequent effects of the irrigation to land on surface water was able to be quantified and mitigation measures established.

Results – Effects of the ORP

Based on the assessment undertaken, the following conclusions were made about the environmental effects of the wastewater irrigation:

- *The results of the soil investigations concluded that the wastewater irrigation and stickwater spreading activities are having a less than minor effect on soils with low sodium levels and no evidence of heavy metal accumulation.*
- *There was evidence of reduced soil permeability, however, this was also evident in the un-irrigated background site and therefore is unlikely to be solely associated with the irrigation activity.*
- *For potential effects on groundwater (and groundwater users) and surface water, the key contaminant of concern associated with the application to land of treated wastewater is nitrate nitrogen. Nutrient modelling, based on the 2015/16 and 2017 irrigation rates and farming operation, indicates that approximately 56 TN TN/ha/yr and 47 kg TN/ha/yr respectively is leaching on a whole farm basis below the soil profile and pasture root zone. Application rates for 2015/16 are considered to be indicative of historic wastewater volumes while application rates for 2017 are considered to be indicative of current wastewater volumes.*
- *There are no consented takes within 3 km of the downstream boundary of the site, but there may be permitted takes from bores within this area and the spring (GND1058) located immediately south of the site is currently used for drinking water. Based on the monitoring undertaken to date, the elevated groundwater concentrations at the site do not currently appear to be significantly affecting downstream groundwater receptors.*
- *Based on average measured groundwater hydraulic conductivities across the site and the modelled nitrogen leaching rates, a simple flow calculation indicates that concentrations of nitrate within the spring would start to increase around 2014. This corresponds well with the results seen within the monitoring data, however, the monitored change in concentration is significantly less than the calculated value indicating that the majority of the nitrate within the groundwater is not migrating southwards, off the site.*
- *The nitrogen loading associated with the discharge of treated wastewater and fertiliser application to land has impacted the groundwater at the site over the last 10 years. However, after an increase in groundwater concentrations between 2009 and 2012, the concentrations appear to have stabilised, albeit at elevated values. This suggests that the current rates of application may be in equilibrium with processes removing nitrate from the groundwater.*
- *For potential effects on surface water, the key identified pathway is nitrogen load migrating to surface water via groundwater. The groundwater contours indicate that shallow*

groundwater and the areas with elevated groundwater nitrate nitrogen concentrations are likely to discharge into the Inaha Stream and the unnamed tributary across the majority of the site. Monitoring of nitrate nitrogen concentrations between the upstream and downstream sample locations with the measured flow rate of the Inaha Stream indicates that the average estimated gain in nitrogen across the site was 4.1 g N/m3 for the Inaha Stream and 5.2 g N/m3 for the unnamed tributary. The results indicate that the total nitrate flux from the site caused by groundwater discharge into the streams is approximately 44 kg N/day.

- *It is considered possible that higher rates of nitrogen application to parts of the site may have occurred between 2009 and 2013, resulting in the increase in groundwater concentrations. However, since 2013 the concentrations appear to have stabilised, despite some seasonal variation, suggesting that the current application rates are not resulting in a worsening of conditions within the groundwater. Based on the current concentrations and the estimated flux into the streams under low flow conditions, it is likely that it would take at least 20 years for the concentrations to return to background concentrations within the groundwater at the site, assuming that no additional nitrate was added within the time frame.*
- *The existing migration of nitrate nitrogen to surface water is resulting in a net increase in nitrate nitrogen concentrations in the western, un-named tributary, which is causing the status of the water quality to degrade from Band C, under the National Policy Statement for Fresh Water Quality 2014, to Band D. In order to maintain the water quality in a Band C status, the average concentration in the un-named tributary will need to decrease by up to 15 %. Based on the historic (2015/16 season) assessed nitrogen leaching rate from the wastewater irrigation activity, as assessed by OverseerFM® modelling and low stream flow nitrogen contribution comparisons, nitrogen leaching rates, on a whole farm basis, will need to decrease from the existing ~~53~~ 56 kg TN/ha/yr to less than 48 kg TN/ha/yr. Overseer FM® modelling indicates that the current leaching rate (2017 season) of 47 kg TN/ha/yr meets this level of reduction.*
- *Potential effects on human or stock health are considered to be less than minor.*
- *Potential nuisance effects associated with spray drift and odour are considered to be less than minor due to the proposed separation distances from boundaries and dwellings and the aerobic na*ture of the irrigated wastewater.

5.2.1 Further technical memo

A further technical memo was prepared in December 2019 by Dr Greer from Aquanet Consulting. This memo responded to questions from TRC regarding the effects of contaminants leaching from the existing burial pits on groundwater and surface water (Appendix 9).

Since the lodgement of the replacement consent applications, TBP have decided to no longer pursue the burial of waste to lined pits, instead seeking to continue burial to unlined pits in an emergency only situation as discussed in Section 3.4 above.

As a result of this amendment to the 2018 application, the existing burial pits are no longer considered to be closed landfills and their effects will continue to be monitored and managed through the replacement of the original consent 5495-1.

This makes assessment undertaken in Section 3 of the Aquanet memo no longer relevant to this application.

5.2.2 Effects on Groundwater from the Burial of Solid Waste

As identified in the AEE by PDP, attached as **Appendix 1**, there are no groundwater users between the burial pit area and the Inaha Stream, the Inaha Stream is considered to be the *"key receptor of nitrogen that migrates from the burial pit activity*".

Additional monitoring is also recommended in Section 7.2 of the PDP report to ensure that effects on groundwater as a result of any future burial activities are understood. An additional 4 down gradient monitoring bores are recommended, resulting in a total of 12 monitoring bores for the purpose of monitoring the burial activity. In addition, quarterly shallow groundwater monitoring is recommended. Conditions have been proposed based on these findings as shown in **Appendix 5.**

The effects of the burial of solid waste are discussed in further detail in Section 5.3.3 below.

5.2.3 Summary of groundwater effects

PDP's report on the Land Treatment of Wastewater – Technical Assessment of Environmental Effects (**Appendix 1**) involved conducting a soil investigation which has allowed TBP to increase their understanding of the effect that their discharge to land is having, beyond the compliance monitoring historically undertaken. This work shows a clear significant adverse environmental effect from the migration of nitrate nitrogen to surface water, particularly during low flow conditions. In addition to existing implemented mitigation measures such as separation distances, irrigation rates and return periods, PDP have recommended additional mitigation measures in order to achieve a 15% reduction in nitrogen leaching from recent years. These measures include soil permeability monitoring and management, and nitrogen loading management.

The emergency burial of waste material is resulting in increased levels of ammoniacal nitrogen in groundwater. However, as there are no ground water users between the burial area and the Inaha Stream, the Inaha Stream is the key receptor of nitrogen from the pits. Surface water monitoring in the section of the Inaha Stream, likely to be influenced by groundwater from the burial area, has not identified an increase in ammoniacal nitrogen. Continued monitoring of groundwater is recommended to ensure any effects from the burial pits are identified.

5.3 Effects on Surface Water

An increase in nitrate-nitrogen concentrations in the Western Tributary has been identified as an issue by TRC. In recent times the concentrations have approached or exceeded the NPSFM national bottom line for nitrate toxicity, which TRC have signalled is unsustainable. It is suspected that the discharge of stickwater to land is the main source of the nitrate measured in the stream, however, the exact pathway and entry point(s) into the stream are unknown. TRC did not raise any particular issue regarding the effects of the direct discharge of wastewater to the Inaha Stream, indicating that the current discharge regime and dilution rates seemed to work well.

Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (**Appendix 3**) assessed the effects that the proposal has on surface water.

The following is an excerpt from the executive summary of that report outlining the results of the assessment undertaken.

Context

The aim of this report is to provide an assessment of the in-stream water quality and ecology effects of the:

- *The non-consumptive abstraction of water from the Inaha stream for use as cooling/backwash water in the ORP;*
- *The point source discharge of stormwater, cooling/backwash water and treated wastewater from the ORP to the Inaha Stream; and*
- *The discharge of treated wastewater from the ORP to land.*

Assessment undertaken

The assessment conducted here is made purely on technical grounds and is limited to water quality and aquatic ecology considerations. It is primarily based on water quality monitoring data collected during the period July 1995 to December 2017, and biological data from October 2015 to March 2017. Where data are considered insufficient to fully inform a robust assessment, the conclusions of this report should be considered preliminary.

The analysis of water quality and ecological data presented in this report includes an assessment against the provisions of:

- *the current resource consent conditions;*

- *The Regional Freshwater Plan for Taranaki Appendix 5 water quality guidelines; and*
- *the National Policy Statement for Freshwater Management 2014 (NPS-FM) relevant numeric attribute states including the 2017 amendments.*

Results – Effects of the ORP

In terms of the effect on water quantity from the water take, as the water take utilised by TBP is non-consumptive, the potential for adverse effects is limited to flow depletion along the section of stream between the take and the discharge point. Based on information provided by TBP and TRC to Aquanet and TRC's interactive resource consent map and aerial photographs, the take and discharge are at the same location. Thus, it is unlikely that the water take has any material effect on the Inaha Stream's flow regime, and any flow-on ecological effects are considered to be less than minor.

From the monitoring data collected within, upstream and downstream of the discharges between July 1995 to December 2017 the following conclusions were made about the effects of point source wastewater, cooling/backwash water and stormwater discharges from the ORP on water quality and freshwater ecology in the Inaha Stream:

- The available *data indicates that that concentrations of ammoniacal nitrogen, nitrate-nitrite nitrogen, soluble inorganic nitrogen, dissolved reactive phosphorus and soluble carbonaceous 5-day biochemical oxygen demand in the Inaha Stream were far greater downstream of the ORP than upstream.*
- *The in-stream ammoniacal nitrogen, pH, temperature, dissolved oxygen saturation and soluble carbonaceous 5-day biochemical oxygen demand limits set out in the conditions of the existing resource consents were met. However, the limit for 5-day biochemical oxygen demand was frequently not met downstream of the ORP, despite the upstream site being generally complaint.*
- *The Regional Freshwater Plan water quality guidelines were complied with as follows:*
    - *Water temperature and dissolved oxygen saturation generally met the guidelines upstream and downstream of the ORP;*
    - *The guideline for 5-day biochemical oxygen demand was met in the Inaha Stream upstream and downstream of the ORP; and*
    - *Dissolved reactive phosphorus frequently did not comply with guidelines upstream and downstream of the ORP. However, the frequency and magnitude of non-compliance was greater at the downstream site.*

- *The macroinvertebrate communities in the Inaha Stream upstream and downstream the ORP are indicative of fair water quality, and the available ecological monitoring data do not indicate that point source discharges from the ORP are having significant adverse effects.*
- *The NPS-FM 2014 assigns sites as follows:*
  - *Ammoniacal nitrogen concentrations were assigned to attribute state B at the upstream monitoring site and attribute state C at the downstream site; and*
  - *Nitrate-nitrate nitrogen concentrations were assigned to attribute state B at the upstream monitoring site and attribute state C at the downstream site.*
- *The major driver of increased ammoniacal nitrogen and 5-day biochemical oxygen demand downstream of the ORP appears to be the continuous discharge of cooling/backwash water and stormwater, while nitrate-nitrite nitrogen, soluble inorganic nitrogen and dissolved reactive phosphorus are equally affected by wastewater discharges and cooling/backwash water and stormwater discharges. From the monitoring data collected upstream and downstream of where wastewater from the ORP is discharged to land, the following conclusions were made about the effects of land-based wastewater discharges on water quality and freshwater ecology in the Inaha Stream and the Western Tributary:*
- *The discharge of treated wastewater from the ORP to land does not to have a significant effect on ammoniacal nitrogen concentrations in the Inaha Stream.*
- *The discharge of treated wastewater to land has a significant effect on nitrate-nitrite nitrogen concentrations in the Inaha Stream, and is responsible for up to 61% of the 1.42 g/m3 average increase in concentration within the irrigation area.*
- *The discharge of treated wastewater from the ORP also has a significant effect on ammoniacal nitrogen and nitrate-nitrite nitrogen concentrations in the Western Tributary. On average, ammoniacal nitrogen concentrations increase by 0.62 g/m3 (18-fold increase) within the irrigation area*[4]*, and nitrate-nitrite nitrogen concentrations increase by 1.11 g/m3 (a 39% increase). As a result, the Western Tributary does not meet the national bottom line for nitrate toxicity under the NPS-FM.*
- *Although the land-based discharge of wastewater from the ORP is significantly degrading water quality in the Inaha Stream and the Western Tributary, there is no consistent evidence of significant adverse effects on macroinvertebrate communities.*

[4] The irrigation area refers to the area irrigated by wastewater from the ORP.

5.3.1 Dilution Rate for Surface Water Discharge

Aquanet Consulting prepared a further technical memo (Appendix 9) in December 2019 which addresses a question from TRC in relation to the appropriateness of the 300:1 dilution rate and any alternative dilution rates considered by TBP and in response to a question about whether a reduction in flow to the Inaha Stream results from water take and discharge activities from the fire pond.

Aquanet Consulting's response is included below:

Response

The proposed dilution rate of 300:1 exists with the existing consent conditions held by Taranaki By-Products (TBP) and is proposed to continue to apply in the replacement consent.

In assessing the appropriateness of this rate, we have considered a number of factors including the degree to which this dilution rate is currently managing instream effects in the Inaha Stream. We refer to our assessment of environmental effects report included with the original application.

As one way of determining appropriateness of this dilution rate, we have considered any potential effects on kākahi (freshwater mussels), which have been found in the Inaha Stream (although to our knowledge not downstream of the Plant). Kākahi are particularly sensitive to ammonia toxicity and so provide a good indicator species when considering the effects of a discharge of this nature.

Recent advice from Dr Chris Hickey of NIWA suggests that to protect kākahi from chronic toxicity effects, unionised ammonia (NH3-N) needs to be managed at so that 95th percentile concentrations do not exceed the NPS-FM attribute state B median concentration threshold (9.2 ppb) (Hickey, 2018). To determine the dilution ratio required to achieve this we have estimated 95th percentile NH3-N concentrations in the Inaha Stream at a range of dilution ratios (100-600), based on:

- *An assumed continuous discharge;*
- *The 95th percentile total ammoniacal nitrogen (NH4-N) concentration recorded in the treated wastewater by TRC between July 1995 and August 2016 (421.7 g/m3);*
- *The average NH4-N concentration recorded in the Inaha Stream upstream of the discharge at Kohiti Rd by TRC between January 1997 and December 2017 (0.043 g/m3); and*
- *The estimated ratio of NH4-N and NH3-N in the Inaha Stream downstream of the discharge based on average pH (7.6) and temperature (13.8 °C).*

The results of this analysis show that if future discharge NH4-N concentrations were to reflect those observed between 1995 and 2016, then a dilution ratio of roughly 1:500 (Figure 1) would be *needed to ensure that 95th percentile NH3-N concentrations in the Inaha Stream do not exceed the kākahi protection threshold downstream of the discharge.*

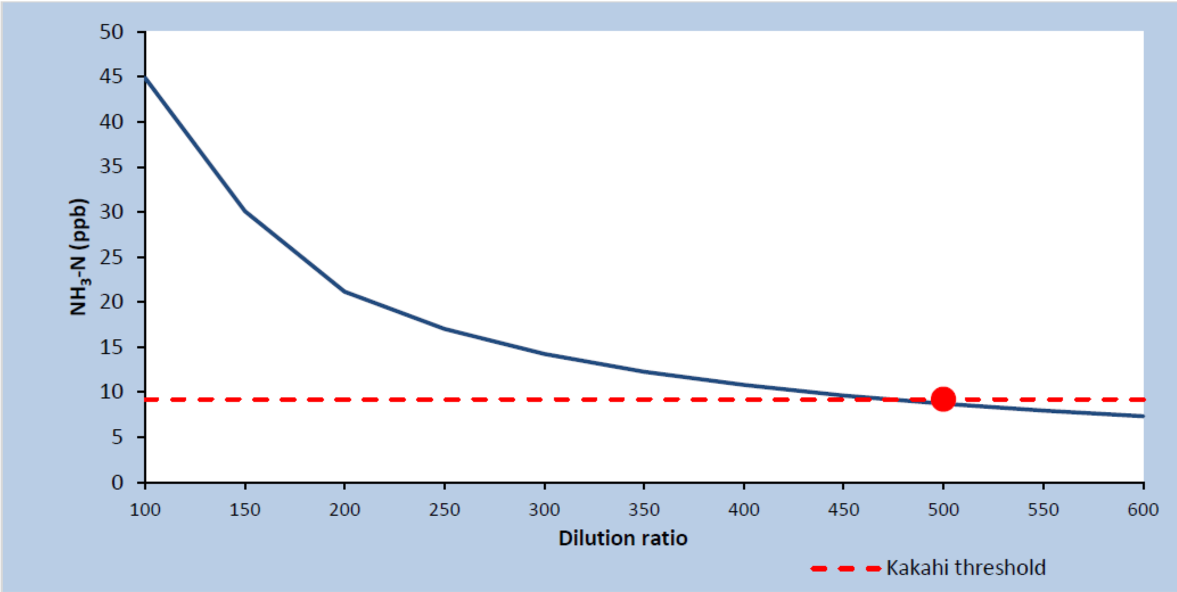

Figure 1: Expected (based on measured discharge quality data between 1995 and 2016) 95th percentile NH_3-N concentration in the Inaha Stream at different dilution ratios compared to the threshold for the protection of kākahi from ammonia toxicity.

While the data collected since 1995 indicates a 1:300 dilution ratio is not appropriate, discharge quality has improved since records began. Analysis of effluent quality collected by TBP between July 2015 and June 2019 shows that over that period NH4-N concentrations did not exceed 272 g/m3. TBP have indicated that the current treatment system is able to keep ammonia below that level, and that an NH4-N limit of 275 g/m3 is achievable (noting that TBP are continuing to implement improvements, including through the addition of a VSEP filter system, the details of which we understand are being provided as a separate component of the response to further information). When this value is used to predict 95th percentile NH3-N concentration in the Inaha Stream at different dilutions (100-600) it appears that a 1:300 ratio should protect kākahi from toxicity effects (Figure 2).

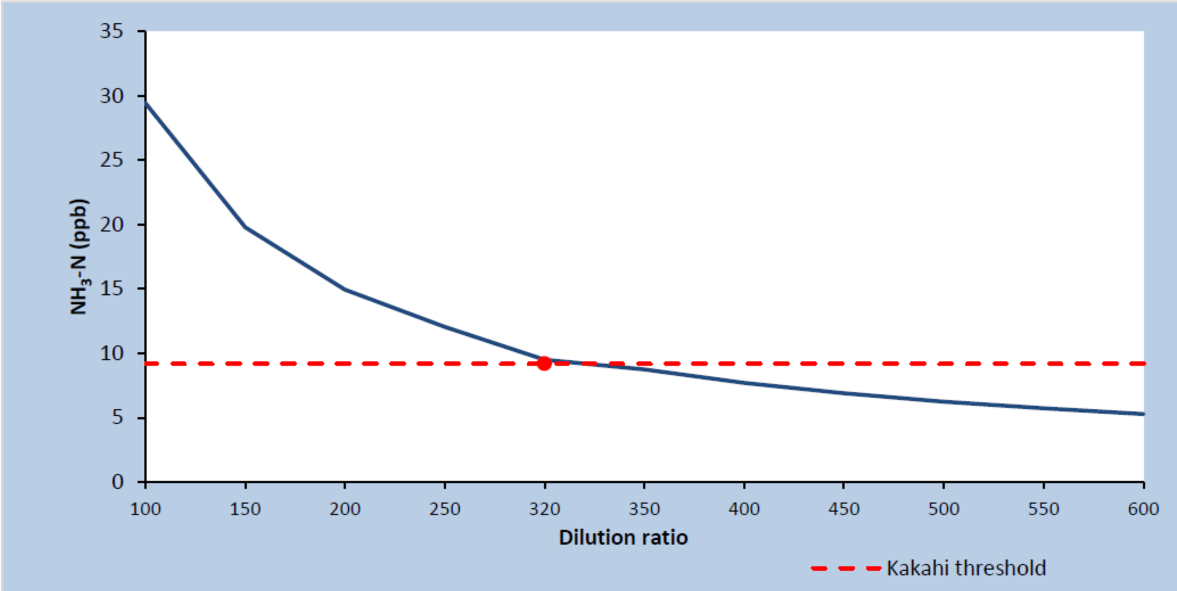

Figure 2: Expected (based on an NH_4-N limit of 275 g/m^3) 95th percentile NH_3-N concentration in the Inaha Stream at different dilution ratios compared to the threshold for the protection of kākahi from ammonia toxicity.

Summary and recommendations

- The 1:300 dilution ratio should protect kākahi (a useful indicator species given its low tolerance for NH4-N) from ammonia toxicity effects provided that a limit is placed on NH4-N in the discharge.
- It is recommended that the effluent limit for NH4-N be set at 275 g/m3. It should apply as a 95th percentile (consistent with the instream threshold for kākahi protection), and compliance should be assessed in accordance with the NZ Municipal Wastewater Monitoring Guidelines (e.g. no more than 2 exceedances in 12 samples).

5.3.2 Rate of take and rate of discharge from fire pond

The December 2019 Aquanet Consulting technical memo (Appendix 9) also explores the rate of take and rate of discharge from the firewater pond as requested by TRC.

The report highlights that there is no flow information available to confirm discharge volumes from the fire pond as the discharge is not metered.

Observations from the memo's author outline that "the abstraction from the Inaha Stream does not result in a reduction in flow in the Stream, as the take is more than offset by the discharge from the fire pond". The author notes that while the water take is metered, the discharge from the fire pond is not and the memo identifies that there are "various practical difficulties and cost implications with monitoring the total discharge". This is due to the undefined water sources (likely ground water and springs) which enter the firewater pond. Dr Greer, author of the memo, observed that there was "a noticeable increase in the discharge volume (associated with natural contributions of groundwater to the fire pond) compared with the rate of take from the Inaha".

Based on the information provided by Dr Greer, it is considered that any effects on surface water quantity as a result of abstractions are considered to be less than minor.

5.3.3 Effects on Surface Water from the Burial of Solid Waste

As a result of the decision by TBP to move away from a lined burial pit option, PDP have amended their AEE to accompany this application to include consideration of the effects on groundwater from the use of unlined emergency burial pits.

Section 5.3 of the amended AEE by PDP (Appendix 1) assess the actual and potential effects on surface water quality as a result of any future emergency burial activity.

The report identifies that concentrations of ammoniacal nitrogen in the Inaha Stream would potentially *"increase by 1.6g NH4-N/m^3 to 2.2 g NH4-N/m^3"* at low flow of 100 L/s in the Inaha Stream year round or *"increase by 0.53 g NH4 N/m^3 to 0.73 g NH4-N/m^3"* at median flow of 300 L/s assuming:

- no loss of ammoniacal nitrogen through nitrification or other means, and
- all ammoniacal nitrogen discharging to the stream.

Based on these rates of increase and the length of time since tipping began, the report outlines that *"… it would be expected that surface water monitoring would be identifying the increase in ammoniacal nitrogen in surface water at low to medium flow conditions".*

The report further identifies that *"surface water monitoring through the stretch of stream of potential influence has not identified an increase in ammoniacal nitrogen, this indicates that there may be attenuation functions occurring in the groundwater system or within the stream hyporheic zone. It may also be that the estimated flux rate of nitrogen is conservatively large, however, tipping rate estimates are also based on aerial photography and nitrogen leaching modelling support the estimated nitrogen flux rates (refer to Appendix G). This indicates that attenuation functions are the more likely cause, however, to avoid potential increases in ammoniacal nitrogen migrating to the stream, the tipping rates should not be increased beyond the estimated historical rates of between 406 tonne/yr and 568 tonne/yr (an average of approximately 487 tonnes per annum)."*

Appendix 4 contains a location plan indicating the proposed future location of solid waste burial.

In addition to the limits to the volume of offal to be buried, quarterly monitoring of the water quality in the Inaha Stream, both upstream and downstream of the burial pit area will be undertaken to ensure any adverse effects of the discharge from the burial pits is identified. Monitoring proposed includes dissolved oxygen, pH, electrical conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate nitrogen, nitrite nitrogen, sulphate and *E coli*. A condition reflecting this requirement has been included in Appendix 5.

5.3.4 Surface Water effects Summary

The available data indicates that the continuous cooling/backwash water discharge from the ORP picks up a significant contaminant load as it flows through the pond used to store the plant's fire water and stormwater. Therefore, the Aquanet report (2018) suggests that the effects of the ORP on water quality in the Inaha Stream may be significantly reduced by shifting the discharge so it no longer mixes with the plants pond water before entering the stream. However, an alternative method of cooling the discharge would also need to be implemented to prevent temperature from increasing in the stream.

Nitrate concentrations in the Inaha Stream are currently in NPS-FM 2014 attribute state C upstream and downstream of the irrigation area. This means that nitrate toxicity affects the growth of up to 20% of species downstream. Should the objective be to maintain nitrate concentration in the Inaha Stream downstream of the ORP within attribute state B, then the cumulative (i.e. from all discharges to land and to water) nitrogen load discharged from the ORP would need to reduce by approximately 83%.

Nitrate concentrations in the Western Tributary are currently in NPS-FM 2014 attribute state C upstream of the irrigation area[1] and attribute state D downstream. The nitrogen load discharged from the ORP to land would need to be reduced by approximately 15% for the Western Tributary to meet the attribute state C threshold. Attribute state B is not currently achievable in the Western Tributary without significant reductions in nitrogen input upstream of, as well as within, the ORP.

It is recommended that future water quality monitoring is undertaken on monthly basis to allow for an unbiased assessment against the NPS-FM 2014 attribute states for ammonia and nitrate toxicity.

Assessment on the take and rate of discharge from the firewater pond at the plant was considered and concluded that there was a noticeable increase in the discharge volume (associated with natural contributions of groundwater to the fire pond) compared with the rate of take from the Inaha". As a result, any effects on surface water quantity as a result of abstractions are considered to be less than minor.

Current surface water monitoring is not detecting increased ammoniacal nitrogen in the Inaha Stream, despite the stream being the key receptor for groundwater in the vicinity of the burial area. To mitigate potential future effects on surface water quality, restrictions on the amount of waste material buried each year and monitoring of surface water quality are recommended.

5.4 Odour

The ORP is located in a rural environment, with the predominant activity of neighbouring properties being dairy farming. There are dwellings located near the ORP, with the closest residential area being Okaiawa, 1km to the east of the ORP.

PDP's report on the Land Treatment of Wastewater – Technical Assessment of Environmental Effects (Appendix 1) includes an assessment of the effects related to odour relating to irrigation. Potential nuisance effects associated with spray drift and odour are considered to be less than minor due to the proposed separation distances from boundaries and dwellings and the aerobic nature of the irrigated wastewater. Since at least 2013, there have been no odour complaints associated with operation of the irrigation system and therefore it is anticipated that there will be minimal potential for generation of odours from the irrigation system going forward.

In terms of odour from the other discharges, due to the use of anaerobic treatment systems, there is a potential for odour to occur in the wastewater treatment system. However, the following conditions are maintained to minimise odour generation in anaerobic pond:

- The load distribution to Pond 1 and 2 shall be uniform.
- During peak processing, the inflows may be diverted partly to Pond 2 so that Pond 1 does not become odorous.
- Encourage solid crust layer in all anaerobic ponds by adding straw.
- Recycling of weak wastewater into the anaerobic ponds may be undertaken if there is strong effluent discharged into these ponds.

The treatment of wastewater requires that there shall be no objectionable odour beyond the property boundary. If there is objectionable odour reported beyond the boundary of the property, TBP fill in an Incident Report Form and advice TRC if an adverse effect has been caused by the odour.

5.5 Effects on Cultural Values

The actual and potential cultural effects of the proposal and methods to address those effects have been identified through consultation hui with Ngāti Manuhikai, Inana Reservation Trust, and Te Korowai o Ngāruahine Trust. There is no known Iwi Environmental Management Plan. As such, TBP have directly consulted with iwi to better understand the effects of the proposal on cultural values.

The Inaha Stream is recognised as an important stream for food gathering. We understand that the most important species along this stretch of the Inaha Stream are tuna (eel) and koura (freshwater crayfish). Kākahi (freshwater mussels) are present further upstream, but not in the vicinity of the plant. Following confirmation of the effects of the discharges, no concerns were raised with regards to potential impacts on these species, providing the temperature of the discharge water continued to be managed effectively and no discharge occurred that would render species unfit for human consumption.

There is a sacred fishing stone downstream of the discharge point, and the southern end of the stream is a sacred area. The Inaha Stream is also a trout fishery area and is a popular place for local people to fish. Water is culturally significant to iwi. Of particular note, Te Kopanga Spring (Shearer's Spring) has significance for the people of the Te Aroha marae.

As part of the pre-application consultation with Ngāti Manuhiakai (hapū) and Te Korowai o Ngāruahine Trust, it was agreed that TBP would provide both parties with a copy of the full resource consent application. Further conversation can then take place, with the benefit of the detail provide in the application documents, to confirm the position on cultural effects.

Certain aspects of the proposal have, however, focused on matters of concern previously noted by iwi. It has been confirmed with iwi that there will be no irrigation of wastewater close to the Marae or near Urupa.In addition, it is important to note that in Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (Appendix 3), whilst significant adverse effects are occurring in the Inaha Stream and the Western Tributary in terms of water chemistry, there is no consistent evidence of significant adverse effects on macroinvertebrate communities / aquatic life.

Following further consultation with Ngāti Manuhikai hapū, a mitigation agreement was developed which captures the outcomes of ongoing discussions between the hapū and TBP and the desire of the parties to establish and maintain a long-term relationship (Appendix 10).

Many matters are included in the agreement including:

- Acknowledgement of sites of significance;
- Proposal to develop a monitoring protocol of the Inaha Stream;
- Agreement regarding monitoring of spray drift on Te Aroha marae drinking water supply;
- Agreement regarding emergency burial activities;
- Correct referencing of Te Kopanga Spring;
- Agreement regarding riparian planting;
- Agreement to hold a regular (annual) meeting between the parties;
- Process for dispute resolution

As a result of the agreement, Ngāti Manuhiakai hapū have agreed that the actual and potential cultural effects [of the applications for resource consent] will be appropriately avoided, remedied or mitigated.

Since the agreement was signed, TBP have decided to proceed with emergency burial activities to unlined pits rather than the lined pits as were originally proposed. Ngāti Manuhiakai have provided TBP with confirmation of their support for this revised approach, see email attached as Appendix 12.

5.6 Effects on Recreation

Although the immediate surrounding land is privately owned, there is recreational activity that occurs on the Inaha Stream primarily relating to fishing.

As stated earlier, the Inaha Stream is recognised as a water body of known regional significance for their native fishery habitat value. It is said to be a habitat of threatened or regionally distinctive (aquatic) species including Lamprey, Freshwater mussel and Longfin eels.

As referred to in the Aquanet report (2018), the New Zealand Freshwater Fish Database contains records of longfin eel (Anguilla dieffenbachii), shortfin eel (Anguilla australis), lamprey (Geotria australis), brown trout (Salmo trutta) and kōura/freshwater crayfish (Paranephrops planifrons) in the Inaha Stream. Kākahi/freshwater mussels (Echyridella menziesi) are also present upstream of the ORP. While brown trout are present in the Inaha Stream, and people do occasional fish in it, it is not considered a significant fishery (pers. comm. Alan Stancliff, South Taranaki Fish & Game).

There is limited information in regard to the estimated population of the above listed species in the Inaha, however, TBP have engaged with Fish & Game as part of pre-application consultation. Similar to the approach with iwi, it was agreed that TBP would provide Fish & Game with a copy of the full resource consent application. It is considered that once they have viewed the application, then it could be determined what effects the proposal may have on recreation. Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (Appendix 3) did find that while significant adverse effects are occurring in the Inaha Stream and the Western Tributary, there is no consistent evidence of significant adverse effects on macroinvertebrate communities / aquatic life.

It is also noted that TBP have engaged with the Inaha Reservation Trust who informed TBP that Kākahi are not present in the Inaha where TBP is located. Through pre-application consultation, they stated they had only found Kākahi upstream before an area of land where there has been significant willow removal. The Inaha Reservation Trust did note that there were freshwater crayfish and eels in the Inaha where TBP is located and downstream, however, they are still in the stages of developing their sampling so TBP could not refer to this reporting. It is recognised that this is also a cultural effect matter. Aquanet Consulting Limited found in their Assessment of Effects on Freshwater Quality and Ecology (Appendix 3) that current NNN concentrations in the Inaha Stream both upstream (at Ahipai Road) and downstream (at Normanby Bridge Road) of the ORP irrigation area were assigned to attribute state C under the NPS-FM 2014. Furthermore, since December 2011, median NNN concentrations at both sites, and 95th percentile concentrations at the downstream site have frequently been in attribute state C. This suggests that at both sites, the growth of up to 20% of species (mainly sensitive species such as fish) may have been affected by nitrate toxicity sites, but there would have been no acute effects.

5.7 Summary of Environmental Effects

The operation of the ORP has been found to have several significant adverse effects, including:

- The discharge of treated wastewater to land having a significant effect on nitrate-nitrate nitrogen concentrations in the Inaha Stream;
- The discharge of treated wastewater from the ORP is having a significant effect on ammoniacal nitrogen and nitrate-nitrate nitrogen concentrations in the Western Tributary;
- The nitrate within groundwater discharging into the streams is having a significant effect on the nitrate concentrations within the streams during low flow conditions;
- There do not appear to be a significant adverse effect on aquatic life associated with the changes in water chemistry noted above;

With the mitigation proposed, it is considered that the level of adverse environmental effects can be reduced at the ORP.

All other environmental effects are considered to be no more than minor.

6 Policy and Planning Assessment

6.1 Section 104 of the RMA

Section 104(1)(b) of the RMA sets out the suite of planning instruments that must be considered in any assessment of the proposal. The following assessment identifies the relevant documents and considers the proposal in relation to the relevant provisions.

The relevant policy and planning documents are:

- National Policy Statement for Freshwater Management 2014 (amended 7 August 2017);
- National Environmental Standard for Sources of Human Drinking Water 2007;
- Regional Policy Statement for Taranaki;
- Regional Fresh Water Plan for Taranaki; and
- Regional Air Quality Plan for Taranaki.

There is no record of an Iwi Environmental Management Plan being submitted to Taranaki Regional Council for this area.

6.1.1 Section 104(2A)

Section 104(2A) of the RMA states:

"When considering an application affected by section 124, the consent authority must have regard to the value of the investment of the existing consent holder."

The ORP is an essential service within the community and TBP have put significant investment into the plant and associated infrastructure. The total value of the plant and infrastructure assets is estimated to be $80 million.

6.1.2 Section 124 of the RMA

TBP request that TRC exercise their discretion with respect to section 124(2) of the RMA to enable TBP to continue to operate under existing resource consents 2049-4, 2050-4, 2051-4, 3941-2, 5426-1 and 5495-1 until a new consent is granted and all appeals are determined, or a new consent is declined, and all appeals are determined.

6.1.3 Sections 105 and 107 of the RMA

Sections 105 and 107 of the RMA set out additional matters that need to be considered in relation to applications for discharge permits.

6.1.3.1 Section 105 of the RMA

Section 105(1) of the RMA states:

> *If an application is for a discharge permit or coastal permit to do something that would contravene section 15 or section 15B, the consent authority must, in addition to the matters in section 104(1), have regard to—*
>
> *(a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
>
> *(b) the applicant's reasons for the proposed choice; and*
>
> *(c) any possible alternative methods of discharge, including discharge into any other receiving environment.*

As such, s105 is relevant for this application given TBP are seeking to continue to discharge treated wastewater to the Inaha Stream and to land and the technical reports by Aquanet (2018) and PDP (2018) have both conducted monitoring in order to understand the nature of the discharge and the sensitivity of the receiving environment to adverse effects.

Drawing on the conclusions made by Aquanet (2018) and PDP (2018), TBP are proposing to continue their current operations and generally wish to have like-for-like consent conditions, but are committed to implementing mitigations measures including treatment upgrades to improve environmental outcomes, by focusing on the causes of the compliance issues occurring at the site.

The assessments carried out and the approach to mitigation was discussed with key stakeholders at the pre-application stage, and there was general agreement with those mitigation measures. In particular, the move from unlined to fully lined burial pits was considered to be a better alternative method of discharge to land however this option is no longer viable for TBP. Future burial activities are proposed to only occur in emergency situations where all other alternatives have been exhausted and a significant reduction in the volume of material that can be buried is recommended as discussed in Section 3.4 above.

As such, TBP consider that the above satisfies 105(1)(b) and (c).

6.1.3.2 Section 107 of the RMA

Alongside the considerations under s105 are the requirements under s107 of the RMA. Section 107(1) states that a discharge permit "shall not be granted" where, after reasonable mixing, the contaminant is likely to give rise to all or any of the following effects in the receiving waters:

> *(c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials:*
>
> *(d) any conspicuous change in the colour or visual clarity:*
>
> *(e) any emission of objectionable odour:*

> *(f) the rendering of fresh water unsuitable for consumption by farm animals:*
>
> *(g) any significant adverse effects on aquatic life.*

The exception provided in Section 107(2) is a discharge permit causing such effects can be granted where the Council is satisfied that:

> *(a) exceptional circumstances justify the granting of the permit, or*
>
> *(b) the discharge is of a temporary nature*

Aquanet Consulting Limited's report on the Assessment of Effects on Freshwater Quality and Ecology (Appendix 3) involved collecting of monitoring data upstream and downstream of where the wastewater is discharged from the ORP. With reference to the above criteria, they found:

- no evidence of the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials
- no conspicuous change in the colour or visual clarity
- no emission of objectionable odour
- that the fresh water is not considered likely to be classed as unsuitable for consumption by farm animals
- the discharges from the ORP are significantly degrading water quality in the Inaha Stream, but this degradation does appear not be adversely affecting aquatic life.

6.2 National Policy Statement for Freshwater Management 2014

The National Policy Statement for Freshwater Management 2014 ("NPSFM") provides national direction for the management of freshwater under the RMA. The NPSFM sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and water quality limits.

The National Policy Statement for Freshwater Management ("NPSFM") first took effect on 1 July 2011. Further amendments to the NPSFM were gazetted on 4 July 2014 and superseded the earlier 2011 version. On 7 September 2017, further amendments to the NPSFM came into effect. The amendments to the NPSFM seek to ensure that freshwater quality improves over time, and the key changes include requirements on regional councils to set regional swimming targets, achieve freshwater objectives and consider Te Mana o Te Wai in the management of freshwater and additional monitoring requirements.

The key objectives contained within the NPSFM of relevance to this proposal are primarily concerned with:

- Safeguarding the life-supporting capacity, ecosystem processes and indigenous species of freshwater through sustainably managing the use and development of land, discharges of contaminants, (Objective A1);
- Maintaining or improving the overall quality of freshwater within a region, including improvement in freshwater quality in water bodies that have been degraded by human activities to the point of being over allocated (Objective A2);
- To safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the taking, using, damming, or diverting of fresh water (Objective B1);
- To improve and maximise the efficient allocation and efficient use of water (Objective B3);
- Improving the integrated management of freshwater and the use and development of land in whole catchments (Objective C1);
- Establishing freshwater objectives for national values that are nationally consistent while recognising regional and local circumstances (Objective CA1);
- Providing an approach for the monitoring of progress towards, and the achievement of, freshwater objectives (Objective CB1);
- Improving information on freshwater takes and sources of freshwater contaminants (Objective CC1);
- Providing for the involvement of iwi and hapū an ensuring that tangata whenua values and interests are identified and reflected in the management of freshwater (Objective D1);

Regional Councils are required to give effect to the NPSFM through their regional plans. Taranaki Regional Council is proposing to merge the current Fresh Water and Soil Plans into a Regional Freshwater and Land Management Plan for Taranaki which will give effect to the NPSFM. Taranaki Regional Council have included transitional policies in regard to the NPSFM in the Regional Fresh Water Plan in Section 5A. In addition, Policy A4 of the NPSFM provides interim matters for regional councils to have regard to when considering any application for discharge consent.

The NPS-FM 2014 assigns sites as follows:

- Ammoniacal nitrogen concentrations were assigned to attribute state B at the upstream monitoring site and attribute state C at the downstream site; and
- Nitrate-nitrate nitrogen concentrations were assigned to attribute state C at the upstream and downstream monitoring sites.

Nitrate concentrations in the Western Tributary are currently in NPS-FM 2014 attribute state C upstream of the irrigation area and attribute state D downstream. The discharge of treated wastewater to land has a significant effect on ammoniacal nitrogen and nitrate-nitrite nitrogen concentrations in the Western Tributary. On average, ammoniacal nitrogen concentrations increase by 0.62 g/m3 (18-fold increase) within the irrigation area, and nitrate-nitrite nitrogen concentrations increase by 1.11 g/m3 (a 39% increase).

NNN concentrations at the most downstream site on the Western frequently exceed the national bottom line for nitrate toxicity under the NPS-FM 2014, and it would appear that discharge of treated wastewater from the ORP is a driver of this. Mitigation measures have been proposed in order to reduce the cumulative N-load required to meet the NPSFM attribute state for nitrate toxicity.

6.3 National Environmental Standard for Sources of Human Drinking Water

The National Environmental Standard (NES) for Sources of Human Drinking Water is intended to reduce the risk of contaminating drinking water sources. It came into effect on 20 June 2008. The NES requires regional councils to ensure that effects on drinking water sources are considered in decisions on resource consents. Specifically, councils are required to:

- Decline discharge or water permits that are likely to result in community drinking water becoming unsafe for human consumption following existing treatment;
- Place conditions on relevant resource consents requiring notification of drinking water suppliers if significant unintended events occur (e.g. spills) that may adversely affect sources of human drinking water.

The NES for Drinkwater 2007 does not appear to apply to small drinking water sources (<25 persons), but for standards it specifically references the Drinking water standards 2005 (updated 2008). In considering the Te Kopanga Spring (Shearer’s Spring), the key parameter for consideration is nitrate nitrogen. The Drinking Water Standard 2008 sets a limit on Nitrate nitrogen of 11.3 g NO3-N/m3, which we have assessed against.

As discussed in the PDP Report (Appendix 1), TBP currently hold a consent to take and use groundwater for industrial water supply only at the site. There are no other additional consented groundwater takes within 3km of the southern site boundary (i.e. down gradient of the site). However, permitted takes may exist and it is understood that the spring (GND1058) located just to the south of the site boundary is currently used for domestic supply. Concentrations at the spring remain significantly below the DWSNZ 2008 limit.

6.4 Regional Policy Statement for Taranaki

The Regional Policy Statement for Taranaki was made operative on 1st January 2010. The Regional Policy Statement contains a number of chapters that are relevant to the consideration of replacement consent applications. Chapter 6 relating to freshwater is of particular relevance. Also relevant are Chapters 9 - Indigenous Biodiversity, and Chapter 16, relating to iwi interests.

The RPS is a high-level planning instrument with a purpose to promote the sustainable management of natural and physical resources in the Taranaki region. On water quality, the RPS seeks to maintain and enhance surface water quality in Taranaki's rivers, streams, lakes and wetlands by avoiding, remedying or mitigating any adverse effects of point source and diffuse source discharges to water (WQU Objective 1).

The following outlines an assessment of the application against the RPS, in terms of the relevant objectives and policies. For succinctness, the following is assumed to be read alongside the full text of the RPS, and therefore RPS provisions are not replicated verbatim here unless considered useful for the analysis.

6.4.1 Chapter 4: Recognising the Role of Resource Use and Development in Taranaki

Chapter 4 describes how a notable feature of the Taranaki region is its reliance on the region's natural and physical resources for its economic and social wellbeing.

The following matters within Chapter 4 are considered of relevance to the application:

- UDR Issue 1: Recognising the role of resource use and development in the Taranaki region.
- UDR Objective 1: To recognise the role of resource use and development in the Taranaki region and its contribution to enabling people and communities to provide for their social, economic and cultural wellbeing.
- UDR Policy 1: Recognition will be given in resource management processes to the role of resource use and development in the Taranaki region

In the background to this issue, it is noted that the region has developed a national and international reputation for its food processing industries, particularly in dairy and meat products. It is considered that a large rendering plant such as ORP is necessary to provide support to a region where the dairy and meat industry contributes so highly to the community's ability to provide for their social and economic wellbeing.

The proposal is considered consistent with the provisions of Chapter 4 as it will enable TBP to continue to operate its business which uses natural resources in a way to promote the sustainable management purpose of the RMA. TBP is the main animal rendering plant in the Taranaki region and it provides employment and a necessary function to the community.

6.4.2 Chapter 6: Fresh water

Chapter 6 identifies resource management issues of regional significance that primary effect on Taranaki's fresh water (both surface and groundwater) resources.

The following matters within Chapter 6.1 are considered of relevance to the application:

- WIAL Issue 1: Providing for a range of water uses while avoiding, remedying or mitigating any adverse effects on the environment.
- WIAL Issue 2: Maintaining the natural character and life-supporting capacity of Taranaki water bodies.
- WIAL Objective 1: Sustainable management of the take, use, damming or diversion of fresh water.
- WIAL Objective 2: Protect natural character of water bodies from inappropriate subdivision, use and development.
- WIAL Policy 1: Making water available for use.
- WIAL Policy 3: Maintain in-stream values and life-supporting capacity.
- WIAL Policy 4: Promote the restoration of the life-supporting capacity of waterbodies which have become degraded.
- WIAL Policy 5: Recognise the rights of existing water permit holders.

TBP relies on a range of water uses in order to operate, including water discharges and water take. TBP are currently utilising consents and wish to use the time of renewal in order to improve the environmental outcomes related to those water uses. Therefore, the mitigation proposed has focused on avoiding, remedying or mitigating any adverse effects on the environment to ensure that it will operate compliantly. It is considered that this approach to maintain the natural character and life-supporting capacity of the water bodies, namely the Inaha Stream, the Western Tributary, and the groundwater.

It is considered that the current water take is operating compliantly and in line with sustainable management principles, and that the combination of the current consent conditions and the proposed mitigation will protect the natural character of the water bodies from inappropriate use/development.

The provision of water assists TBP to provide for the continued operation of their plant. It is considered that TBP have adequately demonstrated the need to the volume of water sought and they request adequate recognition that they are existing water permit holders. The water take is only for non-consumptive use and the daily take is equivalent to the daily discharge and consequently that there is no net effect in the stream flow. It is not considered that the water take impacts on the life-supporting capacity of the waterbody.

The following matters within Chapter 6.2 are considered of relevance to the application:

- WQU Issue 1: Managing adverse effects on water quality arising from point source discharges to water bodies.
- WQU Issue 3: Managing the cumulative adverse effects on water quality arising from both multiple point source discharges and diffuse source discharges to water bodies.
- WQU Policy 1: Sustainable land management practices.
- WQU Policy 4: Domestic and community water supplies.
- WQU Policy 5: Point source discharges to surface water.
- WQU Policy 6: Restoration of water quality.

The discharge to water from the ORP focuses on two aspects of point source discharges; the discharge of the stormwater and cooling/backwash water, and the discharge of the wastewater. It is considered that with the suggested mitigation proposed, that the adverse effects on water quality will be sufficiently managed and assist in the necessary restoration of water quality. The mitigation in particular is considered to manage the cumulative adverse effects on water quality arising from both multiple point source discharges and the diffuse source discharges to land (that is near the Inaha Stream).

In regard to domestic water supplies, PDP (2018) investigated whether there was an adverse effect from nitrate nitrogen migrating off-site in the groundwater. They found that concentrations at the spring remain significantly below the DWSNZ 2008 limit.

It is considered that the proposal is consistent with WQU Policy 6 as TBP is looking to improve water quality through the proposed mitigation measures. However, it is important to note that upstream of the TBP discharge points there has been a reduction in water quality over recent years and TBP can only improve what happens at their site.

The following matters within Chapter 6.3 are considered of relevance to the application:

- GWR Issue 2: Managing adverse effects on groundwater quality arising from land use, the discharge of contaminants and poor well and bore sitting and construction.
- GWR Objective 1: Sustainable management of groundwater.
- GWR Policy 4: Groundwater quality.

TBP acknowledge that groundwater is discharging into the Inaha Stream and the unnamed tributary across the majority of the site and that the concentration of NNN within the groundwater is elevated. The PDP (2018) report proposes mitigation and monitoring measures for both the ongoing effects associated with the historical treated wastewater land treatment activities and the effects associated with proposed treated wastewater land treatment activities. These include a range of irrigation control methods, nutrient management, soil and stock health management, an updated irrigation management plan and increased monitoring. Combined with the VSEP upgrade, it is considered that this approach will assist in the necessary restoration of groundwater quality.

6.4.3 Chapter 7: Air and climate change

Chapter 7 identifies resource management issues of regional significance which have their primary effect on Taranaki's air quality.

The following matters within Chapter 7 are considered of relevance to the application:

- AQU Issue 2: Managing reverse sensitivity
- AQU Policy 3: Reverse sensitivity

As the ORP has been operating since 1936 and is located within the rural zone, that a certain level of odour is to be expected. In terms of the existing consent relating to odour, it is noted that the ORP has been operating in line with the consent condition relating to odour. No expansion to operations is proposed through this application. Accordingly, the proposal is considered to maintain the ambient air quality in this environment and will not be detrimental to amenity values, human health, property or the life-supporting capacity of air.

6.4.4 Chapter 10.3 Maintaining and enhancing amenity values

Chapter 10.3 recognises that Taranaki residents place high value on amenity.

The following matters within Chapter 10.3 are considered of relevance to the application:

- AMY Issue 1: Recognising the positive effects of use and development in relation to maintenance and enhancement of amenity values.
- AMY Objective 1: Recognise positive contributions to maintenance and enhancement of amenity values.
- AMY Policy 1: Amenity values.

It is considered that as TBP is proposing to improve its current processes without proposing any expansion of their plant, that the proposal is consistent with the direction given by the above objective and policies.

6.4.5 Chapter 12: Waste management

Chapter 12 recognises the need to minimise waste and manage its disposal.

The following matters within Chapter 12 are considered of relevance to the application:

- WST Issue 2: Providing for the efficient and effective disposal of waste while avoiding, remedying or mitigating any adverse environmental effects associated with waste disposal.
- WST Objective 1: Minimise the quantity of waste being produced and disposed of within the Taranaki region and to ensure that the disposal of wastes avoids or mitigates adverse environmental effects.
- WST Policy 1: Encourage waste minimisation practices and practices to avoid, remedy or mitigate the adverse environmental effects of final disposal by promoting lower levels of waste generation, higher levels of reuse, recycling and recovery of waste and efficient and effective treatment and disposal of waste.

As a meat rendering operation where the proposal is not to expand their operation, it is considered that the proposal is consistent with the direction given by the above objective and policy. TBP supports this objective and policy, as it encourages resource efficiency and beneficial reuse by making use of what might otherwise be regarded as a 'waste' product, and creating a saleable export product, which helps create sustainable, economic growth. The proposal also protects our communities, land, water and air from harmful and hazardous wastes by treating liquid wastes and discharging those treated wastes in a legal and environmentally friendly manner (as authorised by TRC resource consents).

6.4.6 Chapter 15.2 Providing for regionally significant infrastructure

Chapter 15.2 outlines that the region's network utilities and other infrastructure are physical resources of considerable importance to Taranaki.

The following matters within Chapter 15.2 are considered of relevance to this application:

- INF Issue 1: Recognising and providing for the continue operation of regionally significant infrastructure.
- INF Objective 1: Provide for the continued safe and efficient operation of the infrastructure of regional significance.
- INF Policy 1: Provision made for the efficient and effective maintenance and update of physical infrastructure of regional significance.

Objective INF 1 and associated Policy INF 1 seek to ensure that the benefits of infrastructure and other physical resources of regional or national importance are recognised by providing for their establishment, operation, maintenance and upgrading.

In accordance with Policy INF 1, the ORP is considered a physical resource of regional importance. The ongoing feasible operation of the ORP is therefore important. TBP considers that the site is regionally significant infrastructure and they wish to maintain the permissions granted in their existing consents and are committed to make significant investment in the ORP in order to reduce its environmental effects.

6.4.7 Chapter 16 Statement of resource management issues of significance to iwi authorities

Chapter 16 outlines the key issues of significance to iwi authorities:

- Taking into account the principles of the Treaty of Waitangi;
- Recognising kaitiakiatanga;
- Recognising and providing for the relationship of Māori with ancestral lands, water, sites, wāhi tapu and other taonga;
- Recognising cultural and spiritual values of tangata whenua in resource management processes.

The following matters within Chapter 16 are considered of relevance to this application:

- TOW Issue 1: Effective relationship and acknowledging different perspectives on kawanatanga and rangatiratanga in resource management.
- KTA Issue 1: Shared understanding of kaitiakitanga.
- REL Issue 2: Restoring, maintaining and enhancing the cultural relationship and links of Iwi of Taranaki with the water resources of the region.
- REL Issue 3: Recognising the air resource as a taonga and protecting wāhi tapu from the intrusion of odour or visual pollutants.
- CSV Issue 1: To adopt resource management processes that give particular consideration to the relationship that tangata whenua have with the environment.
- TOW Objective 1: Take into account the principles of the Treaty of Waitangi in the exercise of functions and powers under the RMA.
- KTA Objective 1: Have particular regard to kaitiakitanga.
- REL Objective 1: Recognise and provide for the cultural and traditional relationship of Māori with their ancestral lands, water, air, coastal environment, wāhi tapu and other sites and taonga within Taranaki.
- CSV Objective 1: Management of natural resources in a manner that takes into account the cultural and spiritual values of Iwi o Taranaki.
- TOW Policy 1: Effective relationship.
- TOW Policy 2: Treaty of Waitangi.
- KTA Policy 1: Kaitiakitanga.
- REL Policy 4: Protection of mahinga kai.
- REL Policy 7: Protection of water bodies of significance to iwi.

- CSV Policy 1: Cultural and spiritual values.

Having regard to the mauri of natural and physical resources to enable hapū and iwi to provide for their social, economic and cultural wellbeing is the focus of the chapter and associated policies. The objective and associated policies also seek to ensure that Kaitiakitanga is given particular regard and the relationship of hapu and iwi with their ancestral lands, water, sites and wāhi tapu and other taonga are recognised and provided for.

TBP understands the importance given to the relationship that tangata whenua have with the environment. It has been a priority for TBP to ensure that tangata whenua are informed about the consent renewals and pre-application consultation has been focused on being open and transparent about what the renewal process has brought out in terms of up-to-date monitoring of the existing level of environmental effects. TBP has engaged with Te Korowai o Ngāruahine Trust and Ngāti Manuhiakai and has informed them of the mitigation improvements planned for the ORP. Whilst there was acknowledgement from both hapū and iwi of these improvements in addition to the reassurance that stickwater would not be discharged near the Marae, it is not considered possible to confirm what the effects are in terms of cultural effects from the application until both parties view the application once it is submitted. However, TBP has endeavoured to be consistent with the direction provided by the aforementioned objectives and policies.

The mitigation agreement between TBP and Ngāti Manuhiakai resulted in Ngāti Manuhiakai considering the actual and potential cultural effects [of the applications for resource consent] will be appropriately avoided, remedied or mitigated as discussed in Section 5.5 above. In addition to the mitigation agreement, Ngāti Manuhiakai have provided their support for this revised application, which alters the method for burial of waste in an emergency (see Appendix 11).

6.5 Regional Freshwater Plan for Taranaki

The operative Regional Freshwater Plan became operative on 8th October 2001. The Freshwater Plan contains the objectives and policies relevant to the renewal of consents for the Plant, and the rules applicable to the proposed discharges and water take.

The following outlines an assessment of the application against the Regional Freshwater Plan, in terms of the relevant objectives and policies. For succinctness, the following is assumed to be read alongside the full text of the Regional Freshwater Plan, and therefore the Regional Freshwater Plan provisions are not replicated verbatim here unless considered useful for the analysis.

6.5.1 Chapter 3 Natural, ecological and amenity values and public access

- Objective 3.1.3 Natural character;

- Objective 3.1.4 Life-supporting capacity;
- Objective 3.1.5 Amenity values;
- Objective 3.1.6 Recognition of the differences in and between streams in the region;
- Policy 3.1.2 Avoid, remedy, or mitigate adverse effects of activities on the natural character, ecological and amenity values of all rivers;
- Policy 3.1.3 Safeguard life-supporting capacity of fresh water.

The renewal of the necessary consents for ORP, including the investment into mitigation measures, is considered to be consistent with the above objectives and policies. Whilst there are adverse effects which have resulted from certain activities at the ORP, it is considered that the natural character and life-supporting capacity of the Inaha Stream has still been maintained. The significant adverse effects which have been found through the Aquanet (2018) and PDP (2018) reports has found that over recent years the adverse effects of the discharge to land and discharge to water has largely been related to the introduction of Zeal Grow. Therefore, one of the key mitigation measures is to upgrade the Zeal Grow system. Once installed, the improvements at the ORP will be monitored and there will be a reduction in stickwater discharge to land significantly over time. It is anticipated that the environmental effects should revert back to the pre-2011 environmental conditions. It is considered that this proposal is consistent with Policy 3.1.2 as TBP is attempting to remedy the adverse effects of their activities on the natural character, ecological and amenity values of the Inaha Stream, with a view to safeguard the life-supporting capacity of the fresh water. Whilst TBP wishes to improve the environmental condition of the Inaha Stream, it is also important to note that there have been adverse effects on the water quality of the Inaha upstream of the TBP site which are not possible to resolve by TBP improving their processes.

6.5.2 Chapter 4 Tangata Whenua

- Objective 4.1.1 Recognise and provide for the cultural relationship and values of iwi and hapu with water;
- Policy 4.1.1 Wāhi tapu and other sites or features of historical or cultural significance to Iwi;
- Policy 4.1.2 Mahinga kai;
- Policy 4.1.3 Access;
- Policy 4.1.5 Opportunities for incorporating the customary knowledge of iwi and hapū about river resources.

TBP recognises the cultural relationship and values of iwi and hapū with water. TBP understands the views of tangata whenua in regard to the request to not discharge stickwater in the vicinity of the Marae and has agreed to not do so in future. The discussions that TBP have had with Te Korowai o Ngāruahine

Trust and Ngāti Manuhiakai have demonstrated that mahinga kai is high in importance in terms of ensuring the water quality in the Inaha continues to support aquatic life.

TBP is positive about looking for opportunities for incorporating the customary knowledge of iwi and hapū about river resources. The reports of what kind of aquatic life has been found in the Inaha has been beneficial in terms of assessing the current environmental condition of the Inaha Stream. The Aquanet (2018) report demonstrates that whilst the water quality of the Inaha has been adversely affected by the ORP, this has not affected the life-supporting capacity of the Inaha Stream. The mitigation proposed aims to improve the environmental condition of the Inaha Stream in order to ensure that mahinga kai continues to reside and grow.

As discussed in Section 5.5 above, Ngāti Manuhiakai considered that the actual and potential cultural effects [of the applications for resource consent] will be appropriately avoided, remedied or mitigated and have since provided a letter to TBP (Appendix 11) acknowledging the revised approach to emergency burial and providing their support for this approach, and the ongoing relationship with TBP.

6.5.3 Chapter 5 Use and development of fresh water

- Objective 5.1.1 Enable people and communities to use and develop fresh water resources in accordance with sustainable management;
- Objective 5.1.2 Efficient procedures for activities which have no or only minor adverse effects on the environment;
- Policy 5.1.1 List of items Taranaki Regional Council will consider when managing the use and development of fresh water (including avoid, remedying or mitigating environmental effects, the positive benefits from the use, existing uses of physical resources, effects on lawfully established activities, need to allow existing users to progressively upgrade their environmental performance, where improvements are necessary to meet the provisions of the Plan;
- Policy 5.1.2 Minimise administrative procedures for those activities with minor or no adverse effects on the environment;

Allowing TBP to continue to operate through the renewal of the necessary consents and by putting into place mitigation measures that will improve the environmental condition of the Inaha Stream will enable them to use and development fresh water resources in a manner more in line with sustainable management. Whilst there are activities which involve more than minor adverse effects on the environment, TBP is also proposing activities which will have no or only minor adverse effects on the environment. It is therefore requested that these permitted activities are efficiently proceeded.

It is also important that TRC consider the positive benefits from the ORP as it is providing a necessary service to the Taranaki region and it also provides employment for the local community. Policy 5.1.1 also requires that TRC consider the existing uses of physical resources, the effects on lawfully established activities and the need to allow existing users to upgrade their environmental performance. It is considered that TBP fit into this category and subsequently request that TRC acknowledge that they are attempting to avoid, remedy or mitigate the significant environmental effects involved in the operation of their ORP.

6.5.4 Chapter 5A Transitional policies – NPS on Freshwater Management

- Policy 5A.1.1 regard given to the extent the discharge would avoid contamination that will have an adverse effect on the life supporting capacity of fresh water, and the extent to which it is feasible that any more than minor adverse effect resulting from the discharge would be avoided;
- Policy 5A.1.2 regard given to which the discharge would avoid contamination that will have an adverse effect on the health of people and communities, and the extent to which it is feasible that any more than minor adverse effect resulting from the discharge would be avoided;
- Policy 5A.1.3 states that the above policies only apply to a new discharge or a change or increase in any discharge;
- Policy 5A.2.1 gives regard to the life supporting capacity of fresh water but for water quantity;
- Policy 5A.2.2 states that the above policy only applies to any new activity and any change in the character, intensity or scale of any established activity;

TBP has taken account of the direction given by the NPS on Freshwater Management and the transitional policies listed above. The analysis of water quality and ecological data presented in the Aquanet report (2018) includes an assessment against the provisions of the NPS on Freshwater Management. As reported, although there are significant adverse effects found in regard to the discharges to the Inaha Stream, the life supporting capacity does not appear to have been affected as there is no consistent evidence of significant adverse effects on macroinvertebrate communities. In terms of avoiding more than minor adverse effects, it is considered that the mitigation proposed should help to remediate the current state of fresh water at and downstream of the site. It is acknowledged that there are upstream causes to the state of water quality in the Inaha Stream that TBP is unable to resolve.

TBP has also taken account of the NES for Drinking Water 2007, which does not appear to apply to small drinking water sources (<25 persons), but for standards it specifically references the Drinking water standards 2005 (updated 2008). In considering the Te Kopanga Spring (Shearer's Spring), the key parameter for consideration is nitrate nitrogen. The Drinking Water Standard 2008 sets a limit on Nitrate nitrogen of 11.3 g NO_3-N/m^3, which we have assessed against.

It is also relevant to note that there is no new discharge or an increase in the existing discharge. TBP is proposing to reduce the amount of discharge to land significantly, once the new irrigation system is in place.

In regard to the policy relating to water quantity and life supporting capacity, it is not a new activity and the established activity relating to the water take is not proposed to be changed.

6.5.5 Chapter 6 Resource Issues in the Taranaki region

- Objective 6.1.1 promote sustainable management of surface waters from take, use, damming or diversion of surface water;
- Objective 6.2.1 Avoid, remedying or mitigating the adverse effects of contaminants discharged to land and water from point sources;
- Objective 6.5.2 Avoid, remedy or mitigate adverse effects on groundwater quality from discharge of contaminants;
- Policy 6.1.3 regard given to various items when assessing the quantity of water taken from any surface water body;
- Policy 6.1.4 states that Taranaki Regional Council require quantities, levels and flows of water in streams that retain at least 2/3 habitat at mean annual low flow;
- Policy 6.1.5 provides list of assessment criteria when assessing water take consents;
- Policy 6.1.8 states that during times of water shortage or when flows fall below that which retains 2/3 habitat, the Taranaki Regional Council will instigate appropriate procedures;
- Policy 6.2.1 lists how Taranaki Regional Council will manage point source discharges;
- Policy 6.2.2 directs that discharges of contaminants or water to land or water should be carried out in a way that avoids, remedies or mitigates significant adverse effects on aquatic ecosystems, maintains or enhances water quality of a standard that allows existing community use for contact recreation and water supply purposes and maintains or enhances aquatic ecosystems, and be a quality that ensures that the size or location required for reasonable mixing does not have a significant adverse effect on community use or life supporting capacity;
- Policy 6.2.3 relates to waste reduction and treatment practices;
- Policy 6.2.4 relates to adoption of the best practicable option in relation to discharge of contaminants to land or water;
- Policy 6.2.7 relates to contingency plans;
- Policy 6.5.3 relates to managing discharge of contaminants to avoid, remedy or mitigate adverse effects on groundwater quality.

Of the above objective and policies, Objective 6.1.1, Policies 6.1.3, 6.1.4, 6.1.5 and 6.1.8 relate to water takes. The Aquanet report (2018) reviewed the effects of the water take on the Inaha Stream and the conclusion was that as the water take is non-consumptive, the potential for adverse effects is limited to flow depletion along the section between the take and the discharge point. As the take and discharge are at the same location, it is unlikely that the water take is having any material effect and any flow on ecological effects are considered to be less than minor. It is therefore considered that the TBP application to renew this consent is consistent with the relevant objectives and policies as there is a need for the water and the continued process will ensure that the adverse effects relating to the water take will remain as less than minor.

In regard to objectives and policies relating to the point source discharges (Objective 6.2.1, Policies 6.2.16.2.2, 6.2.3, 6.2.4, 6.2.7), it is considered that TBP is consistent with the policy direction as they are moving towards a period of remediating the adverse effects on the water quality of the Inaha Stream. It is also important to acknowledge that whilst significant adverse effects are occurring due to the discharges, that the adverse effects have not affected the life supporting capacity of the Inaha Stream. TBP is looking towards waste reduction and treatment practices, with a key mitigation measure being the upgrade of the Zeal Grow as the monitoring undertaken has indicated that when Zeal Grow begun to be discharged is when certain indicators of water quality worsened particularly in regard to nitrate.

In regard to Policy 6.2.1, the diffuse discharge to land and the specific policy relating to groundwater quality (Policy 6.5.3). Based on the monitoring undertaken to date and reported on in the PDP Report (2018), the elevated groundwater concentrations at the site do not currently appear to be significantly affecting downstream groundwater receptors.

6.6 Draft Freshwater Plan (2015)

TRC is in the process of preparing a second-generation plan designed to give effect to the NPSFM. This will supersede the Regional Freshwater Plan once it has been through the formal submission and hearings process.

A draft plan was released in April 2015 and has no legal status. Taranaki Regional Council have since stated that the current Fresh Water and Soil Plan will be merged into a Regional Freshwater and Land Management Plan for Taranaki. A Proposed Freshwater and Land Management Plan is expected to be released for public consultation soon, but at the time of submission it had not been yet released.

6.7 Regional Air Quality Plan for Taranaki

The Regional Air Quality Plan for Taranaki became operative on 25th July 2011. The Regional Air Quality Plan contains objectives and policies for the management of natural and physical resources relating to air quality. One of the high-level objectives of the Plan is to maintain the existing high standard of ambient air quality in the Taranaki region and to improve air quality in those instances or areas where air quality is adversely affected, whilst allowing for communities to provide for their economic and social wellbeing (Objective 3.3.1). The Regional Air Quality Plan also sets out detailed requirements for the replacement consents.

It is considered that TBP's renewal of consents applications is consistent with the direction given in the Regional Air Quality Plan for Taranaki. PDP's report on the Land Treatment of Wastewater (**Appendix 1**) indicates that since at least 2013 there have been no odour complaints associated with the operation of the irrigation system and therefore it is anticipated that there will be minimal potential for generation of odours from the irrigation system going forward, particularly with regard to the mitigation package.

In terms of odour from other discharges, there is no proposed increase in discharge rate and the anaerobic pond is conditioned to avoid objectionable odours beyond the property boundary.

6.8 South Taranaki District Plan

No resource consents will be required from the South Taranaki District Council to provide for the ongoing operation of the ORP as proposed in this application.

7 Part 2 of the RMA – Purpose and Principles

This section of the report assesses the proposal in relation to Part 2 of the RMA 1991.

Overall, the application is considered to be generally consistent with Part 2. The renewal of the existing consents will allow TBP to continue to provide rendering services as an essential service for the rural community, while efforts have been made to improve the efficiency of the system and therefore the use of natural resources. Further commentary on each section of Part 2 is provided below.

7.1 Section 5 – Purpose

The cornerstone of Part 2 is the Purpose of the Act as set out in section 5(1), which is:

> *"To promote the sustainable management of natural and physical resources".*

The promotion of sustainable management requires an overall broad judgement of whether a proposal will meet the requirements of section 5 of the RMA. The approach recognises that the RMA has a single purpose – sustainable management. Such a judgement allows for the comparison of often conflicting considerations and the scale or degree of them and their relative significance or proportion in the final outcome.

The proposal will enable people and communities to continue to provide for their social and economic well-being and for their health and safety through the provision of rendering services. This is an essential service and TBP is the largest operator in the Taranaki region.

The overall assessment of a proposal in relation to the purpose of the RMA is informed by the matters in sections 6, 7 and 8 of the RMA, discussed as follows.

7.2 Section 6 – Matters of National Importance

Section 6 of the RMA sets out the matters of national importance that must be recognised and provided for in managing the use, development and protection of natural and physical resources. The following parts of Section 6 are considered potentially relevant to the proposal:

> *(a) The preservation of the natural character of the coastal environment (including coastal marine area) wetlands and lakes and rivers and their margins and the protection of them from inappropriate subdivision, use and development:*
>
> *(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes and rivers:*
>
> *(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, waahi tapu, and other taonga;*
>
> *(f) The protection of recognised customary activities.*

In terms of 6(a), the consent renewal application for TBP to continue their rendering operation with necessary water take and discharges is considered to be an appropriate use of the Inaha Stream. Whilst there are significant adverse effects in terms of water chemistry, this does not appear to be affecting aquatic life, and it is not considered that the proposal is affecting the natural character of the stream particularly when taking into account the mitigation measures proposed.

No public access to the Inaha Stream is affected, and 6(d) is therefore met.

In terms of section 6(e) and (f), TBP have engaged with both hapū and iwi and this conversation is ongoing.

7.3 Section 7 – Other Matters

Section 7 of the RMA sets out the matters that particular regard must be had to in managing the use, development and protection of natural and physical resources as follows:

(a) kaitiakitanga:

(aa) the ethic of stewardship:

(b) the efficient use and development of natural and physical resources:

(ba) the efficiency of the end use of energy:

(c) the maintenance and enhancement of amenity values:

(d) intrinsic values of ecosystems:

(e) [Repealed]

(f) maintenance and enhancement of the quality of the environment:

(g) any finite characteristics of natural and physical resources:

(h) the protection of the habitat of trout and salmon:

(i) the effects of climate change:

(j) the benefits to be derived from the use and development of renewable energy.

In terms of Section 7(a) and (aa), it is considered that the approach of seeking to allow for the existing ORP to continue its operation, with ongoing discussions with iwi / hapū, to consider how to provide more on these matters.

In terms of the remaining part of Section 7, the assessment of effects has shown in terms of the relevant matters - 7(b), (c), (d), (f), (g), and (h) (i) and (j) – most are not materially affected:

Section 7 (b) The water take is using natural resources, but the water take is not proposed to increase beyond that in the existing consent and it is of non-consumptive use. The discharge consents will look to improve environmental conditions, which is anticipated once mitigation measures are enacted. It is considered that TBP is moving towards a more efficient use and development of natural and physical resources, for example, with the move from unlined to fully lined burial pits.

In addition, the ORP is a physical resource. It is efficient to continue to utilise this existing infrastructural investment.

Section 7 (c) There is no increase to the use or development of the natural or physical resources with this renewal application. It is considered that amenity values will be maintained, and levels of odour should not increase.

Section 7 (d) Not materially affected. There is no consistent evidence of significant adverse effects of aquatic life.

Section 7 (f) Affected. The quality of the environment will be maintained and enhanced as improvements in water quality are proposed as part of this consent through the combination of mitigation measures.

Section 7 (g) Not materially affected. The activity does not involve the use or degradation of any finite characteristics of natural and physical resources.

Section 7 (h) Not affected – no trout or salmon in the Inaha Stream where TBP is located (or downstream).

On the basis of the above, the proposal considered generally consistent to the matters set out above.

7.4 Section 8 – Treaty of Waitangi

Section 8 of the RMA states:

> *"In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi)."*

The requirement to take into account the principles of the Treaty of Waitangi is an obligation on those exercising functions and powers under the RMA, including in this case Taranaki Regional Council making decisions on the applications.

TBP is looking to continue to build their relationship with hapū and iwi long-term. A partnership approach has been taken to the preparation of these applications, with early engagement a key feature. TRC have also been involved in some of these discussions. Further dialogue will occur post lodgement to confirm the final position on cultural effects.

8 Consultation and Notification

TBP have engaged with key stakeholders interested in the renewal of these consents. Advice was sought from TRC on stakeholders that should be consulted, all of whom TBP have approached, as discussed below.

8.1 Pre-Application Meetings

TBP has met with Taranaki Regional Council, Ngāti Manuhiakai, Te Korowai o Ngāruahine Trust, Fish & Game and Inaha Reservation Trust to discuss the consent renewals prior to the submission of this application. A summary of these engagements is provided in Table 17.

Table 8-1: Pre-Application Consultation Meetings

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
23 Nov 2017	Taranaki Regional Council *Attendance:* Consents Manager and Monitoring Officer from TRC 4 representatives from TBP	Discuss the re-consenting proposal	Monitoring data requests Discussion on notification Discussion on neighbours and local community Tangata whenua concerns Environmental effects	Important introductory meeting Information exchange
14 April 2018	Ngāti Manuhiakai *Attendance:* Approx. 20 hapu members 2 representatives from TBP 1 representative from TRC	Annual meeting between TBP and hapu, which forms part of existing consent conditions. Opportunity to discuss the upcoming consent renewals	Ngāti Manuhiakai want to see discharges out of the Inaha Stream. Agreement to continue to stay in contact as further investigations are completed. Agreement to bring TBP's consultant freshwater scientist to the next meeting to discuss effects on Inaha Stream	Important introductory meeting Information exchange Agreement to meet again to discuss detail on instream effects

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
11 June 2018	Taranaki Regional Council *Attendance:* 4 representatives from TRC 6 representatives from TBP	To identify the key issues associated with the reconsenting and develop an agreed approach towards the nature and scope of technical investigations required to accompany the replacement consent applications.	Discussion of the management changes at the Plant – e.g. VSEP at TBE, with initial results being highly positive. Discussion of the water quality issues relating to stickwater and N application Discussion of surface water quality Discussion of interaction between groundwater and surface water TBP enquired as to the freshwater objectives TRC are seeking. Discussion over the burial pits. Discussion of culturally sensitive sites. Discussion over consent duration. Discussion over draft application. A range of questions were requested of TRC.	Concern with the method of application of stickwater (by injection). TRC suggested conditions regarding spreading of stickwater in a more controlled and even manner. TRC noted a key objective was to maintain groundwater quality in terms of it meeting the drinking water standard. Confirmation that Hapu requested that Shearer's Spring be referred to in future as Te Kopanga Spring. TRC indicated the need for more monitoring and analysis of the effects of the existing burial pits, and assessment of alternatives regarding the burial pits. TRC expressed preference for shorter-term consents.
11 June 2018	Hui with Chair of Ngāti Manuhiakai *Attendance:* 1 representative from Ngāti Manuhiakai 2 representatives from TBP 1 representative from TRC	Follow up discussion to meeting held with TRC to discuss TBP renewal applications	Hapu are most concerned about continued burial activity Generally comfortable with other activities provided effects managed	TBP need to focus on buial activity particularly on possible alternatives and management of effects

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
11 June 2018	Hui with Te Korowai o Ngāruahine Trust *Attendance:* 1 representative from Te Korowai o Ngāruahine Trust 4 representatives from TBP	To open dialogue with Te Korowai o Ngāruahine Trust	How Te Korowai o Ngāruahine Trust woks and interacts with hapu – supporting role Importance of freshwater to iwi Concern with burial of waste Interest in a site visit to walk around and look at site	Will hold follow up meeting to discuss detail Key issues include burial, temperature of discharge, surface water take, nutrient loading, and protection of drinking water A site walkover was requested. Potential mitigation was discussed including Inaha Restoration, wetlands and enhanced planting.
27 Oct 2018	Ngāti Manuhiakai *Attendance:* Approx. 20 hapu representatives 3 representatives from TBP	Update on monitoring results and approach to consent renewals	Provided update on approach (mitigation) Update on monitoring results Questions were asked around food safety and the effects on the quantity of freshwater food. Sought confirmation that no irrigation around Urupa and Marae. Enquired as to whether datasets were independent.	Generally comfortable with the approach to burial pits but concerned about renewal of existing burial pits – confirmed that this is only contingency plan before fully lined pits are constructed. Confirmed monitoring shows that water quality effects are not affecting life supporting capacity of the Inaha. Confirmed that large part of data is TRC data. Committed to send a copy of the application and meet early 2019.

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
2 Nov 2018	BNZ Centre, New Plymouth *Attendance:* 1 representative from Fish & Game 2 representatives from Te Korowai o Ngāruahine Trust 4 representatives from TBP	Update on monitoring results and approach to consent renewals	Provided update on hapu meeting. Provided update on approach (mitigation) Update on monitoring results Questions were asked in regard to stream flora and when the point source occurs. Enquired after the temperature loggers giving continuous data. Questioned the need to stick with 3 degrees. Discussion around potential for more planting on western tributary. Discussion around stormwater and cooling water processes. Questioned whether 2018 results been provided by TRC yet on MCI. Enquired as to TBP plans regarding riparian management plans. Questioned how much storage in ponds if couldn't irrigate. Discussion around the stream monitoring – and building in processes in line with the environmental aspirations of the hapu.	Clarified that discharges are seasonal, so critical periods are avoided. TRC provided continuous temperature data to TBP on request after this meeting and this was emailed to the stakeholders. Clarified that the only way to reduce temperature further is to lengthen the pond and TBP are running out of space. Clarified that if irrigation pumps broke down, they could be fixed immediately and there are several pumps there. Power supply is not an issue as have own generator which would run all the ponds. Committed to send a copy of the application and meet early 2019.

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
2 Nov 2018	Taranaki Regional Council *Attendance:* 4 representatives from TRC 4 representatives from TBP	Update on monitoring results and approach to consent renewals	Provided update on hapu meeting. Provided update on approach (mitigation) Update on monitoring results Follow up questions about meeting with iwi (MCI data, continuous temperature data) TBP asked about wider catchment approach to planting. Discussion around flow measurement. TRC confirmed there is potential that Eltham landfill may not open. Discussion around processing. Discussion around closed landfill. Discussion around TBE upgrades with Zeal Grow and that TBP will be soon. Discussion on notification.	TRC confirmed have continuous monitoring of temperature data and updated MCI data – and sent through. TRC confirmed there are no broader catchment-based approaches to riparian planting. TRC confirmed Trees Trust does not exist anymore – need to look into whether the funding goes towards Inaha Stream. TBP discussed how 1:300 is working well and there is not the need for equipment when it is not the source of concerns. TRC are happy to delay processing until consultation finishes – and acknowledge aim to meet the 6-month date by lodging on the 30th November. Confirmed happy to proceed on the basis that the existing burial pits will be applied for renewal and then relinquished once the permitted activity status of the fully lined pits is confirmed. TRC happy with the level of data provided to demonstrate permitted activity status and can do own monitoring to check.

Date	Location & Attendance	Purpose of Meeting	Key Messages Received	Outcomes
9 Nov 2018	Inaha Reservation Trust *Attendance:* 4 representatives from Inaha Reservation Trust 2 representatives from TBP	Introductory meeting	Comfortable with the Aquanet report and the efforts made. Confirmed no Kakahi present in the Inaha at TBP or downstream – only present further upstream. Confirmed freshwater crayfish and eels are in the Inaha at TBP and downstream but don't consider these to be affected. Main concern was the temperature of the discharge Noted that there is only so much TBP can do with the upstream issues.	The Inaha Reservation Trust generally comfortable with approach Do want to see improvements over time Agreed to meet in early February – with hapu group once final application documents had been circulated

8.2 Other Pre-Application Consultation

8.2.1 South Taranaki District Council

In In addition to the above in-person meetings, TBP have also made contact with South Taranaki District Council. On the 5th of February 2018, TBP contacted South Taranaki District Council (STDC). A memo was sent to STDC on the 9th February 2018 to follow up on this phone call and covered a brief outline of the consent applications; clarification of the scope of consents; particular items of relevance to STDC and to seek any advice to or requests from STDC, including regarding consultation. No further correspondence was received from STDC.

8.2.2 Department of Conservation

Following initial conversations by phone, DOC's RMA lead outlined their preferred process; once the AEE is prepared, this is submitted by email along with relevant information (e.g. compliance reports). The AEE would then be checked in terms of whether the content meets their satisfaction. TBP will follow up with DOC following lodgement.

8.2.3 Local Community

The Plant is located less than 1 km from Okaiawa, a village of about fifty dwellings. Many members of the community work at the ORP.

There is a cluster of homes just to the south of the Plant, who draw on Te Kopanga Spring (Shearers' Spring) for drinkable water. The owner is in regular contact with TBP.

It is suggested submitters to the initial or subsequent consent applications are also involved in early conversations.

8.3 Post application meetings

Following the discussions with hapū and hapū representatives prior to lodgement, TBP met with Ngāti Manuhiakai hapū on a number of occasions in 2019 and hosted a visit to the site in July 2020. An agreed position between the parties on the application was reached in early December 2019, resulting in the signed mitigation agreement attached as **Appendix 10.** This agreement outlines the approach to the management of cultural and environmental effects of concern to hapū and signals the desire of both parties to work together in the long term and outlines the objectives and principles for achieving this.

Later in December 2019, TBP identified that the proposed lined burial pit system was not a practical long term approach. TBP discussed their decision to alter their approach to ensuring that the burial of waste to unlined pits occurred on a emergency only basis with Ngāti Manuhiakai who provided their support to the amended approach in July 2020 (**Appendix 11**).

9 Conclusion

TBP is seeking replacement consents to continue to operate the ORP. All replacement consents are sought for a term of 35 years.

The TBP operation at ORP provides important services and significant social and economic benefits to the communities of the Okaiawa area, the Taranaki region and the rural economy of a large part of the North Island. As much of the site's product is exported, the operation also helps to support the wider New Zealand economy. The operation also supports the Taranaki Region's and New Zealand's waste minimisation strategy, by helping to avoid the deposition of meat processing by-products into landfills, and other less environmentally-friendly disposal methods.

During the preparation for the renewal of the six replacement consents, technical assessments have indicated that there are several significant environmental effects occurring with the current operation of the ORP.

TBP is seeking to address these matters and to improve environmental outcomes associated with the ORP. To do so, TBP are proposing upgrades to the ORP, including Zeal Grow upgrade, stormwater improvements and improved management of the burial of solid waste.

TBP have engaged with key stakeholders in the preparation of these applications and this process has informed the suggested mitigation measures.

No increase in operations or discharges are proposed, and environmental performance will be improved with the mitigations proposed.

Public notification has been requested for four of the consent renewal applications, and limited notification is deemed appropriate for the two remaining applications.

PART C

APPENDICES

Appendix 1

PDP Report – Land Treatment of Wastewater – Technical Assessment of Environmental Effects prepared for Taranaki By-Products Limited, 2020

Auckland Tauranga Wellington **Christchurch**

PATTLE DELAMORE PARTNERS LTD

Land Treatment of Wastewater and Burial Pit Activity – Technical Assessment of Environmental Effects

Taranaki By Products Limited

solutions *for your environment*

Land Treatment of Wastewater and Burial Pit Activity – Technical Assessment of Environmental Effects

Prepared for

Taranaki By-Products Limited

August 2020

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Taranaki By-Products Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Taranaki By-Products Limited for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Executive Summary

Taranaki-By Products Ltd (TBP) operates an inedible protein recovery plant on Kohiti Road near Okaiawa. An edible protein recovery plant, owned by Taranaki Bio-Extracts Ltd, shares the site and a dairy farm is run on adjacent land owned by TBP. The wastewater from the two plants and dairy farm effluent is combined and treated in an onsite biological treatment facility before it is either discharged onto company owned dairy farmland under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, with a portion discharged to the Inaha Stream under TRC Resource Consent No. 2049-4 (when soil conditions do not allow all wastewater to be irrigated).

TBP also operates a burial pit activity under Resource Consent No. 5495-1, which allows for the burial of un processable wastes from the meat rendering operations.

Both discharge consents and the burial pit consent have expired on 1 June 2019. To assist with renewal of the discharge to land consent No. 3941-2, and the burial pit consent No. 5495-1, a technical assessment of environmental effects of the wastewater irrigation activity and burial pit activity has been prepared by Pattle Delamore Partners Limited (PDP). This assessment is to accompany the consent application prepared by Mitchell Daysh Limited (now being managed by Traverse Environment Limited) as required by Schedule 4 of the Resource Management Act 1991.

Wastewater generated from the plant is characterised into two main waste streams:

- **Process Wastewater:** consisting of floor drains, raw material bin drains, some stickwater and condensates from Taranaki By-Products, and wastewater generated from Taranaki Bio-extracts Ltd; and
- **Zeal Grow:** Rendering stickwater.

Process wastewater is treated on site in a dissolved air flotation (DAF) and lagoon-based treatment system, prior to discharge.

TBP has had stickwater generated from the plant registered as a fertiliser (under the trading name Zeal Grow) with the intention that it could be spread to land on a district wide basis as a nutrient source for pasture growth. Utilisation of the Zeal Grow by farmers in the district has been limited, and as such, a large portion of the Zeal Grow has been spread to land that is also utilised for wastewater irrigation.

Treated wastewater from the TBP plant is irrigated to 330 ha of company owned and neighbouring dairy farmland. Irrigation is conducted utilising travelling irrigators and spreading of Zeal Grow is conducted utilising a tanker trailer (pulled by tractor), which injects the Zeal Grow just below the soil surface.

Irrigation to land is utilised as the primary wastewater discharge method during late spring, summer, and autumn months. In winter months (June – September),

the risk of damaging soils increases and the capacity of the soil to receive wastewater decreases. As such, a portion of the treated wastewater is discharged to the Inaha Stream.

The burial pit activity occurs in a localised area, northeast of the processing plants. Offal material that cannot be processed, due to poor material quality or plant malfunction, is progressively tipped into excavated pits and backfilled. The burial pit activity has occurred for at least 20 years, with an estimated average annual tipping rate of between 406 tonnes/yr and 568 tonnes/yr (based on estimates from aerial imagery and nitrogen flux modelling). Five operational monitoring bores are situated around the burial pit area for ongoing groundwater monitoring, for potential contaminant migration from the burial pit area.

Potential Environmental Effects

The potential environmental effects from the irrigation of wastewater and Zeal Grow (stickwater) to land include:

- Potential effects on soils, including impacts on soil structure through pugging, cation imbalances, and potential accumulation of heavy metals;
- Potential effects on groundwater and groundwater users as a result of nutrient migration, particularly nitrate;
- Potential effects on surface water in terms of effects on water quality through nutrient migration from either direct runoff, or nutrient migration via groundwater;
- Potential effects on human and stock health as a result of exposure to microorganisms; and
- Potential nuisance effects on neighbours, such as odour and spray drift, as result of system operation.

The potential environmental effects from the burial pit activity include:

- Potential effects on groundwater from nitrogen migration; and
- Potential effects on surface water from nitrogen migration.

Potential effects associated with discharge to air are covered under an existing consent, No. 4058-4.

Assessment Undertaken

To assess the effects that the current irrigation system has had on soils as an indication of potential effects going forward, a soil investigation was conducted to investigate soil nutrient levels, infiltration rates, and heavy metal levels in comparison to a selected background monitoring site.

TBP has conducted regular monitoring of irrigated wastewater and stickwater since 2015, and TRC has conducted regular groundwater monitoring within the irrigation area. Utilising the irrigation loading rate data, an Overseer nutrient model was developed to estimate the rate of nutrient loss to surface water via runoff, or to groundwater via leaching.

Modelled nutrient leaching rates were then compared with groundwater and surface water monitoring data to estimate the flux rate of nitrogen to surface water. Based on the surface water monitoring results and assessment of effects on the fresh water aquatic environment, conducted by Aquanet Consulting Ltd, the subsequent effects of the irrigation to land on surface water was able to be quantified and mitigation measures established.

To assess the potential effects of the burial pit activity, groundwater monitoring results have been utilised to assess the existing rate of nitrogen migration into groundwater against subsequent levels observed in surface water, to identify suitable tipping rates going forward.

Results of Assessment

Based on the results of the soil investigations, it was concluded that the wastewater irrigation and stickwater spreading activities are having a less than minor effect on soils, with low sodium levels and no evidence of heavy metal accumulation. There was evidence of reduced soil permeability, however, this was also evident in the un-irrigated background site, and therefore is unlikely to be solely associated with the irrigation activity.

For potential effects on groundwater (and groundwater users) and surface water, the key contaminant of concern associated with the application to land of treated wastewater is nitrate nitrogen. Nutrient modelling, based on the 2015/16 and 2017 irrigation rates, as well as the farming operation, indicates that approximately 56 kg TN/ha/yr and 47 kg TN/ha/yr respectively is leaching on a whole farm basis below the soil profile and pasture root zone. Application rates for 2015/16 are considered to be indicative of historic wastewater volumes while application rates for 2017 are considered to be indicative of current wastewater volumes.

There are no consented takes within 3 km of the downstream boundary of the site, but there may be permitted takes from bores within this area and the spring (GND1058) located immediately south of the site is currently used for drinking water. Concentrations of nitrate nitrogen within these downstream bores and the spring have not exceeded the DWSNZ 2008 limit of 11.3 mg NO_3-N/L during the monitored period. Concentrations of nitrate nitrogen in the spring had been increasing slowly in a linear fashion from <2 g N/L to approximately 4 g N/L between 2000 and 2013. In 2013 and 2014 the concentration increased more rapidly before stabilising at around 5 g N/L. The concentration remains stable at this level, although there are more seasonal peaks which were not present before 2013. Based on the monitoring undertaken to date, the elevated groundwater concentrations at the site do not currently appear to be significantly affecting downstream groundwater receptors.

Based on average measured groundwater hydraulic conductivities across the site and the modelled nitrogen leaching rates, a simple flow calculation indicates that concentrations of nitrate-nitrogen within the spring would start to increase around 2014. This corresponds well with the results seen within the monitoring data, however, the monitored change in concentration is significantly less than the calculated value, indicating that the majority of the nitrate within the groundwater is not migrating southwards, off the site.

The nitrogen loading associated with the discharge of treated wastewater and fertiliser application to land has impacted the groundwater at the site over the last 10 years. However, after an increase in groundwater concentrations between 2009 and 2012, the concentrations appear to have stabilised, albeit at elevated values. This suggests that the current rates of application may be broadly in equilibrium with processes removing nitrate from the groundwater.

For potential effects on surface water, the key identified pathway is nitrogen load migrating to surface water via groundwater. The groundwater contours indicate that shallow groundwater and the areas with elevated groundwater nitrate nitrogen concentrations are likely to discharge into the Inaha Stream and the unnamed tributary across the majority of the site. Monitoring of nitrate nitrogen concentrations between the upstream and downstream sample locations with the measured flow rate of the Inaha Stream indicates that the average estimated gain in nitrogen across the site was 4.1 g N/m^3 for the Inaha Stream and 5.2 g N/m^3 for the unnamed tributary. The results indicate that the total nitrate flux from the site caused by groundwater discharge into the streams is approximately 44 kg N/day.

It is considered possible that higher rates of nitrogen application to parts of the site may have occurred between 2009 and 2013, resulting in the increase in groundwater concentrations. However, since 2013 the concentrations appear to have stabilised, despite some seasonal variation, suggesting that the current application rates are not resulting in a worsening of conditions within the groundwater. Based on the current concentrations and the estimated flux into the streams under low flow conditions, it is likely that it would take at least 20 years for the concentrations to return to background concentrations within the groundwater at the site, assuming that no additional nitrate was added within the time frame.

The existing migration of nitrate nitrogen to surface water is resulting in a net increase in nitrate nitrogen concentrations in the western, un-named tributary, which is causing the status of the water quality to degrade from B and C, under the National Policy Statement for Fresh Water Quality 2014, to Band D. In order to maintain the water quality in a Band C status, the average concentration in the un-named tributary will need to decrease by up to 15 %. Based on the historic (2015/16 season) assessed nitrogen leaching rate from the wastewater irrigation activity, as assessed by OverseerFM® modelling and low stream flow nitrogen contribution comparisons, nitrogen leaching rates, on a whole farm basis, will need to decrease from the existing 56 kg TN/ha/yr to less than 48 kg TN/ha/yr.

OverseerFM modelling indicates that the current leaching rate (2017 season) of 47 kg TN/ha/yr meets this level of reduction.

Potential effects on human or stock health are considered to be less than minor. Microbial die-off in the irrigated water is promoted primarily by desiccation and ultraviolet light exposure during a stock withholding period. Potential stock health risks associated with calcium and magnesium deficiencies are considered low due to the relatively low potassium levels in the wastewater

Potential nuisance effects associated with spray drift and odour are considered to be less than minor due to the proposed separation distances from boundaries and dwellings, as well as the aerobic nature of the irrigated wastewater. Since at least 2013, there have been no odour complaints associated with operation of the irrigation system, and therefore it is anticipated that there will be minimal potential for generation of odours from the irrigation system going forward.

In addition to existing implemented mitigation measures, such as separation distances, irrigation rates, and return periods, the following additional mitigation measures are recommended:

- Soil Permeability Monitoring and Management
  Once per year, it is recommended that soil infiltration testing is conducted at six representative locations across the irrigation areas, with duplicate tests at each site, assessing both the saturated (K_{sat}) and unsaturated (K_{-40}) infiltration rates. If the average saturated infiltration rate at any assessed location is less than the achievable minimum irrigation rate, then TBP will investigate the cause and implement mitigation measures to increase the saturated infiltration rate.

- Nitrogen Loading Management
  The nitrogen loading rate to land associated with wastewater irrigation, fertiliser loading, and other nitrogen based soil amendments shall not exceed a farm wide average of 200 kg TN/ha/yr or a maximum nitrogen load of 250 kg/ha/yr, for a pastoral grazed system, with a maximum of 50 kg TN/ha applied in any given month.

> To achieve a 15% reduction in nitrogen leaching, from recent years, the average leachable fraction of nitrogen across the whole farm cannot exceed 48 kg TN/ha/yr, as assessed utilising OverseerFM nutrient modelling, or other approved methods.
>
> Once per year, following the end of the dairy season (30 June), TBP will prepare a nutrient management budget for each whole farm in which there is wastewater irrigation. The nutrient management budget will include all nutrient inputs and farm practices to assess nutrient losses (nitrogen and phosphorus) to groundwater and surface water, and identify potential mitigation measures to reduce nutrient losses.

Based on the observed, elevated nitrogen concentrations in the groundwater, it is estimated that approximately 5,000 kg N/yr to 7,000 kg N/yr is currently migrating from the burial pit area, in groundwater, towards the Inaha Stream. While estimated travel times in the groundwater suggest that the migration of nitrogen from the burial pit should have been observed in the Inaha Stream, an observable increase in nitrogen levels in the Inaha Stream, for the short section of stream adjacent to the burial pits, has not been identified. This indicates that attenuation factors may be limiting nitrogen migration to the stream.

It is therefore recommended that, while an observed effect in surface water has not been identified, tipping rates for the burial pit activity should be limited to historical rates, so as to not exceed the potential attenuation capacity of the existing system.

To allow for the expansion of the burial pit area, to the south of the existing burial pit area, TBP proposes to increase the number of ground water monitoring bores to include an additional back ground monitoring bore and an additional four down gradient monitoring bores, while maintaining the existing five operational bores. Quarterly monitoring of groundwater and the Inaha Stream (upstream and downstream of the burial pit area) will be conducted to continue monitoring for potential effects.

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Appendices

1.0 Introduction

Taranaki-By Products Ltd (TBP) operates an inedible protein recovery plant on Kohiti Road near Okaiawa. An edible protein recovery plant, owned by Taranaki Bio-Extracts Ltd (TBE), shares the site, and a dairy farm is run on adjacent land owned by TBP. The wastewater from the two plants and dairy farm effluent is combined and treated in an onsite biological treatment facility before it is either discharged onto company owned dairy farmland and neighbouring owned properties, under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, with a portion discharged to the Inaha Stream under TRC Resource Consent No. 2049-4 (when soil conditions do not allow all wastewater to be irrigated).

The site operates under 12 resource consents, of which six have expired on 1 June 2019. This includes Consent No. 3941-2, which allows for the irrigation of treated wastewater to land, and Consent No. 5495-1, which allows for the burial of un processable wastes from the meat rendering operations. For these consents to be renewed, an assessment of environmental effects (AEE) from both the wastewater irrigation and the burial activities needs to be prepared to accompany the consent application, as required by Schedule 4 of the Resource Management Act 1991.

Accordingly, this AEE has been prepared by PDP for TBP to accompany the consent application (prepared by Traverse Environmental Limited) for irrigation of treated wastewater to land. It identifies the relevant issues to be evaluated, and assesses the effects of the proposal on the receiving environment.

1.1 Wastewater Discharge to Land Consent

TBP is seeking a replacement consent (refer to Appendix A) that would allow continued wastewater irrigation (land treatment), including the activities currently allowed by TRC Resource Consent No. 3941-2, which authorise "*discharge up to 1,400 m^3/d of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into TBP owned dairy farm land and neighbouring farm land, and any subsequent discharge to air*".

TBP has progressively increased the land areas utilised for land treatment and the activity now covers 330 ha of land in the vicinity of the plant, as shown in Figure 1.

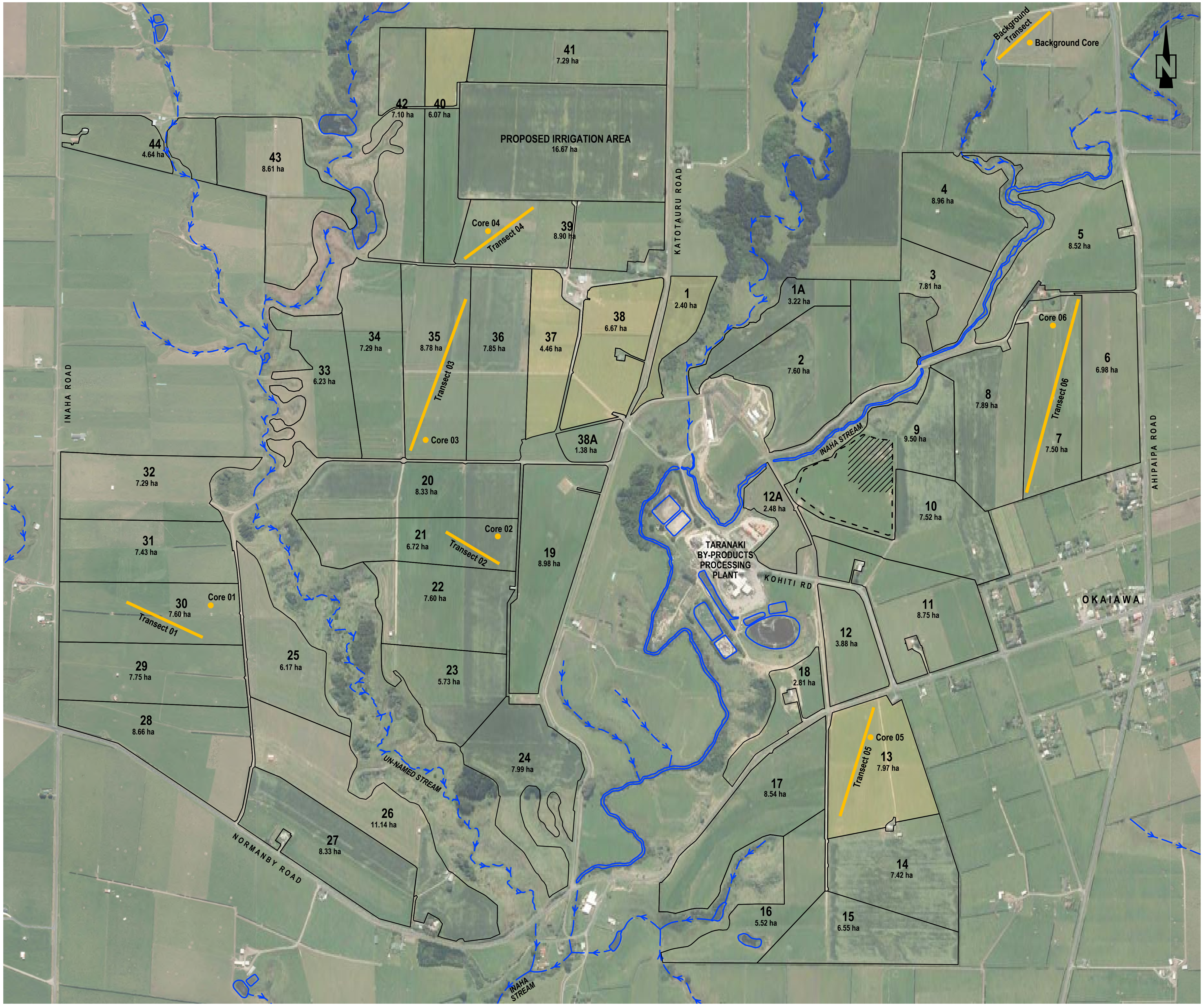
Previously, TBP discharged farm dairy effluent (FDE) onto land under two separate consents, namely Consent Nos. 2446 and 3117. Consent 2446 is no longer exercised, as effluent is combined with the processing plant wastewater for treatment and discharge. Consent 3117 relates to discharge from a small shed used for sick cows on Katotauru Road.

The management of FDE is now integrated with the processing plant's wastewater treatment system, and the discharges now form part of the activities covered under Resource Consent No. 3941-2.

Separately, TBP disposes of one of the waste side streams from the tallow process, known as stickwater, and registered by TBP as a liquid fertiliser, Zeal Grow. This liquid fertiliser application onto land has been operated outside of the consent nutrient loading requirements.

1.2 Waste Burial from Meat Rendering Operations Consent

TBP is also seeking a replacement consent (refer to Appendix B) that would allow the continued burial of un processable wastes from the meat rendering operations during times of plant break-down. The activity currently takes place in a field to the northeast of the plant, with five monitoring bores monitoring nitrogen concentrations in the groundwater.



KEY :

- SOIL PERMEABILITY CORE LOCATION
- SOIL MONITORING TRANSECT
- 1 PADDOCK NUMBER [2]
- EXISTING IRRIGATION AREA [2]
- PROPOSED IRRIGATION AREA
- STREAM [3]
- EXISTING BURIAL AREA
- PROPOSED BURIAL AREA

SOURCE:
1. AERIAL IMAGERY (FLOWN 2011-2012) PROVIDED UNDER LICENCE FROM TARANAKI REGIONAL COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. IRRIGATION AREAS DERIVED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf, BY GPS-it DATA MAPPING SOLUTIONS, DATED 03/05/2016.
3. STREAMS DERIVED FROM A COMPILATION OF INFORMATION SOURCED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf AND LINZ.

NO.	REVISION	DATE	APP.
C	ISSUED FOR REVIEW	JUL 20	
B	ISSUED FOR REVIEW	OCT 19	
A	ISSUED FOR REVIEW	NOV 18	

CLIENT :

TARANAKI BY-PRODUCTS LTD

PROJECT :

ASSESSMENT OF ENVIRONMENTAL EFFECTS

TITLE :

SITE LAYOUT PLAN AND IRRIGATION AREAS

pdp solutions for your environment

PATTLE DELAMORE PARTNERS LTD

Auckland Tauranga Wellington Christchurch

SCALE 1:10,000 (A3)

0 100 200 300 400 500m

PROJECT NO. :	FIGURE NO. :	REVISION :
AJ467202	1	C

FILED : AJ467202D001.dwg

2.0 Description of Proposal

2.1 Processing Plant Operations

The Taranaki By-Products (TBP) Plant is an animal rendering facility which receives raw material from meat and poultry processing plants in the central and southern North Island. TBP also runs a dead or fallen stock collection service in Taranaki and adjacent regions. The facility produces inedible products including meat and bone meal (bovine and poultry), feather and blood meals, as well as tallow and chicken oil.

The plant carries out a rendering processing where fat is separated from the raw material using continuous low temperature drying (under 100°C). The resulting material is dewatered using a mechanical dewatering screw press, and further dried using thermal de-watering.

The plant operates three processing lines as follows:

- A mixed abattoir material line, processing beef and mutton, hard and soft offal, as well as fallen stock; and
- A poultry line, processing soft poultry offal and feathers; and
- A blood line.

The plant can operate 24 hours/day, seven days/week throughout the year, and is able to process up to 26 t/h of raw material, which includes 18 t/h mixed abattoir material, 6-8 t/hr poultry line material, and up to 100,000 L/day of blood. The plant is generally shutdown weekly on Sundays and Mondays for maintenance.

Seasonal variations in processing are largely due to processing of mixed abattoir material, with a peak in beef offal processing occurring from January to May, and fallen stock occurring during the dairy calving season of July and August. Poultry processing is relatively steady throughout the year.

The Taranaki Bio-Extracts plant operates adjacent to the TBP plant and conducts low temperature rendering to produce edible, rendered products (food grade tallow and gelatine bone chip).

2.2 Wastewater Treatment Plant Processes

Wastewater generated from plant is characterised into two main waste streams:

- **Process Wastewater:** consisting of floor drains, raw material bin drains, some stickwater and condensates from Taranaki By-Products, and wastewater generated from Taranaki Bio-extracts Ltd;
- **Zeal Grow:** Rendering stickwater.

2.2.1 Process Wastewater Treatment

Process wastewater is treated on site in a dissolved air floatation (DAF) and lagoon-based treatment system prior to discharge to either the Inaha Stream (sometimes during winter months) or irrigated to land (year-round). The treatment plant process is summarised in figure 2 and described below.

The wastewater undergoes treatment in a lagoon based treatment system, consisting of a DAF tank, an anaerobic lagoon, followed by an extended aeration, operated as a biological nitrogen removal (BNR) reactor, and finally an oxidation lagoon.

Process wastewater (excluding condensate) from the processing plant is passed through a coagulant assisted, 100 m^3/hr, DAF tank, where dissolved air is utilised to float suspended solids to the surface of the tank, where the accumulated solids are scraped off for recycling back into the rendering system. The DAF plant reduces gross solids, including fat and protein-based solids.

A portion of the wastewater is diverted through a Vibratory Shear Enhanced Processing (VSEP) system which generates water for use in the site boiler and concentrate for product recovery, reducing the organic load on the wastewater treatment system. Concentrate from the system is sent to the DAF dewatering unit and permeate is processed through a reverse osmosis unit and used in the plant boilers. The VSEP system at the TBP plant, at the time of writing this report, was undergoing commissioning.

The remaining wastewater (and condensate, that bypasses the DAF) then flows to three anaerobic lagoons (Ponds 1, 2, and 3). The anaerobic lagoons have natural crust cover and are operated as low rate anaerobic reactors, where organic matter is mineralised, with organic nitrogen being converted to ammoniacal nitrogen, and the majority of biochemical oxygen demand (BOD_5) is removed by methanogens. The lagoon maintains an active crust, which helps to provide control of odorous gases release into the atmosphere that are generated from anaerobic degradation processes.

Wastewater from the anaerobic lagoon then flows to an 8,000 m^3 extended aeration lagoon (Pond 4). The extended aeration lagoon utilises 315 kW of mechanical aeration to maintain aerobic conditions and suspend biological treatment bacteria (mixed liquor suspended solids). Ammoniacal nitrogen from the anaerobic lagoon is oxidised to nitrate (nitrification process) and then nitrate is reduced (denitrification process) to nitrogen gas, reducing the nitrogen concentration in the treated effluent. BOD_5 is further reduced as part of the aerobic biological processes. A small settling lagoon (Pond 5), following the extended aeration lagoon, provides for settling of treatment bacteria so that they may be recirculated back to the start of the extended aeration lagoon.

The clarified wastewater then flows to a large, 30,000 m^3, oxidation pond, where the wastewater undergoes further stabilisation with the assistance of four brush aerators (17.5 kW combined capacity).

The treated wastewater is then either irrigated to land, and/or discharged to the Inaha Stream.

Figure 2 provides a summary of the wastewater treatment process.

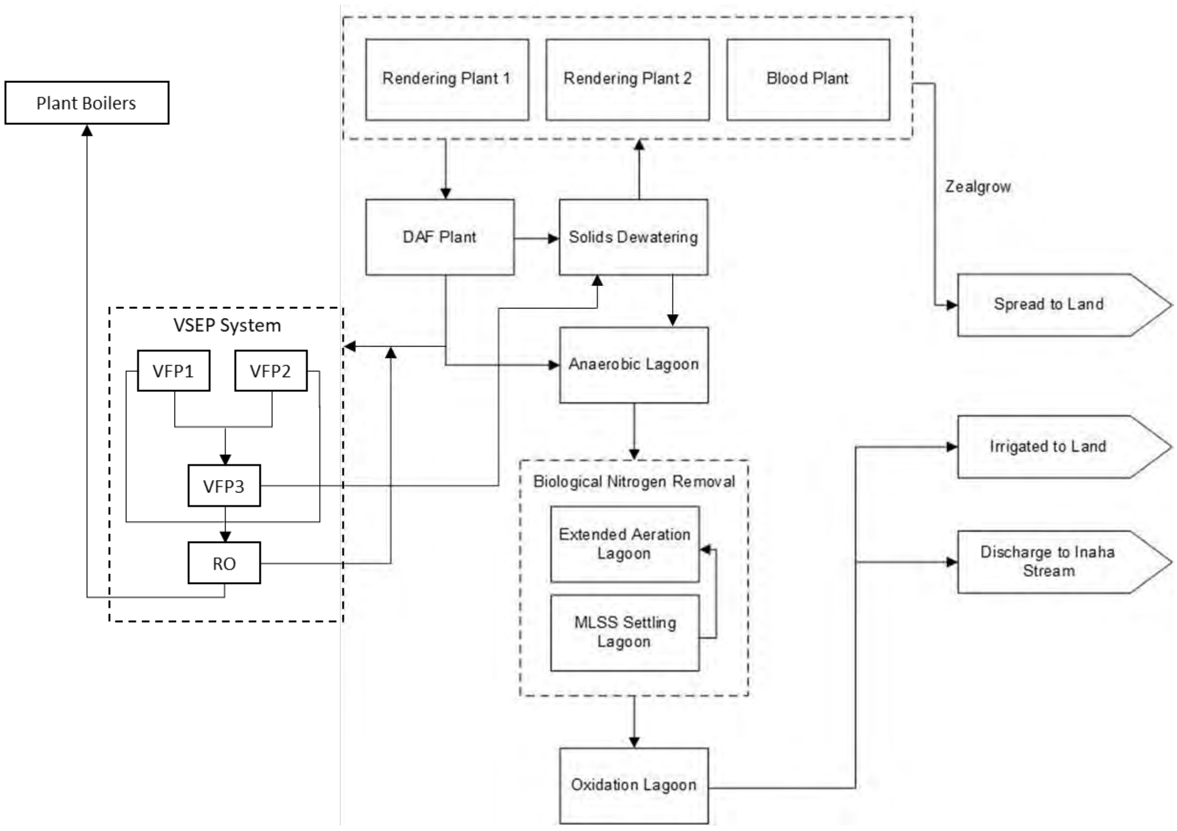


Figure 2: Wastewater Treatment Process Flow Diagram

2.2.2 Zeal Grow/Stickwater Management

Low temperature rendering (LTR), which is utilised at the TBP plant, generates a highly concentrated liquid by-product during the tallow separation process, commonly referred to as stickwater. While some of the stickwater can be treated in the wastewater treatment system, a portion of the stickwater is spread to land, to avoid overloading of the wastewater treatment plant.

TBP has had the stickwater registered as a fertiliser (under the trading name Zeal Grow) with the intention that it could be spread to land on a district wide basis as a nutrient source for pasture growth.

Utilisation of the Zeal Grow by farmers in the district has been limited and as such, a large portion of the Zeal Grow has been spread to land that is also utilised for wastewater irrigation.

In late 2018, TBE installed VSEP technology to assist with reducing stickwater loads. The VSEP system utilises vibrating membrane filtration systems to provide filtration and to concentrate stickwater for recycling of concentrate back into the plant dryer, for product recovery, and for generation of water, for reuse in the processing plant. The installation of the VSEP system means that the volumes of stickwater being spread to land have significantly reduced, from an average of around 300 m^3/wk to an average of around 100 m^3/wk.

2.3 Treated Wastewater Characteristics

A summary of the treated wastewater characteristics for the period between January 2015 and August 2017 is provided in Table 1.

Table 1: Final Treated Wastewater Characteristics

Parameter	Range	Average
pH	6.9-8.2	7.0
Electrical Conductivity	170-305	218
Total Suspended Solids (TSS)	36 – 840	217
Biochemical Oxygen Demand (BOD)	40 – 150	99
Ammoniacal Nitrogen	66 – 200	110
Total Nitrogen	148 - 330	222
Nitrate-Nitrogen	0.001 - 104	28
Nitrite-Nitrogen	22.6 - 140	71
Total Phosphorus	22 - 42	29
Faecal Coliforms (cfu/100 mL)	43 - 2600	225[3]
Sodium	149-225	192
Potassium	75-170	106
Calcium	11-54	25
Magnesium	7.7-18.7	14
Sodium Adsorption Ratio (SAR)	4.5-10.4	8.0

Notes:

1. *All units are g/m³, unless otherwise stated.*
2. *All data sourced from TBP annual monitoring reports 2015 – 2017.*
3. *Faecal Coliform result based on the median value.*

2.4 Existing Wastewater Irrigation System

Treated wastewater from the TBP plant is irrigated to 330 ha of company owned and neighbouring dairy farmland under TRC Resource Consent No. 3941-2. Figure 1 details the combined wastewater irrigation area utilised by the plant.

Irrigation is conducted utilising travelling roto-rainer irrigators and a range of Williams Irrigators, with approximate instantaneous irrigation rates of between 10 mm/hr and 36 mm/hr, and an irrigation depth per pass of approximately 24 mm to 36 mm per pass. Irrigators are rotated between paddocks based on dairy farm stock rotation and to manage nitrogen loading rates.

Spreading of Zeal Grow is conducted utilising a tanker trailer (pulled by tractor) which injects the Zeal Grow just below the soil surface. Approximately 21,000 m^3 and 8,000 m^3 of Zeal Grow has been spread to TBP land during the 2015/16 and 2017 seasons respectively.

Irrigation to land is utilised as the primary wastewater discharge method during late spring, summer, and autumn months. Because the land utilised for irrigation is primarily used for a dairy farming operation, irrigation is limited by soil conditions. Irrigation of wastewater is therefore managed in accordance with soil conditions. Typically, a larger proportion of wastewater will be applied in summer (November – March) as the soil conditions are drier and the soil has a greater capacity to receive the wastewater without encouraging pugging, ponding, or runoff. In winter months (June – September), the risk of damaging soils increases, and the capacity of the soil to receive wastewater decreases. As such, a portion of the treated wastewater is discharged to the Inaha Stream.

Figure 4 and Figure 4 summarise the average hydraulic loading applied per hectare for each month in the 2015/16 and 2017 season respectively. The contribution to the hydraulic load has been defined for each of the wastewater and Zeal Grow applications per month. It is evident that wastewater from the plant makes up the majority of the irrigated hydraulic load, with Zeal Grow only contributing approximately 6% and 12% of the irrigated hydraulic load for 2015/16 and 2017 respectively. For the 2015/16 season, the highest monthly average hydraulic loading per hectare was 5.8 mm in February and May, and the average annual hydraulic load was approximately 52 mm/yr. For the 2017 season, the highest monthly average hydraulic loading per hectare was 5.5 mm in January, and the average annual hydraulic load was approximately 41 mm/yr.

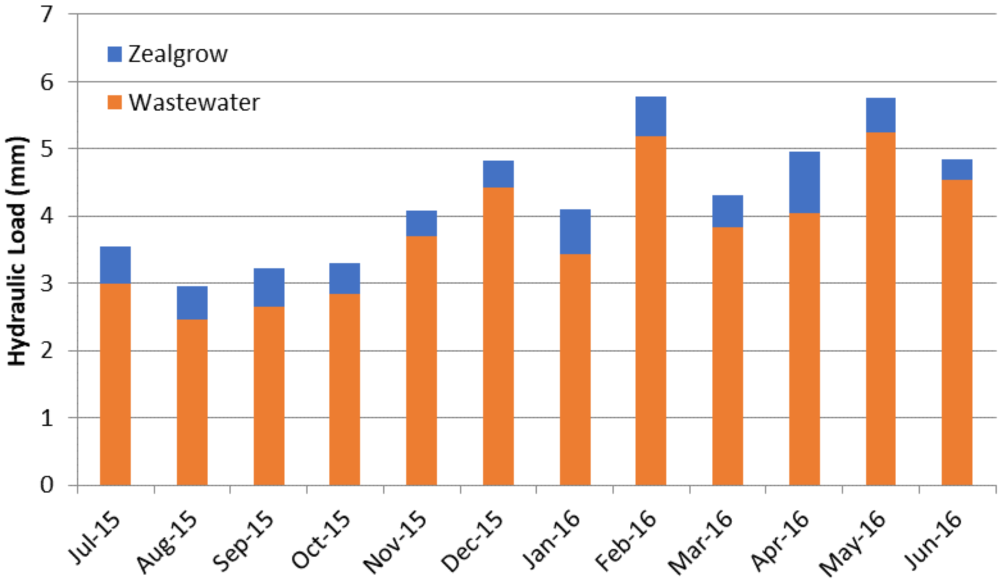


Figure 3: Average Monthly Hydraulic Load for the 2015/16 Season

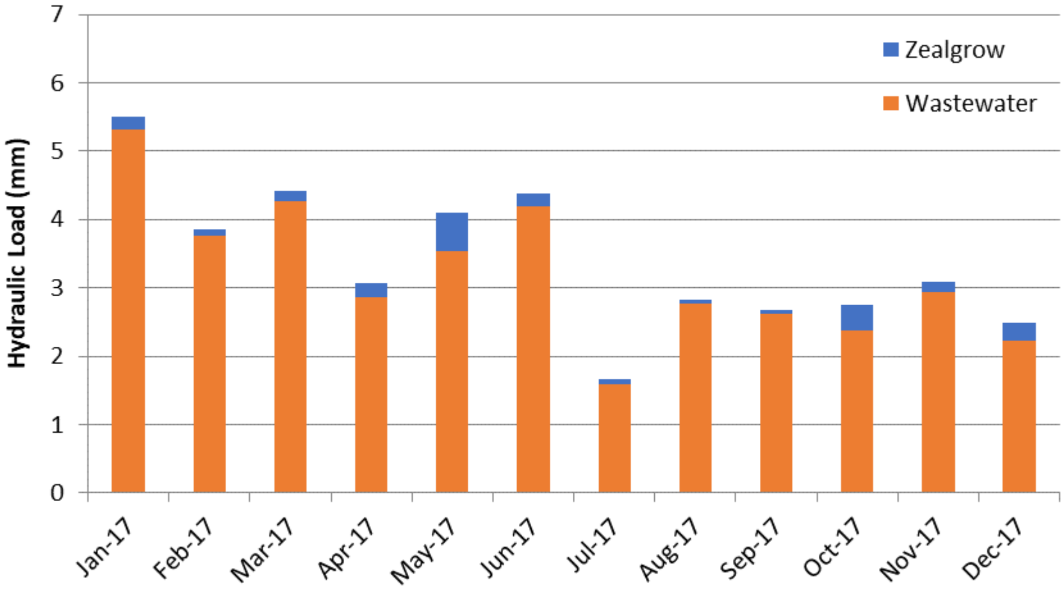


Figure 4: Average Monthly Hydraulic Load for 2017

Figure 5 and Figure 6 summarise the average nitrogen loading per hectare as a result of wastewater irrigation and Zeal Grow application. It is evident, particularly in the 2015/16 season, that the nitrogen loading is influenced to a larger degree by the Zeal Grow application rates due to the high nitrogen concentration in Zeal Grow. Figure 5 shows that monthly nitrogen loading is similar for the majority of the year with loading rates approximately 18 – 21 kg/ha for June through to December and March. The maximum loading rate is 32 kg/ha in April. There is a slight increase in loading over the summer period when soil conditions allow irrigation. Figure 6 indicates a peak nitrogen load in May of approximately 22 kg/ha, and low nitrogen loading from July through to September, when soil conditions are typically wetter.

Historical nitrogen loading data associated with the Zeal Grow has been based on inorganic nitrogen monitoring by TBP. This does not account for the organic nitrogen load, which can be a significant portion of the total nitrogen content of stickwater. As such, historic records of nitrogen loading to land, associated with Zeal Grow, have understated the actual nitrogen load that has been applied to land. As no monitoring data for the organic nitrogen content of the Zeal Grow exists for the assessed period, nitrogen loads have been based on the average of 13 stickwater samples taken over the period 31 January 2019 to 21 March 2019. Results from these samples found the inorganic to organic ratio of nitrogen in Zeal Grow to be 1:3.

Based on the total nitrogen content from the tested samples, the yearly Zeal Grow application in 2015/16 only accounted for 12% of the hydraulic loading but accounted for approximately 63% of the nitrogen loading. The average annual nitrogen load applied across irrigated areas was 251 kg TN/ha/yr. In 2017, the yearly Zeal Grow application only accounted for 6% of the hydraulic loading, but accounted for approximately 43% of the nitrogen loading. The average annual nitrogen load applied across irrigated areas was 168 kg TN/ha/yr. Due to the elevated nitrogen concentration associated with the Zeal Grow, nitrogen loads have been elevated on individual paddocks, with some paddocks receiving in excess of 800 kg TN/ha/yr, and monthly application rates in excess of 290 kg TN/ha.

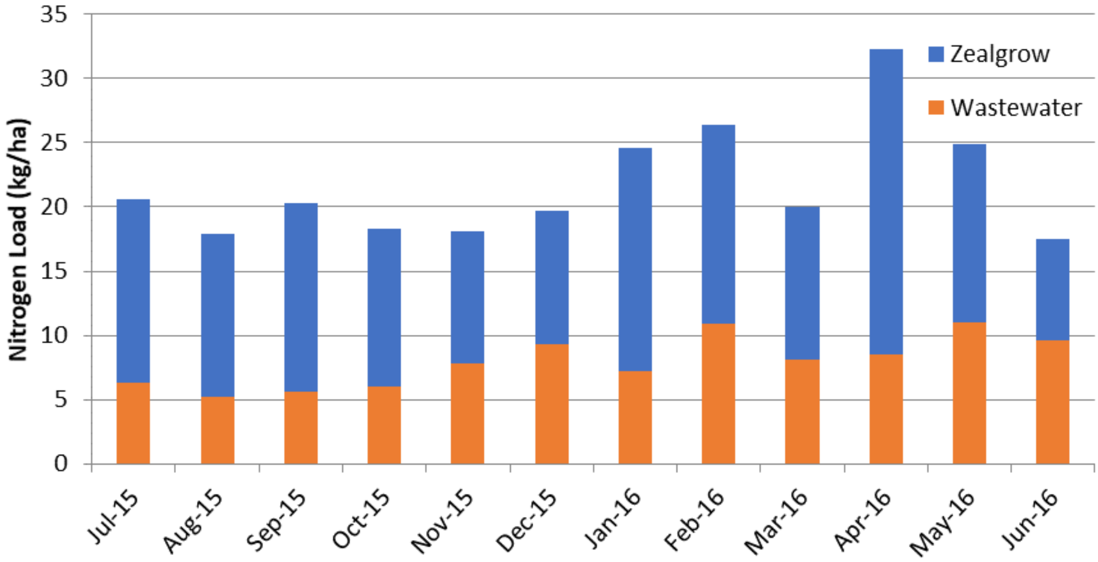


Figure 5: Average Monthly Nitrogen Load per Hectare for 2015/16

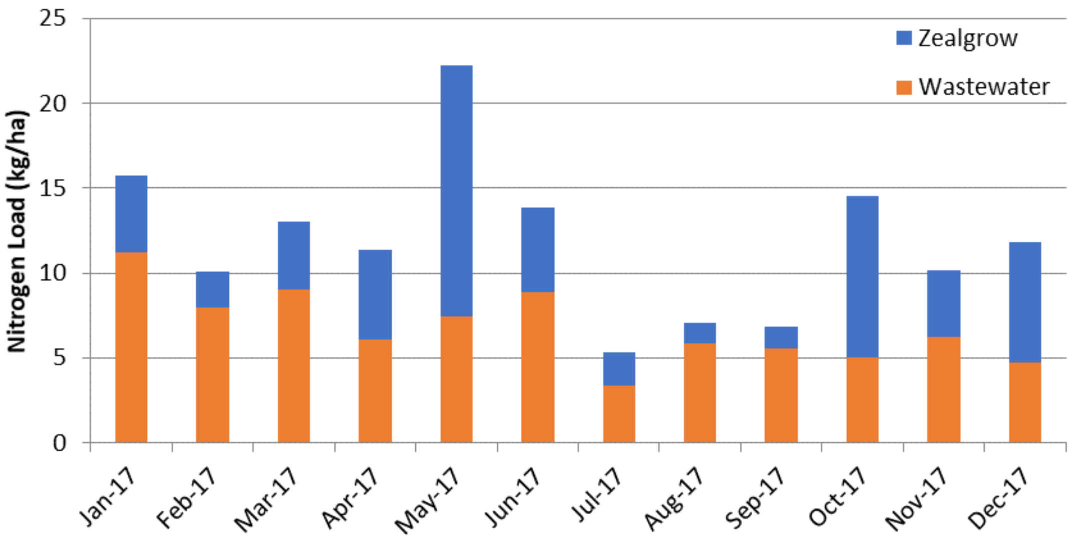


Figure 6: Average Monthly Nitrogen Loading per Hectare for 2017

The phosphorus loading data presented in Figure 7 and Figure 8 has been calculated using the nitrogen application data from TBP and nitrogen to phosphorus ratio determined from the annual monitoring reports for the wastewater. The phosphorus loading rate associated with Zeal Grow has been based on the 13 stickwater samples tested in early 2019.

As summarised in Figure 7, in 2015/16 the phosphorus loading across the irrigated areas reached a maximum of 1.9 kg/ha in the months February and May, with an overall loading rate of 17.3 kg TP/ha/yr.

As summarised in Figure 8, in 2017 the phosphorus loading across the irrigated areas reached a maximum of 1.6 kg/ha in the month of January, with an overall loading rate of 12.5 kg TP/ha/yr.

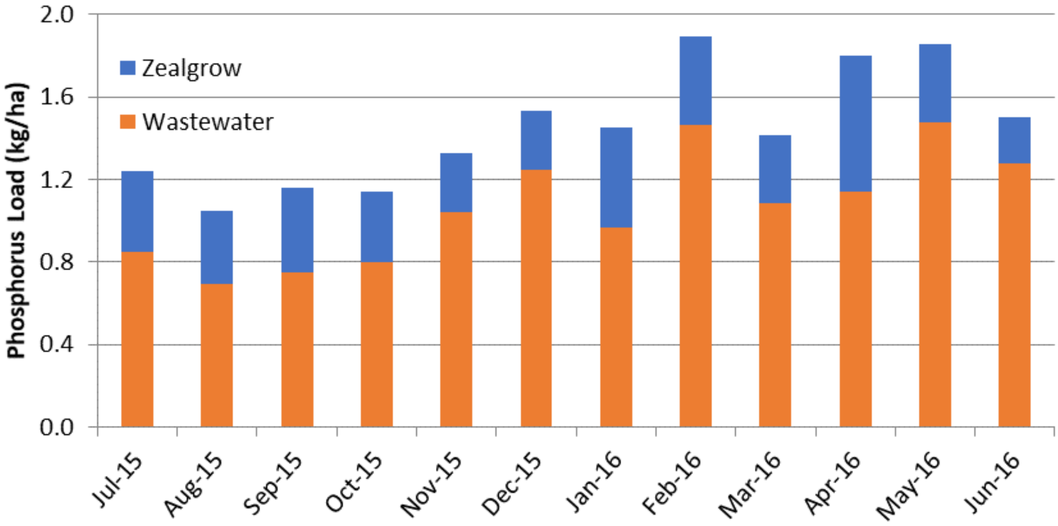


Figure 7: Average Monthly Phosphorus Loading per Hectare for 2015/16

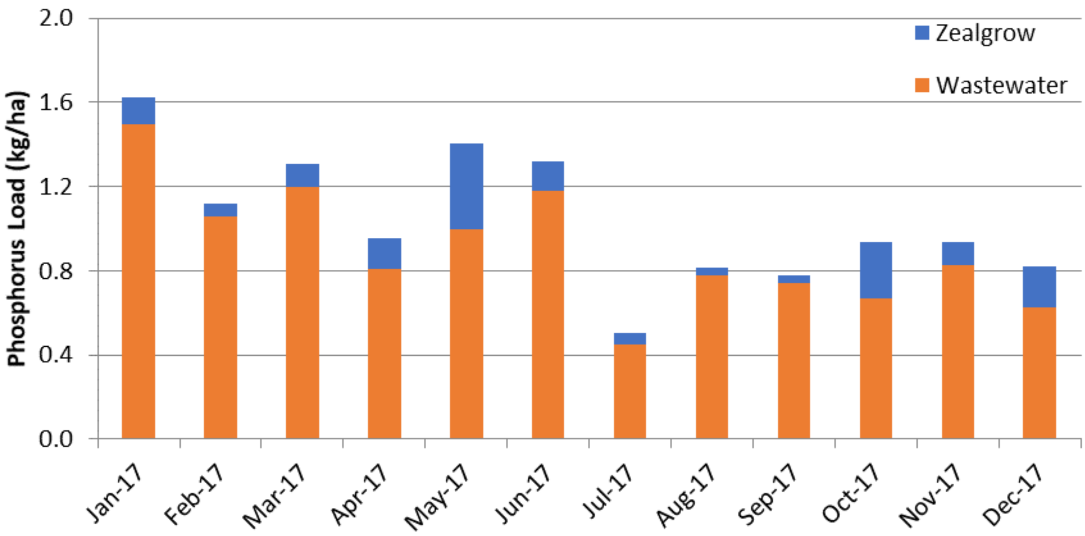


Figure 8: Average Monthly Phosphorus Loading per Hectare for 2017

2.5 Proposed Wastewater Volume and Quality

TBP proposes to maintain the wastewater treatment system and irrigation system as is currently utilised. Processing rates are proposed to remain similar to existing rates, and therefore, future wastewater volumes are expected to be similar to existing volumes.

Management of stickwater, or Zeal Grow, has been a challenge for the site with limited uptake by farmers outside of the main irrigation area. This has meant that at times there has been a potential heavy nitrogen load on the irrigated areas of the farm. While there are limited Zeal Grow data prior to 2015, a general increase in nitrogen concentrations in groundwater from 2009, coinciding with the commencement of Zeal Grow spreading, indicates that heavy loading may have occurred between 2009 and 2015 (compared with 2017). TBP has amended the way spreading of Zeal Grow is managed, to encourage more even spreading, resulting in an expected decrease in groundwater nitrate levels. Following installation of the VSEP system in the TBE plant, stickwater volumes have reduced from an average of approximately 300 m^3/wk to an average of 100 m^3/wk. In late 2019, TBP installed, and are in the process of commissioning, a VSEP system in the TBP plant to treat part of the wastewater (approximately 45%).

No upgrades are proposed for the existing wastewater treatment plant, as it is expected that there will be an overall decrease in nitrogen load on the land treatment system associated with the VSEP upgrades.

Based on nitrogen loading information, 2015/16 is seen more as a historical loading rate. With the installation of the VSEP systems it is considered that the 2017 annual nitrogen loading is more indicative of what the plant can maintain going forward. While the VSEP systems were not in place in 2017, loading rates were lower for that year, and this is a level on which TBP considers it can operate on, going forward, now that the VSEP systems are in place.

Due to the hydraulic residence time in ground water, the effects of the unnamed tributary monitored in 2018 (refer to Section 3.7.7) are seen as more indicative of historic loading (pre 2015/16) rather than 2017 loading rates. Provided that the 2017 nitrogen loading rates are maintained (or lower), nutrient modelling indicates that a 15% reduction in nitrogen leaching can be achieved.

2.5.1 Proposed Irrigation Area

The proposed irrigation area will increase slightly, with TBP having purchased a block of land to the north of the wastewater irrigation area (refer to Figure 1). This will increase the potential irrigation area from 330 ha to 346 ha. While this is only a minor increase proportionally, it will help TBP better manage nitrogen load distribution. TBP will continue to discharge treated wastewater to the receiving paddocks when the soil conditions permit, and discharge to the Inaha Stream at other times.

2.5.2 Proposed Hydraulic Loading

The hydraulic loading rate to land is dictated by four main factors, these being:

- Soil permeability;
- Soil water conditions;
- Available wastewater; and
- Available land.

TBP proposes to maintain the existing irrigation rates. From January 2017 to December 2017, an average depth of 40.8 mm was applied across the whole farm. This corresponds to approximately 3.4 mm applied each month, with a peak monthly application of 5.5 mm observed in January 2017. Although this may not be representative of individual paddock applications, TBP strives to spread the wastewater irrigation as evenly as practicable across the farm. These irrigation rates are expected to continue in the future, though there will likely be some seasonal and annual variation associated with increasing and decreasing production rates.

TBP has reported that existing application rates have not resulted in incidences of ponding or runoff. On some rare occasions, where there is risk of ponding or run-off, likely due to seasonal limitations, then irrigation is stopped. This was confirmed during the site visit conducted by PDP on 21 - 22 June 2018.

Excess soil moisture levels can limit the ability for irrigation to occur. Irrigation is typically limited between June and September, sometimes extending into the shoulder months (i.e. May and October), due to high soil moisture levels.

2.5.3 Nutrient Loading

The average nitrogen loading rate, as averaged across the whole irrigation area, is 251 kg TN/ha/yr and 168 kg TN/ha/yr for the 2015/16 and 2017 seasons respectively. However, nitrogen loading rates to individual paddocks have been elevated in some cases, associated with the spreading of Zeal Grow. Due to the elevated nitrogen concentration of the Zeal Grow, nitrogen loading, primarily as a result of Zeal Grow applications, can be very high, with in excess of 290 kg TN/ha occurring in a single month in some paddocks.

Future nutrient loading rates to land are expected to reduce with the addition of the VSEP units, and now that TBP has a greater understanding of the requirement to spread the Zeal Grow more evenly. Notwithstanding this, utilisation of VSEP systems in the New Zealand rendering industry is relatively new, and allowance needs to be made for lower than expected efficiencies in the system. Therefore, while it is the intention that nutrient loads will reduce, the existing average loading rates (2017 season) have been utilised as the proposed loading rate going forward, but with more even distribution of the wastewater, to limit the loading per paddock, annually and per month.

The anticipated nutrient loading rates associated with the wastewater and Zeal Grow are outlined in Table 2. The past loading rates have been derived from the 2015/16 data, and the proposed future loading rates from the 2017 data.

Table 2: Summary of Past and Future Annual Nutrient Loading Rates

Parameter	Past Loading Rates		Future Loading Rates (average)	
	TN	TP	TN	TP
Treated Wastewater	96	13	<200	<40
Zeal Grow	165	5		

Notes:
1. *TN = total nitrogen, TP = total phosphorus.*
2. *All units are in kg/ha/year.*
3. *The past irrigation area is 330 ha and proposed future irrigation area is 346 ha.*

2.6 Existing and Proposed Burial Pit Activity

TBP has an existing resource consent (5495-1) issued by TRC to bury offal in an area of land to the northeast of the rendering plant (shown in Figure 1) at a maximum rate of 200 tonnes/day. The site has historically buried offal during emergency situations, such as plant breakdown, or when offal is unable to be processed, due to the nature of the offal received. The burial pit system has also been utilised for disposal of collected stormwater sediments and spilled material. The resource consent for the burial of offal was issued on 30 March 2000 and expired on 1 June 2019, and TBP is applying for a replacement consent to enable continued operation of the offal burial practice when material cannot be processed.

Groundwater underlying the existing burial pit location is monitored utilising five operational monitoring bores (BP1, 4, 5, 7, and 10, Figure 11, consisting of one background bore and four down gradient monitoring bores). Two of the down gradient bores indicate elevated levels of ammoniacal nitrogen, with up to approximately 200 g NH_4-N/m^3 in recent years. Despite this, monitoring of the Inaha Stream indicates that there is no identified increase in ammoniacal nitrogen in the section of stream potentially influenced by the groundwater contribution from the burial pit area (Aquanet 2018). This indicates that, despite the elevated groundwater concentrations, the historical rate of tipping has not resulted in an adverse effect on the Inaha Stream.

Records of tipping rates to the burial pits are limited, and aerial imagery of burial pits indicates that more offal has been buried at the site than volume records held by TRC may indicate. Although the existing tipping rate has not resulted in an identified effect on the stream, the groundwater concentrations are elevated. It is therefore important that the historic rate of tipping is identified, and the current potential effects on the receiving environment established, so that a future tipping rate can be confirmed which limits future potential effects on the surface water receiving environment to those currently observed. As the groundwater in this area is not utilised for water supply, the Inaha Stream is considered to be the key receptor.

It is proposed that future burial will occur in an area adjacent and to the south of the current burial area within the same paddock (see Figure 1). The rate of tipping will be limited to 450 to 500 tonnes of offal per year, applied as a five-year rolling average.

3.0 Description of Receiving Environment

3.1 Existing Land Use

The irrigation area is zoned Rural (TBP plant itself is Rural Industrial Zone), with the predominant activity of neighbouring properties being dairy farming. Dwellings in the area are predominantly associated with dairy farms, with the closest residential area being Okaiawa, 1 km to the east of the processing plant. Irrigation of wastewater is common practice in the area, with the TBP irrigation activity having been in place for almost 20 years on the TBP Farm, and irrigation of dairy shed effluent utilised on neighbouring farms.

3.2 Topography

The irrigation area consists of generally flat to undulating topography, with incised streams running through the property. Most paddocks near the Inaha Stream slope slightly towards the waterway.

The TBP plant and the southern portion of the TBP farm sits at an elevation of approximately 100 m RL while the upper regions of TBP farm extend up to approximately 120 m RL.

3.3 Climate

Mean monthly rainfall and potential evapotranspiration recorded by the National Institute of Water and Atmospheric Research (NIWA) at the Hawera AWS site (Network No. E94622, approximately 12 km southeast of TBP) are given in Table 3.

Table 3: Summary of Mean Monthly Climate Data

Month	Rainfall (mm)	PET (mm)
January	72.4	136.7
February	64.3	108.1
March	63.9	91.9
April	95.5	48.7
May	116.6	29.1
June	106.5	21.8
July	113.7	23.7
August	114.1	34.9
September	108.5	56.1
October	101.1	86.1
November	72.3	111.7
December	96.7	129.7

Table 3: Summary of Mean Monthly Climate Data

Month	Rainfall (mm)	PET (mm)
Annual Mean	1061	887

Notes:
1. *PET is potential evapotranspiration;*
2. *Data from NIWA for Hawera Aws site (Network No. E94622), April 2000 to August 2018.*

The predominant wind direction is from the north and south-west, as illustrated by the wind rose plot in Figure 9. Similar to the rainfall and PET data, this data was collected from NIWA's CliFlo database at the Hawera AWS (Network No. E94622).

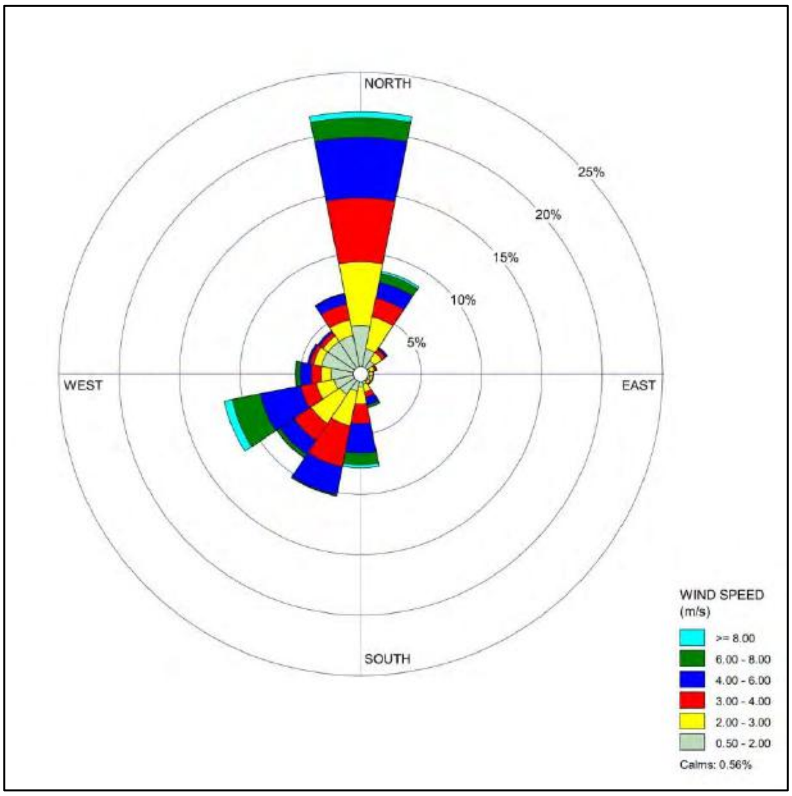


Figure 9: Wind Rose at Hawera AWS Network No. E94622 from 2004 to 2013

3.4 Description of Soils

Figure 10 details the soil types underlying the existing and proposed irrigation areas.

The geology of the TBP Farm irrigation areas has been identified as primarily Opunake Formation, Ngaere Formation, and Stratford Formation rock. The primary soil type on the farm is orthic allophanic, which is a weathered volcanic soil and is typically associated with high phosphorus retention, as well as being well drained.

A soil investigation was conducted on 21 and 22 June 2018, where the soil was assessed in terms of nutrient content, heavy metals, hydraulic conductivity, and soil health. A summary report of the findings can be found in Appendix C, and sampling results in Appendix C.

3.4.1 Soil Nutrient Levels

Soil sampling was conducted to investigate the soil nutrient levels, to compare against background nutrient levels for un-irrigated soils and against recommended nutrient levels for a pastoral grazing system. The results from the soil nutrient investigation are summarised in Table 4.

Table 4: Soil Investigation Monitoring Results

Soil Parameter	Recommended[3]	Average	Range	Background
pH	5.3-6.5	5.6	5.3-6.0	5.9
Olsen P (mg/L)	35-45	76	49-119	46
Anionic Storage Capacity (P Retention) (%)		82.1	80 - 86	79
Total Nitrogen (%)	0.1-0.6[4]	0.7	0.63 – 0.76	0.7
Total carbon (%)	4-10	7.8	7.2 – 8.4	7.8
Carbon: Nitrogen Ratio	10-15	11.2	9.6 – 12.3	11.1
Sodium (me/100 g)		0.32	0.23 – 0.56	0.24
Potassium (me/100 g)	0.5-0.8	0.64	0.17 - 0.91	1.14
Magnesium (me/100 g)	1-3	1.11	0.61 – 1.56	2.15
Calcium (me/100 g)	5-10	6.8	5.3 - 8.9	8.9
CEC (me/100 g)		24	22 – 25	26
ESP (%)		4	2.5%-6.4%	0.9

Notes:

1. *Monitoring results based on samples collected on 21 and 22 June 2018.*
2. *CEC = cation exchange capacity*
3. *ESP = exchangeable sodium percentage.*
4. *Recommended range (or target range) applicable to upper soil layer, sourced from McLeod et al 2014, with the exception of total nitrogen (see note 4).*
5. *Typical total nitrogen range sourced from McLaren et al 1996.*

The soil nutrient level investigation identified that there is very little difference between the irrigated soils and un-irrigated soils, with the exception of available phosphorus (Olsen P) which is elevated for the irrigated soils. This indicates that phosphorus loading rates have likely been in excess of the pasture uptake rates.

3.4.2 Soil Infiltration Rates

The site generally consists of well-drained soils across the entirety of the irrigation area.

The saturated and unsaturated infiltration rates of the soils can be an indicator of how well the soils are being managed to maintain the expected hydraulic conductivity of the soil type.

The saturated infiltration test (K_{sat}) places a constant 10 mm of water head on a soil core and encourages water to flow through all soil pores, including macro-pores (root holes, worm holes, etc.). The unsaturated infiltration test (K_{-40}) places a -40 mm WG tension on top of the soil core, which limits flow through the soil to pore sizes of less than <0.075 mm (via capillary action only) and not through macro-pores. As such, the saturated infiltration rate through a soil is generally higher than the unsaturated rate because water passes through macro-pores (root holes and worm holes etc). The unsaturated infiltration test does not allow water to pass through macro-pores. When a soil has been damaged due to pugging or compaction, the saturated infiltration rate decreases, closer to the unsaturated rate, as the macro-pores are unavailable. Where there is a large difference, with a low K_{-40} value, this indicates that flow through the soil is dominated by macro-pore flow and that there may need to be soil, grazing, or pasture management modifications to restore the full range of soil pore sizes.

Soil cores were collected from selected locations across the irrigated areas (refer to Figure 1 for soil monitoring locations) and sent to Landcare Research to conduct soil infiltration testing. Table 5 summarises the hydraulic conductivity results from soil investigations conducted in June 2018.

Table 5: Summary of Soil Infiltration Testing

Transect	Saturated hydraulic conductivity, K_{sat} (mm/hr)	Unsaturated hydraulic conductivity, K_{-40} (mm/hr)	Field moisture (%w/w)	Dry bulk density (g/cm^3)
Background	25	6	56	0.90
1	182	1	66	0.86
2	4	2	61	0.88
3	38	22	52	0.90
4	243	9	58	0.87
5	12	4	63	0.85
6	69	10	57	0.89
Average (excl. Background)	99	8	59	0.87

As shown in Table 5, the unsaturated hydraulic conductivity (reported as K_{-40} hydraulic conductivity) is consistently low across the irrigated areas, however, the saturated hydraulic conductivity is quite variable across the irrigation areas. This indicates that there may be some evidence of compaction or decreased permeability, potentially due to vehicle compaction or pugging, in places with low K_{sat} results. While the testing was conducted in June, when the soils are wetter and likely to provide the lowest seasonal hydraulic conductivity results, the hydraulic conductivity testing may indicate a need for some soil maintenance works, such as ripping or aeration. As the background testing indicates a similar result, this suggests that it is more likely to be a characteristic of the dairy farm operation and not the irrigation activity.

In these places, soil, grazing or pasture management may be required to restore the pore size distribution and minimise the potential for bypass flow.

3.5 Geology

The site is situated on the ring plain of the Mt Taranaki stratovolcano and is underlain by variable Quaternary lahar deposits. The strata include the Stratford, Opunake and Ngaere Formations and can be quite variable, comprising interbedded fine ash, debris flow and avalanche deposits. Intrusive investigations into the site indicate that the shallow geology is predominantly interbedded horizons of fine ash, thin layers of sandy gravel of volcanic origin, and occasional boulders of basalt, potentially associated with avalanche deposits.

Additionally, there are localised recent alluvial deposits along the banks of the Inaha Stream. These are likely to comprise locally reworked deposits of sand and gravel derived from the underlying Quaternary geology.

The geological description is based on the geological map (Townsend *et al,* 2008) for the area and the results of the recent groundwater investigation (PDP, 2017). A map showing the local geology is presented in Figure 10.

3.6 Hydrology

The site is bisected by two surface water bodies, the Inaha Stream, which enters the site at the north-eastern corner, before flowing southwest, past the plant, to the middle of the southern site boundary, and an un-named tributary that flows in a southerly direction across the western half of the site, feeding into the Inaha stream just to the south of the site boundary. The Inaha Stream continues to flow to the south where it eventually discharges into the Southern Taranaki Bight approximately 6 km from the site.

Both streams flow through the irrigation area associated with TBP. Additionally, there is a spring located immediately to the south of the site and to the east of the Inaha Stream.

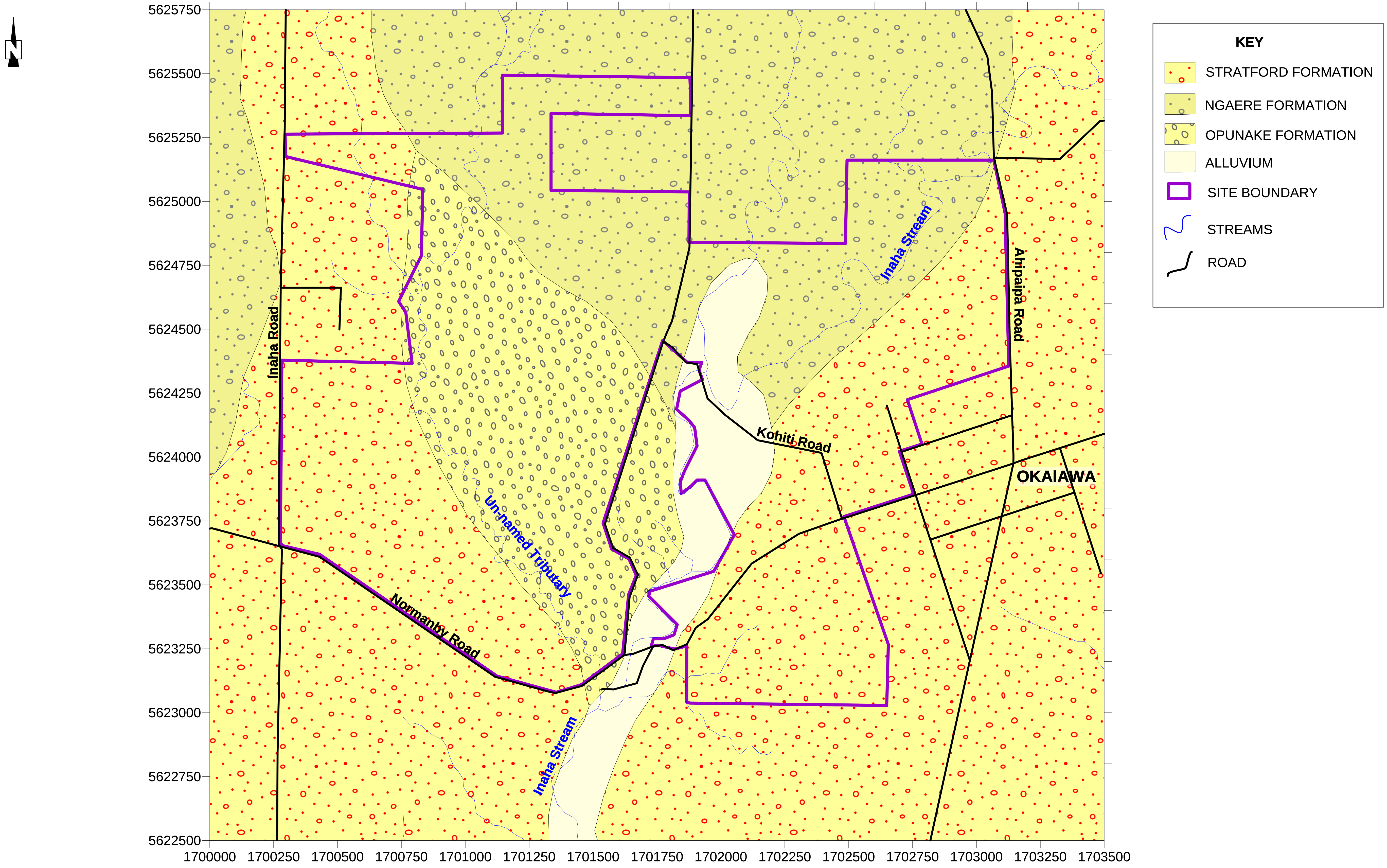
3.7 Hydrogeology

The varying volcanic units present at the site are likely to form a single heterogeneous aquifer, with flow predominantly concentrated into the thin sand and gravel horizons. It is difficult to ascertain the lateral continuity of the layers with any certainty, and as such, the deposits are considered as a whole.

There are a number of monitoring wells present across the site, which are used by TBP and TRC to measure the level and quality of the shallow groundwater at regular intervals. The monitoring bore locations are presented in Figure 11.

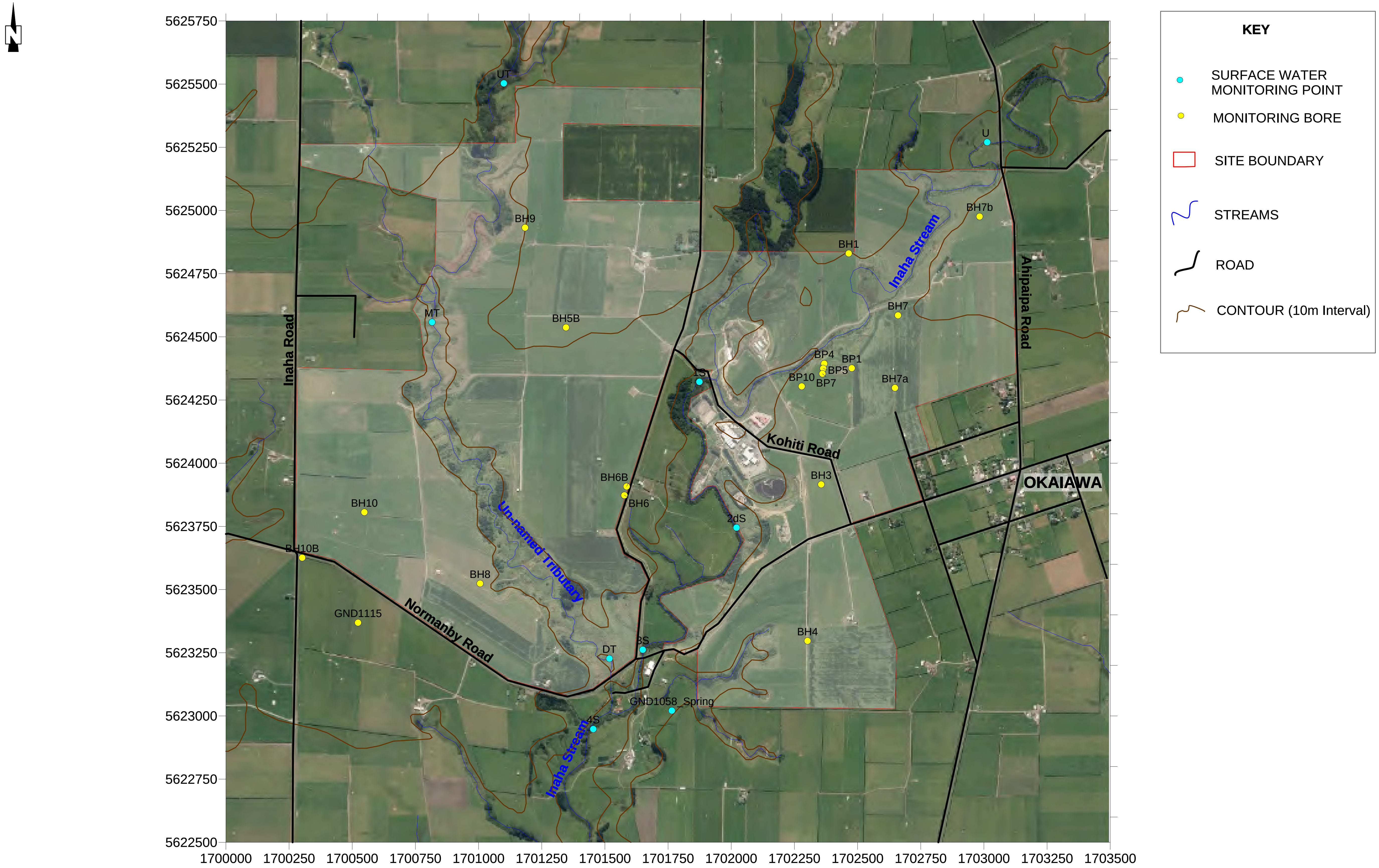
3.7.1 Groundwater Levels

The long-term monitoring undertaken by TRC indicates that groundwater is present at depths ranging from 2 to 12 m below ground level across the site, and fluctuates seasonally by between 1 and 4 m. Water levels generally peak between August and October and are at their lowest between April and August (see Figure 12).



SOURCE:
1. GEOLOGICAL INFORMATION PROVIDED BY QMAPS
2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA.

FIGURE 10: GEOLOGY



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2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA.

FIGURE 11: MONITORING BORE LOCATIONS

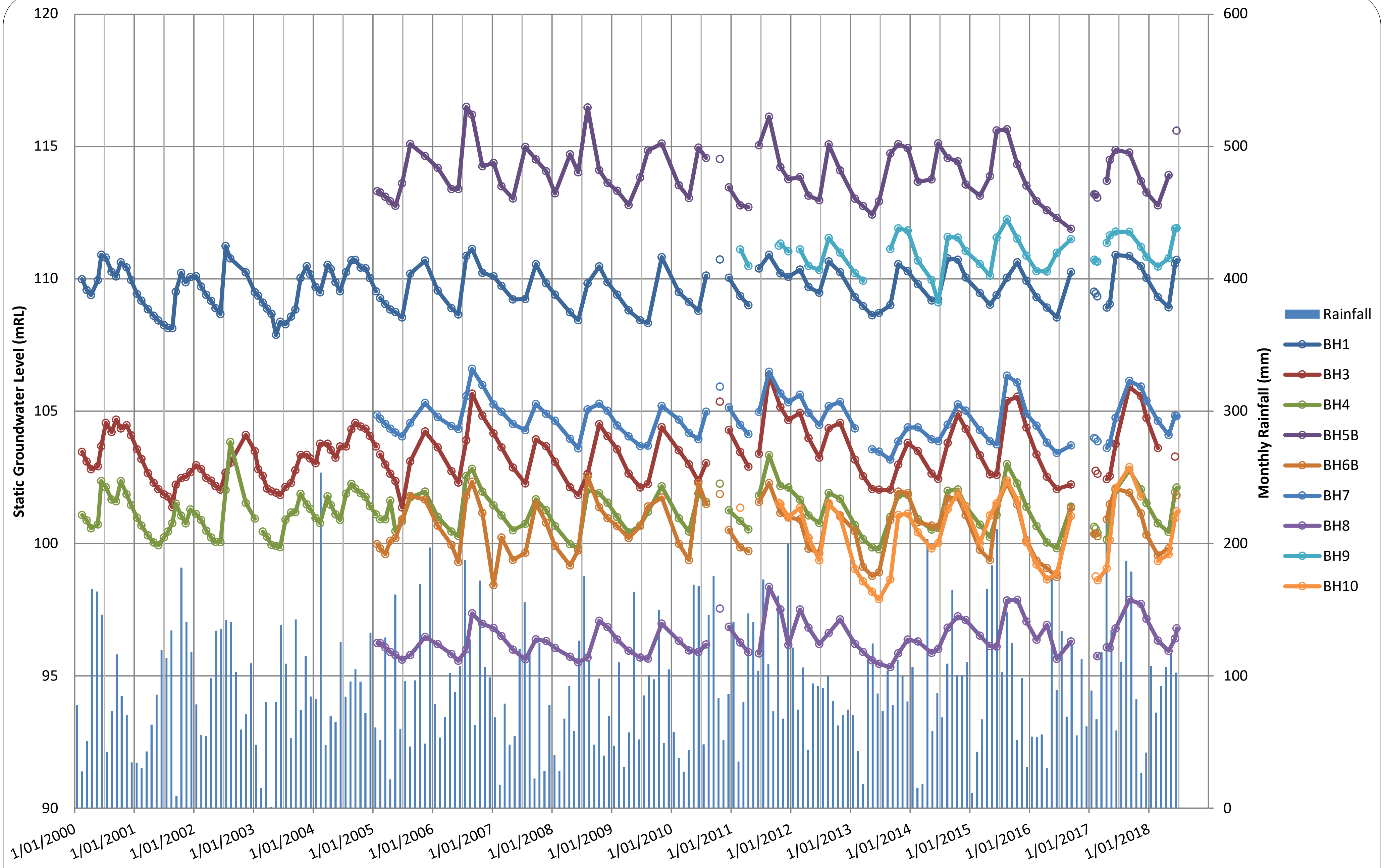


Figure 12: Long-term Trends in Static Groundwater Levels

3.7.2 Aquifer Parameters

In order to estimate the local aquifer parameters, slug tests were undertaken on bores BH1, BH4, BH5B, BH6B, BH7A, BH9, and BH10 on 21 and 22 June 2018. The results and analysis of the tests are presented in Appendix E and are summarised in Table 6 below.

Table 6: Summary of Local Aquifer Parameters

Bore	Average Hydraulic Conductivity (m/s)	Notes
BH1	1.5×10^{-5}	
BH4	1.1×10^{-5}	Very fast recovery
BH5B	8.1×10^{-6}	
BH6B	6.0×10^{-6}	
BH7A	5.0×10^{-6}	
BH9	2.9×10^{-6}	
BH10	4.1×10^{-5}	Very fast recovery
Average	$\mathbf{9.0 \times 10^{-6}}$	

It should be noted that the results are likely to represent the hydraulic conductivities associated with the more permeable layers within the aquifer which are likely to form preferential flow paths. The fine-grained silt ash deposits are considered likely to be less permeable. These values are similar to regional hydraulic conductivity estimates (Rosen and White, 2001).

It is not possible to accurately estimate storage values from slug testing data. The specific yield is likely to be between 0.1 and 0.2 based on the geology present at the site.

3.7.3 Groundwater Flow Direction

The measured groundwater levels have been used to develop the groundwater flow contours presented in Figure 13. These indicate that groundwater flows in a generally southerly direction but is strongly controlled by topography. The gradient is approximately 0.016,and there is little seasonal variation in the groundwater flow patterns, despite the change in water levels.

Comparison of the topographical contours and the groundwater levels indicates that groundwater intersects with the streams at the site. This is likely to affect the local groundwater flow directions in the immediate vicinity of these water bodies, with groundwater discharging into the streams for the majority of the year.

Groundwater pore water velocities through the saturated zone have been estimated based on an average hydraulic conductivity of 9 x 10^{-6} m/s and a porosity of 0.1. This results in an estimated average pore water velocity of 45 m/yr. However, this value is highly sensitive to the aquifer parameters, and values range from 15 to 210 m/yr if the highest and lowest conductivity values are used. The values are also sensitive to the groundwater gradient.

3.7.4 Recharge

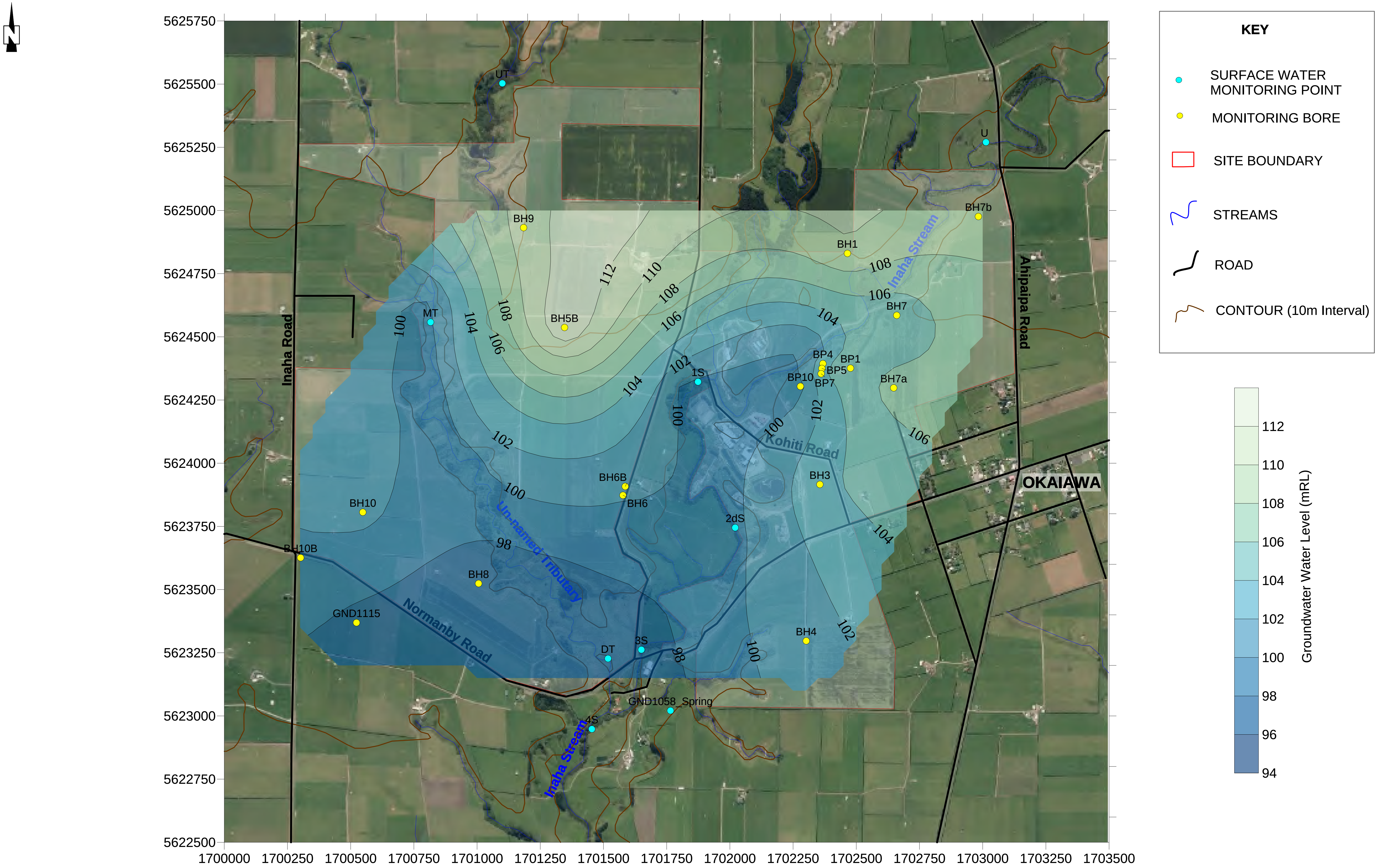
The groundwater in this region is primarily recharged through direct infiltration of rainfall (TRC, 2016). The average annual rainfall over the monitored period is approximately 1,060 mm/year, based on the data from the nearest NIWA Climate Station in Hawera. Whilst the summer months are generally the drier, significant rainfall can occur throughout the year.

Recharge of the unconfined aquifer is estimated to be approximately 15% and 30% of annual rainfall based on an assessment of the broad trends between water level change and total annual rainfall, using porosity values ranging from 0.1 to 0.2. It should be noted that the relationship between total rainfall and water level change is not well defined, possibly due to the coarseness of the data, which does not allow for consideration of individual large-scale rainfall events. The estimated values should be treated within some caution.

3.7.5 Groundwater/surface water interactions

Groundwater can potentially enter the two streams, which cross the site, through diffuse discharge or preferential pathway/spring discharge. Springs are present in the local area, including GND1058, situated just to the south of the site boundary. Furthermore, comparison of the groundwater levels in both summer and winter with the topography of the stream beds of both the Inaha Stream and un-named tributary indicate that flow within these streams is likely to be at least partially supported by discharge from groundwater.

In order to understand the relationship between the groundwater and surface water, attempts were made to flow gauge and survey river levels. Unfortunately, during the field programme, it was not possible to safely or usefully gauge the stream flow, as the work was undertaken in the winter, following a period of prolonged rain. Even if safe gauging of the stream had been possible, the results would not have been representative of low flow conditions. Very basic estimates of flow were undertaken on the Inaha Stream in the centre of the site during the groundwater field investigation in 2017.



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2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA.

FIGURE 13: GROUNDWATER CONTOURS (AVERAGE 2014-2018)

An estimate of the mean annual low flow (MALF) within the Inaha Stream can however be calculated by comparing these values with the flow in the nearby Kapuni Stream at Normanby Bridge for the same dates. The results indicate that the MALF for the Inaha Stream at the plant is approximately 80 to 100 L/s, which corresponds with the conditions attached to the discharge and take consents associated with Inaha Stream.

TBP regularly record the water level within the Inaha Stream near the plant using a gauge installed in the river. This gauge is used to estimate streamflow at the plant for consenting purposes, and results support the results of the flow estimations made during the field programme. Analysis of this data indicates that a 7-day MALF of 100 L/s for the Inaha Stream at the plant is realistic.

It is considered likely that groundwater does discharge into the streams across the site. The monitored water levels indicate that groundwater generally flows in a southerly direction, but that the water table also intersects both streams across the site. Base flow during the summer months indicates that groundwater does supplement the flow within the river, and this may occur to varying extents throughout the year.

3.7.6 Existing Groundwater Takes

TBP currently holds a consent to take and use groundwater for industrial water supply at the site. There are no other additional consented groundwater takes within 3 km of the southern site boundary (i.e. down gradient of the site). However, permitted takes may exist and it is understood that the spring (GND1058) located just to the south of the site boundary is currently used for domestic supply.

3.7.7 General Groundwater Quality

The key parameter of interest for this assessment is dissolved nitrogen in the form of nitrate nitrogen (nitrate-N), although consideration has also been given to ammoniacal nitrogen. Nitrate-N concentrations have been monitored in bores across the site since 2000 and are also assessed in the Inaha Stream, the un-named tributary, and the spring just to the south of the site (GND1058).
The trends in the concentrations of nitrate-N within the groundwater over time are presented in Figure 14, and the statistics are summarised in Table 7.

Table 7: Summary Nitrate-N Concentrations (g NO_3-N/m^3)

Bore	Range	Median	Standard Deviation	Number of samples	Years monitored
BH1	0.85 – **30**	3.3	4.3	139	2000 – 2018
BH3	3.3 – **110**	8.8	21	139	2000 – 2018
BH4	4.6 – **85**	7.9	11	139	2000 – 2018
BH5B	4.1 – **100**	**40**	28	80	2005 – 2018
BH6B	0.89 – **76**	**54**	28	81	2005 – 2018
BH7	3.6 – **83**	**19**	25	80	2005 – 2018
BH8	3.0 – **53**	**17**	10	81	2005 – 2018
BH9	**13 – 51**	**21**	8.9	38	2011 – 2018
BH10	**51 – 91**	**61**	11	39	2011 – 2018
GND1058 (spring)	1.4 – 7.8	2.6	1.3	139	2000 – 2018

Notes
1. *Values in bold exceed the DWS for Nitrate of 11.3 g NO_3-N/m^3.*

Background nitrate concentrations in shallow groundwater in the Taranaki region are approximately 3.5 g NO_3-N/m^3 or less (TRC, 2104). Inspection of the results for BH1, which is the most upstream of the monitoring bores at TBP, indicates that groundwater concentrations entering the site were generally less than 5 g NO_3-N/m^3 until 2013. More recently, the concentration has increased to between 7 and 10 g NO_3-N/m^3, although it is occasionally higher, potentially as a result of wastewater irrigation being extended into this area. This suggests that the nitrate nitrogen load within the groundwater entering the site may have increased in the last five years.

The on-site monitoring bores show significant fluctuation, both seasonally and over the monitored period. Plots showing the static water levels are presented in Appendix E, and nitrate-N concentrations are presented in Figure 14.

In general, the nitrate concentrations in the western half of the site have increased since 2009, particularly in BH5B and BH6B. Concentrations in BH6B are currently between 60 and 70 g NO_3-N/m^3, and concentrations in BH5B are similar, although subject to more fluctuation. BH8 shows a steady, but less dramatic, increase over this period. BH9 and BH10 have only been monitored since 2011, but all the measured concentrations within these bores are above the New Zealand Drinking Water Standard (DWSNZ, 2008). These results suggest that the groundwater on the western side of the site may now be consistently above the drinking water standards.

The concentrations of nitrate-N within BH3 and BH4 in the central and southern parts of the site appear to be showing less extreme fluctuations over the last five years than seen in the earlier monitoring data. Whilst concentrations still regularly exceed the DWSNZ 2008, concentrations of over 40 g NO_3-N/m^3 are no longer occurring, indicating that nitrate-N within the groundwater in this area has reduced in recent years.

The concentrations of nitrate-N within bore BH7 show large seasonal variation. The investigations carried out in June 2018 indicated that these variations were likely to be associated with poor bore integrity rather than being representative of seasonal fluctuations in the wider groundwater. However, even if the peak concentrations are ignored, nitrate-N is present within the groundwater at concentrations that exceed the DWSNZ 2008.

Figure 15 shows the median nitrate nitrogen concentrations for the data obtained between 2014 and 2018, which are considered to be representative of the current groundwater. Nitrate nitrogen concentrations within the groundwater are greater than the DWSNZ 2008 across the majority of the site, with the highest concentrations present in the western part of the site. Concentrations in the east are generally lower, although still exceeding the DWSNZ 2008.

The concentrations of ammoniacal nitrogen in the monitoring bores excluding the burial pit bores are presented in Figure 16. Concentrations are generally very low, although occasional spikes are seen in all the bores. There does not appear to be any significant trends between ammoniacal nitrogen concentrations and time or location. The results indicate that aerobic conditions are present across the site and oxidation of ammonia is occurring.

3.7.8 Groundwater Quality Associated with Burial Activity

Monitoring of groundwater associated with the burial pit area is conducted in four monitoring bores (BP4, 5, 7 and 10), down gradient of the burial pits, and one upgradient, background bore (BP1), shown in Figure 11.

Ammoniacal nitrogen is the main species of nitrogen migrating from the burial pits, as there is likely no aerobic zone below the burial pits to oxidise the nitrogen before it migrates to groundwater. Ammoniacal nitrogen migration from the burial pits is discussed further in Section 5.2, but concentrations of over 200 g NH_4-N/m^3 have been observed in those bores.

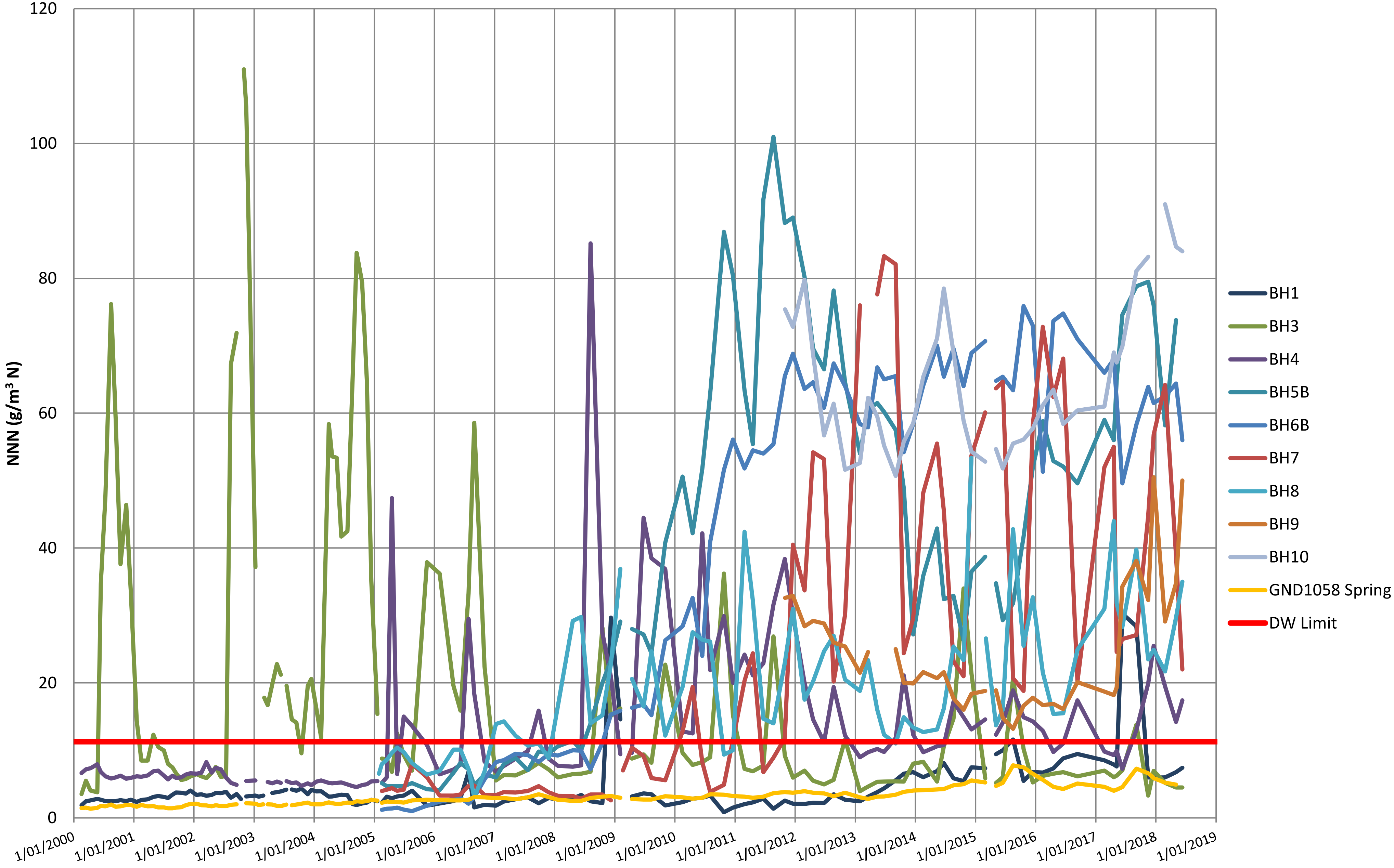
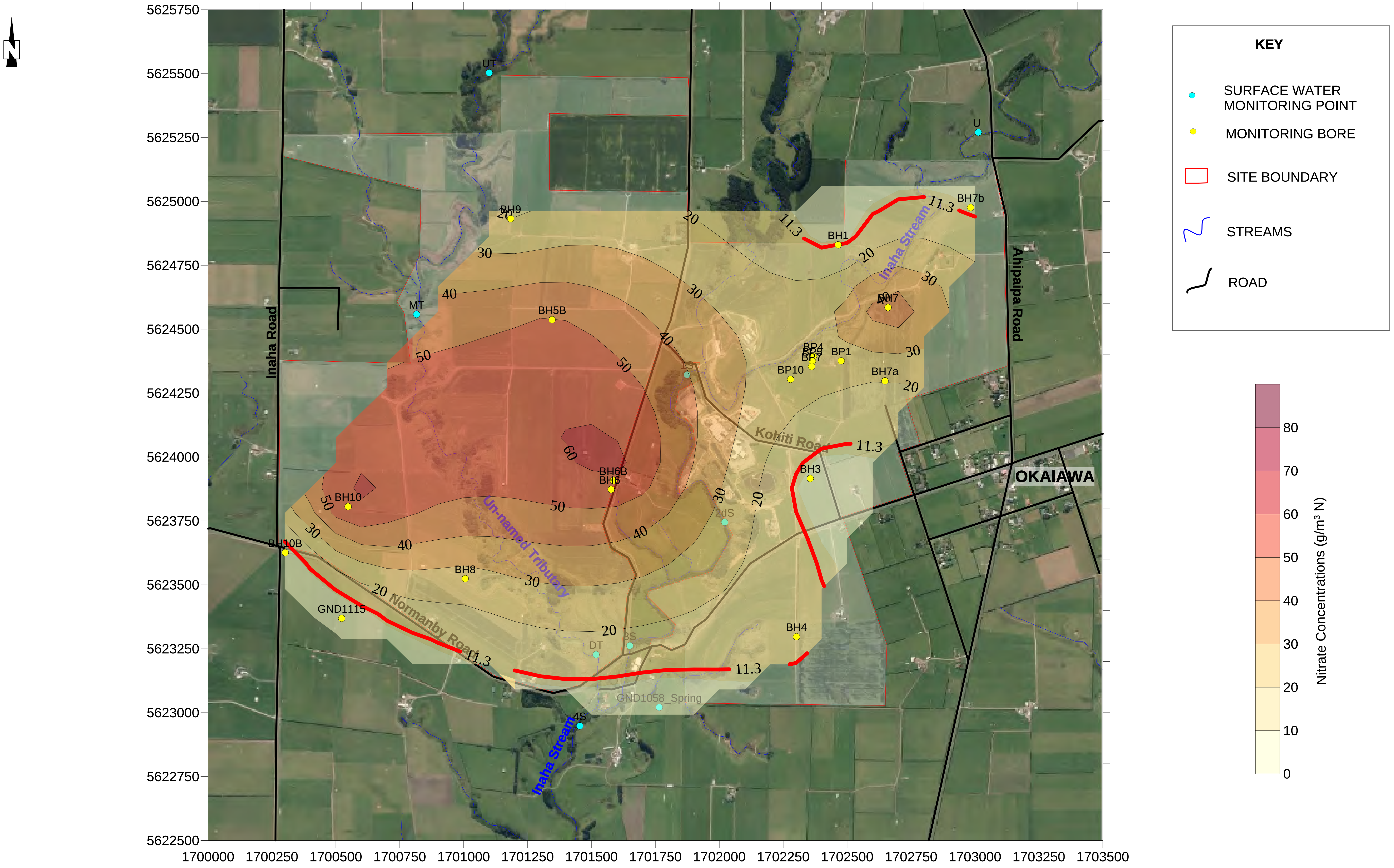


Figure 14: Long-term Trends in Nitrate as N in Groundwater



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2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA.

FIGURE 15: MEDIAN NITRATE CONCENTRATIONS (2014 to 2018)

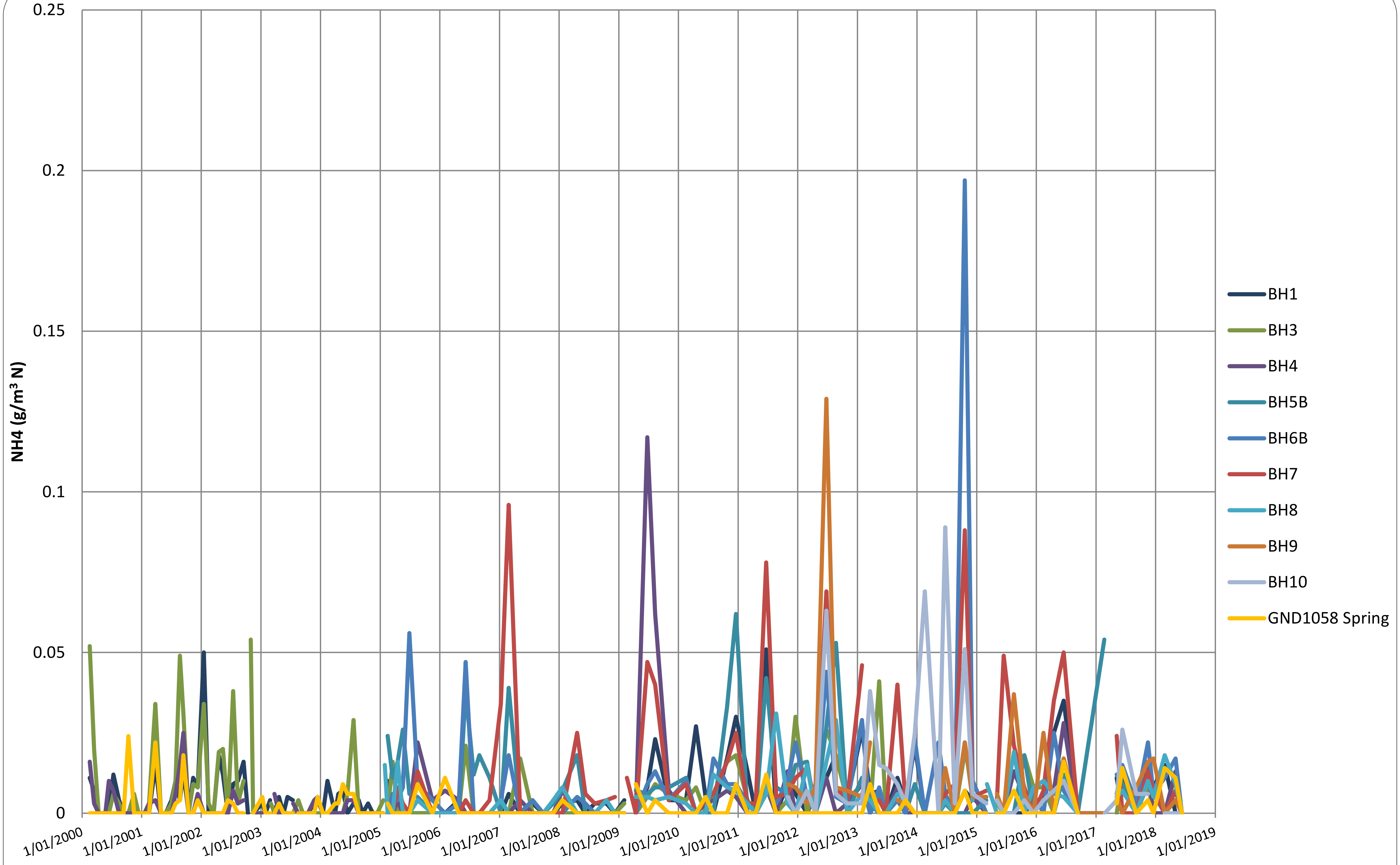


Figure 16: Long-term Trends in Ammonia as N in Groundwater

4.0 Assessment of Environmental Effects of the Irrigation Wastewater Activity

4.1 Assessment Criteria

The assessment criteria include the following:

- Assessment of effects on soils within the irrigation area in terms of hydraulic, fertility and chemical balance effects;
- Assessment effects on groundwater in terms of quality effects through leaching of nutrients;
- Assessment of effects on surface water in terms of quality effects through direct runoff;
- Assessment of potential effects on human and stock health; and
- Assessment of nuisance effects on neighbours as a result of system operation.

4.2 Effects on Soils

The key criteria for assessment of effects on soils include:

- Avoiding saturated soil conditions or potential for pugging;
- Maintenance of suitable cation levels to avoid soils becoming sodic;
- Maintenance of suitable nutrient levels for land use practices; and
- Minimising accumulation of contaminants within the soil profile, such as heavy metals.

A soil investigation was conducted in June 2018. The results of this investigation are presented in Table 4, and are considered to be indicative of soil characteristics for the TBP farm irrigation areas.

4.2.1 Hydraulic Loading Effects

Irrigation of wastewater to land during the drier summer and autumn period helps to maintain moist soil conditions for pasture growth, however, as seasonal rainfall and soil moisture content increases, irrigation must be restricted to avoid saturated conditions or conditions where pugging is promoted.

The annual loading of wastewater (including Zeal Grow application), at an average of approximately 41 mm to 52 mm is only an additional 5% of the hydraulic loading over the average annual rainfall of 1,061 mm/yr. However, the irrigation rate of 25 mm to 36 mm per event, has the potential to generate temporary elevated loading on the soils which will temporarily increase soil moisture levels. TBP implements a standard seven day stock withholding period to enable soils to drain before stock have access to the land for grazing, so as to minimise the potential for pugging to occur beyond the risk that would be expected for unirrigated areas.

When irrigation operators identify that there is an increased risk of runoff, due to wet soil conditions from rainfall, TBP maintains the ability to discharge to the Inaha Stream

It has been demonstrated over the past 18 years that the existing irrigation management method is acceptable for the operation of an underlying pastoral farming system.

Saturated and unsaturated infiltration testing of the soils indicates that in some areas, the existing infiltration capacity of the soils is lower than would normally be expected for the well-drained allophanic soil that is across all irrigated areas. This suggests that the soil may be compacted as a result of farming activities and that soil remediation may be required in areas where there is an observed decrease in infiltration rates. While some of the existing irrigators are capable of irrigating at rates as low as 10 mm/hr, as a general minimum, as outlined in Section 3.4, the near saturation infiltration rates of the soil averages 99 mm/hr, but can be as low as 4 mm/hr. This suggests that there is a potential risk of runoff in some irrigation areas, and these areas require remediation to restore the soil infiltration capacity to greater than the irrigation rate. Remediation may include breaking areas of soil compaction by ripping or with a James Aerator.

4.2.2 Soil Cation Balance

The wastewater generated from the TBP processing plant has low to moderate sodium and potassium levels (refer to Table 1). When irrigated to land for prolonged periods, sodium in wastewater has the potential to displace calcium and magnesium in the soil, as well as raising the sodium level in the soil, potentially dispersing clay particles, weakening soil structure, and reducing hydraulic conductivity. Generally, cation concentrations are within the guideline normal ranges (Hill Laboratories Ltd, 2018), and sodium levels are relatively low, with an average exchangeable sodium percentage (ESP) level of 4%. While elevated ESP levels can result in reduced hydraulic conductivity, given the low ESP levels, the reduced hydraulic conductivity measured in the recent soil sampling event (June 2018) is more likely associated with compaction from pugging or machinery (refer to Section 4.2.1).

4.2.3 Nutrient Management

Nitrogen and phosphorus are key nutrients for consideration of maintaining soil nutrient levels in accordance with the dairy farming land use activities. The OverseerFM® (Version 6.3.1) nutrient model was utilised to model nutrient utilisation and losses for the dairy farming and wastewater irrigation system, for both the 2015/16 processing season and the 2017 annual period. This helps provide an assessment of the nutrient requirements from the dairy farming activity, for comparison with soil sampling results and the expected loss of nutrients to water via leaching and runoff.

The available nitrogen levels (15 cm depth), shown in Table 4 for the TBP farm soils, are similar to the guideline normal range. The estimated annual average nitrogen loading rate of 251 kg TN/ha/yr, applied in 2015/16, is well in excess of the nitrogen load removed as product. While the estimated annual average nitrogen loading rate of 167 kg TN/ha/yr for 2017 is more in keeping with nitrogen removed as product, nitrogen load distribution for both 2015/16 and 2017 indicates that there is scope for more even spreading of nitrogen loads, to minimise nitrogen leaching (refer to Section 4.4).

Soil monitoring indicates that there is surplus available phosphorus for the dairy farming activity, with an average Olsen P level of 76 mg/L, while the recommended range for soil Olsen P on a high producing dairy farm, on volcanic soils, is 35 – 40 mg/L. The phosphorus loading from wastewater and Zeal Grow may have been historically higher than what is required for normal operation as a dairy grazing farm, resulting in the progressive increase in Olsen P. High phosphorus levels in the soil do not affect the health of the soil, however, it is a consideration for potential mobilisation of phosphorus as runoff to surface water (refer to Section 4.4).

4.2.4 Heavy Metal Cumulative Effects

Contaminants such as heavy metals, even at low concentrations in the irrigated wastewater, have the potential to accumulate in soils over an extended period of wastewater irrigation. It is therefore important that the heavy metal contaminant concentrations are assessed on an infrequent basis to confirm if guideline limits for heavy metal concentrations are at risk of being exceeded. Table 8 provides a summary of the soil heavy metal monitoring results. Zinc and copper can be elevated in rendering wastewaters due to use of stock health supplements.

Assessment of heavy metals indicates that there is no indication of net increase in comparison to background levels, and all soil samples were measured below the guideline limits (MfE 2003). Therefore, it is concluded that the irrigation of wastewater from the TBP plants is not resulting in an increase in heavy metal concentrations in the soils.

Table 8: Soil Heavy Metal Monitoring Results

Soil Parameter	Guideline Limit[3]	Average	Range	Back-ground
Arsenic	20	2.7	2-3	3
Cadmium	1	0.59	0.49-0.74	0.7
Chromium	600	6.5	6-7	6
Copper	100	58.3	52-79	51
Lead	300	9.1	8.6-9.3	9.2
Nickel	60	3.7	3-4	3
Zinc	300	123	110-138	134

Notes:

1. *Monitoring results based on samples collected 0n 21 and 22 June 2018.*
2. *All units in mg/kg dry weight.*
3. *Soil heavy metal contaminants analysed as total recoverable.*
4. *Guideline limits based on the Guidelines for the Safe Application of Biosolids to Land in New Zealand (MfE 2003).*

4.3 Effects on Groundwater

As described in Section 3.7, the groundwater flows in a generally southerly direction, with some variation associated with topography and the locations of the Inaha Stream and its unnamed tributary. The potential downstream users or receptors of the groundwater include:

- Permitted groundwater takes for drinking water and other uses;
- Spring discharges used for drinking water; and
- The Inaha Stream and associated tributaries.

The key contaminant of concern associated with the application to land of treated wastewater is nitrate nitrogen, which could potentially impact on the receptors noted above. The potential effects on the Inaha Stream and its tributaries are discussed in Section 4.4.3.

As noted in Section 3.7.6, there are no consented takes within 3 km of the downstream boundary of the site, but there may be permitted takes from bores within this area and the spring (GND1058) located immediately south of the site is currently used for drinking water. Based on this information, an assessment of the potential effects of nitrate nitrogen migrating off-site in the groundwater has been undertaken.

Concentrations of nitrate nitrogen within the downstream bores (BH10B, GND1115) and the spring (GND1058) have not exceeded the DWSNZ 2008 limit of 11.3 mg/L during the monitored period. The spring has been monitored for the longest period, and concentrations of nitrate nitrogen at this location had been increasing slowly in a linear fashion from <2 mg NO_3-N/L to approximately 4 mg NO_3-N/L between 2000 and 2013. In 2013 and 2014 the concentration increased more rapidly before stabilising at around 5 mg NO_3-N/L. The concentration remains stable at this level, although there are more seasonal peaks which were not present before 2013. Concentrations at the spring remain significantly below the DWSNZ 2008 limit.

OverseerFM® nutrient modelling has been conducted for the 2015/16 and 2017 annual periods to identify the rate of nutrient loss from the irrigation and farming activity, either by runoff to surface water or via leaching to groundwater. A summary of the Overseer modelling is provided in Appendix F. Modelling has been based on wastewater nitrogen load data and Zeal Grow nitrogen load data. As discussed above, Zeal Grow nitrogen loads have historically been based on inorganic nitrogen testing, which does not take into account organic nitrogen loads. Therefore, nitrogen loads utilised in the overseer model have been based on the average nitrogen content in 13 stickwater samples analysed over 31 January – 21 March 2019.

The OverseerFM Modelling indicates that on average in 2015/16 and 2017, approximately 68 kg N/ha/yr and 57 kg N/ha/yr respectively may have been lost to groundwater following the application of treated wastewater and fertilisers across the irrigated areas of the farm, with an average nitrogen leaching across the entire farmed area (including unirrigated areas) of 56 kg/ha/yr and 47 kg/ha/yr for 2015/16 and 2017 respectively. Assessment of the nitrogen distribution across the irrigated areas indicates that some paddocks have been heavily loaded with nitrogen, while others have been lightly loaded (refer to Figure 17 and Figure 18). Some of this uneven distribution can be attributed to maize cropping rotation, however, there is capacity to provide more even distribution than has been achieved in the past.

Nitrogen loading per event is also a key impact on leaching rates, as well as timing of the year. To minimise leaching, nitrogen loads per month need to be in keeping with pasture uptake. This is especially important during May to October, when there is generally a surplus of soil moisture levels resulting in drainage to ground water. Due to the elevated concentration of Zeal Grow, some monthly loading rates have been well in excess of pasture requirements, resulting in increased nitrogen leaching. Figure 17 and Figure 18 provide a summary of the nitrogen loading distribution and leaching rates for each paddock for 2015/16 and 2017 respectively. As can be seen, there is capacity for better distribution and optimisation of leaching rates.

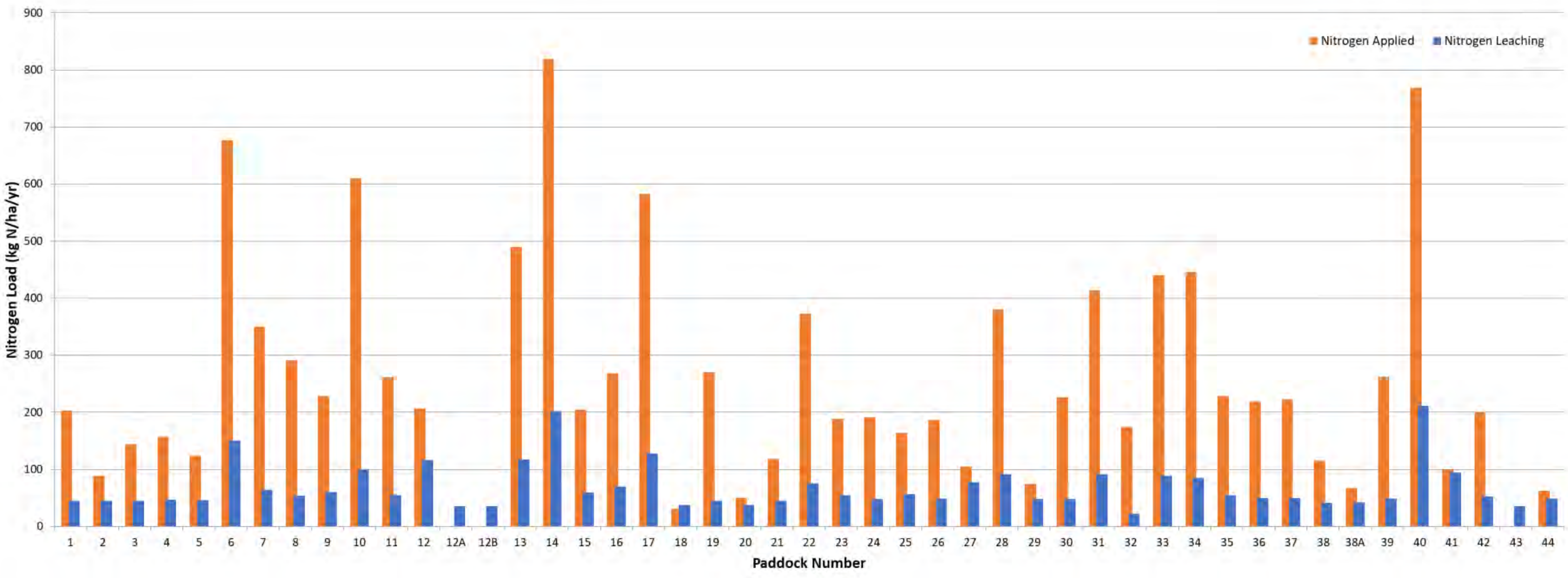


Figure 17: Annual Paddock Nitrogen Loading and Modelled Nitrogen Leaching per Hectare for 2015/16

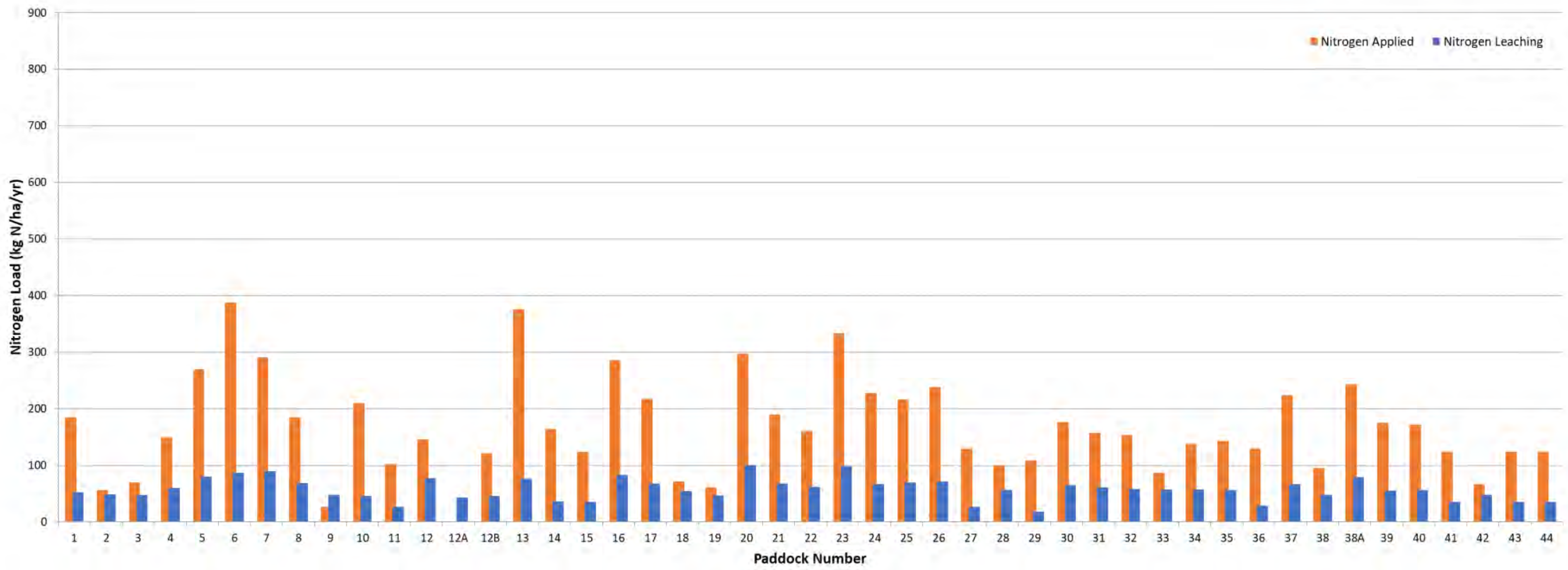


Figure 18: Annual Paddock Nitrogen Loading and Modelled Leaching per Hectare for 2017.

Based on the OverseerFM modelling, it is concluded that there has been a significant difference in the two years modelled, with a 33% decrease in average nitrogen loading and a 16% decrease in average nitrogen leaching in the 2017 season compared with 2015/16. This is attributed to the volume of Zeal Grow applied to the farm over the 2015/16 season, which was approximately 63% more than the volume applied in 2017. The volume of wastewater applied during 2015/16 was only 15% more than the volume applied in 2017. As discussed in Section 2.5 the 2015/16 volume is assumed to be representative of historic loading rates, while 2017 is representative of current loading rates.

If an average pore water velocity of 45 m/year is assumed across the site, which is representative of the average measured hydraulic conductivity, then based on the assumption that nitrate nitrogen has been leaching into the groundwater from the irrigated area at approximately 68 kg N/ha/year (2015/16 leaching rate) since at least 2009, a simple flow calculation indicates that concentrations of nitrate nitrogen within the spring would start to increase around 2014. This corresponds well with the results seen within the monitoring data. However, the monitored change in concentration is significantly less than the calculated value, indicating that the majority of the nitrate nitrogen within the groundwater is not migrating southwards off the site.

The groundwater contours presented in Figure 13 indicate that shallow groundwater is likely to discharge into the Inaha Stream and the unnamed tributary across the majority of the site. Shallow groundwater with elevated concentrations of nitrate present in the north and central parts of the site may be predominantly discharged into the streams.

However, it should be noted that elevated concentrations are also present in BH10, in the most westerly part of the site, where the streams do not intercept the southern flow of the groundwater. Concentrations of nitrate nitrogen in the down gradient monitoring bores in this area (BH10B and GND1115) remain at background levels.

The nitrogen loading associated with the discharge of treated wastewater and fertiliser application to land has impacted the groundwater at the site over the last 10 years. However, after an increase in groundwater concentrations between 2009 and 2012, the concentrations appear to have stabilised, albeit at elevated values. This suggests that the current rates of application may be in equilibrium with processes removing nitrate nitrogen from the groundwater. Whilst some of this may be due to denitrification, based on our conceptual understanding of the groundwater system, it is anticipated that groundwater with elevated concentrations of nitrate nitrogen may be discharging into the surface water bodies crossing the site. The risks to surface water are discussed in Section 4.4.3.

Based on the monitoring undertaken to date, the elevated groundwater concentrations at the site do not currently appear to be significantly affecting downstream groundwater receptors.

4.4 Effects on Surface Water

Potential pathways by which the wastewater irrigation activity could have an effect on surface water include:

- Direct irrigation over drains;
- Surface runoff as a result of ponding or saturated conditions;
- Drainage of soil water from subsurface drains (Novaflow drains) to surface water; and
- Contributions from wastewater affected groundwater.

As indicated in Figure 1, many paddocks of the TBP farm are bordering, or in the catchment of, the Inaha Stream and its associated tributaries. Groundwater levels in the existing irrigation area suggest that a portion of the groundwater (from all areas) will also migrate towards these streams.

4.4.1 Direct Run-off to Surface Water

Under TRC Resource Consent 3941-2, TBP implements a 20 m separation distance from any drain or surface water body. This buffer zone prevents any irrigation water falling directly onto surface waters and takes into account spray drift during high winds.

Runoff of irrigated wastewater can occur if the irrigation rate is greater than the hydraulic conductivity of the soils or if the soils are saturated, preventing further infiltration. As discussed in Section 3.4.2, the soils in the existing irrigation areas have sufficient in-field hydraulic conductivity, as indicated by many years of receiving wastewater irrigation without any major surface ponding. Recent monitoring indicates that in some areas there is reduced hydraulic conductivity, which may require soil remediation measures to restore infiltration rates. In general, however, while ponding may occur occasionally, it is not expected to result in runoff due to the flat topography of the paddocks and reasonable pastoral thatch.

The proposed operation will not introduce any higher hydraulic loads than what has been demonstrated in the past, so no increased risk of surface ponding or runoff is expected.

To further reduce the risk of runoff and ponding, TBP exercises less hydraulic loading during winter months (Figure 4) when soils are generally wetter and the water table is higher. This is managed on a daily basis, and irrigation only occurs when soil conditions permit.

When soil conditions are such that runoff could occur, discharge to the Inaha Stream is preferable to discharging to land. Allowing runoff to occur when irrigating on land enables the mobilisation of contaminants in the soil which could have a more detrimental effect compared to direct discharge to the Stream.

Potential runoff to surface water is the main potential migratory pathway for phosphorus from land treatment systems to surface water. Migration via groundwater is generally a minor contributor as allophanic soil (as present across the irrigation areas) is very effective at retaining phosphorus.

OverseerFM modelling indicates that the existing wastewater irrigation system, as modelled for 2015/16 and 2017, has an average rate of phosphorus migration to surface water of 0.7 kg P/ha/yr and 0.6 kg P/ha/yr respectively (0.4 kg TP/ha/yr from leaching, 0.3 kg TP/ha/yr from runoff), therefore contributing only a very minor load to surface water.

4.4.2 Sub-soil Drain Effects

Wastewater irrigation can make its way to surface water via underground channels. The two main mechanisms that encourage sub-surface drain effects are the migration of soil water through sub-soil drains, and the migration of wastewater-affected groundwater resurfacing in surface water drains and streams.

There are no known active subsurface drains within the irrigation area (pers. comm, R. Stockwell 29 October 2018).

4.4.3 Groundwater Discharge Effects

Stream flow monitoring and groundwater contours indicate that groundwater is discharging into the Inaha Stream and the unnamed tributary across the majority of the site. The concentration of nitrate nitrogen within the groundwater is elevated above the DWSNZ 2008 limit across the site.

TBP and TRC have been monitoring the upstream and downstream water quality of the Inaha Stream and the unnamed tributary. Measured concentrations of total oxidised nitrogen (nitrate nitrogen and nitrite nitrogen) are generally in excess of the ANZECC guideline for lowland rivers in New Zealand in both the upstream and downstream samples.

A comparison of the increase in nitrate nitrogen concentrations between the upstream and downstream sample locations with the measured flow rate of the Inaha Stream is presented in Figure 19.

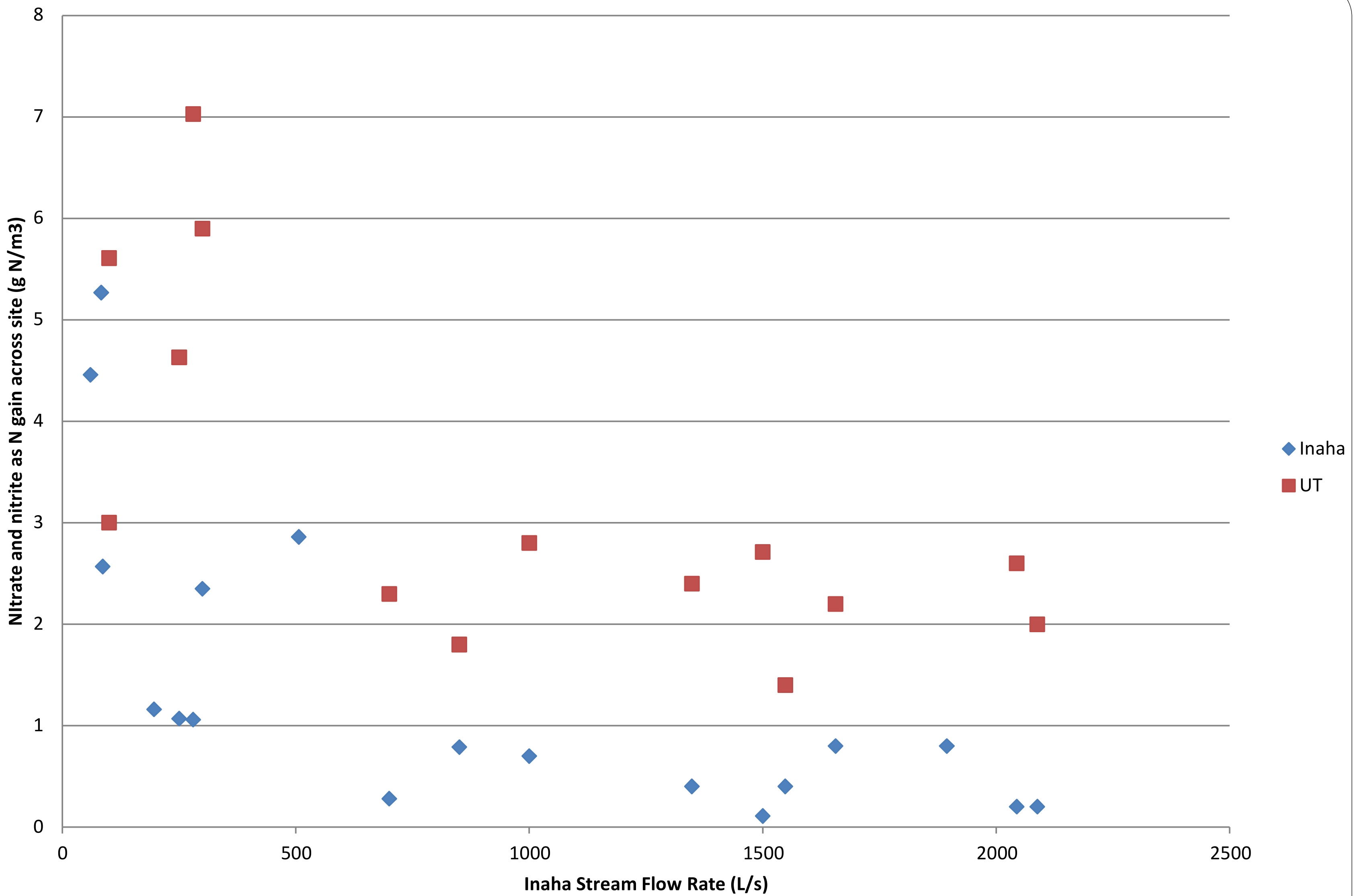


Figure 19: Nitrate and nitrite as nitrogen gain in streams against flow rate

The plot indicates that during higher flow conditions (i.e. greater than 600 L/s in the Inaha Stream) the gain across the site remains constant, at approximately 0.47 g N/m^3 in the Inaha Stream and 2.2 g N/m^3 in the unnamed tributary. The gain is greater in the unnamed tributary due to smaller flows (caused by the smaller catchment size) resulting in less dilution.

During lower stream flow conditions, when groundwater is a more pronounced contributor to stream flow, the gain in nitrate nitrogen between the upstream and downstream sampling points is significantly larger, ranging up to 7 g N/m^3. This indicates that nitrate nitrogen within groundwater discharging into the streams is having a significant effect on the nitrate nitrogen concentrations within the streams during low flow conditions.

In order to quantify the potential impact of nitrate nitrogen within groundwater discharging into the streams, two separate assessments have been undertaken. In the first, the aquifer system below the site has been considered as a simplified input/output black box type model. The different fluxes were estimated using the results of long-term monitoring, the OverseerFM® modelling detailed in Appendix F and the conceptual understanding of the aquifer system presented in Section 3.7.

The groundwater fluxes were estimated based on the average groundwater gradient across the site (0.016) and the median concentrations of nitrate nitrogen recorded upstream (BH1, 7.3 g N/m^3) and downstream (the spring, 5.0 g N/m^3) between 2014 and 2018. This time period was used for the assessment because there were significant changes in nitrate nitrogen concentrations across large areas of the site between 2009 and 2013, after which the concentrations appear to have stabilised. Median values of water level and nitrate nitrogen concentrations for this period are considered to be representative of the current conditions at the site.

An aquifer thickness of 20 m was assumed, and the width of the site was taken to be 2.3 km. These values were used to estimate the groundwater throughflow and the associated nitrate nitrogen fluxes into and out of the site.

The results of the OverseerFM® modelling were used to estimate an average flux of nitrate nitrogen leaching into the groundwater from land application of treated wastewater and Zeal Grow. The results of the modelling did not show any significant differences in the leaching rates in different areas, and as such, an overall average value of 63 kg N/ha/year (average of 2015/16 and 2017 modelled leaching rates) was applied to a total area of 330 ha during the assessment.

A nitrate nitrogen balance based on these results was used to estimate the amount of nitrate nitrogen discharging from the groundwater into the streams.

This assumes that the concentration of nitrate within the groundwater remains constant, which is in accordance with the recent groundwater monitoring data. This model estimates that up to 21,122 kg N/year (equivalent to 58 kg N/day) may be discharged into the streams from groundwater. It should be noted that this estimate is likely to be representative of an upper limit, as it includes no allowance for denitrification in the aquifer system. This method was also used to estimate the flux from groundwater into the separate water courses, with the results indicating 20.3 kg N/day into the unnamed tributary and 34.7 kg N/day into the Inaha Stream.

The second method used to estimate the discharge of nitrate nitrogen from groundwater into the streams was based on the surface water monitoring results. The information presented in the TRC monitoring reports (2012 to 2017) and summarised in Figure 19.

was used to estimate representative low flow conditions in the streams. This was cross checked by a more detailed analysis of the flow records provided by TBP for the Inaha Stream section near the plant. A value of 100 L/s for the Inaha stream was selected as being representative low flow conditions, based on the information available. Monitoring has not been undertaken on the unnamed tributary, so an estimate of the low flow value for this stream was made by assuming that the flows within both the streams are approximately proportional to catchment size, given the similar topography. This results in an estimated flow rate of 19 L/s for the unnamed tributary under low flow conditions.

The flux of nitrate nitrogen off site within the streams was estimated using these flow rates and the average nitrogen gains measured across the site during surface water monitoring under low flow conditions (TRC reports 2012-2017). The average estimated gain in nitrogen across the site was 4.1 g NO_3-N/m^3 for the Inaha Stream and 5.2 g NO_3-N/m^3 for the unnamed tributary. The results indicate that the total nitrate flux from the site caused by groundwater discharge into the streams is approximately 44 kg N/day.

The results of the two models indicated that the flux of nitrate nitrogen estimated from nitrogen leaching is 27% greater than the flux rate estimate from surface water monitoring. Irrigation zone assessments suggest that there is little difference between the two models for the Inaha Stream catchment, however, zone modelling of the unnamed tributary indicates that only 42% of the modelled nitrogen leaching results in the tributary. Whilst the assessments are relatively basic and do not account for smaller scale local variations in conditions, they are based on site specific data and they provide a useful assessment of the likely loads of nitrate nitrogen, which are potentially being discharged into the streams from the groundwater, when the site is considered as a whole.

The results suggest there may be some denitrification occurring in the catchment of the unnamed tributary, and/or indication of lag effect, but potentially not within the irrigated areas of the Inaha catchment. The results within the Inaha catchment may also support the theory that nitrate concentrations within the groundwater system may now be in a state of approximate equilibrium, which is suggested by the monitoring results presented in Figure 14. It is considered possible that higher rates of nitrogen application in the wastewater or Zeal Grow, to parts of the site, may have occurred between 2009 and 2013, resulting in the increase in groundwater concentrations. However, since 2013, the concentrations appear to have stabilised, despite some seasonal variation, suggesting that the current application rates are not resulting in a worsening of conditions within the groundwater.

It is considered likely that a reduction in nitrogen leaching from the irrigation areas would result in some improvement in the nitrate nitrogen concentrations within the groundwater at the site within five years, but it is unlikely to cause an immediate improvement to surface water concentrations during low flow conditions. The heterogeneous nature of the aquifer means that whilst flow is likely to be predominantly within the more permeable gravel and sand horizons, groundwater with elevated nitrate nitrogen is likely to also be present within the lower permeability silt and clay horizons. As the water quality in the more permeable layers improves, nitrate nitrogen will diffuse out of water sitting within the lower permeability layers, but the process may be quite slow.

The groundwater at the site contains nitrate nitrogen at concentrations up to five to six times higher than drinking water values, and two orders of magnitude greater than the recommended ecological limits. Based on the current concentrations and the estimated flux into the streams under low flow conditions, it is likely that it would take at least 20 years for the concentrations to return to background concentrations within the groundwater at the site, assuming that no additional nitrogen was added within the time frame.

This is not considered to be realistic, but a reduction in nitrogen leaching rate below the soil profile is likely to lower the nitrate nitrogen concentrations within the groundwater, and as such, reduce the flux of nitrate into the streams, reducing the potential effects on stream health.

4.4.4 Implications for Surface Water Nitrogen Reduction

The existing migration of nitrate-N to surface water is resulting in a net increase in nitrate-N concentrations in the western, un-named tributary. The direct result is worsening of the stream quality. Based on maintaining a C attribute state under the National Policy Statement for Fresh Water Quality 2014, the average concentration in the unnamed tributary will need to decrease by up to 15%. This in turn will require nitrogen leaching rates to decrease from the existing 68 kg TN/ha/yr (as modelled for 2015/16) to less than 57 kg TN/ha/yr (as applied across irrigated areas only). OverseerFM® nutrient modelling suggests that a reduction may be achieved by maintaining the existing 2017 loading rates. This will mean the real loading of nitrogen will need to decrease at certain times of the year (particularly Winter and Spring) and/or farm management practices will need to be altered to reduce leaching rates.

4.5 Effects on Human and Livestock Health

4.5.1 Potential Pathogens and Micro-organisms

The public health risk due to microbiological components of the TBP wastewater irrigation is not considered to be significant if appropriate irrigation management guidelines are adhered to. A physical barrier (wooden, wire, or electric fence) is in place along the boundary between any public road and any irrigation area. A 20 m separation distance also applies to irrigation areas that border roads or properties. A further separation distance of 150 m applies to any residential dwelling to further ensure public health is not at risk. During high winds, operators assess downwind effects near boundaries and apply a further separation distance accordingly.

Within the irrigation area itself, risk of exposure to microbial contaminants (both for workers on the site and for grazing animals) is minimised due to the following procedures:

- Workers will follow an Irrigation Management Plan to minimise the risk of contact with treated wastewater.
- The proposed irrigation will not be allowed to occur onto wet/saturated soil, nor at times when there is potential for ponding to remain on the ground for greater than the stock withholding period; and
- The irrigated paddocks will be subject to a 14-day stock withholding period for wastewater irrigation. The stock withholding period facilitates desiccation and ultraviolet light exposure to any residual microbial content in the water irrigated.

Microbial die-off in the irrigated water occurs primarily by desiccation (drying out) and ultraviolet light exposure. Both of these factors are maximised when irrigating over the summer period, when dry and sunny weather is prevailing. This die off mechanism is an additional measure that assists in ensuring the pathogen risk to stock is minimised.

4.5.2 Macro-nutrient Limitations for Stock Health

As outlined in Section 4.2.2, the presence of elevated levels of sodium and potassium in the irrigated wastewater has the potential to reduce the availability of dietary calcium and magnesium for dairy cattle and can result in grass tetany (hypomagnesemia) or milk fever (hypocalcaemia) (Mosquera-Losada *et al* 2000). While sodium and potassium levels in the wastewater are relatively low, it is important that calcium and magnesium levels in grass is monitored via herbage monitoring, and that magnesium and/or calcium supplements are fed to stock if required, particularly during calving.

4.6 Nuisance Effects

Potential nuisance effects from the irrigation activity on neighbouring properties include:

- Spray drift from irrigators;
- Odour; and
- Visual and aesthetics.

4.6.1 Spray Drift

The irrigation equipment will generate spray droplets that have the potential to drift from the irrigated area. The amount of spray, and the distance it travels, will depend upon the size of the particles and the wind speed. As outlined in Section 6.1.1, a separation distance of 20 m applies to any irrigation occurring at the boundary between the TBP farm and any neighbouring property. Due to the nature of the irrigation equipment used, the extent of the circular irrigation spray of the roto-rainers will not be any closer to the boundary than is allowed by the separation distances. The roto-rainers will be placed so that even in high winds, spray drift will not encroach on neighbouring properties. Assuming that correct operational procedures are followed, it is expected that spray drift will not cause nuisance effects to neighbouring properties.

4.6.2 Odour

Significant odour is not expected to be associated with the treated wastewater at the time of irrigation. The wastewater has undergone significant treatment, including aeration, and therefore odour is unlikely to be generated during irrigation. Since 2013, there have been no odour complaints associated with operation of the irrigation system and therefore it is anticipated that there will be minimal potential for generation of odours from the irrigation system going forward.

4.6.3 Visual and Aesthetic Effects

Visually, the proposed wastewater irrigation system will look no different from what is currently in place and similar to other water irrigation systems used in rural applications.

Noise generated from the irrigators, even within a close proximity of the irrigator, is low and of an unobtrusive nature in the farm environment.

5.0 Assessment of Environmental Effects of the Burial Pit Activity

5.1 Assessment Criteria

The assessment criteria include the following:

- Assessment effects on groundwater in terms of quality effects through nitrogen leaching;
- Assessment of effects on surface water in terms of quality effects through migration of nitrogen from groundwater.

Assessment of effects associated with potential discharges to air from the burial pit activity are not included in this assessment, as discharges to air associated with the burial pit activity are already covered under Resource Consent 4058-4.

5.2 Effects on Groundwater

The key contaminant of concern with migration from the burial pits is ammoniacal nitrogen.

Monitoring bores have been installed around the existing burial pits (BP1, BP4, BP5, BP7 and BP10), and ground water levels, as well as the adjacent Inaha stream level indicate a potential zone of influent of leaching from the burial pits, summarised in Figure 21. It is expected that future tipping to the south of the existing tipping area will result in an extension of the influenced groundwater zone further south of the existing area, but with a general migration west of the burial pit area.

No ground water users exist between the burial pit area and the Inaha Stream, therefore, the Inaha Stream is considered to be the key receptor of nitrogen that migrates from the burial pit activity.

Monitoring associated with the burial pit area is undertaken by TRC, with results for ammoniacal nitrogen for the past 10 years detailed in Figure 20:.

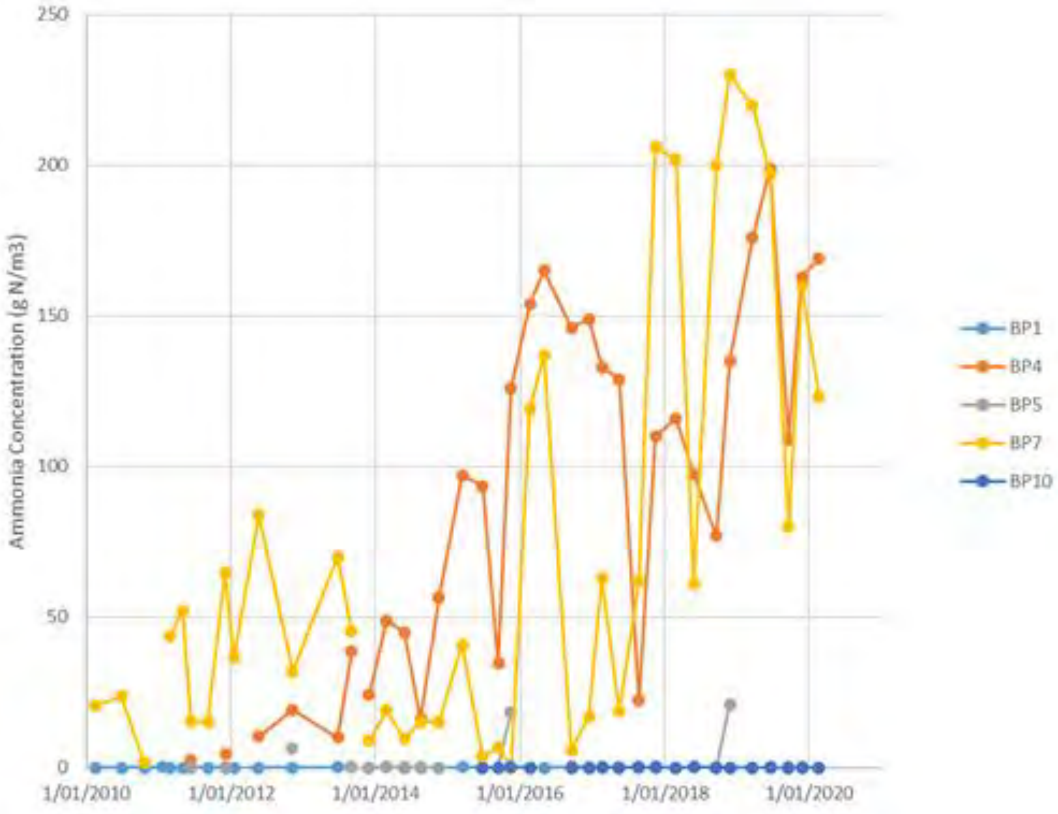
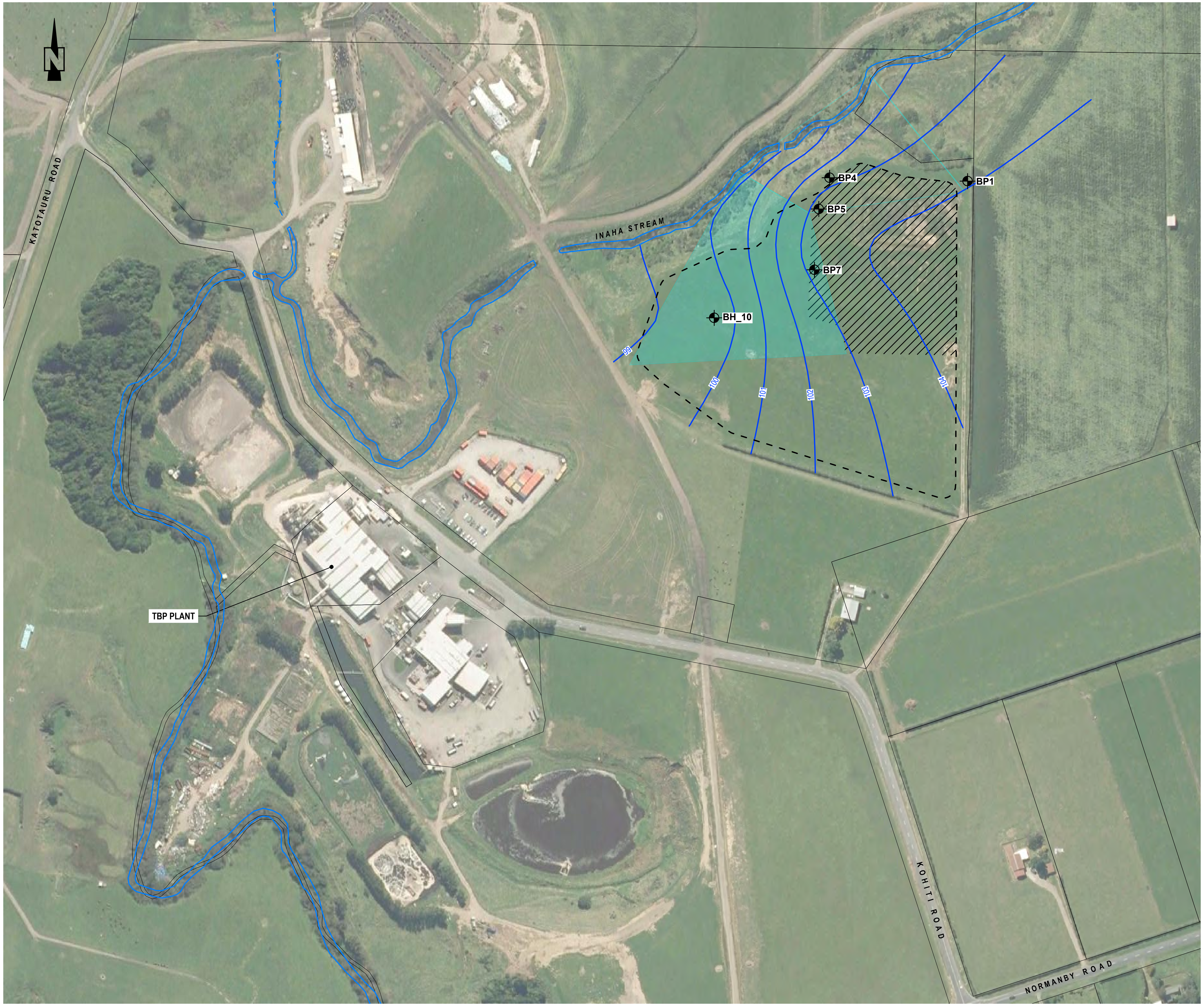


Figure 20: Ammoniacal Nitrogen Groundwater Monitoring Results.



KEY :

- MONITORING BORE [2]
- GROUNDWATER CONTOUR (m RL) [3]
- EXISTING BURIAL AREA
- PROPOSED BURIAL AREA
- ESTIMATED GROUNDWATER ZONE OF INFLUENCE
- PARCEL BOUNDARY [5]

NOTES:

1. AERIAL IMAGERY (FLOWN 2011-2012) PROVIDED UNDER LICENCE FROM TARANAKI REGIONAL COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. EXISTING MONITORING BORES DEPICTED DERIVED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf, BY GPS-it DATA MAPPING SOLUTIONS, DATED 03/05/2016.
3. GROUNDWATER CONTOURS BASED ON AVERAGES OF AVAILABLE MONITORING DATA FROM 2014 TO 2018.
4. STREAMS DERIVED FROM A COMPILATION OF INFORMATION SOURCED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf AND LINZ.
5. PARCEL BOUNDARIES (AS AT 03/05/2020) DERIVED FROM LINZ DATA.

NO.	REVISION	DATE	APP.
A	ISSUED FOR REVIEW	JUL 20	

CLIENT :

TARANAKI BY-PRODUCTS LTD

PROJECT :

ASSESSMENT OF ENVIRONMENTAL EFFECTS

TITLE :

DISPOSAL LAYOUT PLAN

solutions for your environment

PATTLE DELAMORE PARTNERS LTD

Auckland Tauranga Wellington Christchurch

SCALE 1:3,000 (A3)

0 50 100 150m

PROJECT NO. :	FIGURE NO. :	REVISION :
AJ467202	21	A

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BP1 provides an indication of background (up gradient) concentrations. BP4 and BP7 indicate influence from the burial pits, with BP5 and BP10 indicating little influence. This suggests that the nitrogen plumes are relatively narrow, and are likely to be concentrated in the more permeable layers of the ash deposits present in this area. Both BP4 and BP7 have increased in nitrogen concentrations in the past five years, with BP7 showing signs of earlier tipping. Based on the rate of increase in groundwater ammoniacal nitrogen concentrations in Bore BP4 and 7, it is unclear if the maximum concentration has yet been reached.

Based on a basic estimation of groundwater velocity and travel time, ammoniacal nitrogen would be expected to start discharging into the stream approximately 116 days after it is picked up in BP4. There would likely be a larger lag time for BP7, given that it is further from the stream. This estimate is based on an estimated linear velocity of 185 m/yr, based on local gradients and the other regional data. The estimated groundwater velocity for the whole site is 45 m/yr, however, given the incised nature of the stream at this location, and subsequently steeper groundwater gradient, groundwater velocities are expected to be more in keeping with 185 m/yr.

An assessment of the whole potential plume of ammoniacal nitrogen migration from the offal pit location to the stream has been undertaken (refer to Figure 21). The whole area has been used as it is not possible to define the exact plume extents from the data available. Current ammoniacal nitrogen data from each bore was used along with the localised hydraulic gradient to approximate the overall flux rate of ammoniacal nitrogen from the burial pits to the Inaha Stream. This assessment is likely to be conservative as it utilises the elevated concentrations of Bores BP4 and BP7 to represent wider areas. In reality, the plumes are likely to be smaller and more focussed, located predominantly in more permeable horizons, and of more variable concentration. The assessment suggests a conservative range of 5,000 – 7,000 kg N/year is leaving the burial pit area.

On the basis of an estimated groundwater nitrogen flux of between 5,000 kg N/yr and 7,000 kg N/yr over the longer term of 20 years, it is estimated that the average tipping rate has been in the order of 406 tonnes/yr to 568 tonnes/yr (refer to Appendix G). Based on an ongoing average annual tipping rate, Figure 22 demonstrates the modelled rate of progressive increase in nitrogen leaching (since 2000) to meet the existing estimated nitrogen flux rates in ground water. It is anticipated, based on maintaining the existing estimated tipping rates, that groundwater nitrogen flux rates will remain similar to this, estimated from groundwater monitoring.

As the burial pit area is extended south, it can be expected that leaching out of the existing burial pits will decrease, while leaching from the new burial pit areas will increase to similar levels.

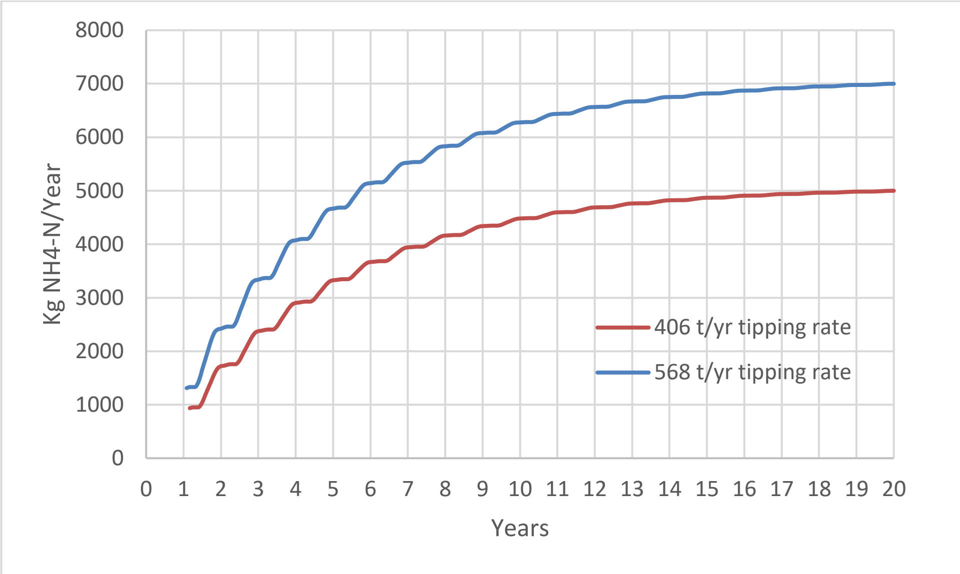

Figure 22: Projected nitrogen leaching rate to ground water.

5.3 Assessment of Potential Effects on Surface Water (based on estimated flux rates)

The assessed flux rates of 5,000 kg NH_4-N/yr to 7,000 kg NH_4-N/yr are equivalent to an average flux rate into the Inaha Stream of 0.16 g NH_4-N/s to 0.22 g NH_4-N/s. Assuming a low flow of 100 L/s in the Inaha Stream year round, no loss of ammoniacal nitrogen through nitrification or other means, and all ammoniacal nitrogen discharging to the stream, concentrations of ammoniacal nitrogen in the Inaha Stream would potentially increase by 1.6 g NH_4-N/m^3 to 2.2 g NH_4-N/m^3. If a median flow of 300 L/s is assumed, which is reasonable from the limited flow data available, then concentrations would potentially increase by 0.53 g NH_4-N/m^3 to 0.73 g NH_4-N/m^3. At these rates of increase and the length of time since tipping began, it would be expected that surface water monitoring would be identifying the increase in ammoniacal nitrogen in surface water at low to medium flow conditions.

Given that surface water monitoring through the stretch of stream of potential influence has not identified an increase in ammoniacal nitrogen, this indicates that there may be attenuation functions occurring in the groundwater system or within the stream hyporheic zone. It may also be that the estimated flux rate of nitrogen is conservatively large, however, tipping rate estimates are also based on aerial photography and nitrogen leaching modelling support the estimated nitrogen flux rates (refer to Appendix G). This indicates that attenuation functions are the more likely cause, however, to avoid potential increases in ammoniacal nitrogen migrating to the stream, the tipping rates should not be increased beyond the estimated historical rates of between 406 tonnes/yr and 568 tonnes/yr (an average of approximately 487 tonnes per annum).

6.0 Wastewater Irrigation to Land - Mitigation and Monitoring

This section addresses the mitigation and monitoring measures for both the ongoing effects associated with historical treated wastewater land treatment activities and the effects associated with proposed treated wastewater land treatment activities.

6.1 Irrigation Control

6.1.1 Separation Distances

Irrigation areas will continue to be restricted by the following buffer distances:

- 20 m from the banks of any watercourse;
- 50 m from any bore, well, or spring used for water supply purposes;
- 20 m from any public road; and
- 150 m from any dwelling or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance.

These separation distances exist to reduce the risk of microbial contact with the public due to spray drift.

6.1.2 Irrigation Rates

The average irrigation application rate will be limited to a maximum depth of 15 mm per application event. The daily irrigation rate will be managed to avoid saturated conditions and to limit the nitrogen loading rate to no more than 50 kg N/ha/event.

6.1.3 Irrigation Return Periods

For all irrigation paddocks across the land treatment system, an irrigation return period of seven days is proposed, which gives the pasture time to absorb nutrients, and the wastewater time to either be taken up by pasture/crops or evaporated.

6.1.4 Stock Withholding Period

Stock will be withheld from pasture for a period of 14 days following wastewater irrigation. This will reduce the likelihood of pugging damage to pastures and ensure the die-off of any potential microbial pathogens in treated irrigated wastewater.

6.1.5 Soil Conditions

Irrigation will not occur when soil conditions are not suitable, such as when there is risk of soils becoming saturated or resulting in ponding or runoff.

6.1.6 Weather Conditions

Irrigation will not occur close to boundaries when high winds are present as spray drift is more likely to travel across the boundary in these conditions. A larger separation distance may apply if high winds are predicted.

6.2 Nutrient Management

6.2.1 Nitrogen Loading Management

Nitrogen loading will be managed to ensure that the nitrogen loading per year will remain in accordance with the nitrogen requirements of the land use activity, and that nitrogen leaching to groundwater is minimised, with the intension that there is a 15% reduction in nitrogen migrating to surface water over long term projection. The 2015/16 season is representative of historic nitrogen loading rates and OverseerFM modelling indicates that a 15% improvement can be achieved with a 20% reduction in Zeal Grow application and with more evenly distributed loads across paddocks. The 2017 season is representative of current loading rates and OverseerFM modelling indicates that a 15% improvement can be achieved while maintaining the current average paddock wide nitrogen loading rate of <200 kg TN/ha/yr.

Therefore, the nitrogen loading rate to pastoral grazed land associated with wastewater irrigation, fertiliser loading, and other nitrogen based soil amendments will not exceed 250 kg TN/ha/yr in any paddock, with a farm wide average of 200 kg TN/ha/yr, and a maximum of 50 kg TN/ha/month.

If additional nitrogenous fertiliser is applied to the irrigation area, the cumulative nitrogen load applied should not be in excess of normal farmland use requirements, as allowed under a Farm Nutrient Management Plan.

To achieve a 15% reduction in nitrogen leaching, from recent years, the average leachable fraction of nitrogen on a farm wide basis cannot exceed 48 kg TN/ha/yr, as assessed utilising OverseerFM nutrient model or other approved method.

6.2.2 Nutrient Management Plan

Once per year, following the end of the dairy season (30 June), TBP will prepare a nutrient management budget for each whole farm in which there is wastewater irrigation. The nutrient management budget will include all nutrient inputs and farm practices, to assess nutrient losses (nitrogen and phosphorus) to groundwater and surface water, and identify potential mitigation measures to reduce nutrient losses.

6.3 Soil and Stock Health Management

The grazed pasture system requires nutrient management to ensure that the nitrogen off-take is optimised at all times and that sufficient nutrient levels and moisture levels are maintained for optimum pasture yield. Sodium and potassium levels in soils must also be managed to maintain soil structure and stock health.

Once per year, TBP will conduct soil infiltration testing at six representative locations across the irrigation areas, with duplicate tests at each site, assessing both the saturated (K_{sat}) and unsaturated (K_{-40}) infiltration rates.

If the average saturated infiltration rate at any assessed location is less that the achievable minimum irrigation rate, TBP will investigate the cause and implement mitigation measures to increase the saturated infiltration rate.

6.4 Irrigation Management Plan

Once the new consent has been granted, TBP will update its existing irrigation management plan to allow for the new monitoring regime required for the discharge permit, and include management procedures for spreading of stickwater (Zeal Grow) and any other waste product generated from the rendering processes and associated wastewater treatment plant. The existing management plan will be updated to reflect the proposed consent conditions and will include the day-to-day management and operation of the wastewater irrigation activities.

The Irrigation Management Plan will incorporate all procedures relating to irrigation application, including areas, rates, and frequencies. It is also proposed to cover issues related to the discharge, such as odour generation, spray drift, runoff and ponding, as well as nutrient management. The plan will encourage the monitoring of physiochemical properties of the soil and the prevention or mitigation of any adverse effects to the soil, as a result of land treatment.

An outline of the Management Plan contents and the items to be covered in this plan is provided as follows:

1. Introduction to the Irrigation Management Plan
    i. Identify the requirements of the Plan and outline the purpose of the Plan;
    ii. Identify general responsibilities and provide a structure for the Management Plan; and
    iii. Provide relationship to related documents.
2. Overview of Wastewater Treatment and Irrigation System
    i. Outline of processing plant operations; and
    ii. Wastewater systems.

3. Management Procedures for Efficient Operation of the Irrigation System
    i. Checking Compliance with Consent Conditions;
    ii. Adjustments to the land treatment programme;
    iii. Efficient operation of the land treatment system to meet pasture hydraulic loading requirements and minimising potential for saturated soils and ponding events; and
    iv. Land treatment system management and operator training.
4. Nutrient Management Plan
    i. Farm information, including applied nitrogen and phosphorus loads from all sources, stocking rates, and food supplement addition;
    ii. Nutrient cycles will be observed by maintaining good records in a nutrient balance table, so as to identify when nutrient loading limits are being approached, or to observe and estimate any net gains or losses of nutrients. This will be particularly important for nitrogen and phosphorus, to identify any leaching; and
    iii. Cation balance assessments for calcium, magnesium, potassium, and sodium, to identify ESP and EPP levels in the soils and potential for hydraulic conductivity issues.
5. Operation and Maintenance.
    i. Purpose and operation of all pumping and irrigation equipment;
    ii. Inspection and maintenance procedures; and
    iii. Contingency procedures.
6. Health and Safety Procedures
7. Monitoring Programme
    i. Compliance monitoring requirements;
    ii. Operational monitoring requirements; and
    iii. Nutrient management and monitoring requirements.
8. Contingency and Incident Monitoring
9. Response to discharge limit breaches and notification of Council of non-compliance
10. Responding to Complaints

11. Assessment Methods and Reporting

    i. End of year summary of wastewater and stickwater application;

    ii. Soil tests, soil drain tests, and groundwater monitoring; and

    iii. Other matters arising.

6.5 Monitoring

6.5.1 Wastewater Irrigation Operational Monitoring

Under the proposed operation, TBP proposes to undertake daily monitoring of soil conditions to reduce the risk of ponding or runoff. Daily operational monitoring will include:

- A qualitative assessment of soil conditions and potential to receive additional irrigation;
- Rain forecast, wind strength, and wind direction; and
- Spray drift potential in relation to neighbouring properties.

The irrigation sites will be regularly monitored for ponding or overland flow.

6.5.2 Wastewater Monitoring

In order to assess the nutrient loading and other aspects of the land treatment activity, the irrigation details for every land application will be recorded. Irrigation volumes and nutrient loads will be noted to assist in determining nitrogen, phosphorus, and hydraulic loading.

The treated wastewater or applied stickwater will be characterised monthly for total Kjeldahl nitrogen, ammoniacal nitrogen, oxidised nitrogen, total phosphorus, potassium, sodium, chloride, and electrical conductivity. Weekly testing will be conducted for total nitrogen and electrical conductivity.

6.5.3 Soil Pasture Interaction Monitoring

The dairy grazed pasture requires nutrient management to ensure that the nutrient levels in the soil are sufficient to produce optimum crop yields. TBP proposes that annual soil nutrient analyses are undertaken to assess whether the nutrient levels in the soil are maintained at sufficient levels. One soil monitoring site will be established for every 50 ha of wastewater irrigation area. Soil analysis of irrigation area soils will include: nitrogen, Olsen P, cationic suite (Ca, Mg, Na, K, CEC), phosphorus retention capacity, and hydraulic conductivity. Soil monitoring will be conducted annually.

6.5.4 Groundwater Monitoring

TBP proposes to continue shallow groundwater monitoring (conducted by TRC) as has been conducted in previous years under the existing consent. A total of 12 monitoring bore holes have been installed within the TBP irrigation areas, with another five installed in a location near TBP plant to monitor carcass disposal, and one borehole outside of the TBP farm area to compare with as a background sample.

Shallow groundwater monitoring will be conducted quarterly, testing for: depth to groundwater, pH, electrical conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate nitrogen, nitrite nitrogen, sulphate, and *E coli*.

6.6 Contingency

As soil conditions become wetter due to storm events during the normal irrigation period, the risk of runoff to surface water, and mobilisation of land based contaminants poses a greater risk of effect on surface water than if the highly treated wastewater was discharged directly to surface water.

For this reason, TBP proposes to maintain the discharge to the Inaha Stream as a contingency measure year-round. This is essential for the operation of the wastewater irrigation system.

7.0 Burial Pit Mitigation and Monitoring

7.1 Future Tipping Rate

Due to the potential uncertainty associated with the capacity of the attenuation functions, it is recommended that tipping is limited to the estimated average historic tipping rate of 450 - 500 tonnes offal/year. It is acknowledged that emergency events may require more than this amount as a single event, and therefore it is recommended that this limit is applied as a rolling five-year average. The slow rate of nitrogen release from the burial pits (as indicated by modelling) would help even out fluctuations in annual tipping rates.

7.2 Monitoring

To allow for the expansion of the burial pit area, to the south of the existing burial pit area, TBP proposes to increase the number of ground water monitoring bores to include an additional back ground monitoring bore and an additional four down gradient monitoring bores, while maintaining the existing five operational bores.

Shallow groundwater monitoring will be conducted quarterly, testing for: depth to groundwater, pH, electrical conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate nitrogen, nitrite nitrogen, sulphate, and *E coli*.

In addition to groundwater monitoring, quarterly monitoring of the Inaha Stream, upstream and downstream of the burial pit area will be conducted. Stream monitoring will include dissolved oxygen, pH, electrical conductivity, dissolved reactive phosphorus, ammoniacal nitrogen, nitrate nitrogen, nitrite nitrogen, sulphate, and *E coli*.

8.0 Proposed Consent Conditions

To be developed

9.0 References

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Aquanet 2018, *Taranaki By-Products Okaiawa Rendering Plant: Assessment of current effects on freshwater quality and ecology*. Report Prepared for Taranaki By-Products Limited, Aquanet Consulting Limited.

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Appendix A

TRC Resource Consent 3941-2

Discharge Permit

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA 4640
Change To Conditions Date:	9 November 2009 [Granted: 15 December 1999]

Conditions of Consent

Consent Granted:	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries
Expiry Date:	1 June 2019
Review Date(s):	June 2011, June 2014, June 2017
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Existing areas: Lot 1 DP 6457 Pt Sec 93 Blk IV Waimate SD [factory site], Lot 1 DP 378038, Pt Sec 93 Lots 2 & 3 DP 6457 Ngatimanuhiakai 17B2 17A2 17A3 Sec 88 Pt Sec 90 Lot 1 DP 10174 Lot 1 DP 11864 Pt Secs 90 & 94 DP SO219 Pt Sec 8 Sec 9 Pt Sec 154 Pt Sec 87 & Sec 89 Lot 2 DP 10412 Sec 92 Ngatimanuhiakai 3B Pt Sec 149 Ngatimanuhiakai 17B1 Lots 1 & 2 DP 4415 Sec 151 Blk IV Waimate SD New areas: Ngatimanuhiakai 3A Blk IV Waimate SD, Ngatimanuhiakai 2A & 2B Blk, Ngatimanuhiakai 4A Blk IV Waimate SD, Ngatimanuhiakai 10A2 Blk IV Waimate SD, Lot 1 DP 5153 Sec 86 Blk Waimate SD, Lot 1 DP 10412 Lot 2 DP 11864 Pt Sec 94 Blk IV Waimate SD, Ngatimanuhiakai 7C1 Blk IV Waimate SD [between the following points; NW (1700589E-5625245N), NE (1700909E-5625245N), SW (1700631E-5625092N), SE (1700921E-5625046N)
Catchment:	Inaha

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

Condition 1 – new

1. The discharge authorised by this consent shall only occur on the land shown in the map labelled Figure 1 attached.

Conditions 2 to 12 [previously conditions 1 to 11] – unchanged

Management plan

2. Prior to the exercise of the consent, the consent holder shall provide, and subsequently shall maintain, a spray irrigation management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters:

   a) designated application areas;
   b) selection of appropriate irrigation methods for different types of terrain;
   c) application rate and duration;
   d) application frequency;
   e) farm management and operator training;
   f) soil and herbage management;
   g) prevention of runoff and ponding;
   h) minimisation and control of odour effects offsite;
   i) operational control and maintenance of the spray irrigation system;
   j) monitoring of the effluent [physicochemical];
   k) monitoring of soils and herbage [physicochemical];
   l) monitoring of groundwater beneath the irrigated area [physicochemical];
   m) monitoring of drainage water downslope of the irrigated area [physicochemical];
   n) monitoring of Inaha Stream and relevant tributaries;
   o) remediation measures;
   p) liaison with submitters to the consent, and interested parties;
   q) reporting monitoring data;
   r) procedures for responding to complaints; and
   s) notification to the Council of non-compliance with the conditions of this consent.

An objective of the plan shall be to maximise discharges to land and to minimise discharges to surface water under consent 2049.

3. The consent shall be exercised in accordance with the procedures set out in the spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the 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 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 31 May each year.

5. The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the spray irrigation system. The officer shall be regularly trained on the content and implementation of the spray irrigation management plan, and shall be advised immediately of any revision or additions to the spray irrigation management plan.

6. The consent holder shall at all times adopt the best practicable option or options, as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise the adverse effects of the discharges on the environment. This shall include, but not be limited to the minimisation of total nitrogen concentration in the treated effluent.

7. In circumstances where spray irrigation of wastewater is not possible, and where a dilution rate of 1:200 in the Inaha Stream cannot be maintained, the consent holder shall seek the permission of the Chief Executive, Taranaki Regional Council, prior to discharging wastewater to the Inaha Stream.

Odour and spray effects

8. The level of dissolved oxygen within the wastewater pond from which irrigation water is drawn shall be maintained above 1.0 gm^{-3} at all times.

9. There shall be no offensive or objectionable odour as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.

10. There shall be no spray drift as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.

Land effects

11. The sodium adsorption ratio [SAR] of the wastewater shall not exceed 15.

12. There shall be no ponding of wastewater, and/or any direct discharge to a watercourse due to the exercise of this consent.

Condition 13 [previously condition 12 - changed]

13. The edge of the spray zone shall be at least:

    a) 25 metres from the banks of any watercourse;
    b) 50 metres from any bore, well or spring used for water supply purposes;
    c) 20 metres from any public road, except as detailed in f) and g) of this condition;
    d) 20 metres from any property boundary;
    e) 150 metres from any dwellinghouse or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance;
    f) 200 metres from Normanby Road adjacent to the property described as Lots 3 & 4, Pt Lot 1 DP 2707, Lot 1 DP 3731, Blk IV, Waimate SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; and
    g) 50 metres from Ahipaipa Road adjacent to the properties described as Pt Lot 1 and Lot 2 DP 3322, Lot 2 DP12129, Blk IV, Waimate SD.

Conditions 14 to 26 [previously conditions 13 to 25] – unchanged

14. The effluent application rate shall not exceed 300 kg nitrogen/hectare/year except on land described as Pt Sec 154 Blk IV Waimate SD, where the effluent application rate shall not exceed 200 kg/nitrogen/hectare/year.

15. The consent holder shall investigate, and report in writing on, options for upgrading the wastewater treatment system to reduce the concentration of ammonia in the wastewater prior to discharge; the report to be received by the Chief Executive, Taranaki Regional Council, not later than twelve months from the date the consent is granted. Any necessary works associated with the report on reduction of ammonia concentrations shall be completed within twelve months after the receipt of the report.

16. The average application rate shall not exceed 5 mm/hour.

17. The return period between applications shall be at least seven days and the application depth shall not exceed 25 mm at each application.

Monitoring and liaison

18. The consent holder shall site, install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, a minimum of nine monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge. The bores are to be sited in the following locations: upslope of the Kohiti Road and Katotauru Road irrigation areas (2), at the southern boundary of the western Normanby Road irrigation area (2), within the Normanby Road, Kohiti Road and Katotauru Road irrigation areas (3), at the southern boundary of the Katotauru irrigation area, and at the southern boundary of the Ahipaipa Road irrigation area. The spring downslope of the Normanby Road irrigation area, and three bores in the vicinity of Inuawai Road shall also be monitored.

19. The consent holder shall undertake such baseline and operational monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council.

20. The consent holder and staff of the Regional Council shall meet as appropriate, quarterly or at such other frequency as the parties may agree, with representatives of Ngati Manuhiakai Hapu and other interested submitters to the consent, and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of the resource consent, in order to facilitate ongoing consultation.

21. The consent holder shall, where practicable, advise the Chief Executive, Taranaki Regional Council, and representatives of Ngati Manuhiakai Hapu, prior to discharge to Inaha Stream under consent 2049.

Mitigation

22. Should monitoring of the discharge under conditions 14 and 18 indicate contamination of local groundwater 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 spray irrigation management plan prepared under condition 2, or such action reasonably required by the Chief Executive, Taranaki Regional Council;
    b) shall review the spray 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.

Review

23. 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.

24. The Taranaki Regional Council may review conditions 7 and 14 of this consent within two weeks after the completion of works to be investigated under condition 15 of this consent, for the purpose of evaluating the appropriateness of the required dilution rate and application rate, and the effects of the discharge on the Inaha Stream and soil.

25. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, and/or June 2007, for the purpose of assessing the need to increase the land area for wastewater disposal, reduce nitrogen loading to land and/or increase treatment at the wastewater treatment system to reduce the nitrogen concentration of the effluent.

26. The Taranaki Regional Council may, pursuant to section 128 of the Resource Management Act 1991, review any or all of the conditions of this consent by giving notice of review during June 2001, June 2003, June 2005, June 2007, June 2009, June 2011, June 2014 and/or June 2017, 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 that time.

Signed at Stratford on 9 November 2009

For and on behalf of
Taranaki Regional Council

____

Director-Resource Management

Consent 3941-2

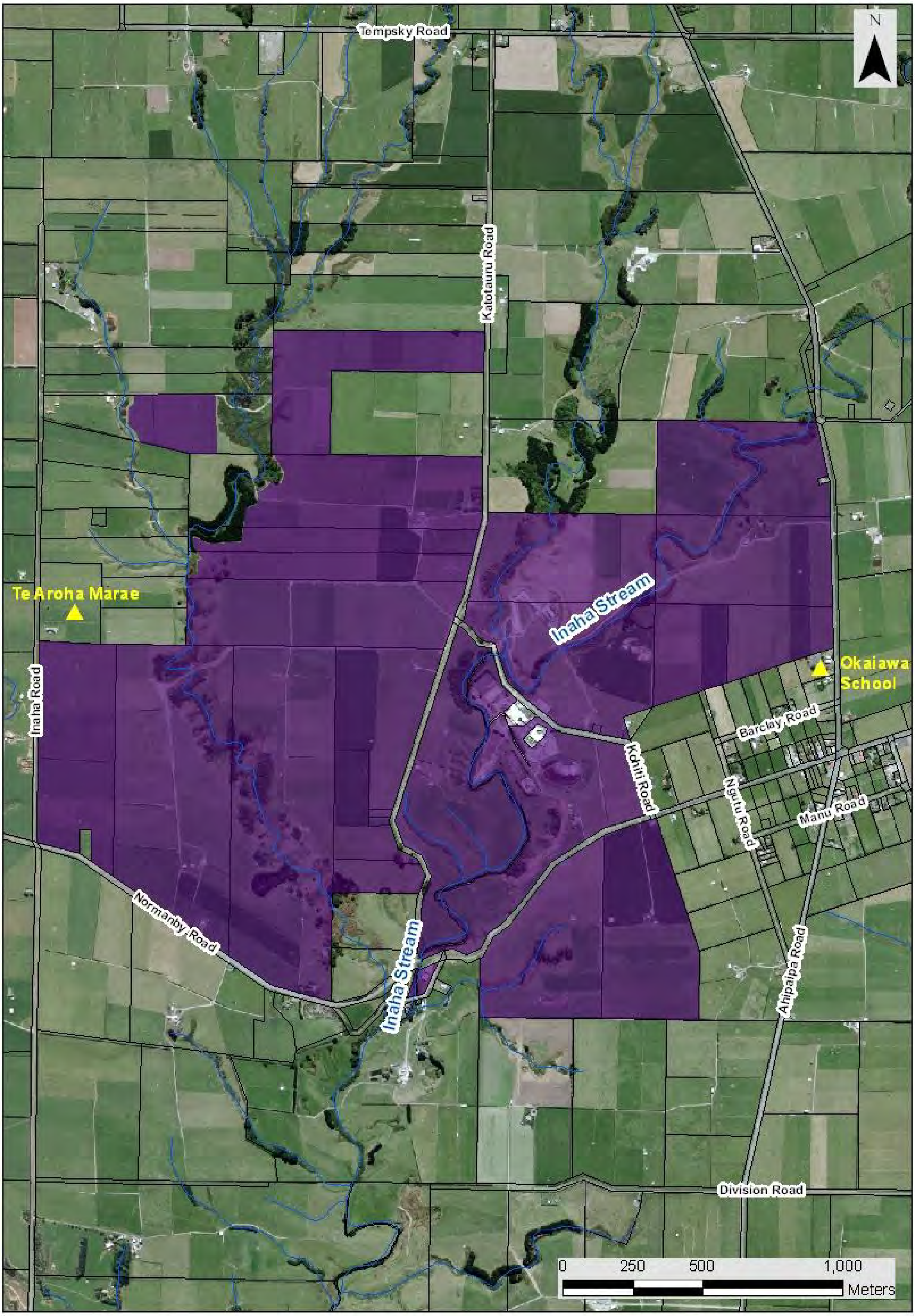

Figure 1 Location of the authorised area to receive wastewater, via spray irrigation, onto and into land

Appendix B

TRC Resource Consent 5495-1

Discharge Permit

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

Name of Consent Holder:	Taranaki By-Products Limited P O Box 172 HAWERA
Change To Conditions Date:	4 August 2000 [Granted: 30 March 2000]

Conditions of Consent

Consent Granted:	To discharge up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-859
Expiry Date:	1 June 2019
Review Date(s):	June 2001, June 2003, June 2005, June 2011, June 2017
Site Location:	Kohiti Road, Okaiawa
Legal Description:	Lot 1 DP 10174 Lot 1 DP 11864 Sec 88 Pt Sec 90 SO 268 Blk IV Waimate SD
Catchment:	Inaha

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 General Manager, Taranaki Regional Council (hereinafter the General Manager), 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

special condition 1 [amended]

1. THAT by 1 November 2000, the consent holder shall provide a waste burial management plan, to the approval of the General Manager, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters:

   a) nature of wastes discharged;
   b) discharge control;
   c) waste cover;
   d) addition of hydrated lime to stabilise the wastes;
   e) minimisation and control of odour effects offsite;
   f) stormwater control;
   g) leachate management;
   h) monitoring of groundwater beneath the burial area [physicochemical];
   i) site re-instatement and after care (including maintaining the integrity of the cover material);
   j) site contouring;
   k) reporting monitoring data;
   l) procedures for responding to complaints; and
   m) notification to the Council of non-compliance with the conditions of this consent.

special conditions 2-5 [unchanged]

2. THAT the consent shall be exercised in accordance with the procedures set out in the waste burial management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the General Manager, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

3. THAT the waste burial management plan described in special condition 1 of this consent shall be subject to review upon two months notice by either holder the Taranaki Regional Council.

4. THAT the consent holder shall designate an officer with the necessary qualifications and/or experience to manage the waste burial site. The officer shall be regularly trained on the content and implementation of the burial management plan, and shall be advised immediately of any revision or additions to the burial management plan.

5. THAT the disposal pit[s] shall not intercept shallow groundwater.

special conditions 6 – 7 [amended]

6. THAT the disposal pits shall be constructed when required in general accordance with the information supplied by the applicant in support of application 1084.

7. THAT the consent holder shall notify the Council of the commencement to construct additional disposal pits outside of the disposal area indicated in the map supporting the application.

special condition 8 [unchanged]

8. THAT an officer of the Council is to inspect all constructed disposal pits prior to disposal operations.

special condition 9 [amended]

9. THAT special conditions 1 to 4 shall apply after 1 November 2000 when the disposal pit required by special condition 6 is constructed and also for all subsequent disposal pits.

special conditions 10 – 15 [unchanged]

10. THAT the discharged material shall be covered within a period of four hours or less so as to avoid the generation of offensive offsite odours.

11. THAT at the completion of the disposal operation a low permeability, clean, compacted soil cover with a minimum thickness of 1.0m be placed over the discharged wastes.

12. THAT the cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area to the satisfaction of the General Manager, Taranaki Regional Council.

13. THAT the disposal site shall be rehabilitated and pasture re-established to the satisfaction of the General Manager, Taranaki Regional Council.

14. THAT there shall not be any irrigation of effluent under resource consent 3941 or resource consent 2466 onto the disposal area.

15. THAT the exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.

special condition 16 [amended]

16. THAT the consent holder shall install and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a minimum of eight monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge.

special condition 17-18 [unchanged]

17. THAT 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 resources of monitoring.

18. 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 2001, June 2003, June 2005, 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 consent, which was 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 4 August 2000

For and on behalf of
Taranaki Regional Council

____

Director-Resource Management

Appendix C

Soil Investigation Report

Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	Soil Investigation	**PROJECT**	Taranaki By-Products Land Treatment of Wastewater
CLIENT	**Taranaki By-Products Ltd**	**PROJECT NO**	AJ467202
CLIENT CONTACT	Paul Drake	**PREPARED BY**	Luke Heath-Edwards
CLIENT WORK ORDER NO/ PURCHASE ORDER		**SIGNATURE**	
		DATE	21 November 2018

Introduction

Taranaki By-Products Ltd (TBP) operates a protein rendering plant on Kohiti Road near Okaiawa. The wastewater from the plant is treated in a biological treatment facility before it is either discharged onto company-owned dairy farmland under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, or discharged to the Inaha Stream under TRC Resource Consent No. 2049-4 (when soil conditions do not allow irrigation to land). Stickwater from the rendering plant (registered as a fertiliser called Zeal Grow) is also applied to various paddocks in the farm throughout the year. A soil investigation was conducted by Pattle Delamore Partners Ltd (PDP) on 21 and 22 June 2018 to assist with the assessment of effects of the plant's discharges to the surrounding soils, for consent application purposes. This included collecting soil samples and soil cores at evenly distributed locations across the farm, for nutrients, heavy metals, and hydraulic conductivity analysis.

Sampling Methodology

Two types of soil samples were collected during the soil investigation: composite soil samples were taken to be analysed for nutrients and heavy metals concentrations, and soil cores were taken to assess the hydraulic conductivity of the soils.

Sampling locations were selected to provide a representative sample for the whole site. Six composite soil samples and eleven soil cores (roughly two at each sampling site) were taken across the farm at six, evenly distributed, locations. One background soil sample and two background cores were taken outside of the boundary of the farm at a location where wastewater or Zeal Grow had never been applied to provide a baseline of soil characteristics and concentrations.

A manual soil corer was used to collect approximately 20 to 30 soil cores per composite sample, along a transect of each paddock. The 75 mm deep corer was used to retrieve soil cores. A total of seven composite samples were collected across the farm. These samples were transported to Hill Laboratories for analysis.

Thirteen soil cores (approximately two at each of the seven sampling sites) were collected in accordance with "*Field guide to taking core samples for physical analyses*", written and provided by Landcare Research. This involved inserting a greased, stainless steel ring (100 mm diameter, 75 mm depth) into the soil to retrieve an undisturbed core of soil. A section of soil around the ring was carefully dug out to ensure that the core could be removed without disturbing the soil within the core. These soil cores were sent to Landcare Research Soil Physics Laboratory for analysis of saturated hydraulic conductivity (K_{sat}), unsaturated hydraulic conductivity (K_{40}), bulk density, and soil moisture.

Results

General Soil Observations

The soil type found in the paddocks surrounding the rendering plant were confirmed as an orthic allophanic nature. The paddocks were generally flat with a small portion having a slight slope. Most paddocks in which samples were taken had good grass coverage, medium clover content, and little to no evidence of pugging at that time. A supplementary visual soil assessment was conducted at each sampling location. The visual assessment involved a scoring matrix that assessed soil structure, porosity, colour, mottles, earthworm presence, and surface relief. According to "*Field guide for cropping a pastoral grazing on flat to rolling country*" provided by Landcare Research, soils at three sampling locations were in 'moderate' condition and soils at the remaining four locations were in 'good' condition.

Soil Bulk Density and Hydraulic Conductivity

Soil bulk density and hydraulic conductivity results are summarised in the table below. The TBP farm and background soil cores demonstrated similar values for bulk density; however, the TBP farm soils demonstrated higher saturated and unsaturated hydraulic conductivities compared to the background cores.

Soil parameter	Units	TBP Average	Background
Soil bulk density	g/cm^3	0.87	0.90
K_{sat}	mm/hr	99.1	25.0
K_{40}	mm/hr	8.36	5.50

Soil Nutrients

Soil nutrient testing results are presented in the table below. The nutrient concentrations at the six sampling locations within the farm boundary have been averaged to provide an overall farm average. This can then be compared to the background nutrient concentration, which was taken outside the irrigation area. Most soil parameters within the wastewater irrigated areas are equal to, or below that of the background sample. Olsen P and sulphate sulphur show elevated concentrations within the farm.

Soil parameter	Units	TBP Average	Range	Background
pH	pH units	5.6	5.3 - 6.0	5.9
Olsen Phosphorus	mg/L	76	49 - 119	46
Anion Storage Capacity	%	82.1	80 - 86	79
Potassium	me/100g	0.64	0.17 - 0.91	1.14
Calcium	me/100g	6.8	5.3 - 8.9	8.9
Magnesium	me/100g	1.11	0.61 – 1.56	2.15
Sodium	me/100g	0.32	0.23 – 0.56	0.24
CEC	me/100g	24	22 – 25	26
Total Base Saturation	%	38	31 – 49	48
Volume Weight	g/mL	0.74	0.73 – 0.75	0.74
Sulphate Sulphur	mg/kg	89	52 – 120	27
Extractable Organic Sulphur	mg/kg	9.7	9 – 10	9
Potentially Available Nitrogen (15cm Depth)	kg/ha	107	79 – 162	169
Anaerobically Mineralisable N	µg/g	96	72 – 146	152
Organic Matter	%	13.5	12.4 – 14.5	13.5
Total Carbon	%	7.8	7.2 – 8.4	7.8
Total Nitrogen	%	0.70	0.63 – 0.76	0.7
C/N Ratio		11.2	9.6 – 12.3	11.1
Anaerobically Mineralisable N/Total N Ratio	%	1.4	1 - 2	2.2

Soil Heavy Metals

Heavy metal testing results are presented in the table below. The heavy metal concentrations at the six sampling locations within the farm boundary have been averaged to provide a TBP farm average. This can then be compared to the background heavy metal concentration, which was collected from outside the irrigation area. All heavy metal concentrations within the farm boundary are similar to those found in the background sample.

Heavy metal	Units	TBP Average	Background
Arsenic	mg/kg dry wt	5.62	5.9
Cadmium	mg/kg dry wt	76.33	46
Chromium	mg/kg dry wt	82.17	79
Copper	mg/kg dry wt	0.64	1.14
Lead	mg/kg dry wt	6.82	8.9
Nickel	mg/kg dry wt	1.11	2.15
Zinc	mg/kg dry wt	0.32	0.24

Summary

A soil investigation was carried out on 21 and 22 June 2018, to assist with assessment of effects of discharging wastewater and Zeal Grow fertiliser to land.

The condition of the soil and pasture within the TBP farm were generally good in terms of the visual soil assessment. The TBP farm soils also showed little difference to background soil samples, with the exception of plant available phosphorus (as indicated by Olsen P testing) and sulphate, which were elevated for the irrigated areas.

Appendix D

Soil Sampling Results

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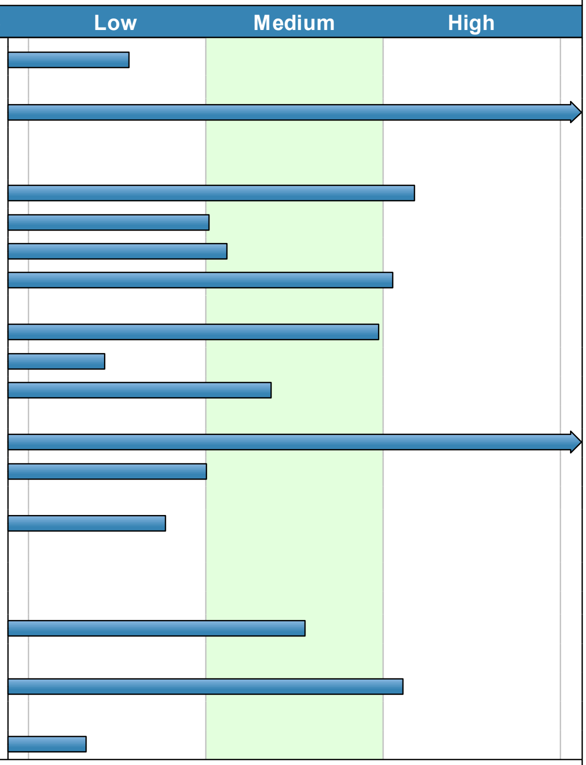
Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	2004631 shpv1
Address:	PO Box 9528 Newmarket Auckland 1149	**Date Received:**	23-Jun-2018
		Date Reported:	28-Jun-2018
		Quote No:	81087
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 01 **Lab Number:** 2004631.1
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	5.5	5.8 - 6.3
Olsen Phosphorus	mg/L	119	20 - 30
Anion Storage Capacity*	%	80	
Potassium	me/100g	0.91	0.50 - 0.80
Calcium	me/100g	6.1	6.0 - 12.0
Magnesium	me/100g	1.24	1.00 - 3.00
Sodium	me/100g	0.56	0.20 - 0.50
CEC	me/100g	25	12 - 25
Total Base Saturation	%	36	50 - 85
Volume Weight	g/mL	0.75	0.60 - 1.00
Sulphate Sulphur	mg/kg	110	7 - 15
Extractable Organic Sulphur*	mg/kg	10	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	89	100 - 150
Anaerobically Mineralisable N*	µg/g	79	
Organic Matter*	%	12.6	7.0 - 17.0
Total Carbon	%	7.3	
Total Nitrogen	%	0.76	0.30 - 0.60
C/N Ratio*		9.6	
Anaerobically Mineralisable N/Total N Ratio*	%	1.0	3.0 - 5.0
Base Saturation %		K 3.7 Ca 25	Mg 5.0 Na 2.3
MAF Units		K 14 Ca 6	Mg 21 Na 19



The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information.
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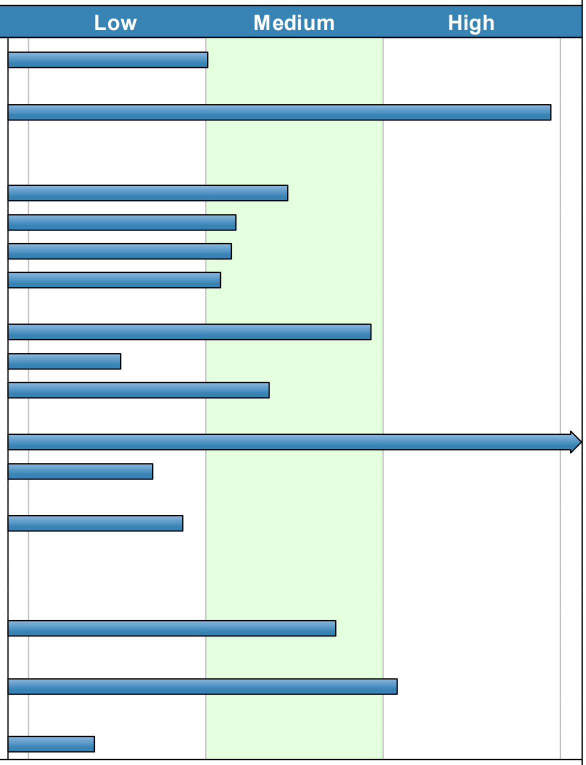
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 02 **Lab Number:** 2004631.2
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	5.8	5.8 - 6.3
Olsen Phosphorus	mg/L	96	20 - 30
Anion Storage Capacity*	%	81	
Potassium	me/100g	0.64	0.50 - 0.80
Calcium	me/100g	7.0	6.0 - 12.0
Magnesium	me/100g	1.29	1.00 - 3.00
Sodium	me/100g	0.23	0.20 - 0.50
CEC	me/100g	24	12 - 25
Total Base Saturation	%	38	50 - 85
Volume Weight	g/mL	0.74	0.60 - 1.00
Sulphate Sulphur	mg/kg	65	7 - 15
Extractable Organic Sulphur*	mg/kg	9	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	94	100 - 150
Anaerobically Mineralisable N*	µg/g	84	
Organic Matter*	%	14.3	7.0 - 17.0
Total Carbon*	%	8.3	
Total Nitrogen	%	0.72	0.30 - 0.60
C/N Ratio*		11.6	
Anaerobically Mineralisable N/Total N Ratio*	%	1.2	3.0 - 5.0
Base Saturation %		K 2.6 Ca 29	Mg 5.3 Na 0.9
MAF Units		K 10 Ca 7	Mg 22 Na 8



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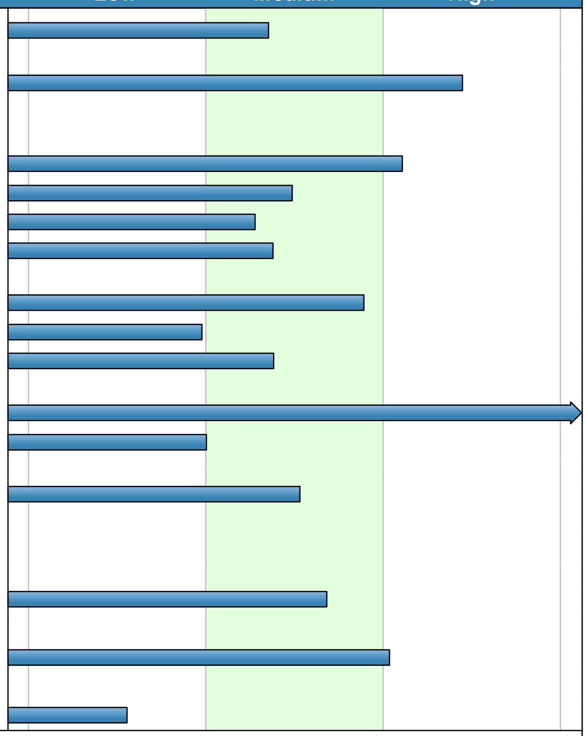
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 03 **Lab Number:** 2004631.3
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	6.0	5.8 - 6.3
Olsen Phosphorus	mg/L	61	20 - 30
Anion Storage Capacity*	%	80	
Potassium	me/100g	0.87	0.50 - 0.80
Calcium	me/100g	8.9	6.0 - 12.0
Magnesium	me/100g	1.56	1.00 - 3.00
Sodium	me/100g	0.31	0.20 - 0.50
CEC	me/100g	24	12 - 25
Total Base Saturation	%	49	50 - 85
Volume Weight	g/mL	0.75	0.60 - 1.00
Sulphate Sulphur	mg/kg	52	7 - 15
Extractable Organic Sulphur*	mg/kg	10	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	127	100 - 150
Anaerobically Mineralisable N*	µg/g	112	
Organic Matter*	%	13.8	7.0 - 17.0
Total Carbon*	%	8.0	
Total Nitrogen*	%	0.65	0.30 - 0.60
C/N Ratio*		12.3	
Anaerobically Mineralisable N/Total N Ratio*	%	1.7	3.0 - 5.0



Base Saturation %	K 3.7	Ca 38	Mg 6.6	Na 1.3
MAF Units	K 13	Ca 8	Mg 26	Na 11

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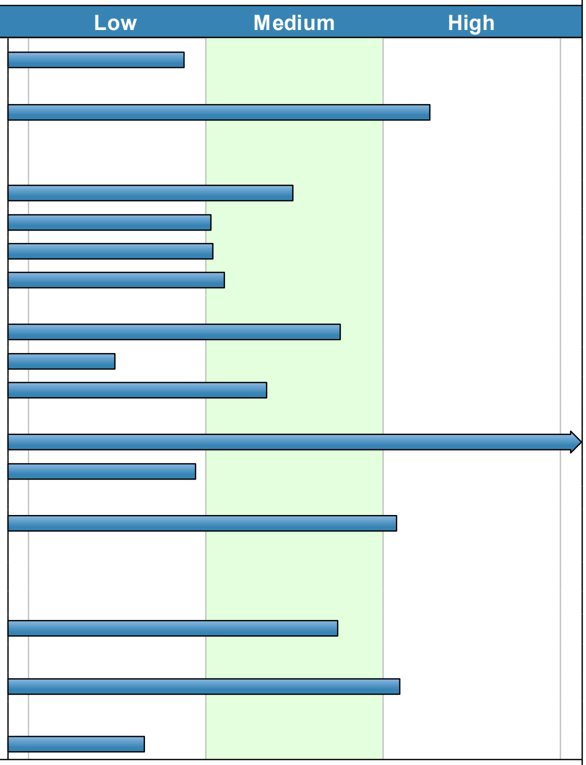
		Quote No:	81087
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 04 **Lab Number:** 2004631.4
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	5.7	5.8 - 6.3
Olsen Phosphorus	mg/L	49	20 - 30
Anion Storage Capacity*	%	82	
Potassium	me/100g	0.65	0.50 - 0.80
Calcium	me/100g	6.2	6.0 - 12.0
Magnesium	me/100g	1.08	1.00 - 3.00
Sodium	me/100g	0.23	0.20 - 0.50
CEC	me/100g	22	12 - 25
Total Base Saturation	%	37	50 - 85
Volume Weight	g/mL	0.74	0.60 - 1.00
Sulphate Sulphur	mg/kg	73	7 - 15
Extractable Organic Sulphur*	mg/kg	10	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	162	100 - 150
Anaerobically Mineralisable N*	µg/g	146	
Organic Matter*	%	14.5	7.0 - 17.0
Total Carbon*	%	8.4	
Total Nitrogen	%	0.74	0.30 - 0.60
C/N Ratio*		11.4	
Anaerobically Mineralisable N/Total N Ratio*	%	2.0	3.0 - 5.0



Base Saturation %	K 3.0	Ca 28	Mg 4.9	Na 1.1
MAF Units	K 10	Ca 6	Mg 18	Na 8

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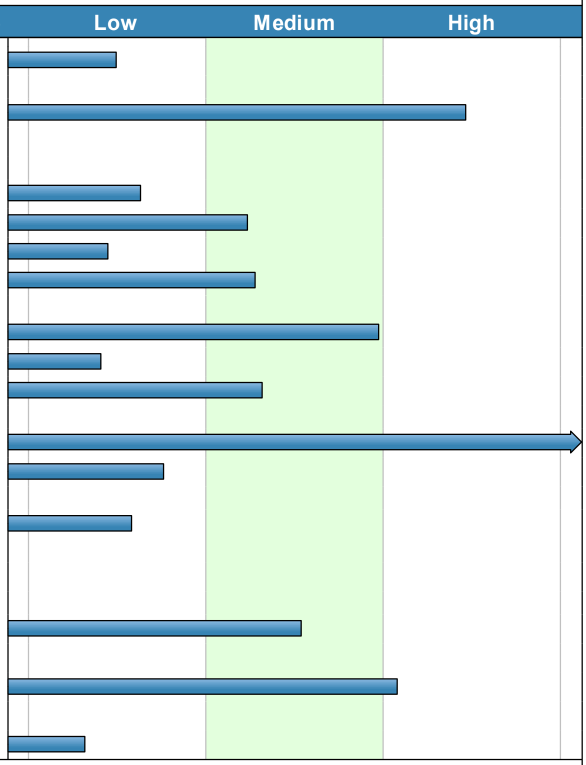
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 05 **Lab Number:** 2004631.5
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	5.4	5.8 - 6.3
Olsen Phosphorus	mg/L	63	20 - 30
Anion Storage Capacity*	%	86	
Potassium	me/100g	0.37	0.50 - 0.80
Calcium	me/100g	7.4	6.0 - 12.0
Magnesium	me/100g	0.61	1.00 - 3.00
Sodium	me/100g	0.28	0.20 - 0.50
CEC	me/100g	25	12 - 25
Total Base Saturation	%	35	50 - 85
Volume Weight	g/mL	0.73	0.60 - 1.00
Sulphate Sulphur	mg/kg	114	7 - 15
Extractable Organic Sulphur*	mg/kg	9	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	79	100 - 150
Anaerobically Mineralisable N*	µg/g	72	
Organic Matter*	%	12.4	7.0 - 17.0
Total Carbon	%	7.2	
Total Nitrogen	%	0.71	0.30 - 0.60
C/N Ratio*		10.1	
Anaerobically Mineralisable N/Total N Ratio*	%	1.0	3.0 - 5.0



Base Saturation %	K 1.5	Ca 30	Mg 2.5	Na 1.1
MAF Units	K 6	Ca 7	Mg 10	Na 9

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information.
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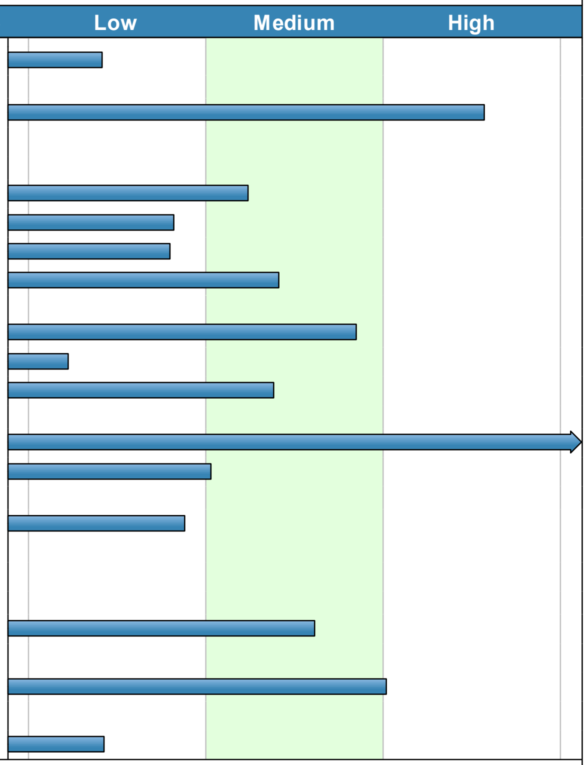
		Date Reported:	28-Jun-2018
		Quote No:	81087
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil 06 **Lab Number:** 2004631.6
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	5.3	5.8 - 6.3
Olsen Phosphorus	mg/L	70	20 - 30
Anion Storage Capacity*	%	84	
Potassium	me/100g	0.57	0.50 - 0.80
Calcium	me/100g	5.3	6.0 - 12.0
Magnesium	me/100g	0.86	1.00 - 3.00
Sodium	me/100g	0.32	0.20 - 0.50
CEC	me/100g	23	12 - 25
Total Base Saturation	%	31	50 - 85
Volume Weight	g/mL	0.75	0.60 - 1.00
Sulphate Sulphur	mg/kg	120	7 - 15
Extractable Organic Sulphur*	mg/kg	10	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	94	100 - 150
Anaerobically Mineralisable N*	µg/g	83	
Organic Matter*	%	13.2	7.0 - 17.0
Total Carbon*	%	7.6	
Total Nitrogen*	%	0.63	0.30 - 0.60
C/N Ratio*		12.2	
Anaerobically Mineralisable N/Total N Ratio*	%	1.3	3.0 - 5.0



Base Saturation %	K 2.5	Ca 23	Mg 3.7	Na 1.4
MAF Units	K 9	Ca 5	Mg 15	Na 11

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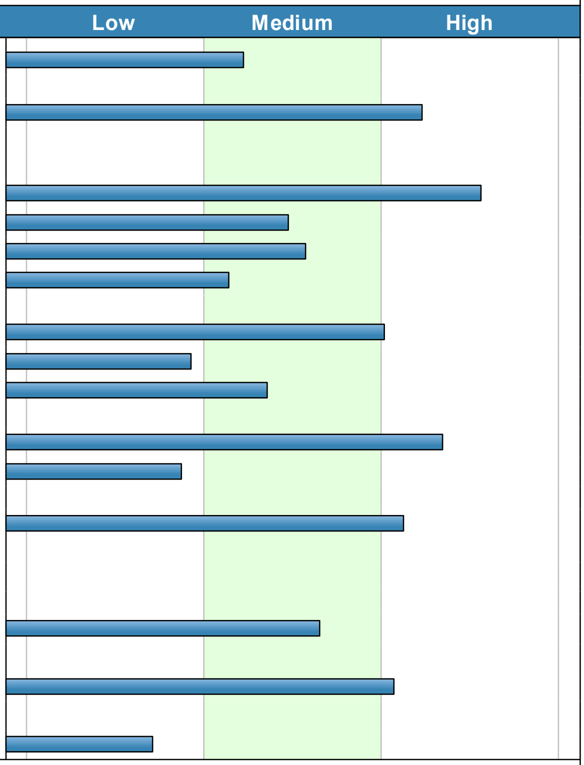
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Name: TBP Soil Background **Lab Number:** 2004631.7
Sample Type: SOIL General, Outdoor (S10)

Analysis	Units	Level Found	Medium Range
pH	pH Units	5.9	5.8 - 6.3
Olsen Phosphorus	mg/L	46	20 - 30
Anion Storage Capacity*	%	79	
Potassium	me/100g	1.14	0.50 - 0.80
Calcium	me/100g	8.9	6.0 - 12.0
Magnesium	me/100g	2.15	1.00 - 3.00
Sodium	me/100g	0.24	0.20 - 0.50
CEC	me/100g	26	12 - 25
Total Base Saturation	%	48	50 - 85
Volume Weight	g/mL	0.74	0.60 - 1.00
Sulphate Sulphur	mg/kg	27	7 - 15
Extractable Organic Sulphur*	mg/kg	9	10 - 20
Potentially Available Nitrogen (15cm Depth)*	kg/ha	169	100 - 150
Anaerobically Mineralisable N*	µg/g	152	
Organic Matter*	%	13.5	7.0 - 17.0
Total Carbon*	%	7.8	
Total Nitrogen*	%	0.70	0.30 - 0.60
C/N Ratio*		11.1	
Anaerobically Mineralisable N/Total N Ratio*	%	2.2	3.0 - 5.0



Base Saturation %	K 4.4	Ca 34	Mg 8.4	Na 0.9
MAF Units	K 17	Ca 8	Mg 36	Na 8

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information.
IANZ Accreditation does not apply to comments and interpretations, i.e. the 'Range Levels' and subsequent graphs.

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Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	2004631 shpv1
Address:	PO Box 9528 Newmarket Auckland 1149	**Date Received:**	23-Jun-2018
		Date Reported:	28-Jun-2018
		Quote No:	81087
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Analyst's Comments

Samples 1-7 Comment:
The medium or optimum range guidelines shown in the histogram report relate to sampling protocols as per Hill Laboratories' crop guides and are based on reference values where these are published. Results for samples collected to different depths than those described in the crop guide should be interpreted with caution.
For pastoral soils, the medium ranges are specific for a 75mm sample depth, but if a 150mm sampling depth is used the nutrient levels measured may appear low against these ranges, as nutrients are typically more concentrated in the top of the soil profile. These soil profile differences are altered upon cultivation or contouring.

Samples 1-7 Comment:
The Potentially Available Nitrogen (kg/ha) test above assumes the sample is taken to a 15 cm depth. If the depth is 7.5 cm, then the result reported above should be divided by two.
To calculate Potentially Available Nitrogen (as kgN/ha) for other sample depths use the reported Anaerobic Mineralisable Nitrogen (AMN) result in the following equation:
AN (kg/ha) = AMN (µg/g) x VW (g/ml) x sample depth (cm) x 0.1
Note that the AN and AMN results reported include the readily available Mineral N (NH4-N and NO3-N) fraction, which is typically quite low.

Samples 1-7 Comment:
Anion Storage Capacity (also known as Phosphate Retention) is an inherent property of the soil type and does not change. Phosphorus and sulphur fertiliser recommendations should take this value into account. Soils may be classified as Low (less than 30%), Medium (30-60%) or High (greater than 60%) ASC.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Sample Registration*	Samples were registered according to instructions received.	-	1-7
Soil Prep (Dry & Grind)*	Air dried at 35 - 40°C overnight (residual moisture typically 4%) and crushed to pass through a 2mm screen.	-	1-7
pH	1:2 (v/v) soil:water slurry followed by potentiometric determination of pH.	0.1 pH Units	1-7
Olsen Phosphorus	Olsen extraction followed by Molybdenum Blue colorimetry.	1 mg/L	1-7
Sulphate Sulphur	0.02M Potassium phosphate extraction followed by Ion Chromatography.	1 mg/kg	1-7
Extractable Organic Sulphur*	Determined by NIR, calibration based on; 0.02M Potassium phosphate extraction. Total extractable S determined by ICP-OES from which the Sulphate-S is subtracted.	2 mg/kg	1-7
Potentially Available Nitrogen*	Determined by NIR, calibration based on Available N by Anaerobic incubation followed by extraction using 2M KCl followed by Berthelot colorimetry. (Calculation based on 15cm depth sample). Note that any Mineral N present is included in the AN/AMN result reported.	1 mg/L	1-7
Anaerobically Mineralisable N*	As for Potentially Available Nitrogen but reported as µg/g.	5 µg/g	1-7
Organic Matter*	Organic Matter is 1.72 x Total Carbon.	0.2 %	1-7
Total Carbon	Dumas combustion.	0.1 %	1, 5
Total Nitrogen	Dumas combustion.	0.04 %	1-2, 4-5
Anion Storage Capacity	Equilibration with 1000 mg/L P solution followed by colorimetric analysis.	3 %	1-7

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Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	2004631 shpv1
Address:	PO Box 9528 Newmarket Auckland 1149	**Date Received:**	23-Jun-2018
		Date Reported:	28-Jun-2018
		Quote No:	81087
		Order No:	
		Client Reference:	AJ467202
Phone:	09 523 6900	**Submitted By:**	Jack Feltham

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Total Carbon*	Determined by NIR, calibration based on Total Carbon by Dumas combustion.	0.1 %	2-4, 6-7
Total Nitrogen*	Determined by NIR, calibration based on Total N by Dumas combustion.	0.04 %	3, 6-7
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.01 me/100g	1-7
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.5 me/100g	1-7
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.04 me/100g	1-7
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.05 me/100g	1-7
CEC	Summation of extractable cations (K, Ca, Mg, Na) and extractable acidity. May be overestimated if soil contains high levels of soluble salts or carbonates.	2 me/100g	1-7
Total Base Saturation	Calculated from Extractable Cations and Cation Exchange Capacity.	5 %	1-7
Volume Weight	The weight/volume ratio of dried, ground soil.	0.01 g/mL	1-7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Stephen Haylett-Petty BSc (Tech) Hons
Senior Technologist - Agriculture

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Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	2004879	SPv1
Contact:	Mr D Irvine	**Date Received:**	25-Jun-2018	
	C/- Pattle Delamore Partners Limited	**Date Reported:**	28-Jun-2018	
	PO Box 9528	**Quote No:**	81087	
	Newmarket	**Order No:**		
	Auckland 1149	**Client Reference:**	AJ467202	
		Submitted By:	Jack Feltham	

Sample Type: Soil

Sample Name:		TBP Soil 01 21-Jun-2018 11:00 am	TBP Soil 02 21-Jun-2018 12:30 pm	TBP Soil 03 21-Jun-2018 1:30 pm	TBP Soil 04 21-Jun-2018 3:00 pm	TBP Soil 05 21-Jun-2018 4:30 pm
Lab Number:		2004879.1	2004879.2	2004879.3	2004879.4	2004879.5
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	3	2	2	3
Total Recoverable Cadmium	mg/kg dry wt	0.49	0.55	0.55	0.60	0.74
Total Recoverable Chromium	mg/kg dry wt	7	6	7	6	6
Total Recoverable Copper	mg/kg dry wt	79	59	53	52	55
Total Recoverable Lead	mg/kg dry wt	9.1	9.1	9.1	8.6	9.3
Total Recoverable Nickel	mg/kg dry wt	4	4	4	4	3
Total Recoverable Zinc	mg/kg dry wt	134	125	138	117	110

Sample Name:		TBP Soil 06 22-Jun-2018 9:30 am	TBP Soil Background 22-Jun-2018 10:30 am			
Lab Number:		2004879.6	2004879.7			
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	3	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.60	0.70	-	-	-
Total Recoverable Chromium	mg/kg dry wt	7	6	-	-	-
Total Recoverable Copper	mg/kg dry wt	52	51	-	-	-
Total Recoverable Lead	mg/kg dry wt	9.1	9.2	-	-	-
Total Recoverable Nickel	mg/kg dry wt	3	3	-	-	-
Total Recoverable Zinc	mg/kg dry wt	111	134	-	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil

Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Martin Cowell - BSc
Client Services Manager - Environmental

Soil Physics Laboratory
Analytical Report

Landcare Research
Manaaki Whenua

Private Bag 11052
Palmerston North 4442

phone: +64 6 353 4911
fax: +64 6 353 4801

Job Number: PJ17029

Date Received: 21/06/2018

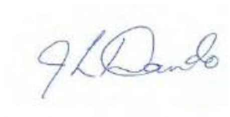
Customer: PATTLE DELAMORE PARTNERS LTD, Daryl Irvine

Date Reported: 12/07/2018

Sample name	Core No.	ID number	Remarks	Dry bulk density (g/cm³)	Unsaturated hydraulic conductivity (K_{-40}) (mm/hr)	Saturated hydraulic conductivity (mm/hr)	Field moisture (%w/w)	Field moisture (%v/v)
TBP 01 a	873	PP17-1136	Cavity at top	0.80	1	121	72	57
TBP 01 b	986	PP17-1137		0.91	1	243	60	55
TBP 02 a	752	PP17-1138		0.88	2	4	61	54
TBP 03 b	824	PP17-1139		0.87	14	27	54	47
TBP 03 b	903	PP17-1140	Cavity at top	0.93	30	49	49	45
TBP 04 a	811	PP17-1141	Small cavity at top	0.88	6	381	58	51
TBP 04 b	935	PP17-1142		0.85	11	104	57	49
TBP 05 a	959	PP17-1143		0.82	6	13	61	50
TBP 05 b	735	PP17-1144	Cavity on bottom	0.87	2	10	64	56
TBP 06 a	853	PP17-1145	Cavity on bottom	0.88	13	83	56	50
TBP 06 b	883	PP17-1146		0.90	6	55	57	51
TBP Background a	948	PP17-1147		0.91	4	25	49	45
TBP Background b	918	PP17-1148	Cavity at top	0.89	7	25	63	56

References:

Gradwell, M.W. 1972: Methods for physical analysis of soils. *Scientific Report 10C.* Lower Hutt, N.Z. Soil Bureau.
Dando, J. L. 1998: Laboratory Manual – Saturated hydraulic conductivity. Version 2.2. Palmerston North, Soil Physics Laboratory, Landcare Research.
Dando, J. L. 1998: Laboratory Manual – Unsaturated hydraulic conductivity. Version 4. Palmerston North, Soil Physics Laboratory, Landcare Research.



John Dando
Laboratory manager

Appendix E

Bouwer Rice Slug Test Analyses

Bouwer & Rice (1976) Slug Test Analysis Sheet

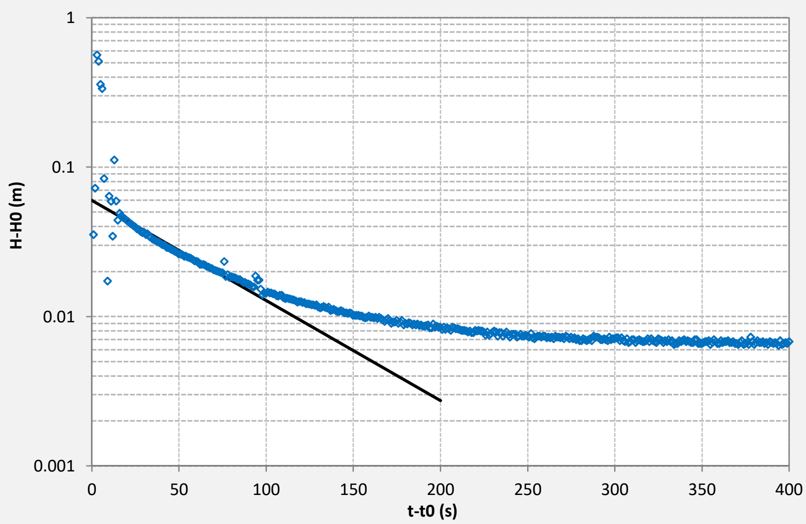
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting | Job No: AJ467202 | Bore ID: **BH1**

Test date:	22/06/2018	**Bore depth:**	13.52	mBGL	**Slugs used:**	3	
Test time:	8:28	**SWL:**	6.87	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	6.65	m	**Obs displacement:**	0.56	m
		Piezo sat. thickness (Lw):	6.65	m	**Eff. casing radius:**	0.033	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.06	m			
Displaced GWL (m):	0.562	**Hydraulic conductivity (K):**	**1.70E-05**	m/s			
			1.47E+00	m/d	**Test duration:**	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.035
2.0		0.072
3.0		0.562
4.0		0.509
5.0		0.358
6.0		0.335
7.0		0.084
8.0		-0.016
9.0		0.017
10.0		0.064
11.0		0.059
12.0		0.034
13.0		0.112
14.0		0.059
15.0		0.044
16.0		0.049
17.0		0.047
18.0		0.046
19.0		0.045
20.0		0.044
21.0		0.043
22.0		0.042
23.0		0.041
24.0		0.041
25.0		0.040
26.0		0.039
27.0		0.038
28.0		0.037
29.0		0.036
30.0		0.037
31.0		0.035
32.0		0.036
33.0		0.034
34.0		0.034
35.0		0.033
36.0		0.033
37.0		0.032
38.0		0.032
39.0		0.031
40.0		0.030
41.0		0.030
42.0		0.030
43.0		0.029
44.0		0.029
45.0		0.029
46.0		0.028
47.0		0.028
48.0		0.027
49.0		0.027
50.0		0.026
51.0		0.026
52.0		0.026
53.0		0.025
54.0		0.025
55.0		0.025
56.0		0.025
57.0		0.025
58.0		0.024
59.0		0.024
60.0		0.024
61.0		0.023
62.0		0.022
63.0		0.022



Notes:

$K = 1.7 \times 10^{-5}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

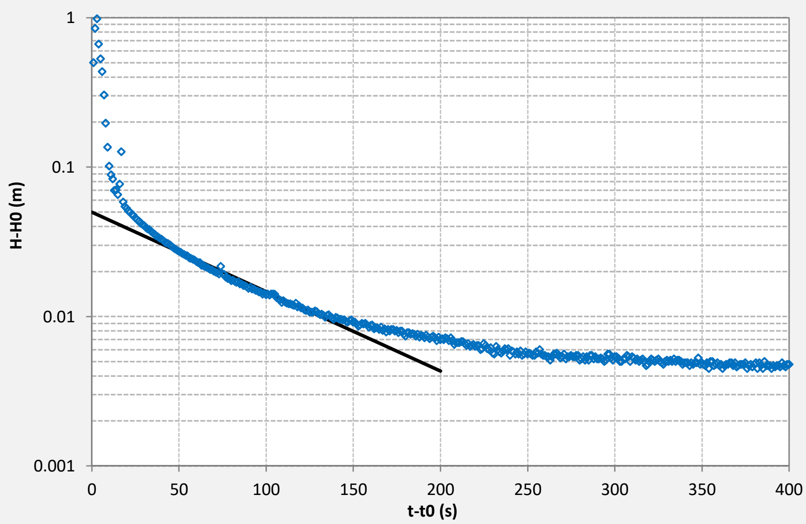
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting | **Job No:** AJ467202 | **Bore ID:** BH1

Test date:	22/06/2018	**Bore depth:**	13.52	mBGL	**Slugs used:**	3	
Test time:	8:42	**SWL:**	6.87	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	6.65	m	**Obs displacement:**	0.98	m
		Piezo sat. thickness (Lw):	6.65	m	**Eff. casing radius:**	0.025	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.05	m			
Displaced GWL (m):	0.984	**Hydraulic conductivity (K):**	**1.35E-05**	m/s			
			1.17E+00	m/d	**Test duration:**	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.499
2.0		0.846
3.0		0.984
4.0		0.665
5.0		0.531
6.0		0.435
7.0		0.304
8.0		0.197
9.0		0.136
10.0		0.102
11.0		0.089
12.0		0.083
13.0		0.070
14.0		0.071
15.0		0.066
16.0		0.077
17.0		0.127
18.0		0.058
19.0		0.055
20.0		0.053
21.0		0.051
22.0		0.050
23.0		0.048
24.0		0.047
25.0		0.046
26.0		0.045
27.0		0.044
28.0		0.042
29.0		0.041
30.0		0.041
31.0		0.039
32.0		0.039
33.0		0.038
34.0		0.037
35.0		0.036
36.0		0.036
37.0		0.035
38.0		0.034
39.0		0.033
40.0		0.033
41.0		0.032
42.0		0.031
43.0		0.031
44.0		0.031
45.0		0.030
46.0		0.029
47.0		0.029
48.0		0.028
49.0		0.028
50.0		0.027
51.0		0.027
52.0		0.026
53.0		0.026
54.0		0.026
55.0		0.026
56.0		0.025
57.0		0.025
58.0		0.024
59.0		0.024
60.0		0.023
61.0		0.023
62.0		0.023
63.0		0.022



Notes:

$K = 1.35 \times 10^{-5}$ m/s

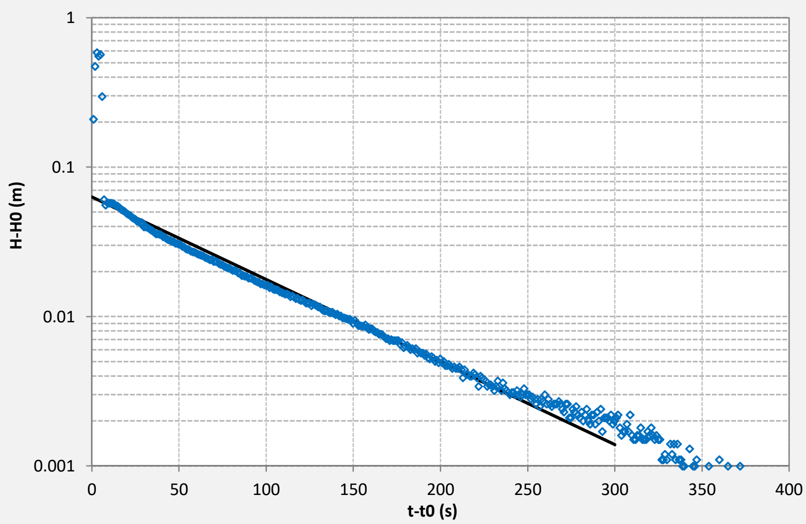
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting	**Job No:**	AJ467202		**Bore ID:**	**BH1**	
Test date:	22/06/2018	**Bore depth:**	13.52	mBGL	**Slugs used:**	3	
Test time:	8:50	**SWL:**	6.87	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	6.65	m	**Obs displacement:**	0.58	m
		Piezo sat. thickness (Lw):	6.65	m	**Eff. casing radius:**	0.032	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.063	m			
Displaced GWL (m):	0.583	**Hydraulic conductivity (K):**	**1.40E-05**	m/s			
			1.21E+00	m/d	**Test duration:**	300	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.209
2.0		0.470
3.0		0.583
4.0		0.552
5.0		0.565
6.0		0.297
7.0		0.061
8.0		0.056
9.0		0.058
10.0		0.057
11.0		0.057
12.0		0.057
13.0		0.057
14.0		0.055
15.0		0.055
16.0		0.053
17.0		0.052
18.0		0.051
19.0		0.051
20.0		0.049
21.0		0.048
22.0		0.047
23.0		0.046
24.0		0.045
25.0		0.045
26.0		0.043
27.0		0.043
28.0		0.042
29.0		0.042
30.0		0.040
31.0		0.040
32.0		0.039
33.0		0.039
34.0		0.038
35.0		0.038
36.0		0.036
37.0		0.036
38.0		0.036
39.0		0.036
40.0		0.035
41.0		0.034
42.0		0.034
43.0		0.033
44.0		0.033
45.0		0.032
46.0		0.032
47.0		0.032
48.0		0.031
49.0		0.031
50.0		0.031
51.0		0.030
52.0		0.030
53.0		0.029
54.0		0.029
55.0		0.028
56.0		0.028
57.0		0.027
58.0		0.027
59.0		0.027
60.0		0.027
61.0		0.026
62.0		0.026
63.0		0.026



Notes:

$K = 1.4 \times 10^{-5}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

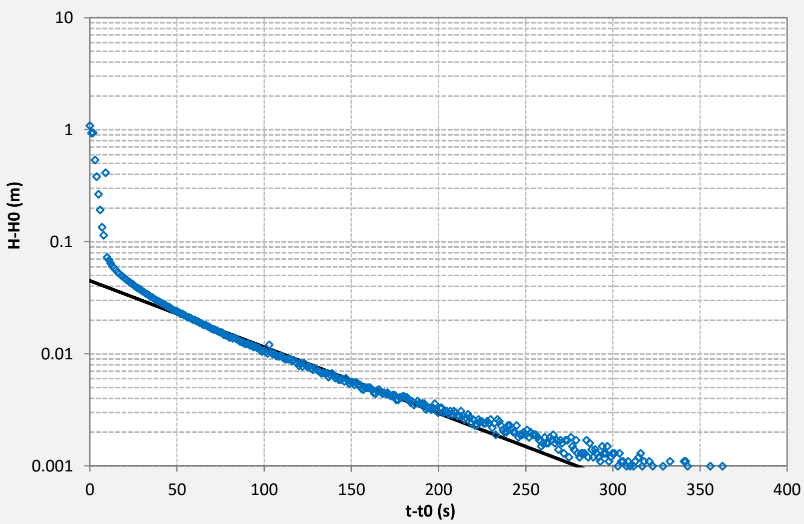
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting | **Job No:** AJ467202 | **Bore ID:** BH1

Test date:	22/06/2018	**Bore depth:**	13.52 mBGL	**Slugs used:**	3	
Test time:	9:01	**SWL:**	6.87 mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025 m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055 m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6 m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	6.65 m	**Obs displacement:**	1.08	m
		Piezo sat. thickness (Lw):	6.65 m	**Eff. casing radius:**	0.024	m
				Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**		**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.045 m			
Displaced GWL (m):	1.083	**Hydraulic conductivity (K):**	**1.50E-05** m/s			
			1.30E+00 m/d	**Test duration:**	300	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		1.083
1.0		0.933
2.0		0.941
3.0		0.536
4.0		0.382
5.0		0.266
6.0		0.193
7.0		0.135
8.0		0.114
9.0		0.412
10.0		0.073
11.0		0.069
12.0		0.064
13.0		0.061
14.0		0.059
15.0		0.056
16.0		0.054
17.0		0.052
18.0		0.050
19.0		0.049
20.0		0.048
21.0		0.046
22.0		0.045
23.0		0.044
24.0		0.043
25.0		0.042
26.0		0.040
27.0		0.039
28.0		0.038
29.0		0.038
30.0		0.037
31.0		0.036
32.0		0.035
33.0		0.034
34.0		0.033
35.0		0.033
36.0		0.032
37.0		0.031
38.0		0.030
39.0		0.030
40.0		0.029
41.0		0.029
42.0		0.028
43.0		0.028
44.0		0.027
45.0		0.026
46.0		0.026
47.0		0.025
48.0		0.025
49.0		0.024
50.0		0.024
51.0		0.024
52.0		0.023
53.0		0.023
54.0		0.022
55.0		0.022
56.0		0.021
57.0		0.021
58.0		0.021
59.0		0.020
60.0		0.020
61.0		0.020
62.0		0.020
63.0		0.019



Notes:

$K = 1.5 \times 10^{-5}$ m/s

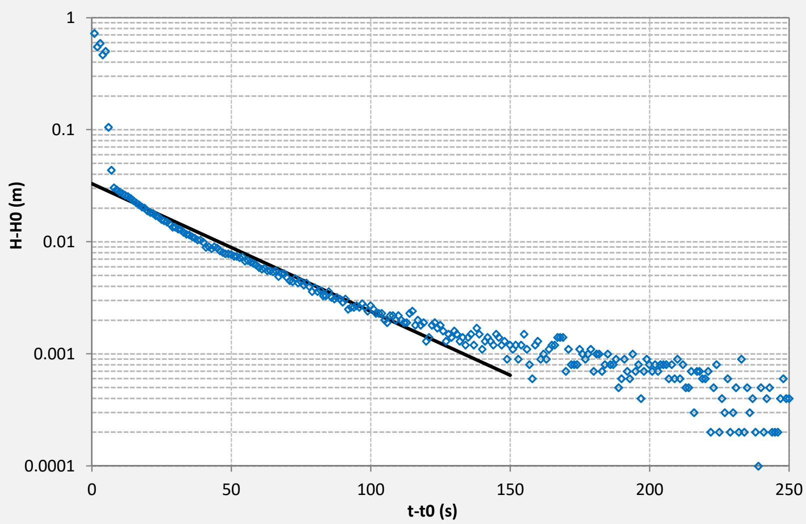
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting		Job No:	AJ467202		Bore ID:	BH1	
Test date:	21/06/2018		Bore depth:	11.11	mBGL	Slugs used:	3	
Test time:	16:52		SWL:	5.55	mBGL	Slug length:	0.5	m
Performed by:	KG		Screen radius (rc):	0.025	m	Slug radius:	0.02	m
Analysed by:	KG		Borehole radius (Re):	0.055	m	Displacement vol:	0.00188	m3
Reviewed by:			Saturated screen length (Le):	6	m	Expected displ:	0.96	m
Test type:	Falling head		Aquifer sat. thickness (h):	5.57	m	Obs displacement:	0.72	m
			Piezo sat. thickness (Lw):	5.56	m	Eff. casing radius:	0.037	m
						Correct for displacement:	FALSE	
GWL measurement:	Depth to water		Curve fitting:			Well screened across water table:	TRUE	
Static GWL (m):	0		Y-intercept shift:	0.033	m	Filter pack porosity:	0.3	
Displaced GWL (m):	0.721		Hydraulic conductivity (K):	1.10E-05	m/s			
				9.50E-01	m/d	Test duration:	150	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.721
2.0		0.547
3.0		0.587
4.0		0.464
5.0		0.501
6.0		0.105
7.0		0.044
8.0		0.030
9.0		0.029
10.0		0.028
11.0		0.027
12.0		0.026
13.0		0.025
14.0		0.024
15.0		0.023
16.0		0.022
17.0		0.021
18.0		0.020
19.0		0.020
20.0		0.019
21.0		0.018
22.0		0.018
23.0		0.017
24.0		0.017
25.0		0.016
26.0		0.015
27.0		0.015
28.0		0.014
29.0		0.014
30.0		0.014
31.0		0.013
32.0		0.013
33.0		0.012
34.0		0.012
35.0		0.012
36.0		0.011
37.0		0.011
38.0		0.010
39.0		0.010
40.0		0.010
41.0		0.009
42.0		0.009
43.0		0.009
44.0		0.009
45.0		0.009
46.0		0.008
47.0		0.008
48.0		0.008
49.0		0.008
50.0		0.008
51.0		0.007
52.0		0.007
53.0		0.007
54.0		0.007
55.0		0.007
56.0		0.007
57.0		0.007
58.0		0.006
59.0		0.006
60.0		0.006
61.0		0.006
62.0		0.006
63.0		0.006



Notes:
Issues with other test results for this bore. Generally recovery extremely rapid, within seconds.

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$$K = 1.1 \times 10^{-5} \ m/s$$

Bouwer & Rice (1976) Slug Test Analysis Sheet

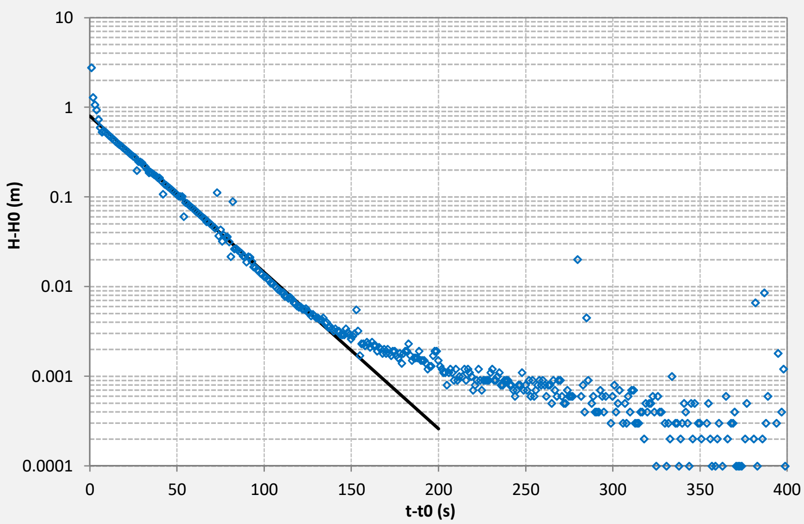
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting | **Job No:** AJ467202 | **Bore ID:** BH5B

Test date:	22/06/2018	**Bore depth:**	8.92	mBGL	**Slugs used:**	3	
Test time:	12:16	**SWL:**	2.65	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	6.28	m	**Obs displacement:**	2.76	m
		Piezo sat. thickness (Lw):	6.27	m	**Eff. casing radius:**	0.015	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.8	m			
Displaced GWL (m):	2.761	**Hydraulic conductivity (K):**	**8.00E-06**	m/s			
			6.91E-01	m/d	**Test duration:**	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		2.761
2.0		1.281
3.0		1.062
4.0		0.934
5.0		0.729
6.0		0.594
7.0		0.531
8.0		0.541
9.0		0.527
10.0		0.506
11.0		0.484
12.0		0.466
13.0		0.448
14.0		0.432
15.0		0.415
16.0		0.395
17.0		0.385
18.0		0.370
19.0		0.356
20.0		0.342
21.0		0.331
22.0		0.318
23.0		0.304
24.0		0.295
25.0		0.284
26.0		0.276
27.0		0.197
28.0		0.249
29.0		0.246
30.0		0.240
31.0		0.224
32.0		0.216
33.0		0.202
34.0		0.185
35.0		0.189
36.0		0.183
37.0		0.178
38.0		0.171
39.0		0.164
40.0		0.163
41.0		0.151
42.0		0.107
43.0		0.139
44.0		0.135
45.0		0.130
46.0		0.125
47.0		0.120
48.0		0.116
49.0		0.111
50.0		0.107
51.0		0.102
52.0		0.102
53.0		0.101
54.0		0.060
55.0		0.086
56.0		0.085
57.0		0.081
58.0		0.078
59.0		0.075
60.0		0.072
61.0		0.069
62.0		0.066
63.0		0.064



Notes:

$K = 8 \times 10^{-6}$ m/s

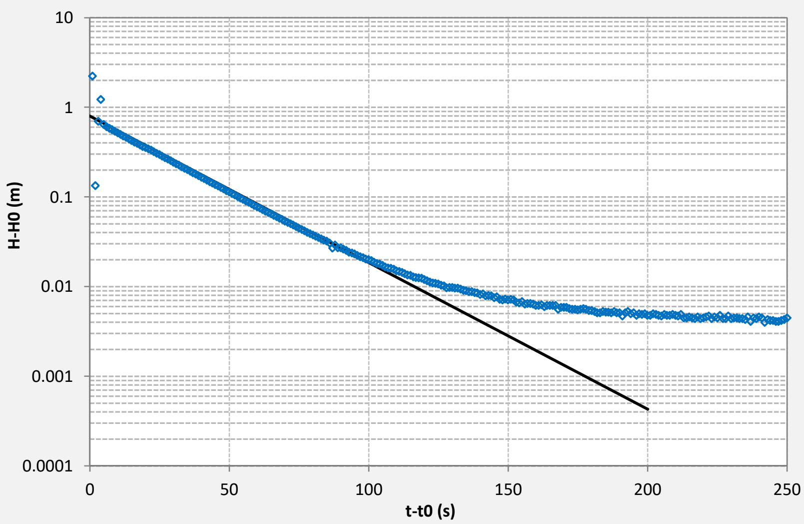
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting	**Job No:**	AJ467202		**Bore ID:**	**BH5B**	
Test date:	22/06/2018	**Bore depth:**	8.92	mBGL	**Slugs used:**	3	
Test time:	12:25	**SWL:**	2.65	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	6.28	m	**Obs displacement:**	2.23	m
		Piezo sat. thickness (Lw):	6.27	m	**Eff. casing radius:**	0.016	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.8	m			
Displaced GWL (m):	2.231	**Hydraulic conductivity (K):**	**7.50E-06**	m/s			
			6.48E-01	m/d	**Test duration:**	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		2.231
2.0		0.134
3.0		0.698
4.0		1.224
5.0		0.644
6.0		0.606
7.0		0.584
8.0		0.562
9.0		0.540
10.0		0.519
11.0		0.499
12.0		0.480
13.0		0.462
14.0		0.445
15.0		0.426
16.0		0.411
17.0		0.395
18.0		0.380
19.0		0.367
20.0		0.355
21.0		0.345
22.0		0.332
23.0		0.320
24.0		0.308
25.0		0.296
26.0		0.285
27.0		0.274
28.0		0.264
29.0		0.254
30.0		0.244
31.0		0.235
32.0		0.226
33.0		0.218
34.0		0.210
35.0		0.202
36.0		0.194
37.0		0.187
38.0		0.180
39.0		0.173
40.0		0.166
41.0		0.160
42.0		0.154
43.0		0.148
44.0		0.143
45.0		0.137
46.0		0.133
47.0		0.128
48.0		0.123
49.0		0.118
50.0		0.114
51.0		0.109
52.0		0.105
53.0		0.101
54.0		0.098
55.0		0.094
56.0		0.090
57.0		0.087
58.0		0.084
59.0		0.081
60.0		0.078
61.0		0.075
62.0		0.072
63.0		0.070



Notes:

$K = 7.5 \times 10^{-6}$ m/s

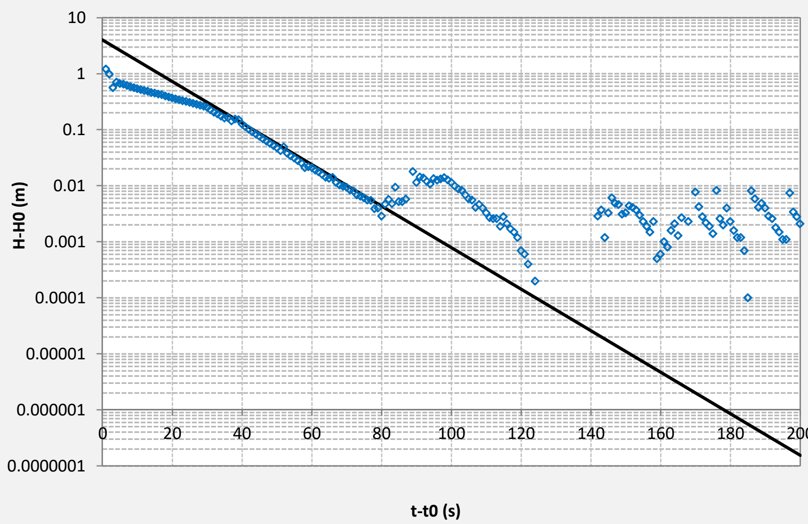
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH5B**

Test date:	22/06/2018	**Bore depth:**	8.92	mBGL	**Slugs used:**	3	
Test time:	12:38	**SWL:**	2.65	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	6.28	m	**Obs displacement:**	1.20	m
		Piezo sat. thickness (Lw):	6.27	m	**Eff. casing radius:**	0.022	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	4	m			
Displaced GWL (m):	1.203	**Hydraulic conductivity (K):**	**1.70E-05**	m/s			
Observed data			1.47E+00	m/d	**Test duration:**	200	s

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		1.203
2.0		0.976
3.0		0.564
4.0		0.703
5.0		0.668
6.0		0.653
7.0		0.615
8.0		0.589
9.0		0.566
10.0		0.544
11.0		0.524
12.0		0.504
13.0		0.485
14.0		0.465
15.0		0.450
16.0		0.433
17.0		0.420
18.0		0.401
19.0		0.386
20.0		0.371
21.0		0.358
22.0		0.342
23.0		0.331
24.0		0.318
25.0		0.306
26.0		0.295
27.0		0.284
28.0		0.273
29.0		0.262
30.0		0.250
31.0		0.227
32.0		0.204
33.0		0.192
34.0		0.174
35.0		0.161
36.0		0.163
37.0		0.144
38.0		0.156
39.0		0.152
40.0		0.126
41.0		0.114
42.0		0.102
43.0		0.092
44.0		0.084
45.0		0.076
46.0		0.069
47.0		0.063
48.0		0.057
49.0		0.052
50.0		0.047
51.0		0.042
52.0		0.049
53.0		0.038
54.0		0.034
55.0		0.031
56.0		0.028
57.0		0.026
58.0		0.021
59.0		0.022
60.0		0.021
61.0		0.019
62.0		0.018
63.0		0.016



Notes:
Change in gradient may be associated with slugs not being fully submerged during test.

$$K = 1.7 \times 10^{-5}\ m/s$$

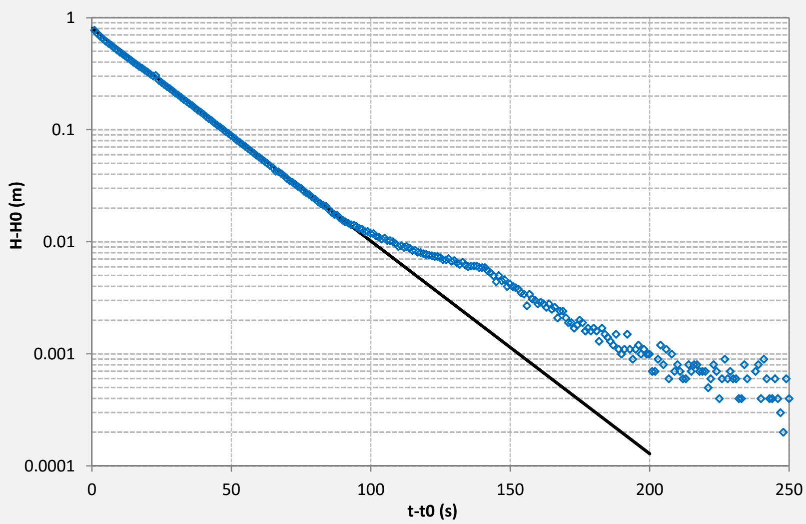
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting		Job No:	AJ467202		Bore ID:	BH5B	
Test date:	22/06/2018	Bore depth:	8.92	mBGL		Slugs used:	3	
Test time:	12:43	SWL:	2.65	mBGL		Slug length:	0.5	m
Performed by:	KG	Screen radius (rc):	0.025	m		Slug radius:	0.02	m
Analysed by:	KG	Borehole radius (Re):	0.055	m		Displacement vol:	0.00188	m3
Reviewed by:		Saturated screen length (Le):	6	m		Expected displ:	0.96	m
Test type:	Rising head	Aquifer sat. thickness (h):	6.28	m		Obs displacement:	0.77	m
		Piezo sat. thickness (Lw):	6.27	m		Eff. casing radius:	0.028	m
						Correct for displacement:	FALSE	
GWL measurement:	Depth to water	Curve fitting:				Well screened across water table:	FALSE	
Static GWL (m):	0	Y-intercept shift:	0.8	m				
Displaced GWL (m):	0.772	Hydraulic conductivity (K):	**8.70E-06**	m/s				
			7.52E-01	m/d		Test duration:	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.772
2.0		0.720
3.0		0.681
4.0		0.649
5.0		0.618
6.0		0.591
7.0		0.564
8.0		0.540
9.0		0.517
10.0		0.494
11.0		0.474
12.0		0.454
13.0		0.435
14.0		0.417
15.0		0.400
16.0		0.383
17.0		0.367
18.0		0.354
19.0		0.342
20.0		0.328
21.0		0.314
22.0		0.301
23.0		0.305
24.0		0.276
25.0		0.264
26.0		0.253
27.0		0.243
28.0		0.232
29.0		0.222
30.0		0.213
31.0		0.204
32.0		0.195
33.0		0.187
34.0		0.179
35.0		0.171
36.0		0.164
37.0		0.157
38.0		0.150
39.0		0.144
40.0		0.137
41.0		0.131
42.0		0.126
43.0		0.120
44.0		0.115
45.0		0.110
46.0		0.106
47.0		0.101
48.0		0.097
49.0		0.093
50.0		0.089
51.0		0.085
52.0		0.081
53.0		0.077
54.0		0.074
55.0		0.071
56.0		0.068
57.0		0.065
58.0		0.062
59.0		0.059
60.0		0.057
61.0		0.054
62.0		0.052
63.0		0.050



Notes:

$K = 8.7 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

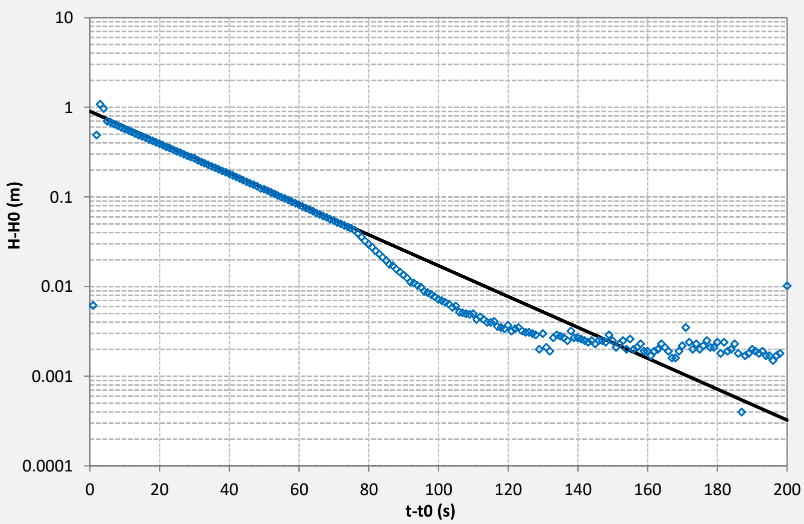
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH5B**

Test date:	22/06/2018	**Bore depth:**	8.92	mBGL	**Slugs used:**	3	
Test time:	12:51	**SWL:**	2.65	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	6.28	m	**Obs displacement:**	1.08	m
		Piezo sat. thickness (Lw):	6.27	m	**Eff. casing radius:**	0.024	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.9	m			
Displaced GWL (m):	1.079	**Hydraulic conductivity (K):**	**7.90E-06**	m/s			
			6.83E-01	m/d	**Test duration:**	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.006
2.0		0.491
3.0		1.079
4.0		0.971
5.0		0.699
6.0		0.674
7.0		0.648
8.0		0.622
9.0		0.598
10.0		0.575
11.0		0.553
12.0		0.532
13.0		0.512
14.0		0.493
15.0		0.474
16.0		0.458
17.0		0.439
18.0		0.423
19.0		0.407
20.0		0.392
21.0		0.377
22.0		0.363
23.0		0.349
24.0		0.336
25.0		0.324
26.0		0.311
27.0		0.300
28.0		0.289
29.0		0.278
30.0		0.269
31.0		0.256
32.0		0.247
33.0		0.238
34.0		0.229
35.0		0.220
36.0		0.212
37.0		0.204
38.0		0.196
39.0		0.189
40.0		0.181
41.0		0.174
42.0		0.167
43.0		0.161
44.0		0.154
45.0		0.148
46.0		0.142
47.0		0.137
48.0		0.132
49.0		0.124
50.0		0.122
51.0		0.117
52.0		0.112
53.0		0.108
54.0		0.104
55.0		0.100
56.0		0.096
57.0		0.092
58.0		0.088
59.0		0.085
60.0		0.082
61.0		0.078
62.0		0.075
63.0		0.072



Notes:

$K = 7.9 \times 10^{-6}$ m/s

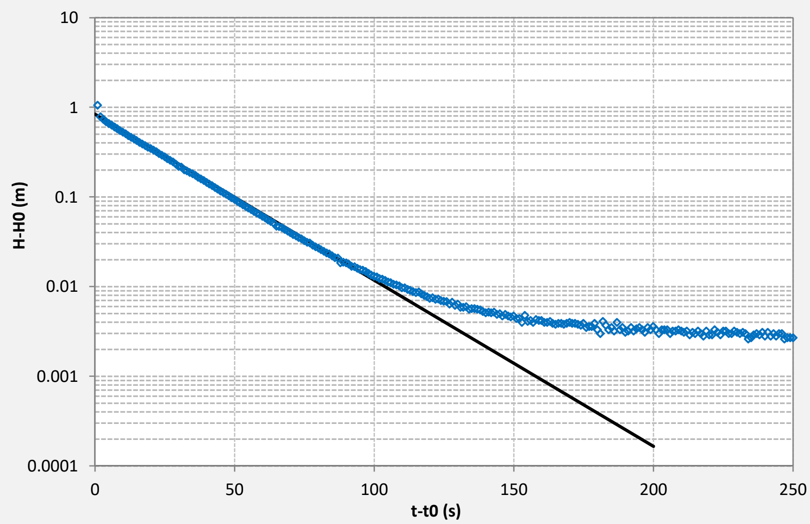
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting		Job No:	AJ467202		Bore ID:	BH5B	
Test date:	22/06/2018		Bore depth:	8.92	mBGL	Slugs used:	3	
Test time:	12:57		SWL:	2.65	mBGL	Slug length:	0.5	m
Performed by:	KG		Screen radius (rc):	0.025	m	Slug radius:	0.02	m
Analysed by:	KG		Borehole radius (Re):	0.055	m	Displacement vol:	0.00188	m3
Reviewed by:			Saturated screen length (Le):	6	m	Expected displ:	0.96	m
Test type:	Rising head		Aquifer sat. thickness (h):	6.28	m	Obs displacement:	1.06	m
			Piezo sat. thickness (Lw):	6.27	m	Eff. casing radius:	0.024	m
						Correct for displacement:	FALSE	
GWL measurement:	Depth to water		Curve fitting:			Well screened across water table:	FALSE	
Static GWL (m):	0		Y-intercept shift:	0.84	m			
Displaced GWL (m):	1.057		Hydraulic conductivity (K):	**8.50E-06**	m/s			
				7.34E-01	m/d	Test duration:	200	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		1.057
2.0		0.787
3.0		0.734
4.0		0.694
5.0		0.661
6.0		0.632
7.0		0.603
8.0		0.577
9.0		0.552
10.0		0.528
11.0		0.506
12.0		0.484
13.0		0.464
14.0		0.444
15.0		0.425
16.0		0.407
17.0		0.390
18.0		0.373
19.0		0.359
20.0		0.347
21.0		0.333
22.0		0.319
23.0		0.305
24.0		0.292
25.0		0.280
26.0		0.268
27.0		0.257
28.0		0.246
29.0		0.233
30.0		0.220
31.0		0.216
32.0		0.200
33.0		0.196
34.0		0.188
35.0		0.181
36.0		0.174
37.0		0.166
38.0		0.159
39.0		0.152
40.0		0.145
41.0		0.139
42.0		0.133
43.0		0.127
44.0		0.122
45.0		0.117
46.0		0.112
47.0		0.107
48.0		0.103
49.0		0.098
50.0		0.094
51.0		0.090
52.0		0.086
53.0		0.082
54.0		0.079
55.0		0.075
56.0		0.072
57.0		0.069
58.0		0.066
59.0		0.064
60.0		0.061
61.0		0.058
62.0		0.056
63.0		0.053



Notes:

$K = 8.5 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

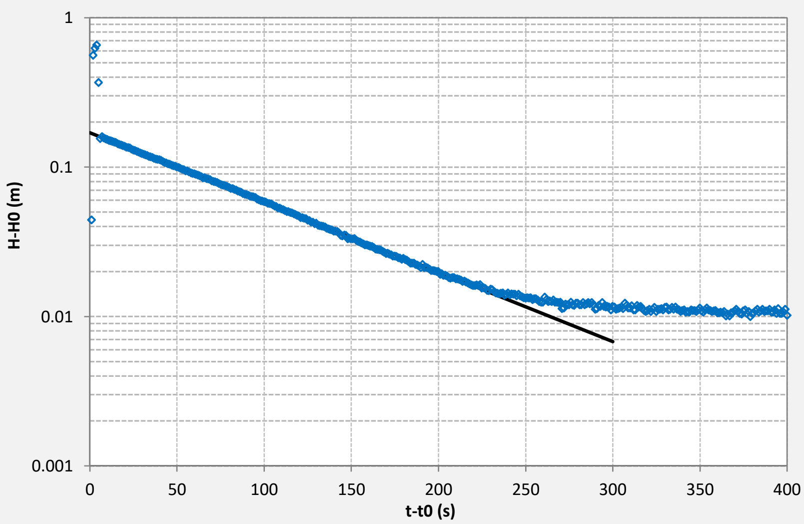
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH6B**

Test date:	21/06/2018	**Bore depth:**	12.36	mBGL	**Slugs used:**	3	
Test time:	14:53	**SWL:**	6.78	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	5.59	m	**Obs displacement:**	0.65	m
		Piezo sat. thickness (Lw):	5.58	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.17	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.655	**Hydraulic conductivity (K):**	**4.50E-06**	m/s			
			3.89E-01	m/d	**Test duration:**	300	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.044
2.0		0.559
3.0		0.625
4.0		0.655
5.0		0.369
6.0		0.155
7.0		0.160
8.0		0.157
9.0		0.155
10.0		0.153
11.0		0.151
12.0		0.150
13.0		0.148
14.0		0.147
15.0		0.146
16.0		0.144
17.0		0.142
18.0		0.141
19.0		0.139
20.0		0.138
21.0		0.136
22.0		0.135
23.0		0.135
24.0		0.132
25.0		0.130
26.0		0.129
27.0		0.127
28.0		0.126
29.0		0.125
30.0		0.123
31.0		0.122
32.0		0.121
33.0		0.119
34.0		0.118
35.0		0.117
36.0		0.116
37.0		0.115
38.0		0.113
39.0		0.113
40.0		0.112
41.0		0.111
42.0		0.109
43.0		0.107
44.0		0.107
45.0		0.105
46.0		0.104
47.0		0.103
48.0		0.102
49.0		0.102
50.0		0.100
51.0		0.099
52.0		0.098
53.0		0.097
54.0		0.096
55.0		0.094
56.0		0.094
57.0		0.093
58.0		0.092
59.0		0.091
60.0		0.090
61.0		0.090
62.0		0.088
63.0		0.087



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$$K = 4.5 \times 10^{-6} \quad m/s$$

Bouwer & Rice (1976) Slug Test Analysis Sheet

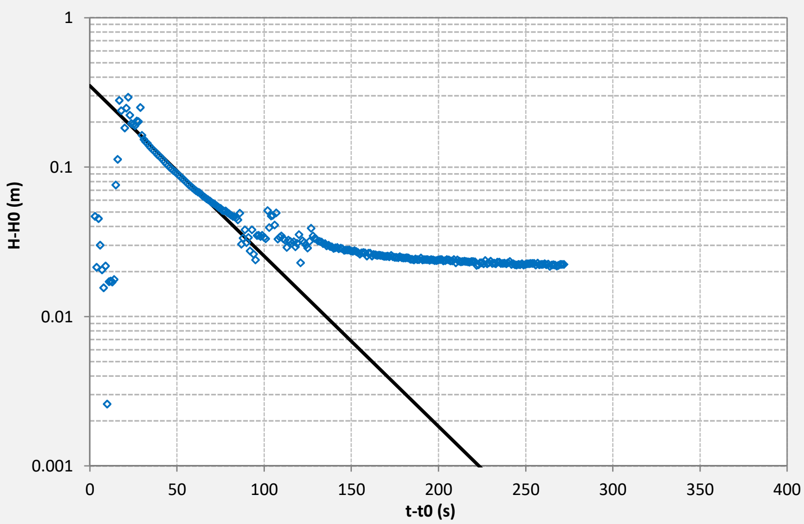
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH6B**

Test date:	21/06/2018	**Bore depth:**	12.36	mBGL	**Slugs used:**	3	
Test time:	15:01	**SWL:**	6.78	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	5.59	m	**Obs displacement:**	0.29	m
		Piezo sat. thickness (Lw):	5.58	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.35	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.293	**Hydraulic conductivity (K):**	**1.10E-05**	m/s			
			9.50E-01	m/d	**Test duration:**	300	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0
1.0		-0.003
2.0		-0.012
3.0		0.047
4.0		0.021
5.0		0.045
6.0		0.030
7.0		0.021
8.0		0.016
9.0		0.022
10.0		0.003
11.0		0.017
12.0		0.017
13.0		0.017
14.0		0.018
15.0		0.076
16.0		0.113
17.0		0.279
18.0		0.238
19.0		-0.069
20.0		0.183
21.0		0.248
22.0		0.293
23.0		0.222
24.0		0.196
25.0		0.193
26.0		0.189
27.0		0.204
28.0		0.202
29.0		0.250
30.0		0.163
31.0		0.153
32.0		0.148
33.0		0.144
34.0		0.140
35.0		0.135
36.0		0.131
37.0		0.128
38.0		0.125
39.0		0.121
40.0		0.118
41.0		0.115
42.0		0.111
43.0		0.108
44.0		0.105
45.0		0.103
46.0		0.100
47.0		0.097
48.0		0.095
49.0		0.093
50.0		0.091
51.0		0.089
52.0		0.086
53.0		0.084
54.0		0.082
55.0		0.080
56.0		0.078
57.0		0.076
58.0		0.075
59.0		0.073
60.0		0.071
61.0		0.070
62.0		0.068
63.0		0.067



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$K = 1.1 \times 10^{-5}$ m/s

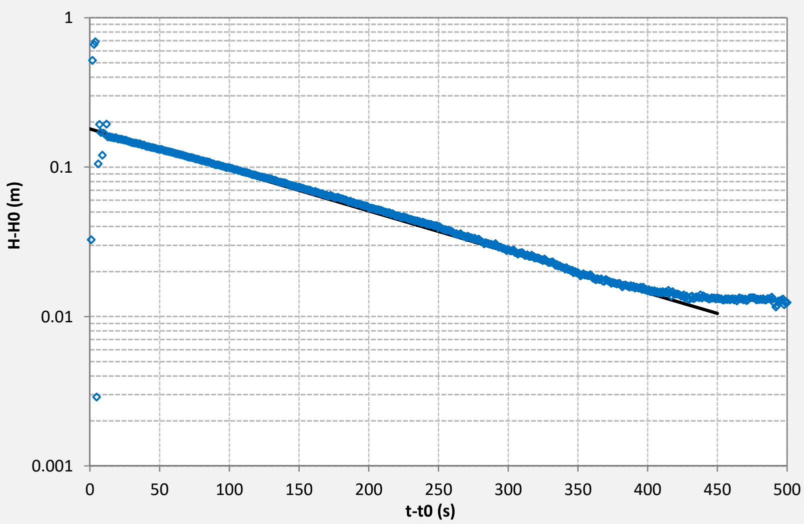
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting	**Job No:**	AJ467202		**Bore ID:**	**BH6B**	
Test date:	21/06/2018	**Bore depth:**	12.36	mBGL	**Slugs used:**	3	
Test time:	15:06	**SWL:**	6.78	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	5.59	m	**Obs displacement:**	0.69	m
		Piezo sat. thickness (Lw):	5.58	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.18	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.690	**Hydraulic conductivity (K):**	**2.65E-06**	m/s			
			2.29E-01	m/d	**Test duration:**	450	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.033
2.0		0.517
3.0		0.661
4.0		0.690
5.0		0.003
6.0		0.105
7.0		0.192
8.0		0.171
9.0		0.120
10.0		0.169
11.0		0.165
12.0		0.194
13.0		0.159
14.0		0.160
15.0		0.159
16.0		0.159
17.0		0.157
18.0		0.157
19.0		0.157
20.0		0.155
21.0		0.155
22.0		0.154
23.0		0.154
24.0		0.152
25.0		0.152
26.0		0.151
27.0		0.150
28.0		0.148
29.0		0.147
30.0		0.146
31.0		0.146
32.0		0.145
33.0		0.145
34.0		0.144
35.0		0.143
36.0		0.143
37.0		0.141
38.0		0.140
39.0		0.141
40.0		0.138
41.0		0.138
42.0		0.137
43.0		0.137
44.0		0.135
45.0		0.135
46.0		0.134
47.0		0.134
48.0		0.132
49.0		0.132
50.0		0.131
51.0		0.131
52.0		0.131
53.0		0.129
54.0		0.129
55.0		0.128
56.0		0.127
57.0		0.127
58.0		0.126
59.0		0.126
60.0		0.125
61.0		0.124
62.0		0.123
63.0		0.123



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$K = 2.65 \times 10^{-6}$ m/s

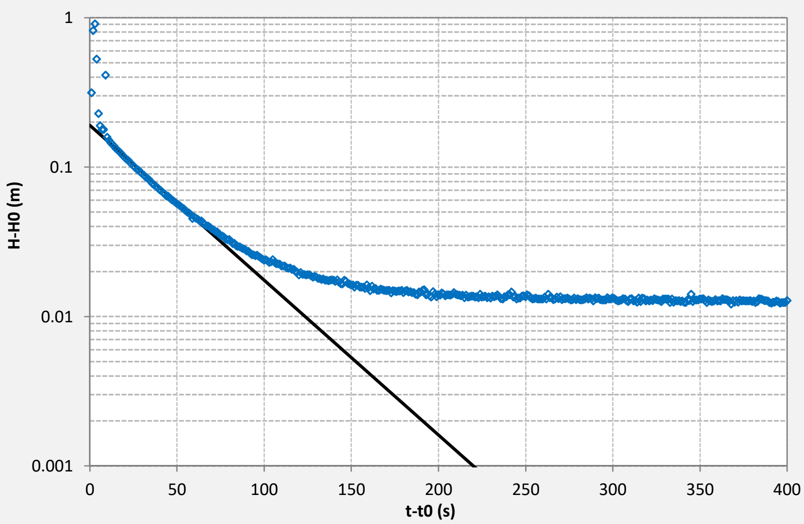
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting	Job No:	AJ467202		Bore ID:	BH6B	
Test date:	21/06/2018	Bore depth:	12.36	mBGL	Slugs used:	3	
Test time:	15:15	SWL:	6.78	mBGL	Slug length:	0.5	m
Performed by:	KG	Screen radius (rc):	0.025	m	Slug radius:	0.02	m
Analysed by:	KG	Borehole radius (Re):	0.055	m	Displacement vol:	0.00188	m3
Reviewed by:		Saturated screen length (Le):	6	m	Expected displ:	0.96	m
Test type:	Rising head	Aquifer sat. thickness (h):	5.59	m	Obs displacement:	0.91	m
		Piezo sat. thickness (Lw):	5.58	m	Eff. casing radius:	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	Curve fitting:			Well screened across water table:	TRUE	
Static GWL (m):	0	Y-intercept shift:	0.19	m	Filter pack porosity:	0.3	
Displaced GWL (m):	0.907	Hydraulic conductivity (K):	**1.00E-05**	m/s			
			8.64E-01	m/d	Test duration:	300	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0
1.0		0.315
2.0		0.818
3.0		0.907
4.0		0.528
5.0		0.228
6.0		0.189
7.0		0.179
8.0		0.179
9.0		0.413
10.0		0.158
11.0		0.151
12.0		0.146
13.0		0.142
14.0		0.138
15.0		0.134
16.0		0.130
17.0		0.127
18.0		0.123
19.0		0.120
20.0		0.116
21.0		0.113
22.0		0.111
23.0		0.108
24.0		0.105
25.0		0.102
26.0		0.100
27.0		0.097
28.0		0.096
29.0		0.093
30.0		0.091
31.0		0.089
32.0		0.086
33.0		0.084
34.0		0.082
35.0		0.080
36.0		0.078
37.0		0.076
38.0		0.075
39.0		0.073
40.0		0.071
41.0		0.069
42.0		0.068
43.0		0.066
44.0		0.064
45.0		0.064
46.0		0.062
47.0		0.061
48.0		0.060
49.0		0.058
50.0		0.057
51.0		0.056
52.0		0.055
53.0		0.054
54.0		0.053
55.0		0.051
56.0		0.050
57.0		0.049
58.0		0.048
59.0		0.045
60.0		0.046
61.0		0.046
62.0		0.045
63.0		0.044



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$K = 1 \times 10^{-5}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

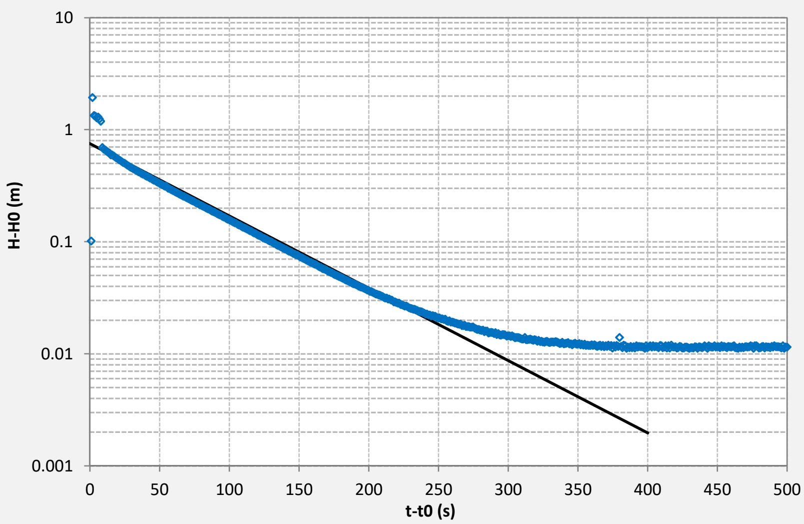
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH7A**

Test date:	22/06/2018	**Bore depth:**	15.07	mBGL	**Slugs used:**	3	
Test time:	9:40	**SWL:**	6.96	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	8.12	m	**Obs displacement:**	1.93	m
		Piezo sat. thickness (Lw):	8.11	m	**Eff. casing radius:**	0.018	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.75	m			
Displaced GWL (m):	1.935	**Hydraulic conductivity (K):**	**3.10E-06**	m/s			
			2.68E-01	m/d	**Test duration:**	400	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.102
2.0		1.935
3.0		1.337
4.0		1.326
5.0		1.281
6.0		1.296
7.0		1.246
8.0		1.194
9.0		0.696
10.0		0.672
11.0		0.657
12.0		0.644
13.0		0.632
14.0		0.620
15.0		0.596
16.0		0.596
17.0		0.584
18.0		0.573
19.0		0.562
20.0		0.551
21.0		0.541
22.0		0.531
23.0		0.521
24.0		0.511
25.0		0.502
26.0		0.492
27.0		0.484
28.0		0.475
29.0		0.466
30.0		0.458
31.0		0.450
32.0		0.443
33.0		0.436
34.0		0.429
35.0		0.422
36.0		0.415
37.0		0.409
38.0		0.402
39.0		0.396
40.0		0.390
41.0		0.383
42.0		0.378
43.0		0.372
44.0		0.366
45.0		0.361
46.0		0.355
47.0		0.349
48.0		0.344
49.0		0.339
50.0		0.333
51.0		0.328
52.0		0.323
53.0		0.318
54.0		0.313
55.0		0.316
56.0		0.301
57.0		0.298
58.0		0.294
59.0		0.290
60.0		0.285
61.0		0.280
62.0		0.276
63.0		0.272



Notes:

$K = 3.1 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

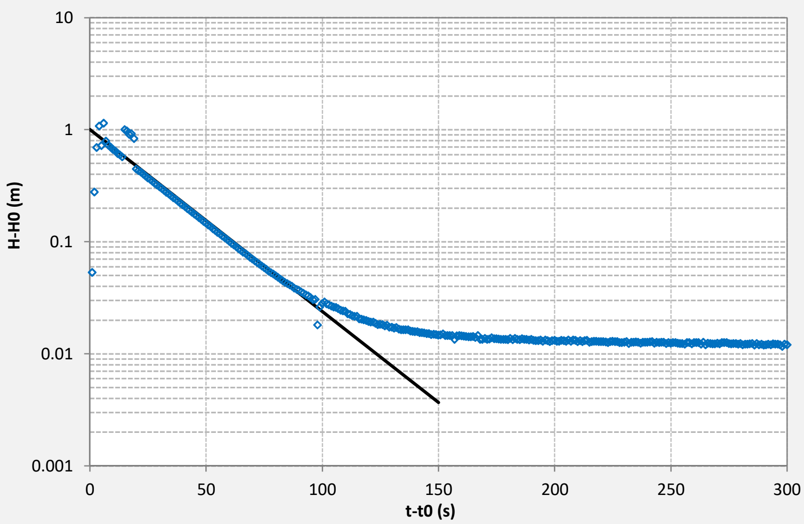
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting | **Job No:** AJ467202 | **Bore ID:** BH7A

Test date:	22/06/2018	**Bore depth:**	15.07	mBGL	**Slugs used:**	3	
Test time:	10:03	**SWL:**	6.96	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	8.12	m	**Obs displacement:**	1.14	m
		Piezo sat. thickness (Lw):	8.11	m	**Eff. casing radius:**	0.023	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	1	m			
Displaced GWL (m):	1.143	**Hydraulic conductivity (K):**	**7.80E-06**	m/s			
			6.74E-01	m/d	**Test duration:**	150	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.054
2.0		0.278
3.0		0.694
4.0		1.077
5.0		0.722
6.0		1.143
7.0		0.794
8.0		0.725
9.0		0.697
10.0		0.667
11.0		0.643
12.0		0.613
13.0		0.595
14.0		0.575
15.0		1.000
16.0		0.976
17.0		0.906
18.0		0.918
19.0		0.837
20.0		0.447
21.0		0.433
22.0		0.417
23.0		0.401
24.0		0.387
25.0		0.373
26.0		0.359
27.0		0.346
28.0		0.333
29.0		0.321
30.0		0.310
31.0		0.298
32.0		0.287
33.0		0.277
34.0		0.267
35.0		0.257
36.0		0.248
37.0		0.239
38.0		0.230
39.0		0.221
40.0		0.213
41.0		0.205
42.0		0.198
43.0		0.191
44.0		0.184
45.0		0.177
46.0		0.170
47.0		0.164
48.0		0.158
49.0		0.152
50.0		0.147
51.0		0.141
52.0		0.136
53.0		0.131
54.0		0.126
55.0		0.122
56.0		0.117
57.0		0.113
58.0		0.109
59.0		0.105
60.0		0.101
61.0		0.097
62.0		0.094
63.0		0.090



Notes:

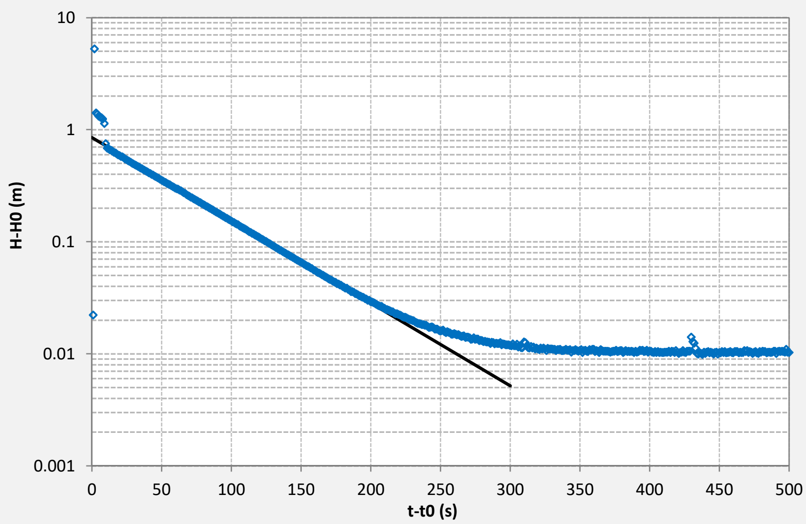
$K = 7.8 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting		**Job No:**	AJ467202		**Bore ID:**	**BH7A**
Test date:	22/06/2018	**Bore depth:**	15.07	mBGL	**Slugs used:**	3	
Test time:	10:11	**SWL:**	6.96	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	8.12	m	**Obs displacement:**	5.27	m
		Piezo sat. thickness (Lw):	8.11	m	**Eff. casing radius:**	0.011	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	0.85	m			
Displaced GWL (m):	5.270	**Hydraulic conductivity (K):**	**3.55E-06**	m/s			
Observed data			3.07E-01	m/d	**Test duration:**	300	s

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.022
2.0		5.270
3.0		1.416
4.0		1.374
5.0		1.322
6.0		1.298
7.0		1.280
8.0		1.245
9.0		1.134
10.0		0.751
11.0		0.687
12.0		0.675
13.0		0.664
14.0		0.652
15.0		0.641
16.0		0.630
17.0		0.619
18.0		0.609
19.0		0.598
20.0		0.588
21.0		0.578
22.0		0.574
23.0		0.563
24.0		0.548
25.0		0.539
26.0		0.530
27.0		0.521
28.0		0.513
29.0		0.504
30.0		0.496
31.0		0.488
32.0		0.480
33.0		0.472
34.0		0.464
35.0		0.457
36.0		0.449
37.0		0.442
38.0		0.434
39.0		0.427
40.0		0.420
41.0		0.413
42.0		0.406
43.0		0.400
44.0		0.393
45.0		0.386
46.0		0.380
47.0		0.374
48.0		0.368
49.0		0.362
50.0		0.356
51.0		0.350
52.0		0.344
53.0		0.338
54.0		0.333
55.0		0.328
56.0		0.323
57.0		0.317
58.0		0.312
59.0		0.307
60.0		0.301
61.0		0.298
62.0		0.295
63.0		0.290



Notes:

$K = 3.55 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

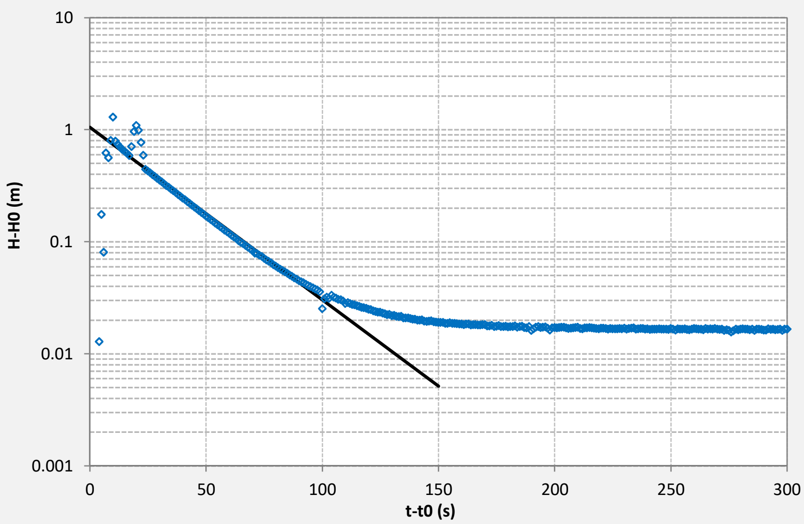
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH7A**

Test date:	22/06/2018	**Bore depth:**	15.07 mBGL	**Slugs used:**	3	
Test time:	10:23	**SWL:**	6.96 mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025 m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055 m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6 m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	8.12 m	**Obs displacement:**	1.30	m
		Piezo sat. thickness (Lw):	8.11 m	**Eff. casing radius:**	0.022	m
				Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**		**Well screened across water table:**	FALSE	
Static GWL (m):	0	**Y-intercept shift:**	1.05 m			
Displaced GWL (m):	1.297	**Hydraulic conductivity (K):**	**7.40E-06** m/s			
			6.39E-01 m/d	**Test duration:**	150	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		-0.008
2.0		-0.113
3.0		-0.119
4.0		0.013
5.0		0.176
6.0		0.081
7.0		0.619
8.0		0.562
9.0		0.803
10.0		1.297
11.0		0.792
12.0		0.742
13.0		0.701
14.0		0.668
15.0		0.639
16.0		0.617
17.0		0.589
18.0		0.707
19.0		0.963
20.0		1.093
21.0		0.988
22.0		0.772
23.0		0.594
24.0		0.444
25.0		0.428
26.0		0.412
27.0		0.397
28.0		0.383
29.0		0.368
30.0		0.355
31.0		0.343
32.0		0.330
33.0		0.318
34.0		0.307
35.0		0.295
36.0		0.285
37.0		0.275
38.0		0.265
39.0		0.255
40.0		0.246
41.0		0.237
42.0		0.228
43.0		0.220
44.0		0.212
45.0		0.204
46.0		0.197
47.0		0.190
48.0		0.183
49.0		0.177
50.0		0.170
51.0		0.164
52.0		0.158
53.0		0.152
54.0		0.147
55.0		0.142
56.0		0.137
57.0		0.132
58.0		0.127
59.0		0.123
60.0		0.119
61.0		0.114
62.0		0.110
63.0		0.107



Notes:

$K = 7.4 \times 10^{-6}$ m/s

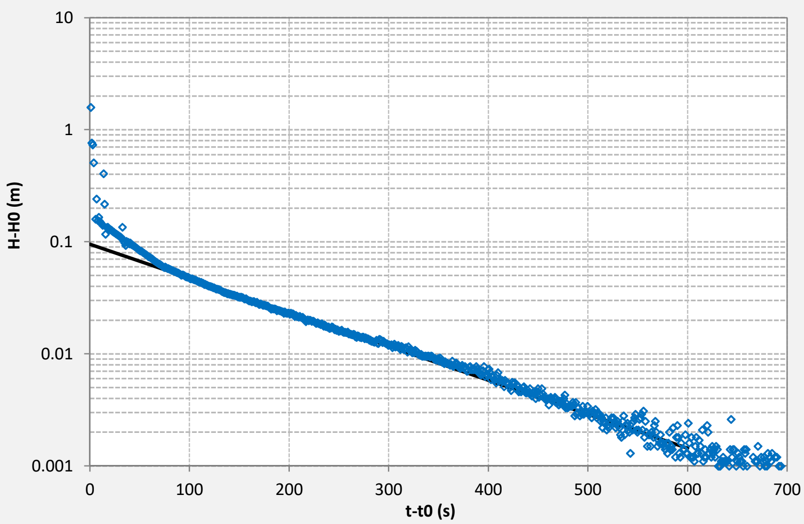
Bouwer & Rice (1976) Slug Test Analysis Sheet

PATTLE DELAMORE PARTNERS

Project:	TBP - Wastewater Irrigation Reconsenting	Job No:	AJ467202		Bore ID:	BH9	
Test date:	21/06/2018	Bore depth:	10.43	mBGL	Slugs used:	3	
Test time:	13:52	SWL:	5.11	mBGL	Slug length:	0.5	m
Performed by:	KG	Screen radius (rc):	0.025	m	Slug radius:	0.02	m
Analysed by:	KG	Borehole radius (Re):	0.055	m	Displacement vol:	0.00188	m3
Reviewed by:		Saturated screen length (Le):	6	m	Expected displ:	0.96	m
Test type:	Falling head	Aquifer sat. thickness (h):	5.33	m	Obs displacement:	1.58	m
		Piezo sat. thickness (Lw):	5.32	m	Eff. casing radius:	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	Curve fitting:			Well screened across water table:	TRUE	
Static GWL (m):	0	Y-intercept shift:	0.095	m	Filter pack porosity:	0.3	
Displaced GWL (m):	1.583	Hydraulic conductivity (K):	**2.90E-06**	m/s			
			2.51E-01	m/d	Test duration:	600	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		1.583
2.0		0.759
3.0		0.730
4.0		0.505
5.0		-0.326
6.0		0.159
7.0		0.240
8.0		0.154
9.0		0.166
10.0		0.152
11.0		0.147
12.0		0.144
13.0		0.140
14.0		0.403
15.0		0.216
16.0		0.117
17.0		0.134
18.0		0.135
19.0		0.132
20.0		0.129
21.0		0.128
22.0		0.126
23.0		0.124
24.0		0.122
25.0		0.120
26.0		0.118
27.0		0.117
28.0		0.115
29.0		0.113
30.0		0.112
31.0		0.111
32.0		0.109
33.0		0.135
34.0		0.101
35.0		0.098
36.0		0.093
37.0		0.101
38.0		0.098
39.0		0.099
40.0		0.096
41.0		0.098
42.0		0.094
43.0		0.093
44.0		0.092
45.0		0.091
46.0		0.090
47.0		0.088
48.0		0.087
49.0		0.085
50.0		0.084
51.0		0.083
52.0		0.082
53.0		0.081
54.0		0.080
55.0		0.078
56.0		0.077
57.0		0.077
58.0		0.075
59.0		0.074
60.0		0.073
61.0		0.072
62.0		0.071
63.0		0.070



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$$K = 2.9 \times 10^{-6} \ m/s$$

Bouwer & Rice (1976) Slug Test Analysis Sheet

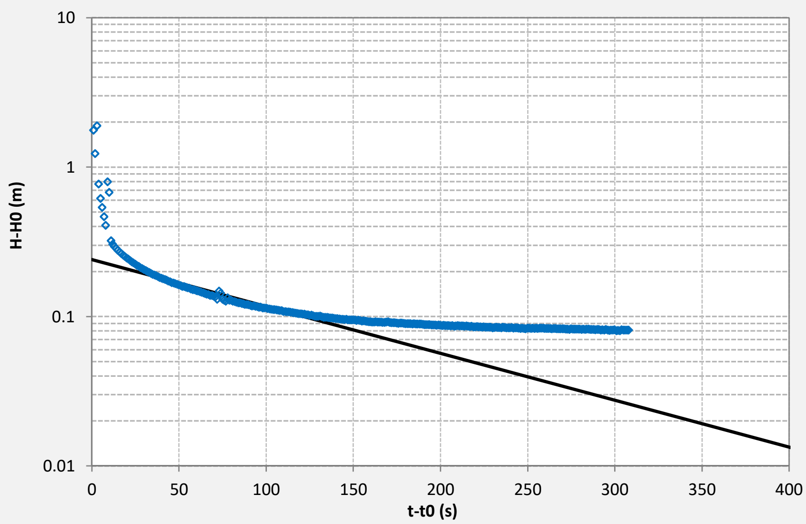
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting
Job No: AJ467202
Bore ID: **BH9**

Test date:	21/06/2018	**Bore depth:**	10.43	mBGL	**Slugs used:**	3	
Test time:	14:05	**SWL:**	5.11	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	5.33	m	**Obs displacement:**	1.89	m
		Piezo sat. thickness (Lw):	5.32	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**<u>Curve fitting:</u>**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.24	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	1.889	**Hydraulic conductivity (K):**	**3.00E-06**	m/s			
			2.59E-01	m/d	**Test duration:**	600	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		1.768
2.0		1.230
3.0		1.889
4.0		0.769
5.0		0.618
6.0		0.538
7.0		0.466
8.0		0.408
9.0		0.796
10.0		0.676
11.0		0.322
12.0		0.304
13.0		0.294
14.0		0.285
15.0		0.278
16.0		0.271
17.0		0.264
18.0		0.258
19.0		0.252
20.0		0.247
21.0		0.242
22.0		0.237
23.0		0.232
24.0		0.229
25.0		0.225
26.0		0.220
27.0		0.216
28.0		0.213
29.0		0.210
30.0		0.206
31.0		0.203
32.0		0.200
33.0		0.197
34.0		0.195
35.0		0.192
36.0		0.190
37.0		0.188
38.0		0.186
39.0		0.182
40.0		0.180
41.0		0.179
42.0		0.177
43.0		0.175
44.0		0.173
45.0		0.171
46.0		0.169
47.0		0.168
48.0		0.166
49.0		0.165
50.0		0.163
51.0		0.161
52.0		0.159
53.0		0.159
54.0		0.157
55.0		0.156
56.0		0.155
57.0		0.153
58.0		0.152
59.0		0.151
60.0		0.149
61.0		0.148
62.0		0.147
63.0		0.145



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$$K = 3 \times 10^{-6} \ m/s$$

Bouwer & Rice (1976) Slug Test Analysis Sheet

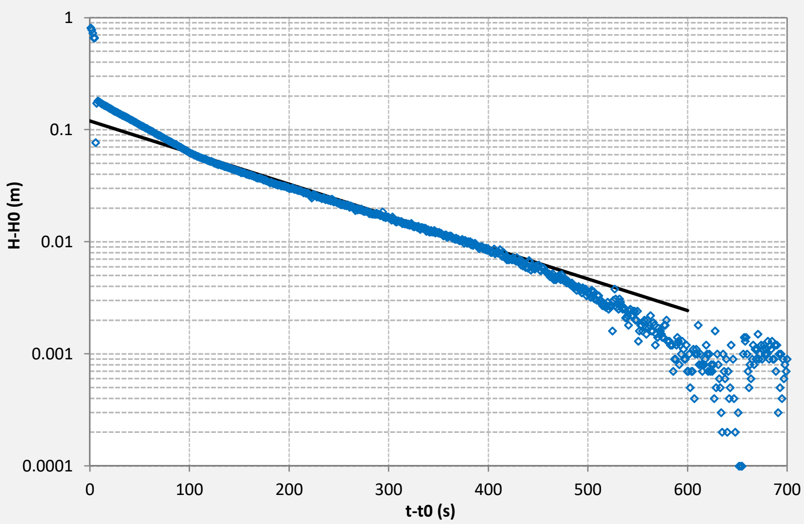
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** BH9

Test date:	21/06/2018	**Bore depth:**	10.43	mBGL	**Slugs used:**	3	
Test time:	14:10	**SWL:**	5.11	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Falling head	**Aquifer sat. thickness (h):**	5.33	m	**Obs displacement:**	0.81	m
		Piezo sat. thickness (Lw):	5.32	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.12	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.807	**Hydraulic conductivity (K):**	**2.70E-06**	m/s			
			2.33E-01	m/d	**Test duration:**	600	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.807
2.0		0.775
3.0		0.725
4.0		0.657
5.0		0.659
6.0		0.077
7.0		0.172
8.0		0.180
9.0		0.177
10.0		0.175
11.0		0.173
12.0		0.170
13.0		0.169
14.0		0.167
15.0		0.165
16.0		0.163
17.0		0.161
18.0		0.159
19.0		0.157
20.0		0.155
21.0		0.154
22.0		0.152
23.0		0.150
24.0		0.148
25.0		0.146
26.0		0.145
27.0		0.143
28.0		0.143
29.0		0.140
30.0		0.139
31.0		0.138
32.0		0.136
33.0		0.134
34.0		0.133
35.0		0.132
36.0		0.130
37.0		0.129
38.0		0.128
39.0		0.126
40.0		0.125
41.0		0.123
42.0		0.122
43.0		0.120
44.0		0.119
45.0		0.117
46.0		0.117
47.0		0.115
48.0		0.114
49.0		0.112
50.0		0.111
51.0		0.110
52.0		0.108
53.0		0.107
54.0		0.106
55.0		0.105
56.0		0.104
57.0		0.103
58.0		0.102
59.0		0.101
60.0		0.099
61.0		0.098
62.0		0.097
63.0		0.096



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$K = 2.7 \times 10^{-6}$ m/s

Bouwer & Rice (1976) Slug Test Analysis Sheet

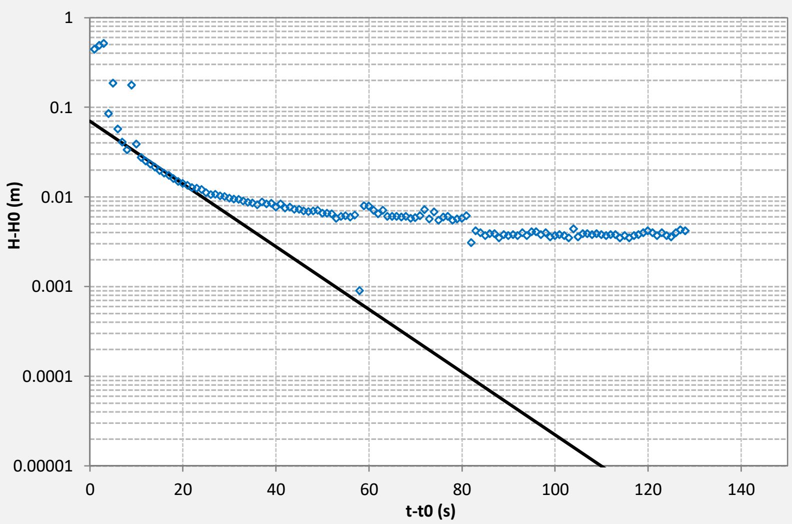
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting
Job No: AJ467202
Bore ID: **BH10**

Test date:	21/06/2018	**Bore depth:**	10.61	mBGL	**Slugs used:**	3	
Test time:	15:51	**SWL:**	5.66	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	4.96	m	**Obs displacement:**	0.51	m
		Piezo sat. thickness (Lw):	4.95	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.07	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.515	**Hydraulic conductivity (K):**	**3.30E-05**	m/s			
			2.85E+00	m/d	**Test duration:**	600	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.445
2.0		0.493
3.0		0.515
4.0		0.085
5.0		0.187
6.0		0.057
7.0		0.041
8.0		0.034
9.0		0.176
10.0		0.039
11.0		0.028
12.0		0.025
13.0		0.023
14.0		0.022
15.0		0.020
16.0		0.018
17.0		0.017
18.0		0.016
19.0		0.015
20.0		0.014
21.0		0.014
22.0		0.013
23.0		0.013
24.0		0.012
25.0		0.011
26.0		0.011
27.0		0.011
28.0		0.010
29.0		0.010
30.0		0.010
31.0		0.010
32.0		0.009
33.0		0.009
34.0		0.009
35.0		0.009
36.0		0.008
37.0		0.009
38.0		0.008
39.0		0.009
40.0		0.008
41.0		0.008
42.0		0.008
43.0		0.008
44.0		0.007
45.0		0.007
46.0		0.007
47.0		0.007
48.0		0.007
49.0		0.007
50.0		0.007
51.0		0.007
52.0		0.007
53.0		0.006
54.0		0.006
55.0		0.006
56.0		0.006
57.0		0.006
58.0		0.001
59.0		0.008
60.0		0.008
61.0		0.007
62.0		0.007
63.0		0.007



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$$K = 3.3 \times 10^{-5} \ m/s$$

Bouwer & Rice (1976) Slug Test Analysis Sheet

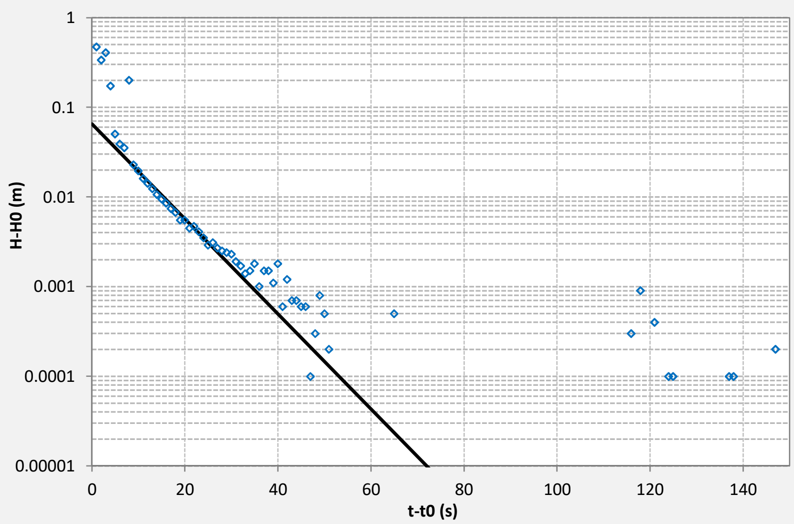
PATTLE DELAMORE PARTNERS

Project: TBP - Wastewater Irrigation Reconsenting **Job No:** AJ467202 **Bore ID:** **BH10**

Test date:	21/06/2018	**Bore depth:**	10.61	mBGL	**Slugs used:**	3	
Test time:	16:00	**SWL:**	5.66	mBGL	**Slug length:**	0.5	m
Performed by:	KG	**Screen radius (rc):**	0.025	m	**Slug radius:**	0.02	m
Analysed by:	KG	**Borehole radius (Re):**	0.055	m	**Displacement vol:**	0.00188	m3
Reviewed by:		**Saturated screen length (Le):**	6	m	**Expected displ:**	0.96	m
Test type:	Rising head	**Aquifer sat. thickness (h):**	4.96	m	**Obs displacement:**	0.47	m
		Piezo sat. thickness (Lw):	4.95	m	**Eff. casing radius:**	0.037	m
					Correct for displacement:	FALSE	
GWL measurement:	Depth to water	**Curve fitting:**			**Well screened across water table:**	TRUE	
Static GWL (m):	0	**Y-intercept shift:**	0.065	m	**Filter pack porosity:**	0.3	
Displaced GWL (m):	0.473	**Hydraulic conductivity (K):**	**5.00E-05**	m/s			
			4.32E+00	m/d	**Test duration:**	600	s

Observed data

t (s)	GWL (m)	H-H0 (m)
0.0		0.000
1.0		0.473
2.0		0.335
3.0		0.406
4.0		0.173
5.0		0.050
6.0		0.039
7.0		0.035
8.0		0.200
9.0		0.023
10.0		0.020
11.0		0.016
12.0		0.014
13.0		0.012
14.0		0.011
15.0		0.010
16.0		0.009
17.0		0.007
18.0		0.007
19.0		0.006
20.0		0.006
21.0		0.005
22.0		0.005
23.0		0.004
24.0		0.004
25.0		0.003
26.0		0.003
27.0		0.003
28.0		0.003
29.0		0.002
30.0		0.002
31.0		0.002
32.0		0.002
33.0		0.001
34.0		0.002
35.0		0.002
36.0		0.001
37.0		0.002
38.0		0.002
39.0		0.001
40.0		0.002
41.0		0.001
42.0		0.001
43.0		0.001
44.0		0.001
45.0		0.001
46.0		0.001
47.0		0.000
48.0		0.000
49.0		0.001
50.0		0.001
51.0		0.000
52.0		0.000
53.0		0.000
54.0		0.000
55.0		0.000
56.0		-0.001
57.0		-0.001
58.0		-0.001
59.0		-0.001
60.0		-0.001
61.0		0.000
62.0		-0.001
63.0		-0.001



Notes:

Well is screened across the water table. K calculation corrected for expected displacement within the filter pack (Eq. 6.10 in Butler, 1996). Curve fitting focussed on latter part of drawdown data.

$K = 5 \times 10^{-5}$ m/s

Appendix F

Overseer Modelling Report

Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	Land Treatment of Wastewater AEE Supplementary Information	**PROJECT**	Taranaki By-Products Land Treatment of Wastewater
CLIENT	**Taranaki By-Products Limited**	**PROJECT NO**	AJ467202M005
CLIENT CONTACT	Paul Drake	**PREPARED BY**	Lenka Craft and Daryl Irvine
CLIENT WORK ORDER NO/ PURCHASE ORDER		**SIGNATURE**	
		DATE	22 January 2020

Introduction

Taranaki By-Products Ltd (TBP) operates an inedible protein recovery plant on Kohiti Road near Okaiawa. Wastewater from the plant is biologically treated onsite before being either discharged onto company owned dairy farmland under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, or discharged to the Inaha Stream under Resource Consent No. 2049-4 (when soil conditions do not allow wastewater to be irrigated). Zeal Grow fertiliser (rendering plant stickwater) is also applied to various paddocks across the farm throughout the year. PDP was engaged to prepare an assessment of environmental effects (AEE) (PDP 2018) of the wastewater irrigation to assist with renewal of discharge to land consent, No. 3941-2.

As part of the consent renewal process, Aquanet Consulting Limited (Aquanet) was engaged to assess the effects of the wastewater irrigation activity on the surface water environment and concluded that within the Western Tributary, there is a change from Attribute B under the National Policy Statement for Freshwater Management 2014 (amended 2017) (NPSFM) to an Attribute C status. Aquanet identified that to maintain an Attribute B status, there would need to be a 15 % reduction in nitrogen migrating to surface water.

To assist in identifying the leaching rate of nitrogen and phosphorus from the existing wastewater irrigation and farming operation to surface water, nutrient modelling was utilised (using Overseer®) to identify the net flux of nutrient below the soil profile. The same modelling programme was then utilised to identify how a 15% decrease in nitrogen leaching could be obtained. This is based on the assumption that a 15% reduction in nitrogen leaching below the soil profile would result in a 15% reduction in nitrogen migration to the Western Tributary.

For the nutrient modelling conducted for the initial consent application (PDP 2018) wastewater and Zeal Grow loading rates per paddock, supplied by TBP, were used to calculate hydraulic, nitrogen and phosphorus loading rates, per month for each paddock within the TBP farm area. A comprehensive Overseer® (Version 6.3.0) nutrient model was created to compare nutrient balances for the season July 2015 – June 2016 and the season January 2017 – December 2017.

Historical nitrogen loading data associated with the Zeal Grow was previously based on inorganic nitrogen monitoring by TBP. This did not account for the organic nitrogen load, which can be a significant portion of the total nitrogen content of stickwater. For the initial consent application assessment (PDP 2018) an assumption that the organic nitrogen content in the Zeal Grow was similar to the inorganic nitrogen content was made. Therefore, the nitrogen loads from Zeal Grow were estimated to be double what was historically reported. This estimate was made, on the understanding that additional monitoring of the Zeal Grow would be conducted to confirm total nitrogen concentrations.

TECHNICAL MEMORANDUM

Further monitoring of the Zeal Grow, between December 2018 and April 2019, has confirmed that the total nitrogen concentration in Zeal Grow is approximately 2,600 g/m^3, four times the average inorganic nitrogen content utilised for previous loading calculations and twice that utilised in the assessment of effects (PDP 2018). The nitrogen to phosphorus ratio was found to be 36, four times the assumed ratio of 8.7.

As a result of the difference in monitored and assumed nitrogen concentration in the Zeal Grow, the Overseer nutrient model was re-run with updated nitrogen and phosphorus loading to investigate nutrient leaching rates across the farm. An updated version of Overseer model, OverseerFM (Version 6.3.2) was used for the re-run. The model was also utilised to identify opportunities for decreasing nitrogen leaching by 15%.

This technical memorandum has been prepared to clarify information around the nitrogen loading associated with the application of Zeal Grow, and the parameters, assumptions and results of the OverseerFM nutrient modelling.

Overseer Modelling Framework and Assumptions

Overseer® Nutrient Budget is an online tool utilised in agricultural applications to model nutrient outputs of farms as a result of various land uses and irrigation applications. Overseer® enables the user to enter irrigation and fertiliser application data to predict the nitrogen and phosphorus leaching rates for farming systems. The model also considers land uses such as grazing by various animals, crops, housing, riparian margins, and wetlands. Overseer® produces a comprehensive report including nutrients added to the system, nutrients removed from the system, and greenhouse gas production at a whole-farm perspective, or at a block-by-block level. The Overseer® model operates with a prediction error of approximately 25% - 30%.

The model for TBP has been set up to model each of the 47 paddocks as a separate block so that the effects of actions to specific paddocks can be identified.

Key assumptions that were utilised in developing the Overseer® models are as follows:

- Nitrogen loading to land associated with wastewater irrigation has been measured as inorganic nitrogen with 15 g/m^3 allowed for organic nitrogen content;
- Zeal Grow loading has been based on average total nitrogen concentrations from 13 samples tested over the period 31 January – 21 March 2019;
- Hydraulic loading associated with wastewater has been based on an average total nitrogen concentration of 212 g/m^3 and hydraulic loading of Zeal Grow has been based on an average total nitrogen loading of 2,598 g/m^3;
- Phosphorus loads have been based on an assumed nitrogen to phosphorus ratio in the wastewater of 7.5N:1P and an assumed nitrogen to phosphorus ratio in the Zeal Grow of 36N:1P;
- It is assumed that both wastewater and Zeal Grow have been spread evenly across allowable irrigation areas in each paddock;
- Nitrogen and phosphorus loads associated with wastewater and Zeal Grow have been applied in the model as an organic fertiliser (rather than as an irrigation function) as is recommended by the Overseer Best Practice Guideline Data Input Standards (April 2015 Version 6.2.0);
- The hydraulic load associated with wastewater irrigation and Zeal Grow spreading has been incorporated via the irrigation function, with no associated nutrient load;
- Farm operations, including stocking rates, milk solids yields, maize production and pond solids spreading have been based off discussions with the farm manager.

Paddock numbers in the TBP farm changed in 2015. Due to the model being set up on a paddock-by-paddock basis, it was difficult to compare the most recent annual periods against historical seasons because of the different paddock numbering system used in previous years. Thus, the earliest season that had a complete set of data under the new paddock numbering system was used, from July 2015 to June 2016. An earlier season may have given a better representation of historical application rates on TBP farm, however limited data in some years and the change of paddock numbers restricted the datasets which could be used. The most recent season with a full data set was selected to model the 'current' application rates. This was from January 2017 to December 2017.

Inputs

The average total nitrogen (TN) concentrations and nitrogen to phosphorus ratio are summarised in the Table 1. The values for wastewater were calculated from the annual monitoring report for each of the respective monitoring periods.

Table 1: Nitrogen and Phosphorus Concentrations

Irrigation type	Average TN concentration (g/m^3)	Nitrogen to Phosphorus ratio
Wastewater (Jul 15 – Jun 16)	213	7.5
Zeal Grow (Jul 15 – Jun 16)	2,598	36
Wastewater (Jan 17 – Dec 17)	211	7.5
Zeal Grow (Jan 17 – Dec 17)	2,598	36

In the Overseer model, Farm Scenario data is data that applies to all paddocks. This includes climate data and farming practice data. The Farm Scenario inputs used are summarised in the Table 2.

Table 2: Farm Management Inputs

Parameter	Value	Parameter	Value
Topography	Flat	Breed of cow	F x J cross
Annual rainfall (mm/yr)	1,225	Average mob weight (kg)	439
Potential evapotranspiration (mm/yr)	835	Milk solids production (kg/yr)	485,000
Total farm area (ha)	424	Peak number of cows milked	900
Paddock area (ha)	330	Hours per day on feed pad	2 hours from Jul - Sep, 0.5 hours every other month
Soil drainage	Well drained		
Soil order	Allophanic (volcanic)	Pasture	Ryegrass/white clover
Top soil (0-10 cm)	Sandy loam	Soil Olsen P (mg/L)	76
Distance to coast (km)	6	Soil QT Potassium (MAF)	10
Dairy effluent management system	Exported	Soil QT Calcium (MAF)	7

Feeding pad solids management	Exported	Soil QT Magnesium (MAF)	19
Susceptibility to pugging	Occasional	Soil QT Sodium (MAF)	11
Lime application to grazing paddocks (t/ha/yr)	1	Soil Organic Sulphur (mg/kg)	10

Among the 47 paddocks modelled, five had rotating crops during the Jul 15 – Jun 16 season and 12 had rotating crops during the Jan 17 – Dec 17 period. The four types of crop across both seasons were fodder beet, barley, oats, and maize. Each of these cropped paddocks were assumed to have had five years in pasture over the ten years prior, and the prior land use was assumed to be grazed pasture. Cultivation practices at sowing were considered to use the conventional method, and irrigation was assumed to be incorporated into the soil. Constant yield rates were used for each crop as summarised in the Table 3.

Table 3: Crop Yield Rates

Crop type	Units	Yield
Fodder beet	T/ha dry matter	8.5
Barley (spring)	T/ha dry matter	8
Oats	T/ha dry matter	4
Maize (medium length)	T/ha dry matter	18.0

The remaining paddocks were pastoral paddocks meaning they were grazed by dairy stock throughout the season and had both wastewater and Zeal Grow fertiliser applied. While some data remained the same between each paddock (climate data, soil data, farming practice data, etc.), irrigation application data, fertiliser application data, and paddock areas are specific to individual paddocks.

Updated Results

The following results supersede those reported for the Overseer modelling data in the AEE (PDP 2018).

Figures 4a and 4b summarise the monthly average nitrogen loading per hectare as a result of wastewater irrigation and Zeal Grow application for the 2015/16 season and 2017 season respectively. Figures 5a and 5b summarise the monthly average phosphorus loading per hectare as a result of wastewater irrigation and Zeal Grow application of the 2015/16 season and 2017 season respectively.

For the 2015/16 season the monthly Zeal Grow application accounted for 12% of the hydraulic loading and 63% of the nitrogen loading. The phosphorus loading across the farm reached a maximum of 1.9 kg/ha in the months February and May, with an overall loading rate across the irrigated area of 17.3 kg TP/ha/yr.

For the 2017 season the monthly Zeal Grow application only accounted for 6% of the hydraulic loading but accounted for 43% of the nitrogen loading. The phosphorus loading across the farm reached a maximum of 1.6 kg/ha in the month of January, with an overall loading rate across the irrigated area of 12.5 kg TP/ha/yr.

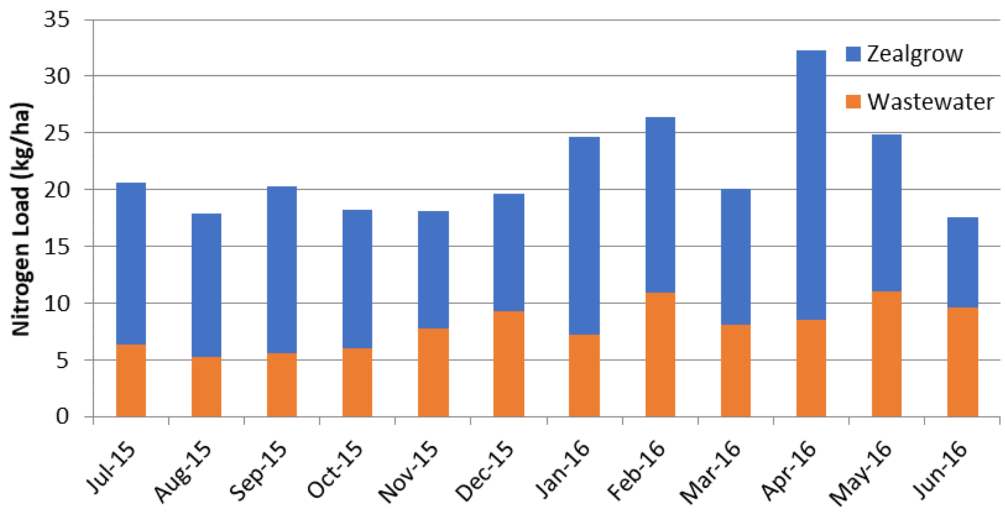


Figure 4a: Average Monthly Nitrogen Load per Hectare for the period July 2015 – June 2016.

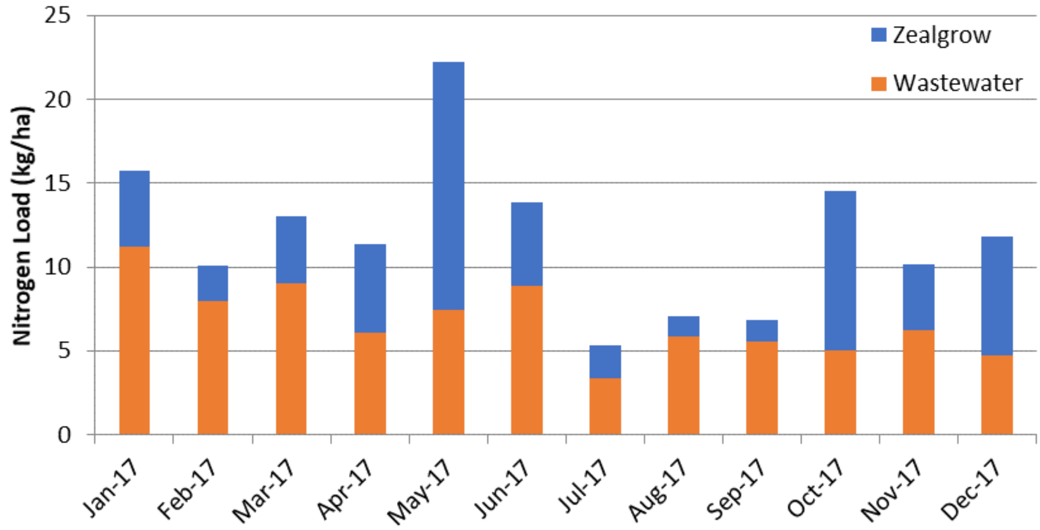


Figure 4b: Average Monthly Nitrogen Loading per Hectare for 2017

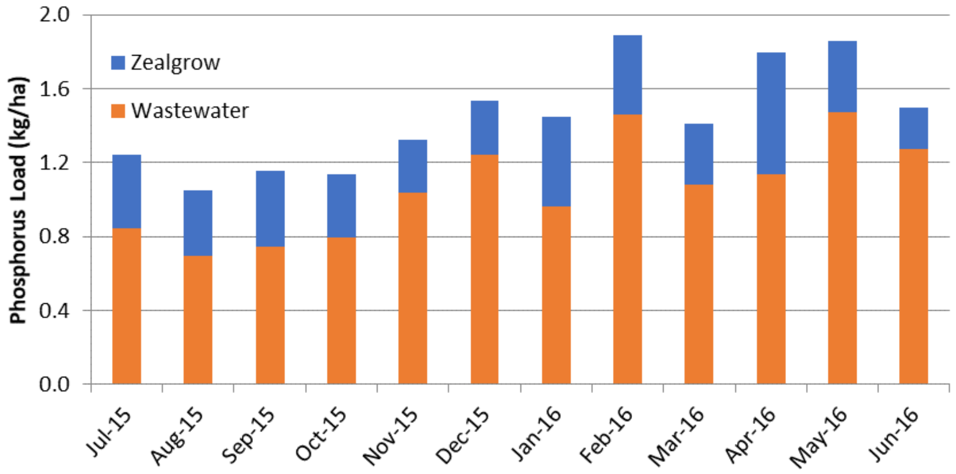


Figure 5a: Average Monthly Phosphorus Loading per Hectare for the period July 2015 – June 2016.

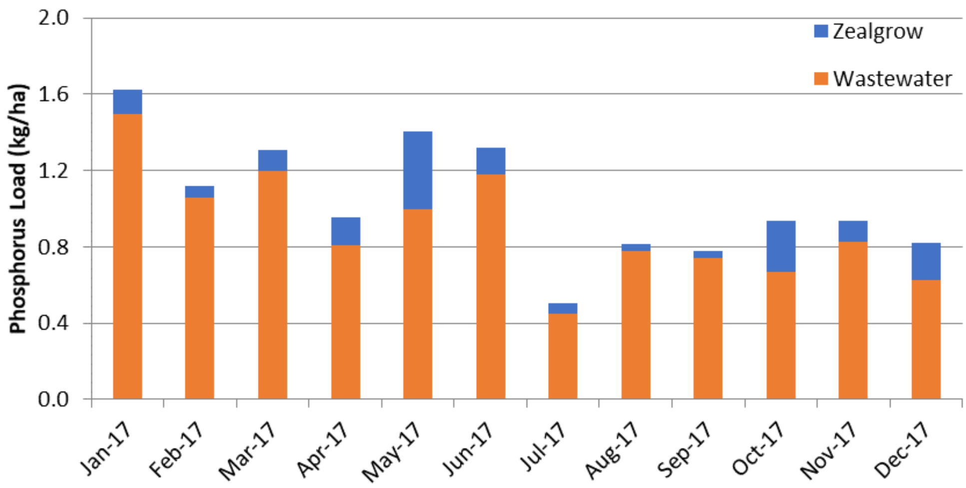


Figure 5b: Average Monthly Phosphorus Loading per Hectare, 2017

Table 4 summarises the average annual nitrogen loading and leaching rates for the two seasons across the irrigated areas.

Table 4: Average nitrogen loading and modelled nitrogen leaching rates across the irrigated areas.

	Jul 15 – Jun 16	Jan 17 – Dec 17
Nitrogen Applied (kg/ha/yr)	251	167
Nitrogen Leaching (kg/ha/yr)	68	57

Compared with the nutrient modelling conducted for the original consent application (PDP 2018), the increased nitrogen load utilised in the model has resulted in a 27% increase in the modelled average nitrogen leaching rate for the 2015/16 annual period and a 15% increase in the modelled average nitrogen leaching rate for the 2017 annual period. Due to elevated nitrogen concentration associated with the Zeal Grow, nitrogen loads have been elevated on individual paddocks, with some paddocks receiving in excess of 800 kg TN/ha/yr and monthly application rates in excess of 290 kg TN/ha.

Previous modelling indicated little difference between the two seasons, however, the updated models (including the additional Zeal Grow organic nitrogen content) indicate a 36% decrease in average nitrogen loading and 16% decrease in average nitrogen leaching from the 2015/16 to 2017.

Based on nitrogen loading and potential reduction in Zeal Grow loads going forwards (as a result of the installation of the VSEP system on the TBE plan) 2015/16 is seen more as a historical loading rate and the 2017 annual period, more indicative of what the plant can maintain going forward. Due to the hydraulic residence time in ground water, the effects on the Western Tributary monitored in 2018 are seen as more indicative of historic loading (pre 2015/16) rather than 2017 loading rates. If the 2017 loads can be maintained, a 15% reduction in nitrogen leaching can potentially be achieved.

TECHNICAL MEMORANDUM

Redistribution Results

Wastewater irrigation and Zeal Grow spreading data indicates that nitrogen distribution across the farm has not been evenly spread, with localised intensification of nitrogen loading rates on individual paddocks. Nutrient modelling indicates greater leaching of nitrogen in those paddocks (refer to Appendix A). The model was run with loads for the 2015/16 season redistributed more evenly across the individual paddocks to investigate the potential to reduce the nitrogen leaching by 15% by applying nitrogen loads more evenly but generally maintaining loads within the existing consented load limits.

When 2015/16 nitrogen loads were redistributed, to limits of 300 kg TN/ha/yr and 50 kg TN/ha/yr, the modelled nitrogen leaching was 50 kg/ha/yr. This would potentially result in a 9% reduction in nitrogen leaching rates from the 2015/16 rate but not the 15% reduction required to achieve improvement in the Western Tributary. Therefore, additional load reduction is required from the existing consent limits if a 15% reduction in nitrogen leaching is to be achieved.

To assess what nitrogen limits would be appropriate for ongoing wastewater and Zeal Grow application, the over 2015/16 redistributed loads were decreased progressively until a 15% reduction was achieved. This required an overall 20% reduction in Zeal Grow nitrogen loads, from what was applied in 2015/16 (refer to Appendix B). This resulted in an average annual farm wide nitrogen loading rate of 226 kg N/ha/yr and a maximum paddock loading of 296 kg N/ha/yr.

Based on the results of the Overseer nutrient modelling and rounding down the nearest 50 kg N/ha, appropriate wastewater and fertiliser nitrogen loading limits to achieve a 15% reduction in nitrogen leaching from recent years, have been assessed as a farm wide average of <200 kg TN/ha/yr or a maximum nitrogen load of 250 kg/ha/yr, with a maximum of 50 kg TN/ha applied in any given month. These limits are based on a pastoral grazed system.

These limits represent a 20% reduction in the amount of Zeal Grow applied to the farm during the 2015/16 season. In the 2017 season the loading rates generally comply with the maximum nitrogen load of 250 kg/ha/yr with seven paddocks exceeding, and only three of those above 300 kg/ha/yr. The irrigated paddock wide average of 167 kg TN/ha/yr applied and modelled nitrogen leaching rate of 57 kg/ha/yr meets the set limits. Therefore, with attention to load distribution. current application rates can be applied to the farm while achieving a 15% reduction in nitrogen leaching from previous years.

Summary

Further monitoring of Zeal Grow indicates that the nitrogen concentration utilised in previous modelling underestimated the nitrogen load associated with Zeal Grow and that the concentration of Zeal grow is twice the assumed value. Therefore Overseer modelling was re-run to incorporate the additional load in 2015/16 and 2017 that would have been associated with Zeal Grow.

Based on updated Zeal Grow concentration data, nutrient modelling indicates a 27% and 15% increase in the nitrogen leaching reported results (PDP 2018) for the seasons 2015/16 and 2017 respectively. The localised intensification of nitrogen loading rates to individual paddocks was exacerbated with some paddocks receiving in excess of 800 kg TN/ha/yr. There is a 36% decrease in nitrogen loading from 2015/16 to 2017 and a 15% decrease in nitrogen leaching.

To achieve a 15% reduction in nitrogen leaching from recent years, the nitrogen loading rate to land associated with wastewater irrigation, fertiliser loading and other nitrogen based soil amendments needs to decrease. Based on adjusting the 2015/16 loading data, applying the nitrogen more evenly and decreasing the Zeal Grow nitrogen load by 20%, a 15% decrease in nitrogen leaching can be achieved. It is therefore recommended that nitrogen loading going forward does not exceed a farm wide average of 200 kg TN/ha/yr or a maximum nitrogen load of 250 kg/ha/yr, with a maximum of 50 kg TN/ha applied in any given month. This is recommended for a for a pastoral grazed system. Based on the 2017 annual period, these proposed limits can be maintained.

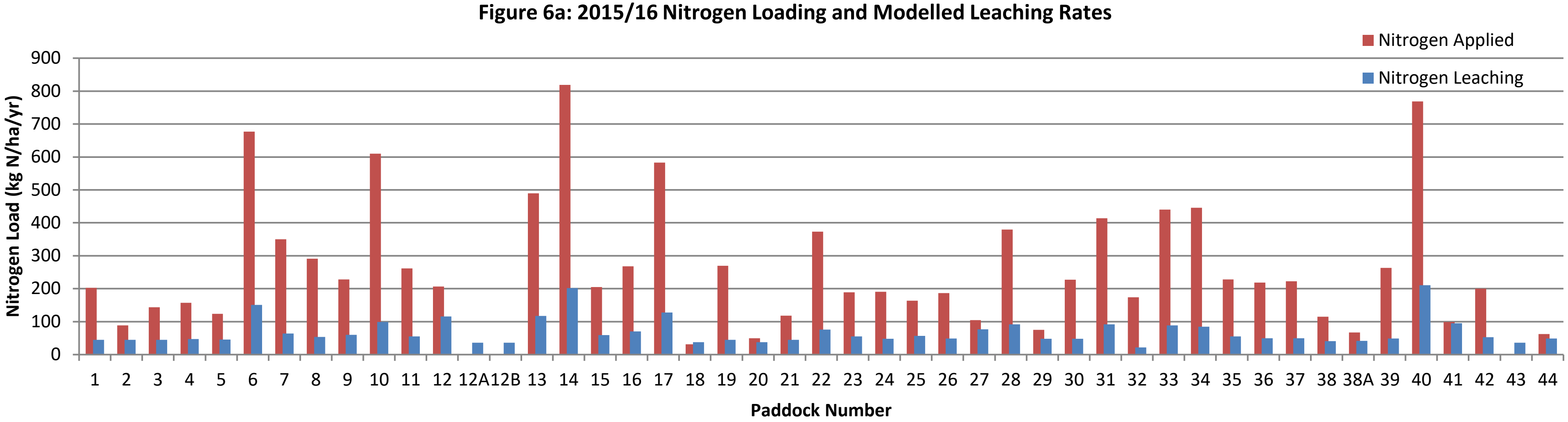
TECHNICAL MEMORANDUM

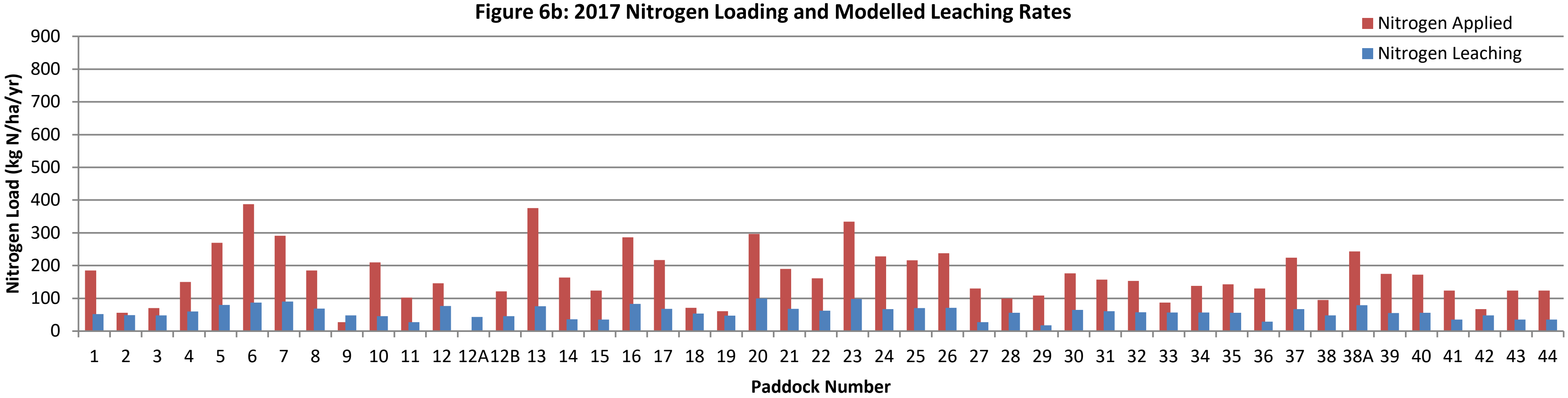
Reference
Pattle Delamore Partners Ltd, 2018. *Land Treatment of Wastewater – Technical Assessment of Environmental Effects*

This memorandum has been prepared by Pattle Delamore Partners (PDP) on the specific instructions of Taranaki By-products Limited, for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

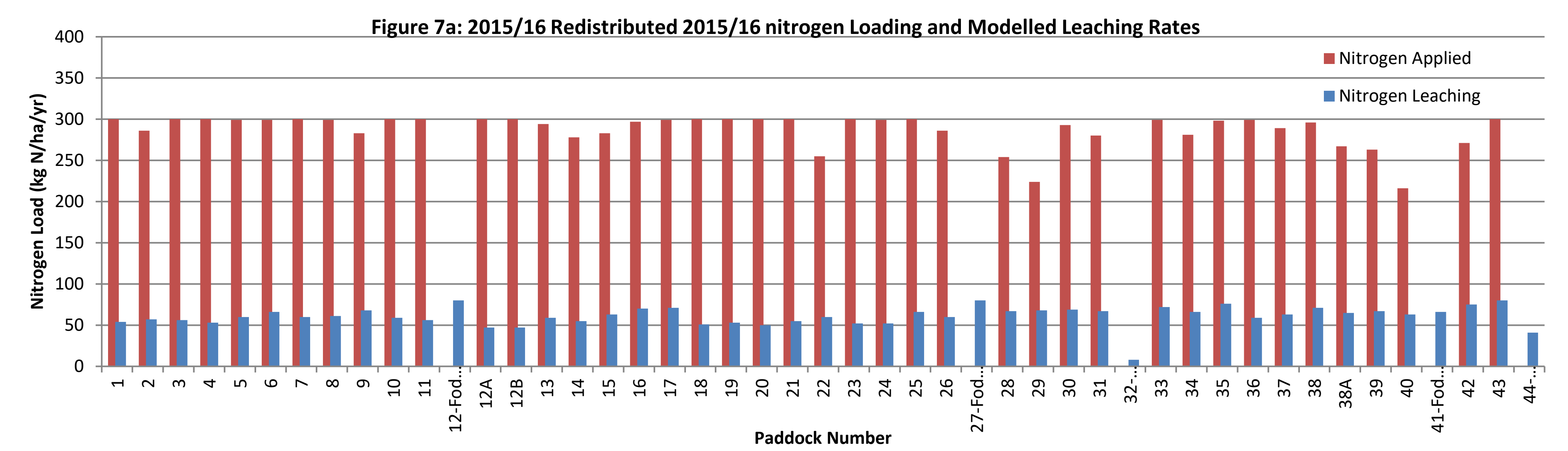
This memorandum has been prepared by PDP on the basis of information provided by Taranaki Byproducts Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

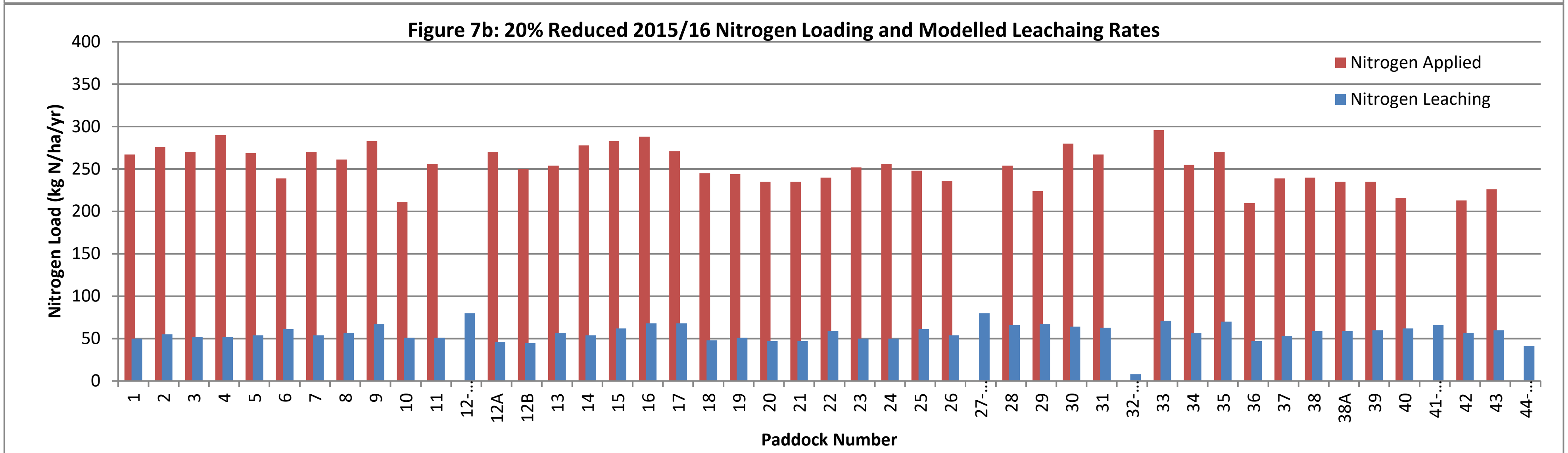
APPENDIX A: HISTORICAL ANNUAL NITROGEN LOADS





APPENDIX B: AMMENDED NITROGEN LOADS





Appendix G

Burial Pit Assessment

Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	Ammonia leaching rate to groundwater from offal pits	**PROJECT**	Taranaki By-Products Burial Pits
CLIENT	**Taranaki By-Products**	**PROJECT NO**	AJ467202
CLIENT CONTACT	Paul Drake	**PREPARED BY**	Felix Morgenstern and Katy Grant
CLIENT WORK ORDER NO/ PURCHASE ORDER		**REVIEWED BY**	Daryl Irvine
		DATE	14 August 2020

Introduction

Taranaki-By Products Ltd (TBP) owns and operates a service rendering plant near Okaiawa, Taranaki. TBP has an existing resource consent (5495-1) issued by Taranaki Regional Council (TRC), to bury offal in an area of land adjacent to the rendering plant at a maximum rate of 200 tonne/day. The site has historically buried offal during emergency situations, such as plant breakdown, or when offal is unable to be processed due to the nature of the offal received. The burial pit system has also been utilised for disposal of collected stormwater sediments and spilled material. The resource consent for burial of offal was issued on 30 March 2000 and expired on 1 June 2019, and TBP is applying for a replacement consent to enable continued operation of the offal burial practice when material cannot be processed.

Groundwater underlying the existing burial pit location is monitored utilising five operational monitoring bores, consisting of one background bore and four down gradient monitoring bores. Two of the down gradient bores indicate elevated levels of ammoniacal nitrogen, with up to approximately 200 g NH_4-N/m^3 in recent years. Despite this, monitoring of the Inaha Stream indicates that there is no identified increase in ammoniacal nitrogen in the section of stream potentially influence by the groundwater contribution from the burial pit area (Aquanet 2018). This indicates that, despite the elevated groundwater concentrations, the historical rate of tipping has not resulted in an adverse effect on the Inaha Stream.

Records of tipping rates to the burial pits are limited, with the volume records for tipping, held by TRC, indicating that more offal has been buried at the site than records may indicate. Although the existing tipping rate has not resulted in an identified effect on the stream, the groundwater ammoniacal nitrogen concentrations are elevated. It is therefore important that the historic rate of tipping is identified, and the current potential effects on the receiving environment established, so that a future tipping rate can be confirmed which limits future potential effects on the surface water receiving environment to those currently observed. The groundwater in this area is not utilised for water supply, so the Inaha Stream is considered to be the key receptor.

This technical memorandum has been prepared to outline the estimated historic tipping rate and subsequent nitrogen migration to groundwater and surface water and to confirm a recommended tipping rate going forward.

Nitrogen Monitoring and Flux Assessment

Monitoring of groundwater is conducted in 4 monitoring bores (BP4, 5, 7 and 10), down gradient of the burial pits and 1 upgradient, background bore (BP1). Drawing 105 (Appendix A) details the monitoring bore locations.

Monitoring is undertaken by TRC, with results for ammoniacal nitrogen for the past 10 years detailed in Figure 1. Ammoniacal nitrogen is the main species of nitrogen migrating from the burial pits as there is no aerobic zone below the burial pits to oxidise the nitrogen before it migrates to groundwater.

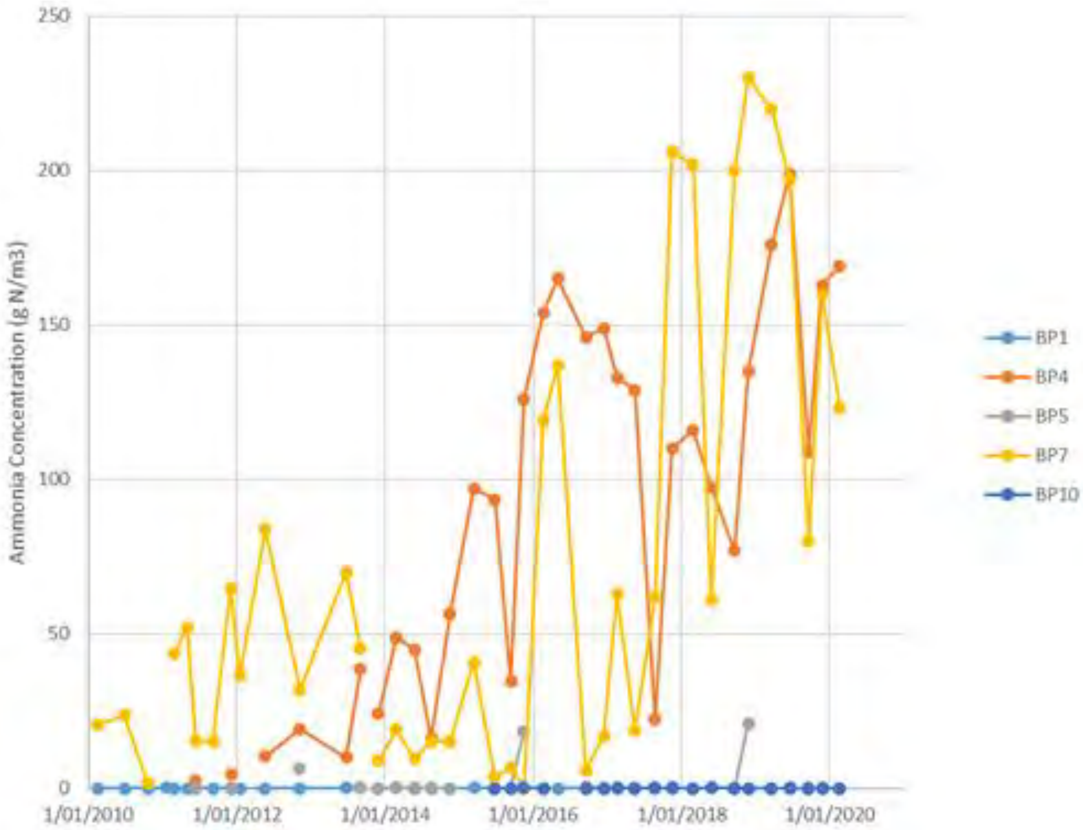


Figure 1: Ammoniacal Nitrogen Groundwater Monitoring Results

BP4 and BP7 indicate influence from the burial pits with BP5 and BP10 indicating little influence. This suggests that the nitrogen plumes are relatively narrow and are likely to be concentrated in the more permeable layers of the ash deposits present in this area. Both BP4 and BP7 have increased in nitrogen concentrations in the past five years, with BP7 showing signs of earlier tipping. Based on the rate of increase in groundwater ammoniacal nitrogen concentrations in Bore BP4 and 7 it is unclear if the maximum concentration has yet been reached.

Based on a basic estimation of groundwater velocity and travel time, ammoniacal nitrogen would be expected to start discharging into the stream approximately 116 days after it is picked up in BP4. There would likely be a larger lag time for BP7, given that it is further from the stream. This estimate is based on an estimated linear velocity of 185 m/yr, based on local gradients and the other regional data. The estimated ground water velocity for the whole site is 45 m/yr, however, given the incised nature of the stream at this location and subsequently steeper groundwater gradient, groundwater velocities are expected to be more in keeping with 185 m/yr.

An assessment of the whole potential plume of ammoniacal nitrogen migration from the offal pit location to the stream has been undertaken (refer to Appendix A). The whole area has been used as it is not possible to define the exact plume extents from the data available. Current ammoniacal nitrogen data from each bore was used along with the localised hydraulic gradient to approximate the overall flux rate of ammoniacal nitrogen from the burial pits to the Inaha Stream. This assessment is likely to be conservative as it utilises the elevated concentrations of Bores BP4 and BP7 to represent wider areas. In reality, the plumes are likely to be smaller and more focussed, located predominantly in more permeable horizons, and of more variable concentration. The assessment suggests a conservative range of 5,000 – 7,000 kg N/year is leaving the burial pit area.

Recorded and Estimated Tipping Rates

The burial pit system is operated by excavating a pit, approximately 5 m wide by 10 to 15 m long, and 4 m deep. Offal is tipped into the pit as required and the offal is temporarily covered, awaiting further offal, until the pit is full. The pit is then covered with approximately 2 m of fill and reinstated to pasture. The type of material that has been historically disposed of includes offal, dead stock and feathers from the plant that cannot be processed, screenings and settled material from stormwater collection sumps.

Tipping volumes and the nature of the material buried are provided to TRC by TBP at the time of tipping. This includes details of the type of material tipped and the volume of material tipped. TRC has maintained a record, provided by TBP, of the tipping volumes. TRC has also regularly inspected the operation. Appendix B provides a summary of the recorded tipping rates, based on advised volumes and site inspections.

The data of recorded tipping volumes is not extensive, and records from council visits indicate that while tipping events may have been recorded, tipping volumes were not always recorded.

Historic Google Earth imagery from 2001 to 2019 was analysed for indications of the locations and size of potential burial pits. 40 potential pits were outlined based on an image taken on 31 August 2019, indicated by pit consolidation (refer to Appendix A). The combined area of the pits was measured to be approximately 4,950 m^2. The pits are assumed to have a 3m offal depth, based on discussions with the plant manager (pers. comm. P Drake 6 May 2020). On this basis, a combined offal volume of 14,800 m^3 is estimated to have been tipped in the burial pit location since tipping began in 2000. This would equate to an average annual tipping rate of approximately 740 m^3/year, or 740 tonne per year, assuming an approximate specific gravity of 1.0. It is acknowledged that this is a very rough estimate and needs to be confirmed with additional observations such as groundwater nitrogen fluxes.

Nitrogen Leaching Model

To assist with approximating what average tipping rate has occurred historically, a nitrogen leaching mass balance model was utilised to compare estimated tipping rates with nitrogen levels observed in the groundwater.

Literature suggests that offal consists of approximately 1.8% nitrogen (w/w) and mineralises within the first few months of tipping (Lee *et al* 2015) and that approximately 18% of nitrogen in the tipped offal is retained as biomass in the offal pit (Speece 1983). This indicates that for every tonne of raw offal tipped, 12.5 kg of nitrogen will leach from the burial pit. Groundwater depth monitoring indicates that the burial pits will be predominantly above the groundwater level, therefore leaching rates will be driven predominantly by rainfall flushing and not flushing by groundwater flow. Based on an estimated rainfall infiltration rate of 447 mm (allowing for evapotranspiration) it can be expected that ammoniacal nitrogen leaching per tonne of offal tipped would have a profile similar to that outlined in Figure 2.

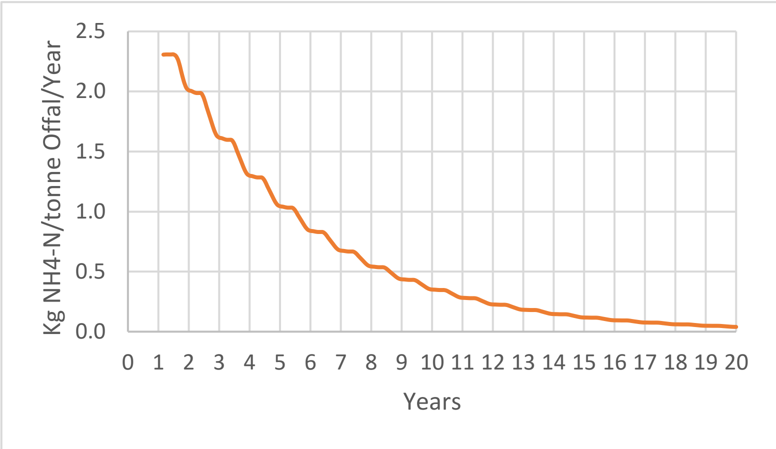


Figure 2: Nitrogen leaching Model based on Soil Drainage Flushing

On the basis of an estimated groundwater nitrogen flux of between 5,000 kg N/yr and 7,000 kg N/yr (assessed above), over the longer term of 20 years it is estimated that the average tipping rate has been in the order of 406 tonnes/yr to 568 tonnes/yr. Based on an ongoing average annual tipping rate, Figure 3 demonstrates the rate of progressive increase in nitrogen leaching to meet the existing estimated nitrogen flux rates in ground water. Based on the estimated groundwater flux rate of 185 m/yr and an approximate distance to the Inaha Stream of between 50m and 250m, there may be a further delay of 3 months to 15 months before nitrogen migrates to surface water (assuming no attenuation).

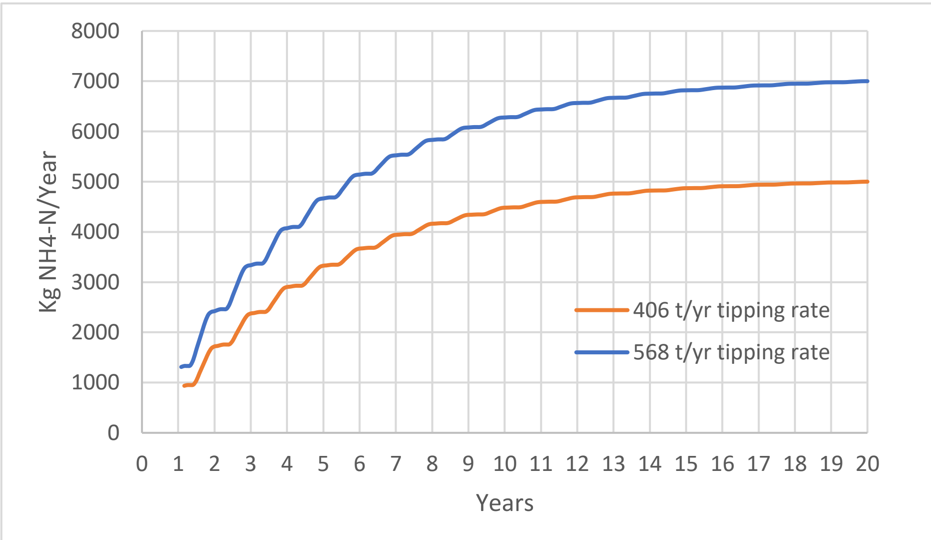


Figure 3: Projected nitrogen leaching rate to ground water

As can be seen, the cumulative effect of ammoniacal nitrogen leaching from the offal as a result of repeated burial events is an initial increase in nitrogen leaching volume until an equilibrium is reached, where the amount of nitrogen leaving the offal is matched by the amount of nitrogen being added by fresh offal. If tipping continues at a similar annual rate, the nitrogen flux is expected to continue at similar rate to that outlined in Figure 3.

TECHNICAL MEMORANDUM

Assessment of Potential Effects on Surface Water (based on estimated flux rates)

The assessed flux rates of 5,000 kg NH_4-N/yr to 7,000 g NH_4-N/yr, are equivalent to an average flux rate into the Inaha Stream of 0.16 g NH_4-N/s to 0.22 g NH_4-N/s. Assuming a low flow of 100 L/s in the Inaha Stream year round, no loss of ammoniacal nitrogen through nitrification or other means, and all ammoniacal nitrogen discharging to the stream, concentrations of ammoniacal nitrogen in the Inaha Stream would potentially increase by 1.6g NH_4-N/m^3 to 2.2 g NH_4-N/m^3. If a median flow of 300 L/s is assumed, which is reasonable from the limited flow data available, then concentrations would potentially increase by 0.53 g NH_4-N/m^3 to 0.73 g NH_4-N/m^3. At these rates of increase and the length of time since tipping began, it would be expected that surface water monitoring would be identifying the increase in ammonical nitrogen in surface water at low to medium flow conditions.

Given that surface water monitoring through the stretch of stream of potential influence has not identified an increase in ammoniacal nitrogen indicates that there may be attenuation functions occurring in the groundwater system or within the stream hyporheic zone. It may also be that the estimated flux rate of nitrogen is conservatively large, however, tipping rate estimates based on aerial photography and nitrogen leaching modelling support the estimated nitrogen flux rates. This indicates that attenuation functions are the more likely cause, however, to avoid potential increases in ammoniacal nitrogen migrating to the stream, the tipping rates should not be increased beyond the estimated historical rates of between 406 tonnes/yr and 568 tonnes/yr (an average of approximately 487 tonnes per annum). Given the modelled delay of nitrogen migration from the burial pits, the tipping rate limit could be averaged over 5 years.

Conclusions and Recommendations

Monitoring of the groundwater downstream of the burial pit area has indicated elevated concentrations of ammoniacal nitrogen in the groundwater, however, no observable increase in ammoniacal nitrogen has been detected in the surface water of the Inaha Stream. The observed mass flux of nitrogen through the groundwater downstream of the burial pit area is estimated to be between 5,000 – 7,000 kg NH_4-N /year. Based on aerial photography and modelled rates of nitrogen leaching, the historic tipping rate has been estimated to have been on average between 406 – 568 tonnes of offal per year over the past 20 years.

The estimated flux rate of nitrogen suggests that an increase in ammoniacal nitrogen in the Inaha Stream as a result of the burial pits should have been identified. As it has not been identified, it is concluded that attenuation functions may be limiting the migration of ammoniacal nitrogen to the stream.

Due to the potential uncertainty associated with the capacity of the attenuation functions, it is recommended that tipping is limited to the estimated average historic tipping rate of 487 tonnes offal/year (with a range of 450 to 500 tonnes per year). At this continued tipping rate, it is expected that the nitrogen flux will remain at similar rates to what is currently experienced (5,000 to 7,000 kg NH_4-N /yr). It is acknowledged that emergency events may require more than this amount as a single event and therefore, it is recommended that this limit is applied as a rolling five-year average. The slow rate of nitrogen release from the burial pits (as indicated by modelling) would help even out fluctuations in annual tipping rates.

References

Aquanet 2018, *Taranaki By-Products Okaiawa Rendering Plant: Assessment of current effects on freshwater quality and ecology.* Report Prepared for Taranaki By-Products Limited, Aquanet Consulting Limited.

Lee, J., Koo, T., Han, G., Shin, S. G., & Hwang, S. (2015). *Anaerobic digestion of cattle offal: protein and lipid-rich substrate degradation and population dynamics of acidogens and methanogens*. Bioprocess and biosystems engineering, 38(12), 2349-2360.

TECHNICAL MEMORANDUM

Speece, R. E. (1983). *Anaerobic biotechnology for industrial wastewater treatment. Environmental science & technology*, 17(9), 416A-427A.

APPENDIX A: DISPOSAL LAYOUT PLAN

APPENDIX B: SUMMARY OF TIPPING RECORDS

Table 1: Burial Pit Tipping Records

Date	Material	Tonnage
11-Jan-15	DAF Float Sludge	8
15-Jan-14	Various	10
3-Jun-10	Offal	3
26-Apr-10	Feathers	22
27-Oct-09	Feathers	50
2-Sep-09	offal	2
27-Aug-09	Cooked product	2
1-Jul-09	Paunch Grass	6
3-Apr-09	Offal	0.5
16-Dec-08	Offal	10
4-Dec-08	Offal	2
9-Mar-08	Offal	Undefined
3-Mar-08	Offal	Undefined
18-Feb-08	DAF Float Sludge	Undefined
15-May-07	Offal	Undefined
4-May-07	Off spec product	Undefined
3-Apr-07	Offal	Undefined
19-Dec-06	Deadstock, hides, sump cleanings	Undefined
1-Dec-06	meat product	Undefined
24-May-06	TBE Spill material	Undefined
30-Mar-06	Liquid waste	Undefined
16-Jan-06	Chicken Feathers	Undefined
13-Jan-06	Chicken feathers	Undefined
13-Dec-05	Undefined	Undefined
27-Jul-05	Screening offal and meat	Undefined
9-Jul-05	Undefined	28
6-Jul-05	Undefined	45
6-May-05	Offspec product	10
23-Mar-05	Sump cleanings	Undefined
2-Mar-05	Washings	Minor
14-Feb-05	Undefined	Undefined
20-Jan-05	Pork	Undefined

Table 1: Burial Pit Tipping Records

Date	Material	Tonnage
19-Nov-04	Aged Meal	Undefined
9-Nov-04	Aged Meal	Undefined
27-Oct-04	Pork	20
15-Jul-04	Meal	Minor
21-May-04	meal	90
11-Mar-04	undefined	Undefined
8-Jan-04	Congealed Blood	2
2-Dec-03	Fat	Large Volume
11-Sep-03	Meal	Undefined
29-Jul-03	meal	Undefined
1-Jul-03	Fat	108
26-Jul-03	Feathers	Undefined
24-Jun-03	Fat	Undefined
2-Apr-03	Feathers	Undefined
4-Feb-03	Undefined	90
26-Jan-03	Off spec product	Undefined
15-Jan-03	Offal	40
13-Dec-02	Chickens	8
27-Aug-02	feathers	Undefined
29-Jul-02	Fat	Undefined
17-Jul-02	Dead stock	15
5-Oct-01	Undefined	10
4-May-01	Dusky drier cleanings (meal)	Undefined
17-Nov-00	Fat	Undefined
27-Sep-00	Dead stock	Undefined
1-Sep-00	Undefined and Feathers	10
18-Apr-00	Pea Fat	Undefined
25-Feb-00	Feathers	Undefined
Total recorded		591.5

Appendix 2

Application forms

Appendix 3

Aquanet Consulting Ltd Report – Taranaki By-Products Okaiawa Rendering Plant: Assessment of current effects on freshwater quality and ecology, 2018

Taranaki By-Products Okaiawa Rendering Plant: Assessment of current effects on freshwater quality and ecology

29th November 2018

Report Prepared for Taranaki By-Products Ltd

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Taranaki By-Products Okaiawa Rendering Plant: Assessment of current effects on freshwater quality and ecology

29th November 2018

<u>Report prepared for Taranaki By-Products Ltd by:</u>

Dr Michael Greer

Fiona Death

Aquanet Consulting Limited

Quality Assurance			
Role	Responsibility	Date	Signature
Prepared by	Michael Greer Fiona Death	29/11/2018	
Approved for issue by:	Olivier Ausseil	29/11/2018	
Status	Final		

EXECUTIVE SUMMARY

Potential environmental effects.

Taranaki By-Products Limited (TBP) own and operate a rendering plant on Kohiti Road, near Okaiawa, South Taranaki. The Okaiawa rendering plant (ORP) takes water from the Inaha Stream for non-consumptive uses, and discharges stormwater, treated wastewater, and cooling/backwash water back to the stream. Treated wastewater from the plant is also discharged to land, and contaminants from this discharge enter the Inaha Stream and one if its tributaries, the Western Tributary, via groundwater. All of these activities have the potential to adversely affect the water quality and/or ecology of the Inaha Stream and its Western Tributary.

Assessment undertaken

The ORP operates under a range of consents, six of which are due to expire on 1 June 2019. The aim of this report is to provide an assessment of the in-stream water quality and ecology effects of:

- The non-consumptive abstraction of water from the Inaha stream for use as cooling/backwash water in the ORP;
- The point source discharge of stormwater, cooling/backwash water and treated wastewater from the ORP to the Inaha Stream; and
- The discharge of treated wastewater from the ORP to land.

This assessment of effects is primarily based on monitoring data collected by Taranaki Regional Council for the period January 1995 to December 2017.

The analysis of water quality and ecological data presented in this report includes an assessment against the provisions of:

- The current resource consent conditions;
- The Regional Freshwater Plan for Taranaki Appendix 5 water quality guidelines; and
- The National Policy Statement for Freshwater Management 2014 (NPS-FM) relevant numeric attribute states, including the 2017 amendments.

Results of assessment

From the monitoring data collected within, upstream and downstream of the discharges between July 1995 to December 2017 the following conclusions were made about the effects of point source wastewater, cooling/backwash water and stormwater discharges from the ORP on water quality and freshwater ecology in the Inaha Stream:

- The available data indicates that that concentrations of ammoniacal nitrogen, nitrate-nitrite nitrogen, soluble inorganic nitrogen, dissolved reactive phosphorus and soluble carbonaceous 5-day biochemical oxygen demand in the Inaha Stream were far greater downstream of the ORP than upstream.
- The in-stream ammoniacal nitrogen, pH, temperature, dissolved oxygen saturation and soluble carbonaceous 5-day biochemical oxygen demand limits set out in the conditions of the existing resource consents were met.

- The Regional Freshwater Plan water quality guidelines were complied with as follows:
  - Water temperature and dissolved oxygen saturation generally met the guidelines upstream and downstream of the ORP;
  - The guideline for soluble carbonaceous 5-day biochemical oxygen demand was met in the Inaha Stream upstream and downstream of the ORP; and
  - Dissolved reactive phosphorus frequently did not comply with guidelines upstream and downstream of the ORP. However, the frequency and magnitude of non-compliance was greater at the downstream site.
- The macroinvertebrate communities in the Inaha Stream upstream and downstream the ORP are indicative of fair water quality, and the available ecological monitoring data do not indicate that point source discharges from the ORP are having significant adverse effects.
- The NPS-FM 2014 assigns sites as follows:
  - Ammoniacal nitrogen concentrations were assigned to attribute state B at the upstream monitoring site and attribute state C at the downstream site; and
  - Nitrate-nitrate nitrogen concentrations were assigned to attribute state C at the upstream and downstream monitoring sites.
- The major driver of increased ammoniacal nitrogen and 5-day biochemical oxygen demand downstream of the ORP appears to be the continuous discharge of cooling/backwash water and stormwater, while nitrate-nitrite nitrogen, soluble inorganic nitrogen and dissolved reactive phosphorus are equally affected by wastewater discharges and cooling/backwash water and stormwater discharges.

From the monitoring data collected upstream and downstream of where wastewater from the ORP is discharged to land, the following conclusions were made about the effects of land-based wastewater discharges on water quality and freshwater ecology in the Inaha Stream and the Western Tributary:

- The discharge of treated wastewater from the ORP to land does not have a significant effect on ammoniacal nitrogen concentrations in the Inaha Stream or the Western Tributary.
- The discharge of treated wastewater to land has a significant effect on nitrate-nitrite nitrogen concentrations in the Inaha Stream, and is responsible for up to 61% of the 1.42 g/m^3 average increase in concentration within the irrigation area[1].
- The discharge of treated wastewater to land also has a significant effect on nitrate-nitrite nitrogen concentrations in the Western Tributary. On average, nitrate-nitrite nitrogen concentrations increase by 1.11 g/m^3 (a 39% increase). As a result, the Western Tributary does not meet the national bottom line for nitrate toxicity under the NPS-FM 2014.
- Although the land-based discharge of wastewater from the ORP is significantly degrading water quality in the Inaha Stream and the Western Tributary, there is no consistent evidence of significant adverse effects on macroinvertebrate communities.

[1] The irrigation area refers to the area irrigated by wastewater from the ORP.

Suggested approach for effects identified

The available data indicates that the continuous cooling/backwash water discharge from the ORP picks up a significant contaminant load as it flows through the pond used to store the plant's fire water and stormwater. Thus, the effects of the ORP on water quality in the Inaha Stream may be significantly reduced by shifting the discharge so it no longer mixes with the plants pond water before entering the stream. However, an alternative method of cooling the discharge would also need to be implemented to prevent temperature from increasing in the stream.

Nitrate concentrations in the Inaha Stream are currently in NPS-FM 2014 attribute state C upstream and downstream of the irrigation area. This means that nitrate toxicity affects the growth of up to 20% of species downstream. Should the objective be to maintain nitrate concentration in the Inaha Stream downstream of the ORP within attribute state B, then the cumulative (i.e. from all discharges to land and to water) nitrogen load discharged from the ORP would need to reduce by approximately 83%.

Nitrate concentrations in the Western Tributary are currently in NPS-FM 2014 attribute state C upstream of the irrigation area[1] and attribute state D downstream. The nitrogen load discharged from the ORP to land would need to be reduced by approximately 15% for the Western Tributary to meet the attribute state C threshold. Attribute state B is not currently achievable in the Western Tributary without significant reductions in nitrogen input upstream of, as well as within, the ORP.

Contents

Tables

Figures

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1. Introduction

1.1. Background

Taranaki By-Products (TBP) own and operate a rendering plant on Kohiti Road, near Okaiawa, South Taranaki. The plant manufactures inedible products such as meat, bone, poultry, feather and blood meals, tallow and chicken oil, and processes raw material from meat and poultry processing plants in the central and lower North Island, and from dead stock collected within the wider Taranaki region.

The Okaiawa rendering plant (ORP) takes water from the Inaha Stream for non-consumptive uses, and discharges stormwater, treated wastewater, and cooling/backwash water back to the stream. Treated wastewater from the plant is also discharged to land, and contaminants from this discharge also enter the Inaha Stream and one if its tributaries (hereafter referred to as the "Western Tributary") via groundwater.

TBP operates under a range of consents, six of which are due to expire on 1 June 2019 (Table 1).

Table 1: Taranaki By-Products consents up for renewal.

Consents up for renewal	Description
Water Discharge Permit 2049-4	To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream at or about GR: Q21:118-858
Water Discharge Permit 2050-4	To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream at or about GR: Q21:118-858
Water Permit 2051-4	To take up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation
Discharge Permit 3941-2	To discharge up to 1400 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries
Water Discharge Permit 5426-1	To discharge up to 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha stream at or about GR: Q21:119-858, Q21:120-858 AND Q21:121-858
Water Discharge Permit 5495-1	To discharge up to 200 tonnes/day of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream at or about GR: Q21:121-859

The Inaha Stream is a hill-fed and groundwater-fed system, that arises just outside Egmont National Park. It has a predominately hard-bottomed bed and is characterised by a largely grassed riparian zone and a plant community comprised of both macrophytes and periphyton. The New Zealand Freshwater Fish Database contains records of longfin eel (*Anguilla dieffenbachii*), shortfin eel (*Anguilla australis*), lamprey (*Geotria australis*), brown trout (*Salmo trutta*) and kōura/freshwater crayfish (*Paranephrops planifrons*) in the Inaha Stream. Kākahi/freshwater mussels (*Echyridella menziesi*) are also present upstream of the ORP. While brown trout are present in the Inaha Stream, and people do occasional fish in it, it is not considered a significant fishery (*pers. comm.* Alan Stancliff, South Taranaki Fish & Game).

1.2. Aim and Scope

This report was prepared to inform the development of an Assessment of Environmental Effects as part of consent renewal applications by TBP for the ORP. It provides an assessment of the in-stream water quality and ecology effects of the:

- The non-consumptive abstraction of water from the Inaha stream for use as cooling/backwash water in the ORP;
- The point source discharge of stormwater, cooling/backwash water and treated wastewater from the ORP to the Inaha Stream; and
- The discharge of treated wastewater from the ORP to land.

This assessment is made purely on technical grounds and is limited to water quality and aquatic ecology considerations. It is primarily based on water quality monitoring data collected during the period July 1995 to December 2017, and biological data from October 2015 to March 2017. Where data are considered insufficient to fully inform a robust assessment, the conclusions of this report should be considered preliminary. Additional data/information may be required if specific parts of the assessment need to be refined in the future.

This report does not cover the full effects of historical or future burial of solid waste; these are assessed in a separate report. However, water quality data collected downstream of the closed burial pits at Taranaki By-Products' Okaiawa Rendering Plant are assessed against the permitted activity thresholds set out in Rule 28 of the Regional Freshwater Plan for Taranaki in Appendix E.

1.3. Structure of the report

This report is comprised of seven sections:

- In Section 2, the data available for analysis are described, maps of the relevant monitoring sites are presented, the approaches used in data analysis are detailed and the relevant water quality targets, against which data were assessed, are outlined;
- In Section 3, the potential ecological effects of ORP's non-consumptive water take from the Inaha stream are described.
- In Section 4, the current state of water quality, periphyton cover and macroinvertebrate health in the Inaha Stream upstream and downstream of the point source discharges from the ORP are assessed, and the relative contributions of the different discharges to any degradation is quantified;
- In Section 5, the effects of the discharge of treated wastewater from the ORP to land on the water quality and ecology of the Inaha Stream and its Western Tributary are described;
- In Section 6 the cumulative effects of all of the proposed activities on surface water quality and ecology are summarised; and
- In Section 7 the main findings of Sections 2 through 6 are summarised, and recommendations are made.

2. Methods

2.1. Available data and data preparation

All data available at the time of writing have been included in the analyses presented in this report, except obvious outliers[2]. The data used for the assessment presented in this report are summarised in Table 2.

2.1.1. Discharge quality

Discharge quality data used in this assessment were sourced from monitoring conducted by TBP between July 1995 and August 2017 (all data provided by TRC). The frequency of sampling has varied over this time.

2.1.2. Effluent quantity

Wastewater quantity data used in this assessment were sourced from daily discharge monitoring conducted between December 2004 and December 2017 (all data provided by TRC).

2.1.3. Water quality and ecology

Water quality and ecological data used in this assessment to describe the state of the Inaha Stream and the Western Tributary were sourced from:

- Water quality monitoring at sites on the Inaha Stream upstream and downstream of the ORP. Monitoring has been conducted by TRC at four upstream sites and four downstream sites since July 1995. The frequency of sampling has varied over this time;
- Water quality monitoring at sites on the Western Tributary. Monitoring has been conducted by TRC three sites since July 1995. The frequency of sampling has varied over this time;
- Biannual macroinvertebrate monitoring at sites on the Inaha Stream upstream and downstream of the ORP. Monitoring was conducted by TRC in October 2015, February 2016, October 2016, February 2017, October 2017 and February 2018 at two upstream sites and three downstream sites; and
- Biannual macroinvertebrate monitoring at sites on the Western Tributary. Monitoring was conducted by TRC in October 2015, February 2016, October 2016, February 2017, October 2017 and February 2018 at three sites.

2.1.4. River flow

River flow data used in this assessment were calculated from daily measurements of river height taken at a staff gauge at Kohiti Road between January 2008 and December 2017 (all data provided by TRC).

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[2] $ScBOD_5$, DRP and NH_4-N data collected from the most downstream site on the Western Tributary (250m u/s of Inaha confluence) on the 28/01/2009 were identified as outliers and were excluded from all analyses.

Table 2: Summary of water quality, periphyton and macroinvertebrate data used in this assessment.

Site(s)		Type	Parameter sampled	Frequency	Period	Source
TBP discharges		WW, CW and SW discharge quality	pH, DO, Temp, TSS, Turbidity, BOD_5, $ScBOD_5$, COD, TKN, NNN, NO_3-N, NO_2-N, TNH_3-N, TN, DRP, TP, *E.coli*	Variable	WW = July 1995 to August 2016 CW and SW Aug 2012 to Aug 2017	TRC
		WW flow	Daily		2004 to 2017	TRC
Inaha Stream		River Flow			2008 to 2017	TRC
Inaha Stream upstream of point source discharges	• Ahipaipa Rd; • Bridge, 420m u/s Kohiti Rd; • Unnamed northern trib. at Inaha conf.; and • Kohiti Road	River water quality	pH, DO, Temp, Continuous Temp, Conductivity, Turbidity, BOD_5, NNN, NO_3-N, NO_2-N, TNH_3-N, DRP, TP, TN	Variable	July 1995 to December 2017 (continuous temp data available up to June 2016)	TRC
Inaha Stream downstream of point source discharges	• 110m d/s CW discharge and 30 m d/s WW discharge; • 500m d/s of discharges; • Normanby Rd Br. 1450m d/s of discharges; and • SH45					
Western Tributary	• 3,500m u/s of Inaha conf.; • 2,550m u/s of Inaha conf.; and • 250m u/s of Inaha conf.					
Inaha Stream upstream of discharges	• Ahipaipa Rd; • Kohiti Road	Biological indicators	Macroinvertebrate community indices (MCI, SQMCI, %EPT taxa, No. of taxa);	Biannual	Oct2015 Feb2016 Oct 2016 Mar 2017 Oct 2017 Feb 2018	TRC
Inaha Stream downstream of discharges	• 500m d/s of discharges; • Normanby Rd Br. 1450m d/s of discharges; and • 100m d/s of Western trib. conf.					
Western Tributary	• 3,500m u/s of Inaha conf.; • 2,550m u/s of Inaha conf.; and • 250m u/s of Inaha conf.					

2.2. Monitoring sites

Long-term water quality, periphyton and macroinvertebrate data were collected from sites on the Inaha Stream upstream and downstream of where point source discharges from the ORP enter the stream. Ecological data were collected at two upstream sites and three downstream sites. Water quality data were collected from four upstream sites and a four downstream sites (Figure 1). Water quality and ecological data were also collected from three sites on the Western Tributary (Figure 1). The location of each monitoring site is shown in Figure 1, and examples of the various sampling locations are shown in Plates 1 to 6.

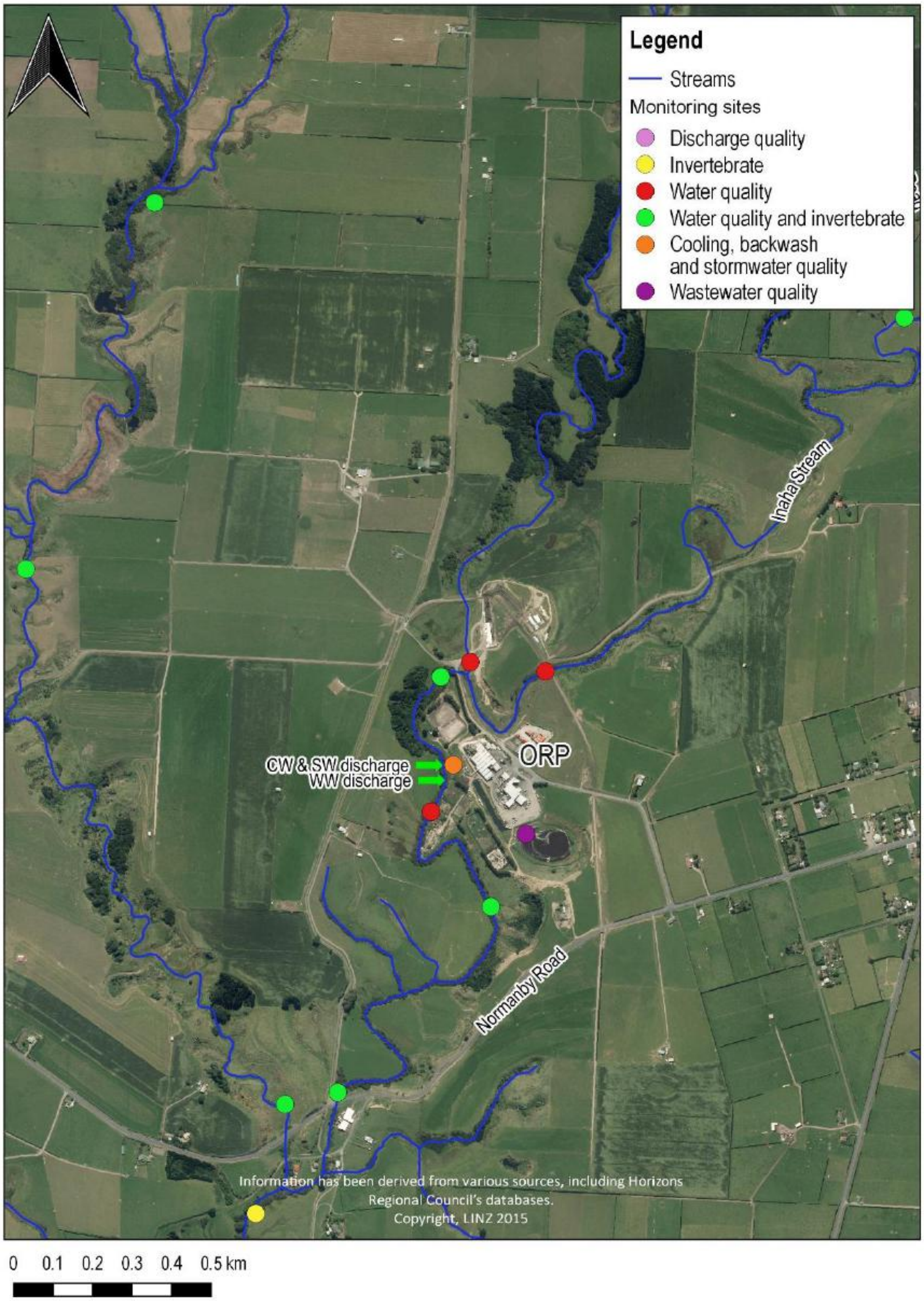

Figure 1: Map showing location of sites sampled for discharge quality, surface water quality and discharge quality.

Plate 1: Inaha Stream upstream at Ahipaipa Rd.

Plate 2: Inaha Stream upstream at Kohiti Road.

Plate 3 : Inaha Stream 500m d/s of point source discharges from the ORP.

Plate 4: Inaha Stream Normanby Rd Bridge, 1450m d/s of point source discharges from the ORP.


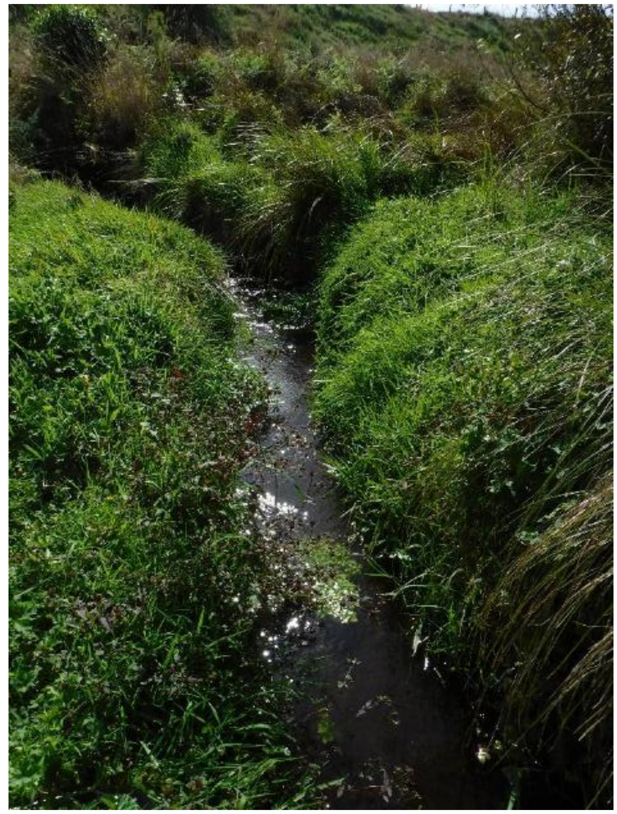

Plate 5: Western Tributary 3,500m u/s of Inaha conf. (left) and 2,550m u/s of Inaha conf. (right).

Plate 6: Western Tributary 250m u/s of Inaha conf.

2.3. Data analysis

2.3.1. Effects of point source discharges

Discharge quality

Descriptive statistics, such as mean, median, distribution percentiles, standard error and confidence intervals, as well as the proportion of samples complying with the relevant consent limits (Table 3) were calculated for each parameter monitored in the treated wastewater and the combined cooling/backwash waster and stormwater discharges (Appendix A). Data were also graphed to highlight seasonal variability in the data.

Table 3: Discharge quality targets used in this assessment

Discharge type	Parameter	Target as per Consent Condition:
Wastewater (from WW management plan not consent)	NH_4-N	<150 g/m^3

Water quality in the Inaha Stream

For each parameter, descriptive statistics, such as mean, median, distribution percentiles, standard error and confidence intervals, as well as the proportion of samples complying with the relevant guidelines or targets were calculated at the sites on the Inaha Stream immediately upstream (Kohiti Road) and downstream (110m d/s CW discharge and 30 m d/s WW discharge) of the ORP (Appendix B). To allow for statistical comparisons of upstream and downstream water quality, data from the different sites were matched for each sampling date; if a parameter was absent for one site then the parameter for the other site was removed from the dataset. These paired upstream and downstream data were then compared using Wilcoxon Signed Rank Tests (TimeTrends v6.3).

To help describe the effects of any observed changes in water quality in the Inaha Stream downstream of the ORP, water quality data were assessed against relevant consent conditions, the guidelines in Appendix 5 of the Regional Fresh Water Plan (RFP) for Taranaki[3&4] and the attribute states in the National Policy Statement for Freshwater Management 2014 (NPS-FM 2014). Specifically:

- Temperature, dissolved oxygen (DO), soluble carbonaceous five-day biochemical oxygen demand ($ScBOD_5$) and dissolved reactive phosphorus (DRP) were assessed against the RFP water quality guidelines;
- Temperature, DO, pH, ammoniacal nitrogen (NH_4-N) and $ScBOD_5$ were assessed against the limits set out in the consent conditions, and

[3] Note the RFP guidelines for water supply purposes were not considered.

[4] All references to the RFP in this report are to the web-based operative version available on the Taranaki Regional Council website, accessed on 28th September 2018.

- NH_4-N and nitrate-nitrate nitrogen (NNN) were assessed against the NPS-FM 2014 attribute states (RFP water quality guidelines and consent limits are set out Table 4; NPS-FM attribute states are described in Appendix C).

NPS-FM 2014 attribute states for NH_4-N and NNN were calculated on a rolling basis for each site on each sampling occasion, based on the median and maximum/95th percentile of the previous 12 data points. For both parameters, an overall current attribute state was also calculated for each site based on the 30 most recent data points; consistent with the recommended approach set out in MfE (2018). It is important to note that the assessment periods used to calculate the overall and rolling attribute states presented in this report far exceed those specified by MfE (2018) and the NPS-FM 2014. Furthermore, monitoring was heavily skewed towards winter sampling. Consequently, the attribute states presented in this report should be considered indicative only.

The NPS-FM 2014 numeric attribute states for NH_4-N are based on pH 8 and temperature of 20^{o}C; concentrations need to be adjusted for these parameters to assess compliance. Accordingly, NH_4-N concentrations recorded in the Inaha Stream were converted to un-ionised ammonia (NH_3-N) concentrations[5] and assessed against NH_3-N thresholds that correspond to the NPS-FM 2014 NH_4-N attribute states[6].

[5] Based on the measured water pH and temperature measured on the day of sampling

[6] Calculated from percentage of total ammoniacal nitrogen composed of unionised ammonia nitrogen at pH of 8 and 20^{o}C (3.8%)

Table 4: Summary of Water Quality targets used in this assessment.

Parameter	Target as per Consent Conditions The discharge shall not cause or give rise to any of the following effects, at any point in the receiving waters below the mixing zone:	Surface water quality guidelines as per Appendix 5 of Regional Fresh Water Plan for Taranaki After reasonable mixing, the contaminant, either by itself or in combination with other contaminants shall not:
Temp (°C)	a temperature rise of more than 3.0 degrees Celsius;	Cause the natural temperature of the water to change by more than 3° Celsius. Cause the natural temperature of the water to exceed 25° Celsius.
DO (% SAT)	A reduction in the dissolved oxygen concentration to below 80% of saturation concentration	Cause the concentration of dissolved oxygen to fall below 80% of saturation.
pH	A fall of more than 0.5 pH units;	
Visual clarity		Result in water that has sufficient clarity such that the standard black disc measurement shall equal or exceed 1.6m/ Cause a decrease in water clarity of between 33% and 50%, as determined using the standard black disc measure
NH_4-N (g/m^3)	Total ammonia concentration in the receiving waters at any point below the mixing zone above 1.5 g/m^3 if the pH of the receiving water is below 7.75, or above 0.7 g/m^3 if the pH of the receiving water lies between 7.75 and 8.00, or above 0.4 g/m^3 if the pH of the receiving water is above 8.00.	
$ScBOD_5$ (g/m^3)	an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 gm-3	Cause the concentration of carbonaceous, filtered BOD to exceed 2 g/m^3
DRP (g/m^3)		Cause the concentration of dissolved reactive phosphorus to exceed 0.03 g/m^3
Enterococci (/100mL)		Cause the numbers of enterococci to exceed 33/100 ml (median of samples over bathing season)

Relative contribution of different discharges from the ORP to changes in water quality in the Inaha Steam

The location of the monitoring sites on the Inaha Stream means that the effects of the cooling/backwash water, stormwater and wastewater discharges are all monitored together. As stormwater and cooling/backwash water is discharged continuously, and wastewater is only discharged episodically, simple upstream-downstream comparisons of water quality would not provide a clear assessment of the effects of each discharge on key water quality statistics. To isolate the effects of the various discharges on each water quality parameter, two separate datasets were generated.

The first dataset included water quality data (July 2008 – July 2016) collected at sites immediately upstream (Kohiti Road) and downstream (110m d/s CW discharge and 30 m d/s WW discharge) of the ORP on days that wastewater was not discharged to the Inaha Stream. Upstream-downstream comparisons of water quality data in this dataset allowed for the combined effects of stormwater and cooling/backwash water discharges[7] on key water quality statistics to be assessed (e.g. median, average and 95th percentile contaminant concentrations).

The second dataset was generated based on the first dataset and water quality data collected at sites immediately upstream (Kohiti Road) and downstream (110m d/s CW discharge and 30 m d/s WW discharge) of the ORP on days that wastewater was discharged. All water quality data collected upstream and downstream of the ORP were compiled, and the downstream data adjusted to remove the effects of stormwater and cooling/backwash water discharges. The adjustment process was as follows:

- Downstream water quality data collected when wastewater was not discharged from the ORP were adjusted to reflect upstream water quality at the time of sampling.
- Downstream water quality collected when wastewater was discharged were adjusted to remove the effects of stormwater and cooling/backwash water discharges using the following equation (SW = stormwater; CW = cooling and backwash water):

$$D/S\ conc._{adj.} = D/S\ conc._{obs.} - av.\Delta\ in\ conc.\ caused\ by\ SW\ \&\ CW$$

Upstream-downstream comparisons of water quality data in the resulting dataset allowed for the effects of wastewater discharges on key water quality statistics to be assessed in isolation from those caused by stormwater and cooling/backwash water discharges.

Effects on aquatic ecology

Macroinvertebrates are good indicators of water quality and ecological health as they show a wide range of responses depending on their degree of sensitivity to pollution. For example, some taxa such as snails (Gastropod) and midges (Chironomidae) are generally considered to be tolerant of poor quality water, while others such as Ephemeroptera (mayflies) and Plecoptera (stoneflies) prefer good water quality. The macroinvertebrate community at a given site may be considered a result of the prevailing water quality at that site. Consequently, macroinvertebrates are used widely both in New Zealand (Stark 1985, Winterbourn 1999) and overseas (Rosenberg and Resh 1993, Hynes 1994) as indicators of ecological condition.

The following biological indices can be calculated to assess relationships between macroinvertebrate communities and water quality at a study site:

- The Macroinvertebrate Community Index (**MCI**) (Stark 1985) considers the presence of macroinvertebrates based on an assigned score which is dependent on their tolerance to pollution (1= highly tolerant, 10 = highly sensitive).
- The Semi Quantitative Macroinvertebrate Community Index (S**QMCI**) is similar to the MCI, but also takes into account the abundance of each species collected.
- Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies) (EPT) consist of insects which are generally sensitive to pollution. The percentage of **EPT taxa** is the proportion of all taxa collected that belong to one of these groups.

[7] The effects of the of the stormwater and cooling/backwash water discharges cannot be isolated as the cooling/backwash water flows through the stormwater detention ponds before being discharged to the Inaha Stream.

These biotic indices were calculated for sites on the Inaha Stream upstream (Kohiti Road) and downstream (500m d/s of discharges) and downstream of the ORP, and compared to provide an indication of the ecological effects of point sources discharges from the plant. Values for the biotic indices discussed above indicative of various water quality categories are given in Table 5.

Table 5: Interpretation of MCI and QMCI values after Stark & Maxted (2007) for stony streams.

Interpretation	MCI	SQMCI
Excellent / Clean water	> 119	> 5.9
Good / Possible Mild pollution	100 -119	5 – 5.9
Fair / Probable Moderate pollution	80 - 99	4 – 4.9
Poor / Probable Severe pollution	<80	< 4

2.3.2. The effects of the discharge of treated wastewater from the ORP to land on the water quality of the Inaha Stream and it's Western Tributary

Water quality

The effects of the land-based discharge of treated wastewater from the ORP on water quality in the Inaha Stream and its Western Tributary were qualitatively assessed by comparing descriptive statistics for key water quality parameters at sites upstream, within and downstream of where groundwater from the area irrigated by wastewater from the ORP (hereafter referred to as the irrigation area) enters the two streams. The monitoring sites considered in this assessment are identified in Table 6.

For the Inaha Stream, comparing the changes in water quality between the most upstream and downstream sites with the estimated impact of the point source discharges (see Section 2.3.1) gave an indication of the relative importance of the two discharge types on water quality. For the Western Tributary it was assumed that all changes in water quality between the most upstream and downstream sites were the result of the discharge of wastewater from the ORP to land. To confirm the validity of this assumption, water quality data collected upstream and downstream of only other potential contaminant source in the immediate area, a small stream located upstream of the 2,550m u/s of the Inaha confluence monitoring site, were also compared.

To inform management decisions, estimates of the contaminant load reduction required to meet various NPS-FM attribute state thresholds for nitrate toxicity are provided.

Aquatic ecology

Macroinvertebrate indices at sites upstream and downstream of where groundwater from the irrigation area enters the Inaha Stream and its Western Tributary were compared to provide an indication of the ecological effects of the land-based discharge of wastewater from the plant The monitoring sites considered in this assessment are identified in Table 6.

Table 6: Water quality and ecological monitoring sites used to assess the effects of the land-based discharge of treated wastewater from the ORP on water quality and ecology in the Inaha Stream and its Western Tributary.

Stream	Location in relation to irrigation area	Water quality monitoring sites	Ecological monitoring sites
Inaha Stream	Upstream	Ahipaipa Rd	
	Within	Bridge, 420m u/s Kohiti Rd	N/A
		Kohiti Road	
		110m d/s CW discharge and 30 m d/s WW discharge	
		500m d/s of discharges	
	Downstream	Normanby Rd Br. 1450m d/s of discharges	
Western Tributary	Upstream	3,500m u/s of Inaha conf.	
	Within	2,550m u/s of Inaha conf.	N/A
	Downstream	250m u/s of Inaha conf.	

3. Effects of non-consumptive water take.

Resource Consent N. 2051-4 allows TBP to take up to 2,160 cubic metres/day (50 L/s) of water from the Inaha Stream to use a cooling /backwash water. Water abstraction reduces the amount of flow in the river, which can lead to a range of detrimental ecological effects, including but not limited to:

- Reduction in aquatic habitat availability and diversity;
- Increased water temperature;
- Reduced flushing flows;
- Increased plant growth; and
- Reduced dissolved oxygen.

The water take utilised by TBP is non-consumptive, meaning that water is returned to the Inaha Stream at the same rate at which it is taken. Consequently, the potential for adverse effects is limited to flow depletion along the section of stream between the take and the discharge point. Based on information provided by TBP and TRC during our site visit and TRC's interactive resource consent map and aerial photographs, it is our understanding that the take and discharge are at the same location. Thus, it is unlikely that the water take has any material effect on the Inaha Stream's flow regime, and any flow-on ecological effects will be less than minor.

4. Effects of point source discharges

4.1. Discharge quality

4.1.1. Treated wastewater

The treated wastewater quality data collected by TRC between July 1995 and August 2016 are summarised in Table 7 and depicted in Figure 2 to Figure 9. Detailed descriptive statistics, such as mean, median, distribution percentiles, standard error and confidence intervals are presented in Appendix A.

Between July 1995 and August 2016, NH_4-N concentrations in the treated wastewater did not meet the target set out in the Wastewater Management Plan on 60% sampling occasions (Table 7 and Figure 2). NH_4-N concentrations followed a seasonal pattern, with higher concentrations observed over winter months and lower concentrations recorded in summer (Figure 2). Over the same period, temperature was generally highest during the summer months (Figure 9). Clear seasonal patterns in other water quality parameters were not observed (Figure 3 to Figure 8).

Table 7: Summary of effluent quality from Pond 6 of the TBP rendering plant operations, July 1995 – August 2016.

	NH_4-N	NNN	DRP	FC[8]	ScBOD$_5$	TSS[8]	Turb	pH	Temp
	g/m^3	g/m^3	g/m^3	/100 mL	g/m^3	g/m^3	NTU		°C
Average	204.3	22.2	30.2	1,095	23.2	171.4	40.0	7.8	20.4
20%ile	99.4	2.5	22.4	150	2.5	64.6	17.0	7.4	15.2
50%ile (median)	186.0	6.4	32.4	375	6.3	130.0	20.0	8.0	20.7
95%ile	421.7	62.3	45.5	4,925	61.1	460.0	138.8	8.4	29.8
Max	570.0	490.0	53.6	20,000	490.0	840.0	280.0	8.6	32.8
N. of Samples	147	80	109	102	72	114	26	141	128
Target	**150**								
Compliance	40%								

[8] TSS = total suspended solids; FC = faecal coliforms.

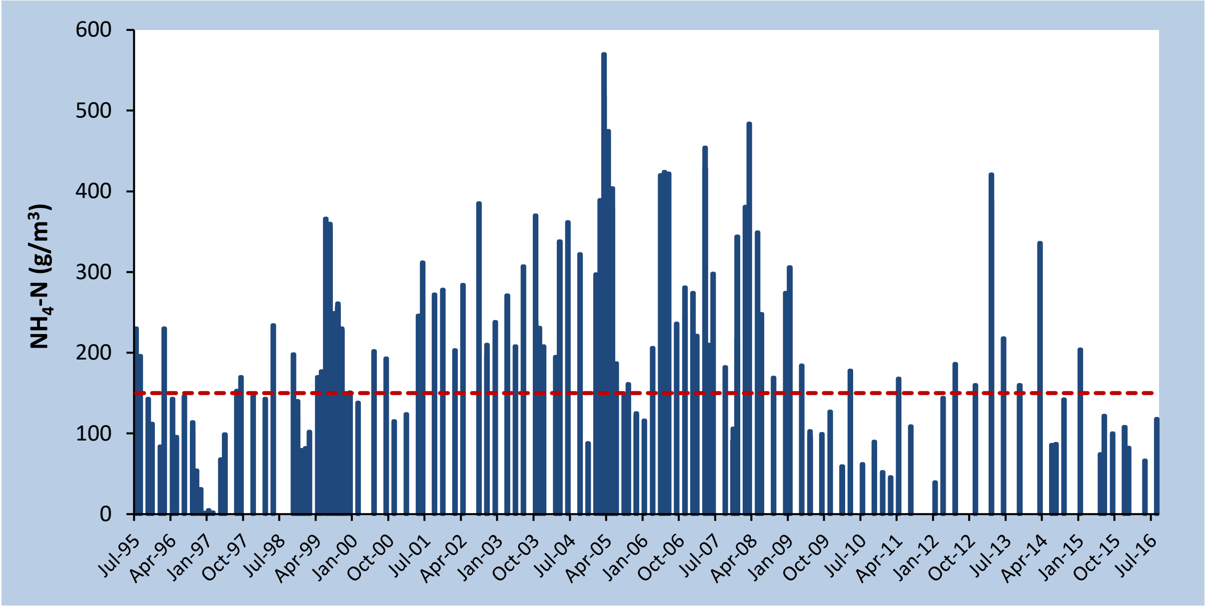

Figure 2: NH_4-N concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

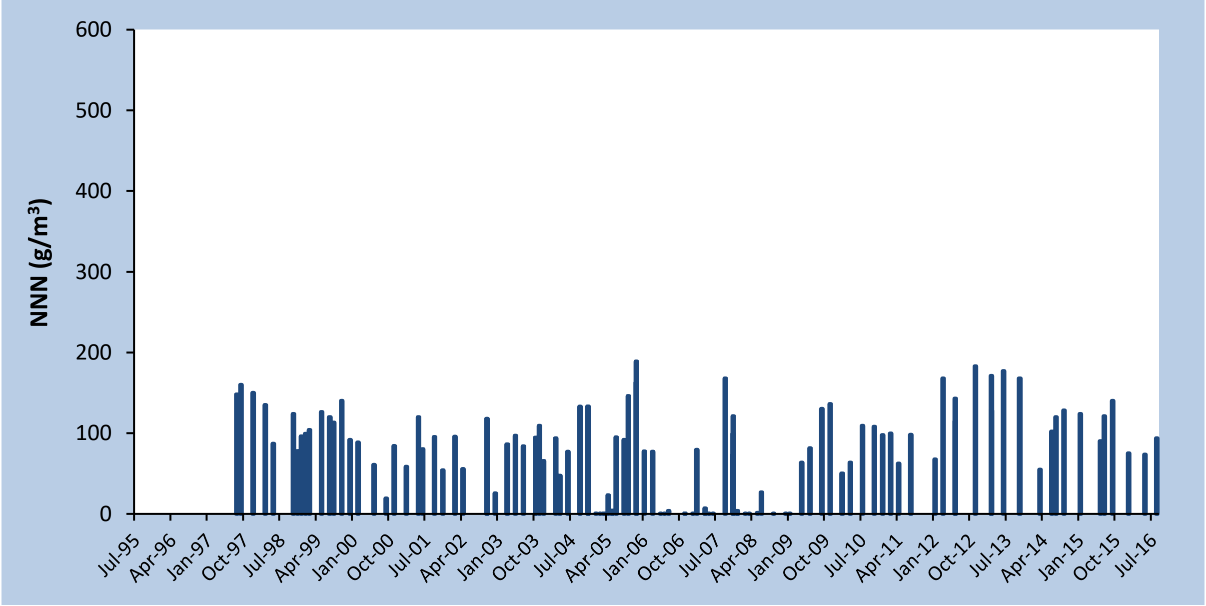

Figure 3: NNN concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

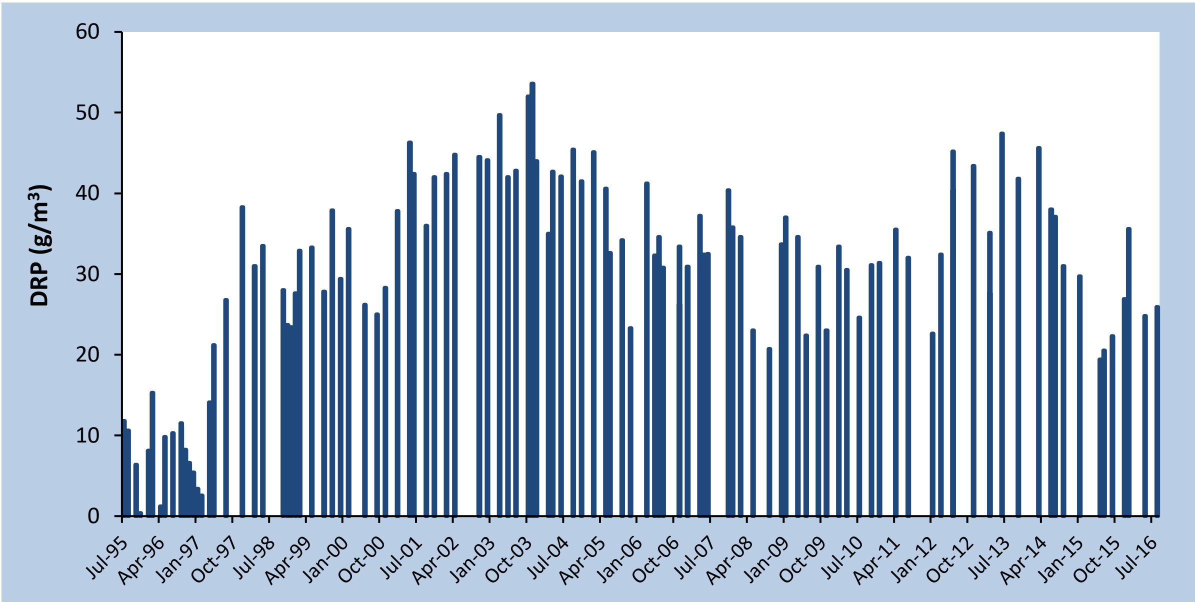

Figure 4: DRP concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

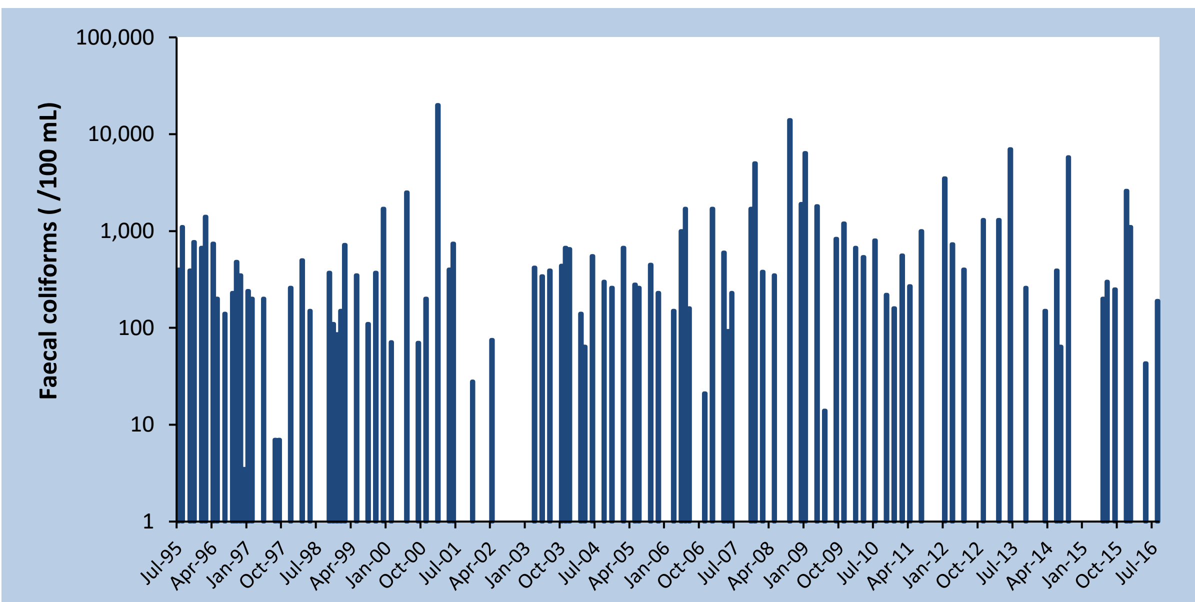

Figure 5: Faecal coliform concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

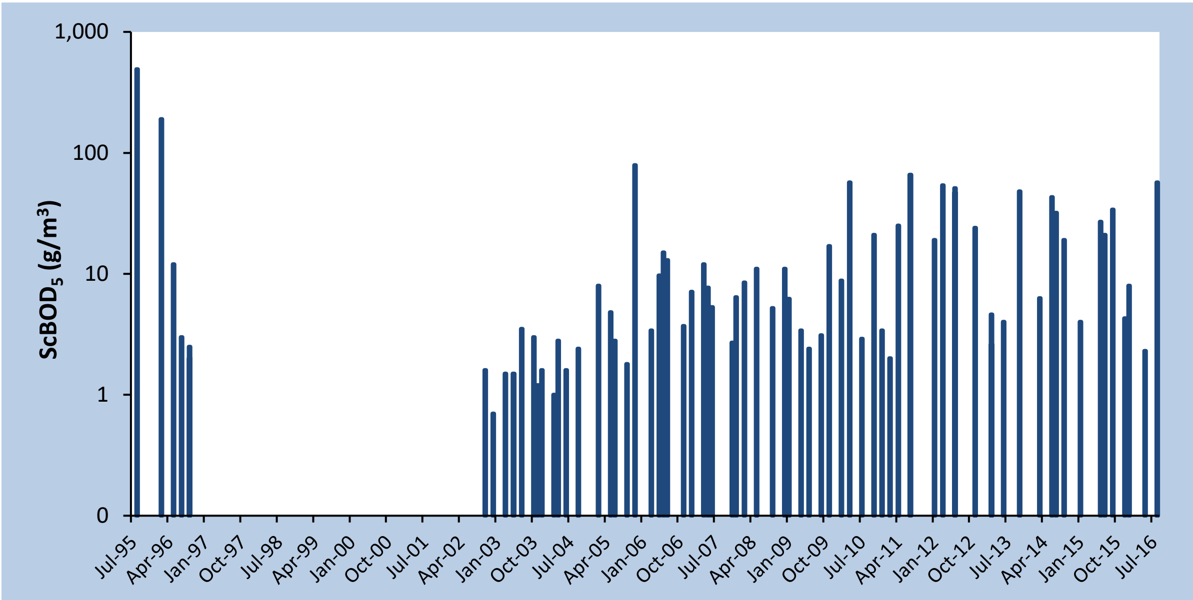

Figure 6: $ScBOD_5$ concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

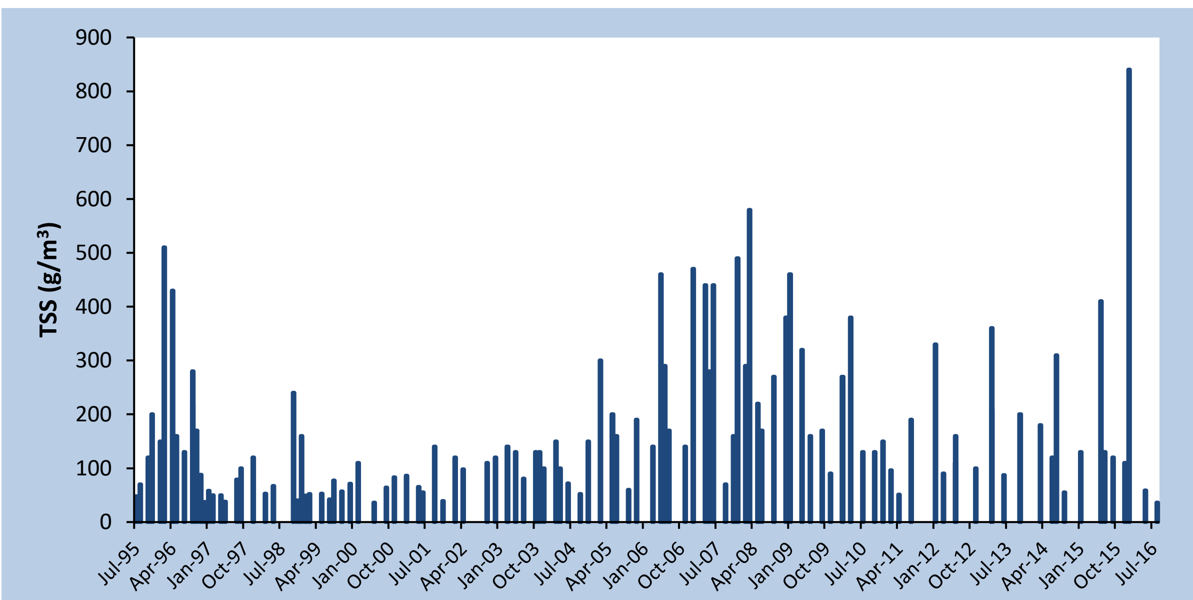

Figure 7: Total suspended solids (TSS) concentrations in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016

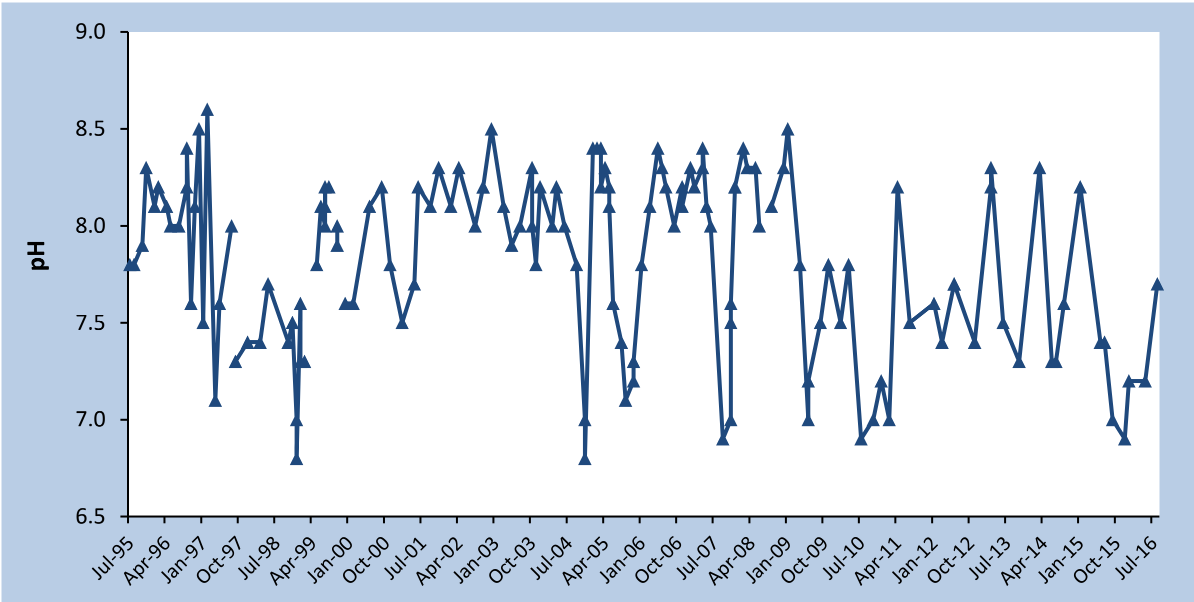

Figure 8: pH in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

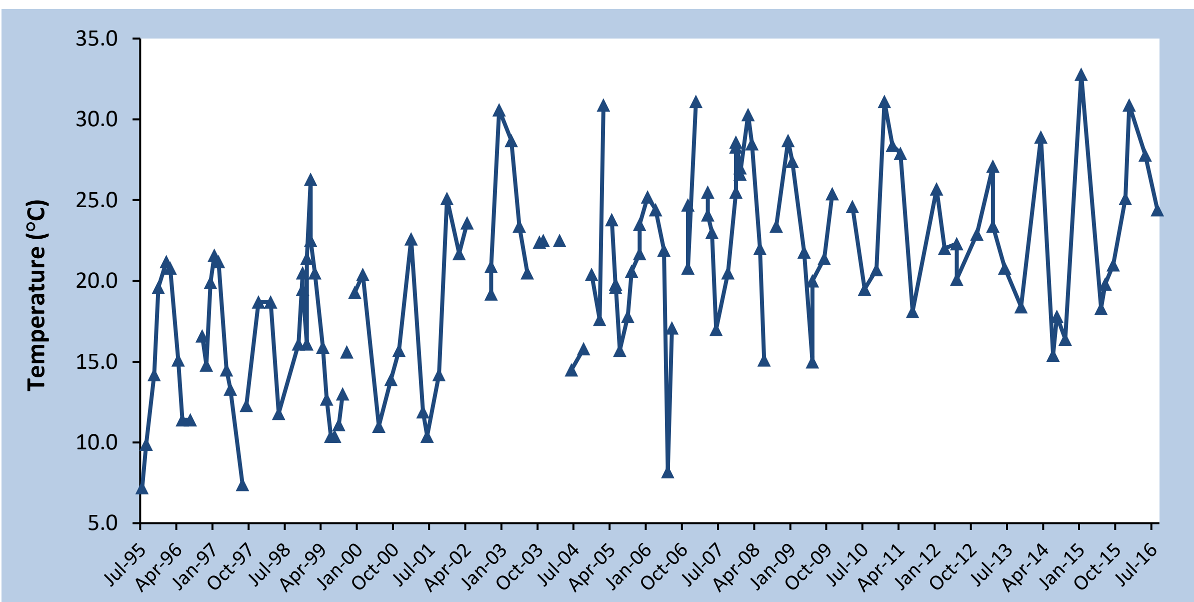

Figure 9: Temperature in the treated wastewater from Pond 6 of the ORP, July 1995 – August 2016.

4.1.2. Combined cooling/backwash water and stormwater

The discharge quality data collected between August 2012 and August 2017 are summarised in Table 8 and depicted in Figure 10 to Figure 16. Detailed descriptive statistics, such as mean, median, distribution percentiles, standard error and confidence intervals are presented in Appendix A.

Table 8: Summary of discharge quality from the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

	NH_4-N	NNN	DRP	FC[8]	BOD_5	TSS[8]	Turb	pH	Temp
	g/m^3	g/m^3	g/m^3	/100 mL	g/m^3	g/m^3	NTU		°C
Average	2.3	3.8	0.2	26,012	13.8	27.8	13.3	7.5	18.7
20%ile	0.7	3.1	0.0	358	2.2	6.0	4.1	7.2	12.1
50%ile (median)	1.6	3.6	0.1	1,300	3.0	8.0	7.8	7.4	19.9
95%ile	6.7	5.4	0.6	100,000	77.2	102.4	45.9	8.0	27.6
Max	6.8	6.7	0.7	370,000	120.0	140.0	48.0	8.7	31.3
N. of Samples	22	17	17	19	22	9	22	22	22

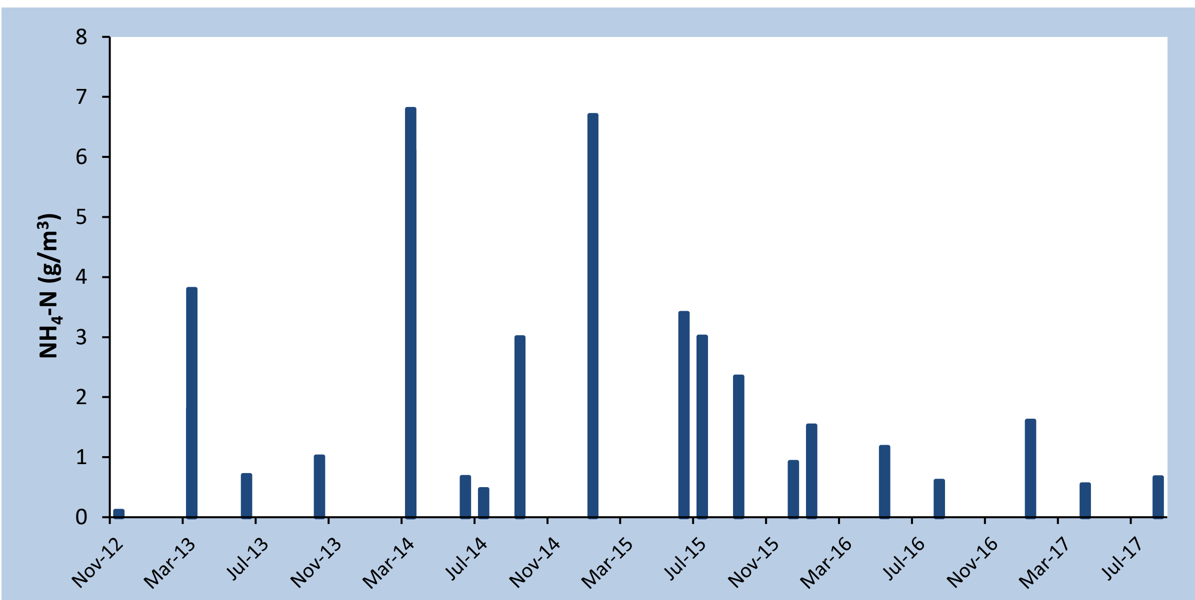

Figure 10: NH_4-N concentrations in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

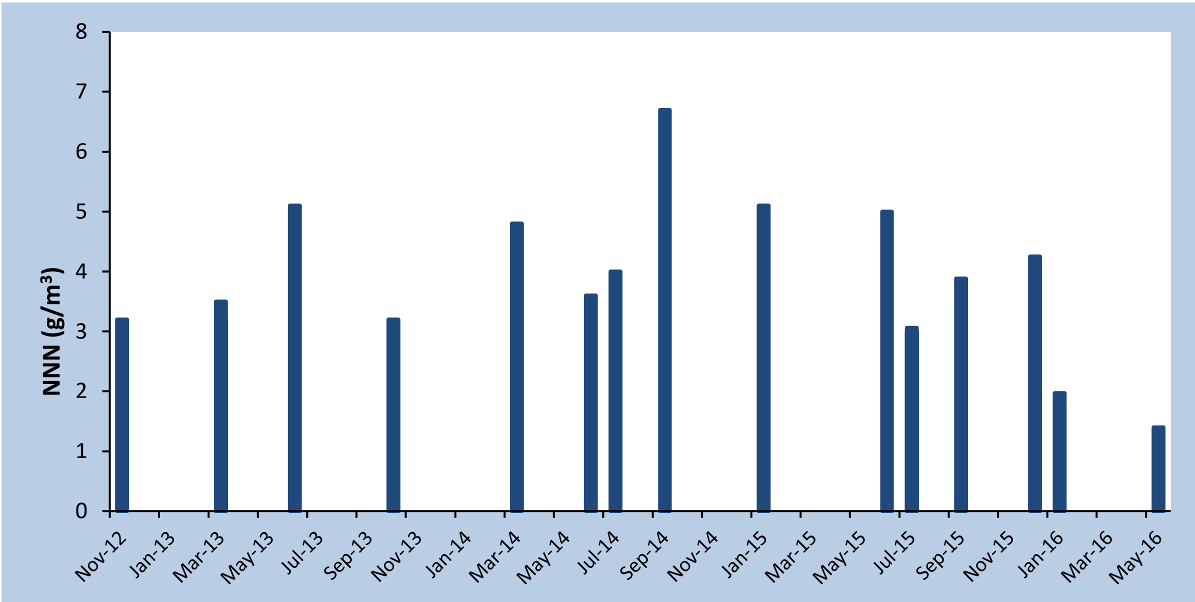

Figure 11: NNN concentrations in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

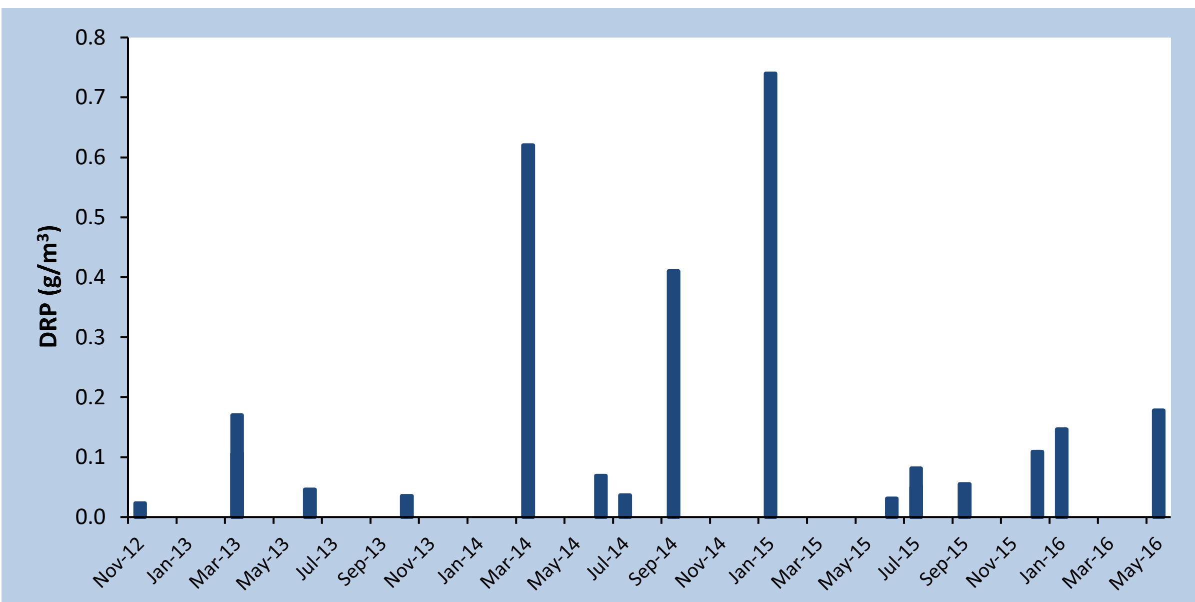

Figure 12: DRP concentrations in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

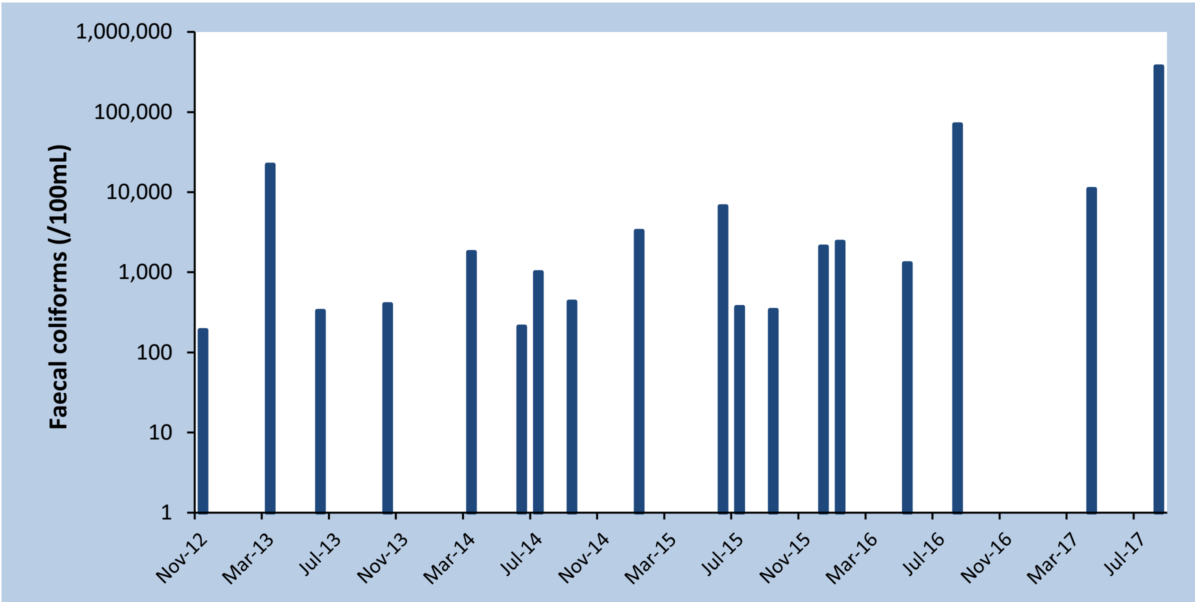

Figure 13: Faecal coliform concentrations in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

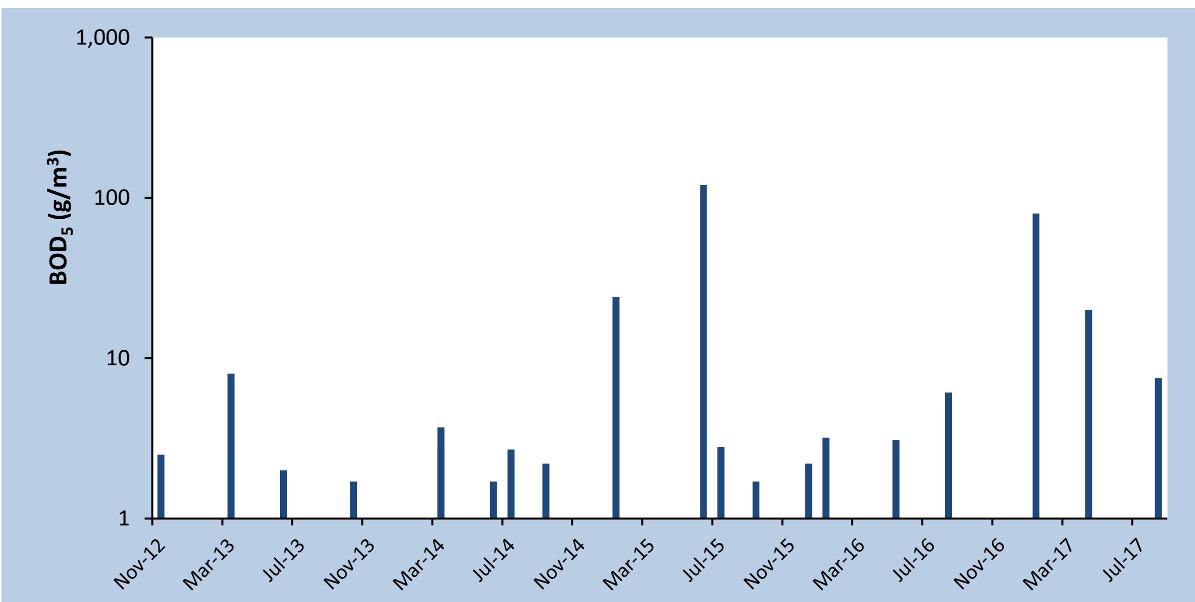

Figure 14: BOD_5 concentrations in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

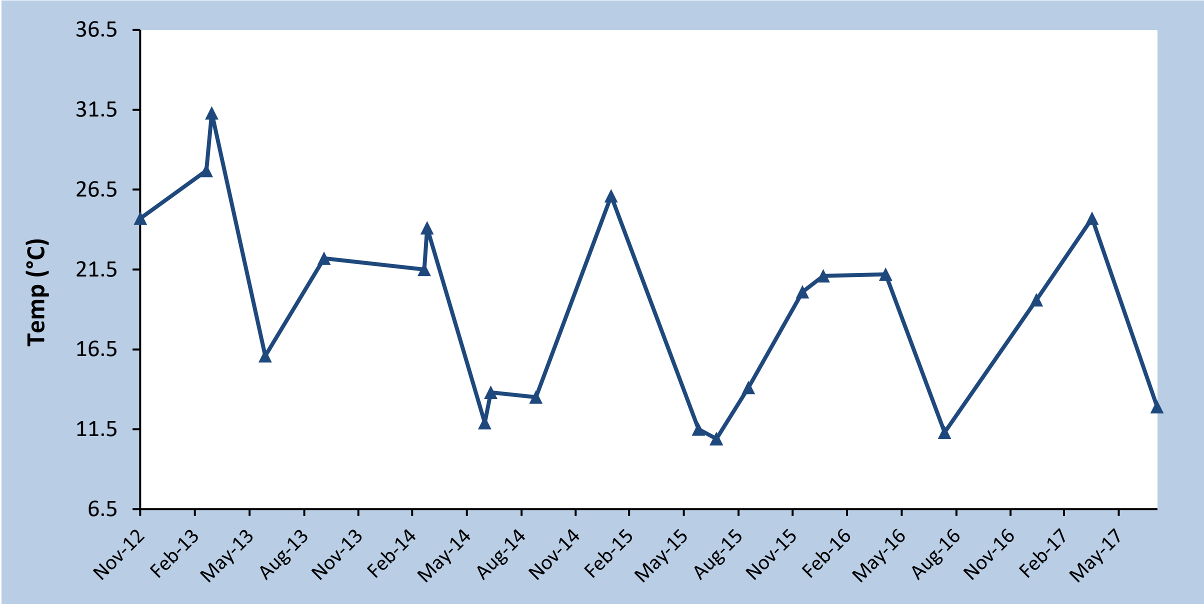

Figure 15: Temperature in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

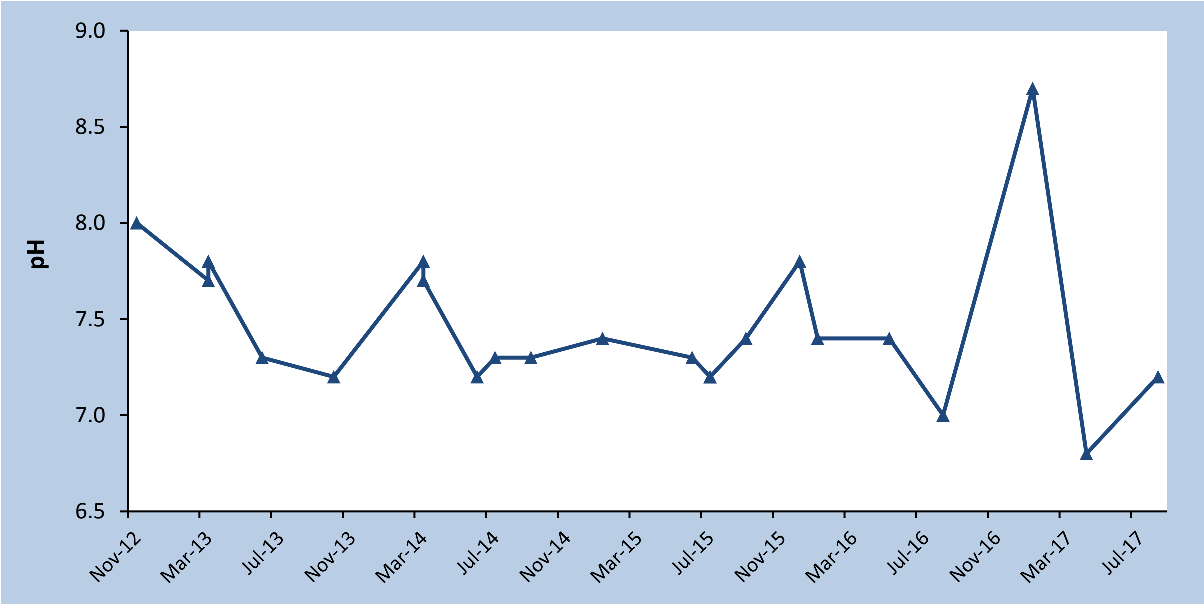

Figure 16: pH in the combined stormwater and cooling/backwash water discharges from the ORP, August 2012 – August 2017.

4.2. Effects on instream water quality

Water quality data collected at sites on the Inaha Stream upstream and downstream of the point source discharges from the ORP between January 1997 and December 2017 have been summarised and are presented in Figure 17 to Figure 43. Detailed descriptive statistics, such as mean, median, distribution percentiles, standard error and confidence intervals are presented in Appendix B.

4.2.1. Ammoniacal nitrogen and nitrate-nitrite nitrogen

Between January 1997 and December 2017 marked and statistically significant increases in NH_4-N (average increase = 0.7 g/m^3; 1634%) and NNN concentrations (average increase = 0.6 g/m^3; 22%) were observed between monitoring sites on the Inaha Stream immediately upstream and downstream of the point sources discharges from the ORP (Figure 17, Figure 18, Figure 19, Figure 20 and Appendix B).

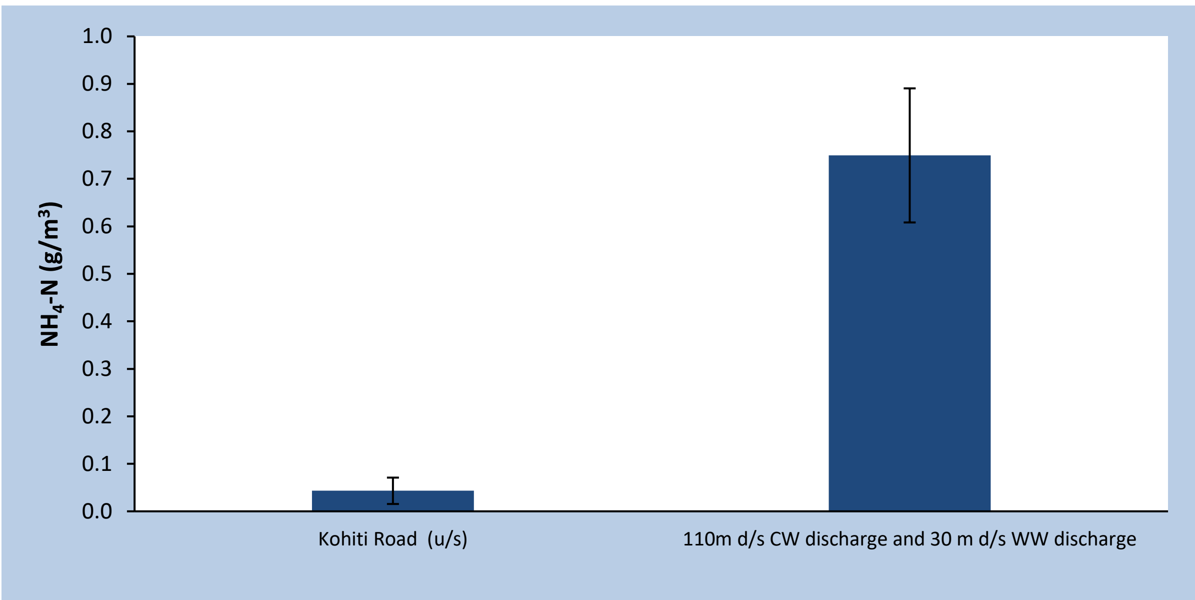

Figure 17: Mean NH_4-N concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

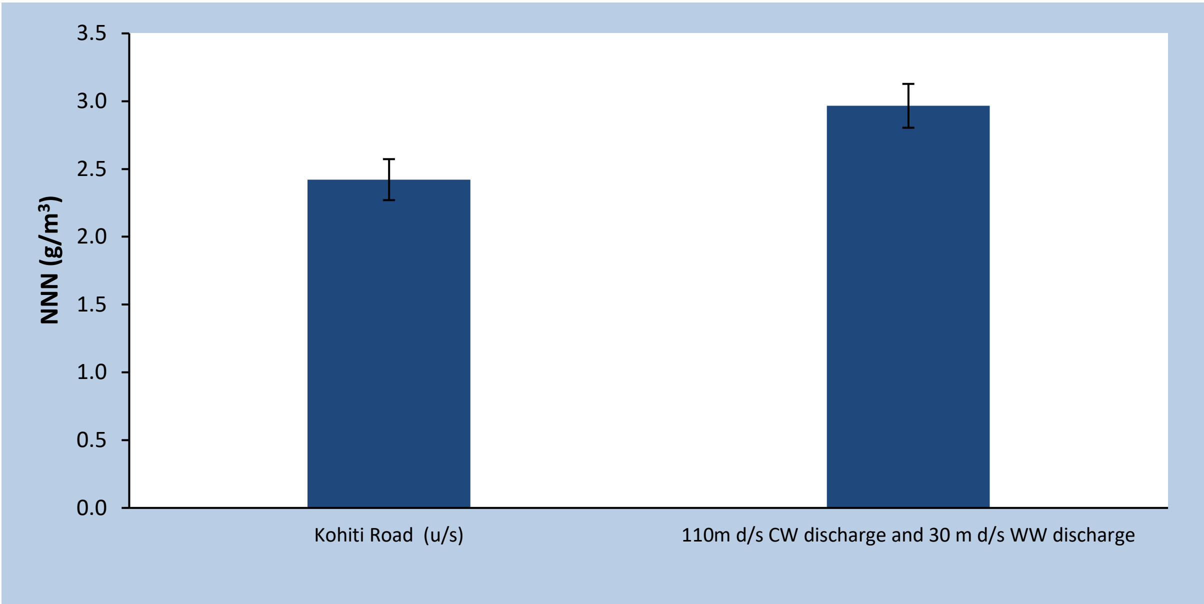

Figure 18: Mean NNN concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

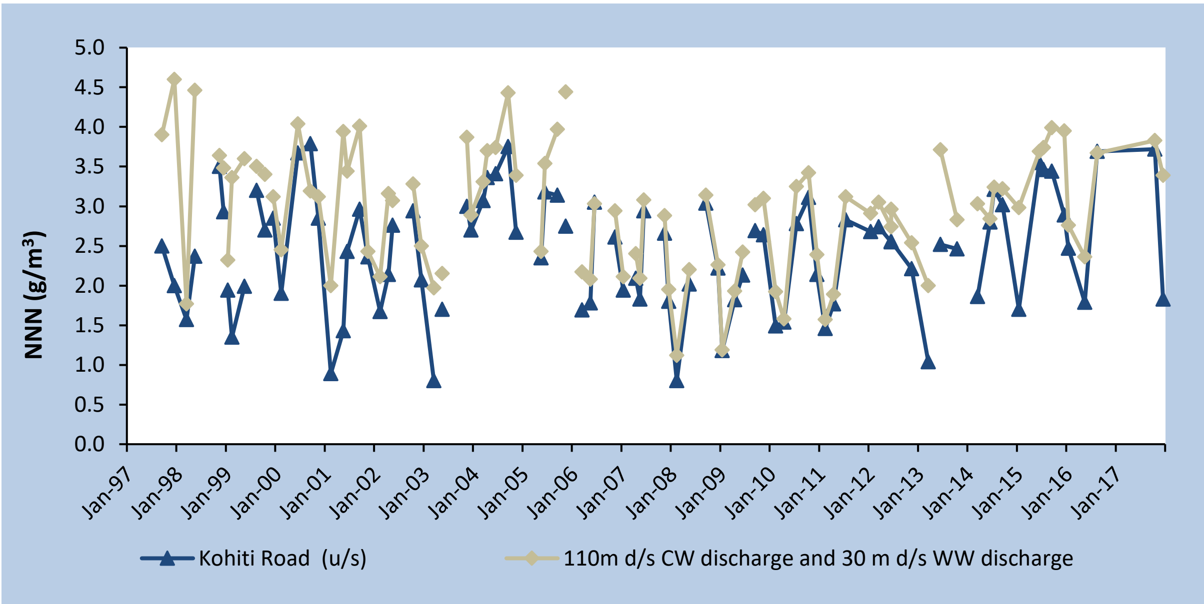

Figure 19: Daily NNN concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP.

Assessment against RFP guidelines and consent conditions

Resource Consent Number 2049-4 sets three in-stream limits for NH_4-N (condition 10):

- *The discharge shall not cause or give rise to total ammonia concentration in the receiving waters at any point below the mixing zone*
    - *Above 1.5 g/m3 if the pH of the receiving water is below 7.75; or*
    - *Above 0.7 g/m3 if the pH of the receiving water lies between 7.75 and 8.00; or*
    - *Above 0.4 g/m3 if the pH of the receiving water is above 8.00.*

NH_4-N concentrations in the Inaha Stream upstream of the ORP met the consent limits on all sampling occasions (100% compliance). NH_4-N concentrations were also generally compliant downstream of the ORP discharges, and while the limits have been breached on 17 occasions (85% compliance), these exceedances were all prior to October 2006. Since then, wastewater has only been discharged to the Inaha Stream when the dilution ratio exceeds 1:300, and this has led to 100% compliance with the NH_4-N consent limit (Figure 20).

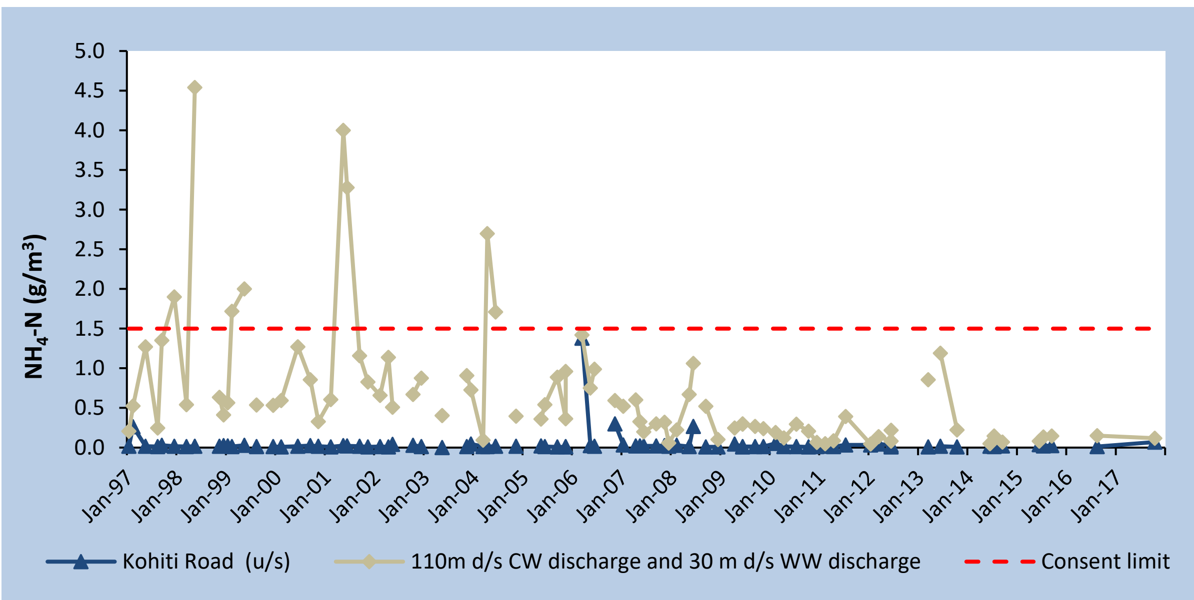

Figure 20: Daily NH_4-N concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP when pH was less than 7.75. The dashed red line represents relevant consent limit for NH_4-N when pH is below 7.75.

Assessment against NPS-FM 2014 attribute states

When corrected for temperature and pH, unionised current ammonia (NH_3-N) concentrations in the Inaha Stream upstream of the point source discharges from the ORP were assigned attribute state B for ammonia toxicity under the NPS-FM 2014. Between January 1997 and December 2017, NH_3-N concentrations fell within the A attribute state 70% of the time (graded as A on 63 occasions) and were within the B attribute state the remaining 30% of the time (graded as B on 27 occasions) (Figure 21 and Figure 22). This suggests that, for most of the time 1-5% of the most sensitive species were occasionally impacted by ammonia toxicity at this site.

Current NH_3-N concentrations in the Inaha Stream downstream of the ORP discharges were assigned to attribute state C under the NPS-FM 2014. Between January 1997 and December 2017, NH_3-N concentrations were within attribute state B 31% of the time (graded as B on 32 occasions) and within attribute state C for the remainder of the time (graded as C on 72 occasions) (Figure 21 and Figure 22). Attribute state C indicates that up to 20% of the most sensitive species were likely regularly impacted by ammonia toxicity, and the survival of the most sensitive species was reduced.

Data indicate that median NH_3-N concentrations at the downstream site decreased consistently between 2004 and 2009/2010, and have remained in attribute state B since mid-2006. From October 2006, wastewater has only been discharged to the Inaha Stream when the dilution ratio exceeds 1:300, and this has likely driven the decreases in median NH_3-N concentrations. Annual maximum concentrations have hovered between attribute state B and C due to occasional spikes. Based on the available data, removal of those occasional spikes, either by further reducing the frequency of wastewater discharges or by improving the quality of the combined cooling/backwash water and stormwater discharge would likely place the site in attribute state B.

Kākahi (freshwater mussels), which have been found in the Inaha Stream, are particularly sensitive to ammonia toxicity, and the current NPS-FM 2014 attribute state B thresholds do not protect for this species. Recent advice from Dr Chris Hickey of NIWA suggests that to protect kākahi from chronic toxicity effects, NH_3-N would need to be managed at level that 95^{th} percentile concentrations do not exceed the attribute state B median concentration threshold (0.0092 g/m^3) (Hickey, 2018).

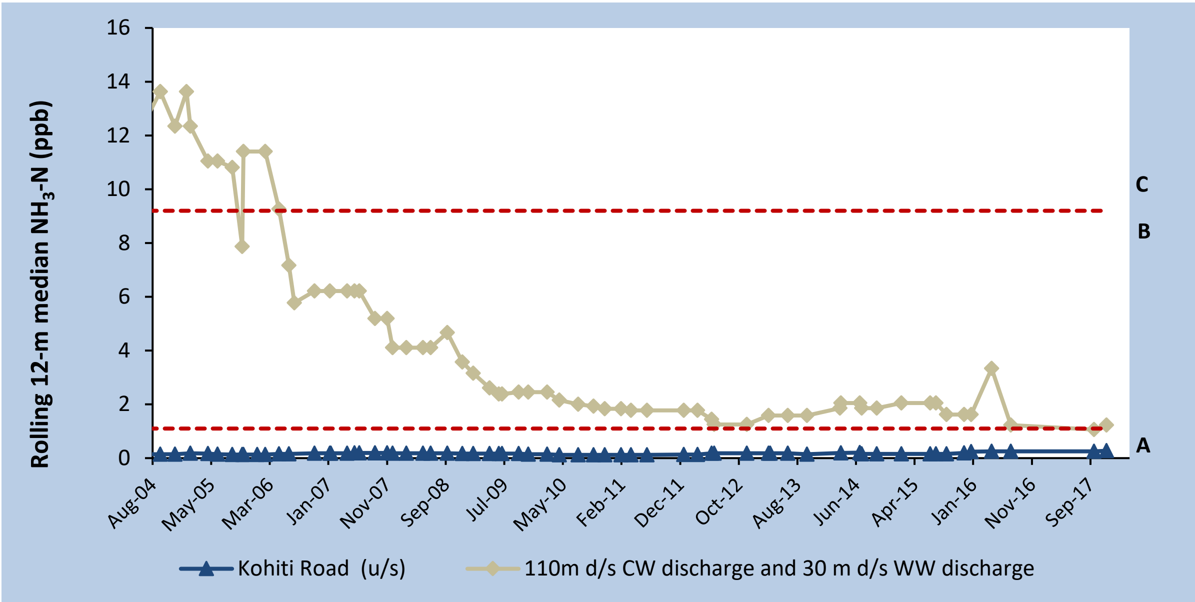

Figure 21: Rolling annual median NH_3-N concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. NPS-FM 2014 Attribute States (A & B) are indicated by the red lines.

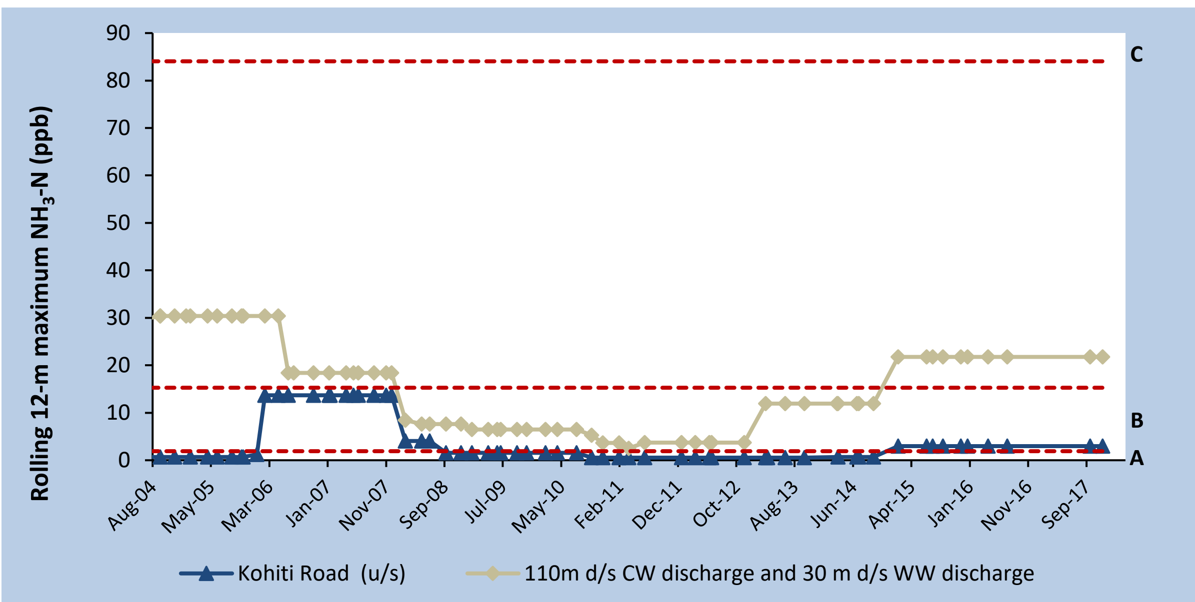

Figure 22: Rolling annual maximum NH_3-N concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. NPS-FM 2014 Attribute States (A, B & C) are indicated by the red lines.

Current NNN concentrations in the Inaha Stream immediately upstream of the ORP were assigned to attribute state C under the NPS-FM 2014. Between January 1997 and December 2017, NNN concentrations were within the B attribute state 38% of the time (graded as B on 33 occasions), and were within the C attribute state the remaining 62% of the time (graded as C on 53 occasions) (Figure 23 and Figure 24). This suggests that the growth of up to 20% of species (mainly sensitive species such as fish) may have been affected by nitrate toxicity at this site, but there would have been no acute effects.

The risk of nitrate toxicity downstream of where the discharges enter the Inaha River was similar to at the upstream site. Current NNN concentrations downstream of the discharge were assigned to attribute state C under the NPS-FM 2014, and between January 1997 and December 2017 NNN concentrations were within attribute state B 19% of the time (graded as B on 18 occasions) and were within attribute state C for the remainder of the time (graded as C on 23 occasions) (Figure 23 and Figure 24). While rolling median and 95th percentile concentrations have been increasing at downstream site since 2011, this is not caused by point source discharges from the ORP, as similar increases have occurred at the upstream site (Figure 23 and Figure 24).

It is important to note, that monitoring has been heavily skewed towards winter. As NPS-FM 2014 attribute states are supposed to be assigned using water quality data that are representative of the range of conditions experienced at a site, the gradings presented above should be considered indicative only.

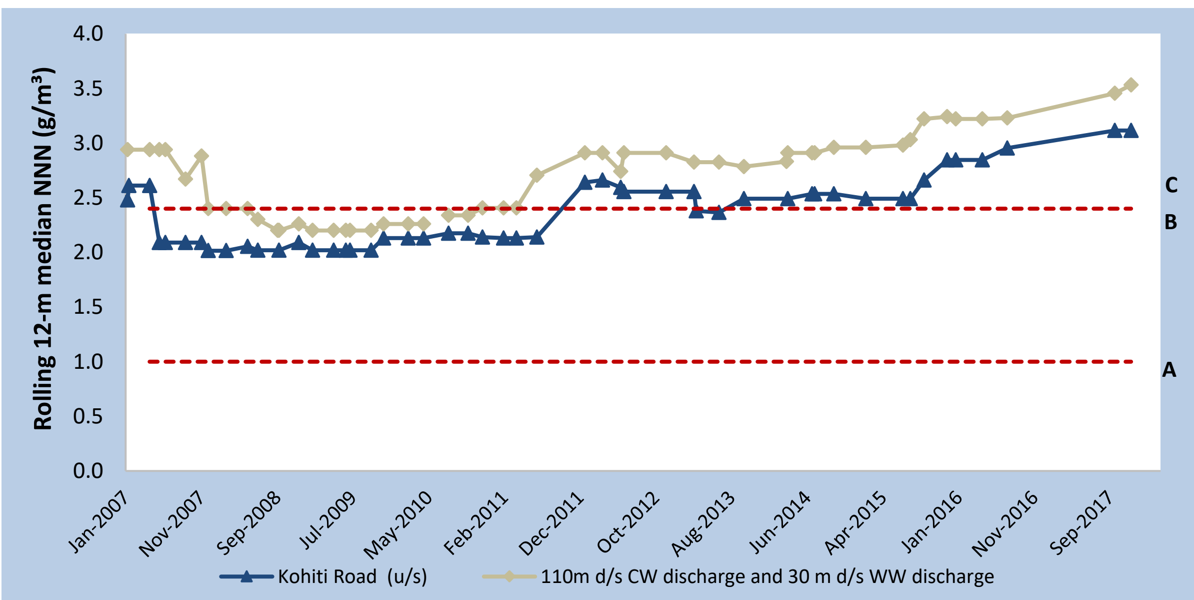

Figure 23: Rolling annual median NNN concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. NPS-FM 2014 Attribute States (A & B) are indicated by the red lines.

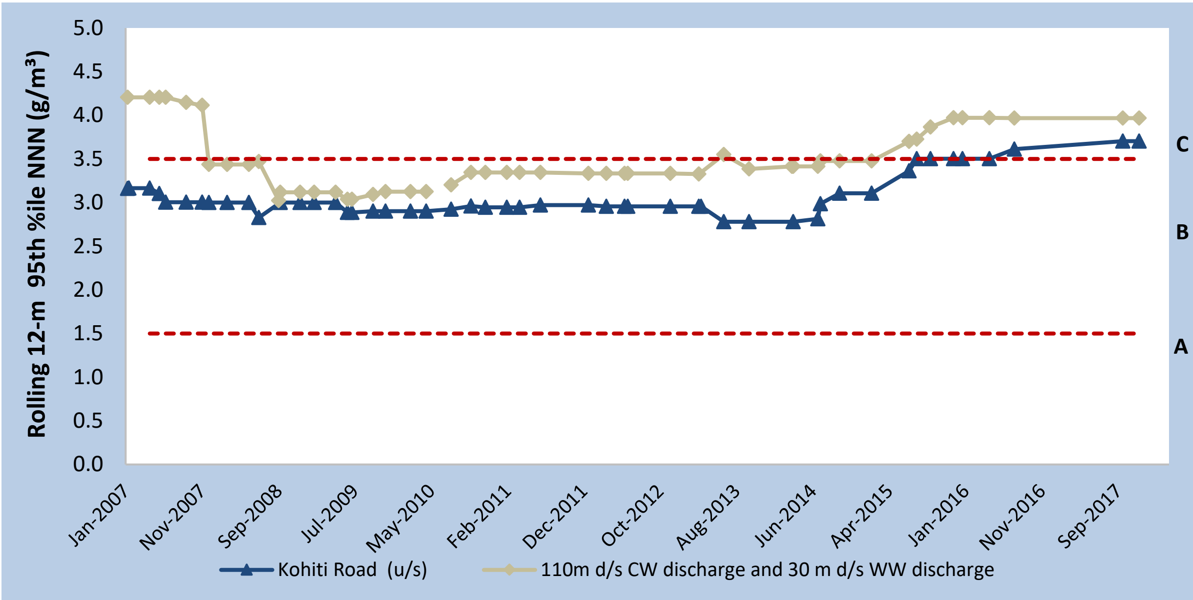

Figure 24: Rolling annual 95th percentile NNN concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. NPS-FM 2014 Attribute States (A & B) are indicated by the red lines.

4.2.1. Soluble Inorganic Nitrogen (SIN) and Dissolved Reactive Phosphorus (DRP)

Between January 1997 and December 2017 marked, statistically significant increases in soluble inorganic nitrogen (SIN) (average increase = 1.2 g/m^3; 48%) and DRP concentrations (average increase = 0.91 g/m^3; 228%) were observed between monitoring sites on the Inaha Stream immediately upstream and downstream of the point source discharges from the ORP (Figure 25, Figure 26, Figure 27, Figure 28 and Appendix B).

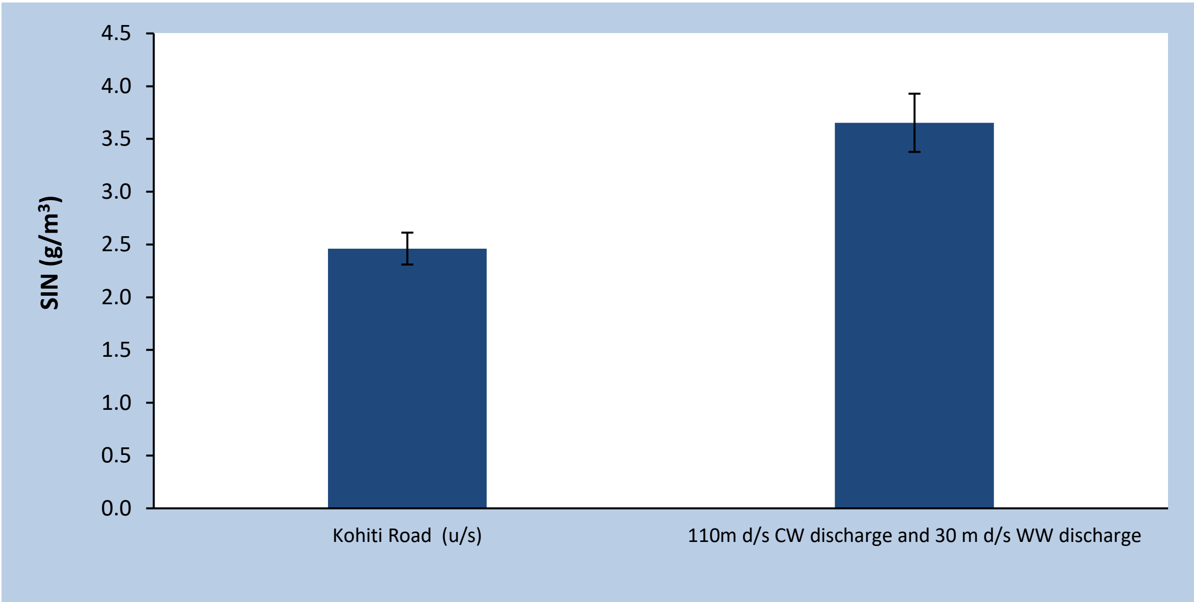

Figure 25: Mean SIN concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

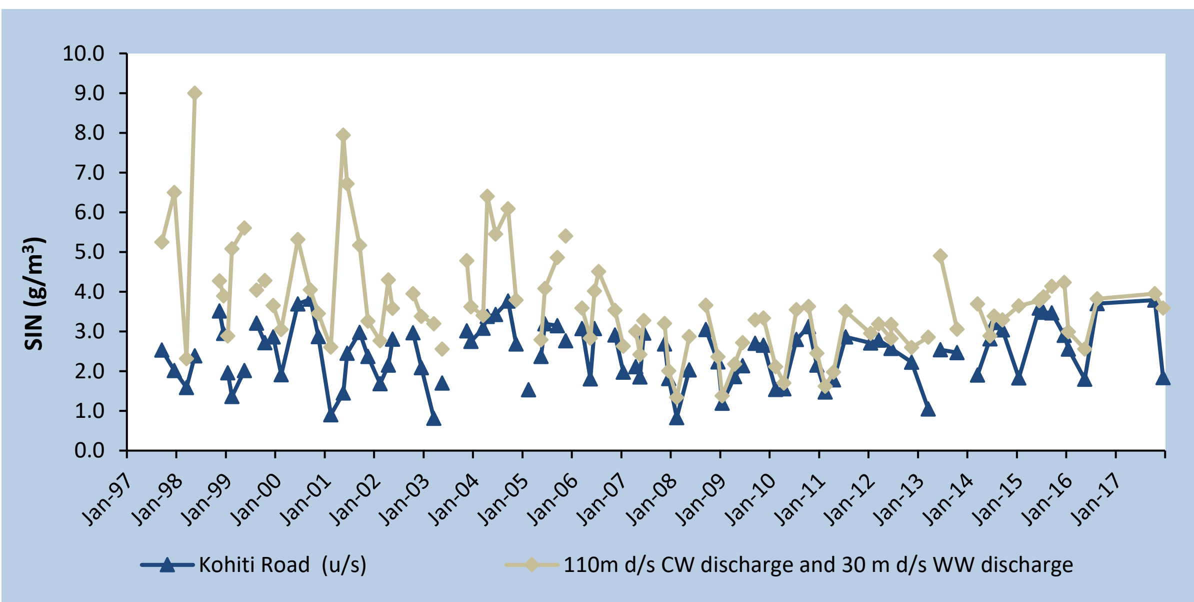

Figure 26: Daily SIN concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP.

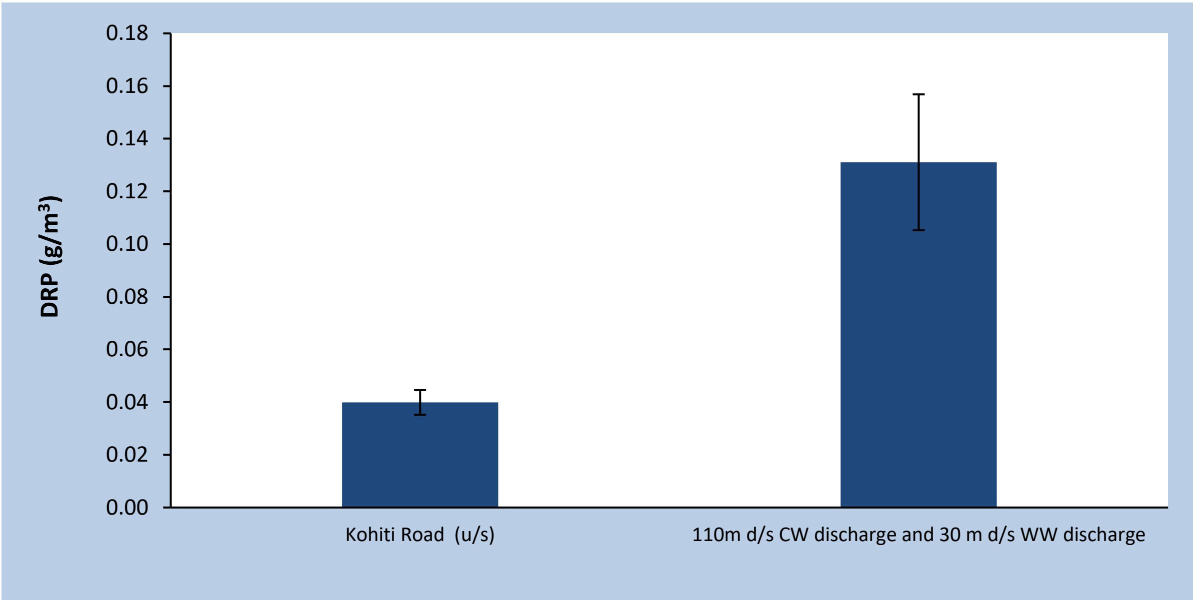

Figure 27: Mean DRP concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

Assessment against RFP guidelines and consent conditions

Neither the relevant resource consents or the RFP stipulate an instream limit for SIN that the available data can be assessed against.

The RFP sets one in-stream guideline for DRP:

- *After reasonable mixing, the contaminant, either by itself or in combination with other contaminants shall not cause the concentration of dissolved reactive phosphorus to exceed 0.03 g/m^3*

DRP concentrations in the Inaha Stream frequently exceeded the RFP guideline both upstream and downstream of the ORP (Figure 28). However, the magnitude and frequency exceedances at the downstream site were greater than at the upstream site. DRP concentrations exceeded the RFP guideline on 62 sampling occasions at the upstream site (33% compliance), and the average exceedance was 0.017 g/m^3 (Figure 28). At the downstream site the DRP guideline was exceeded on 89 occasions (3% compliance), and the average exceedance was 0.10 g/m^3 (Figure 28).

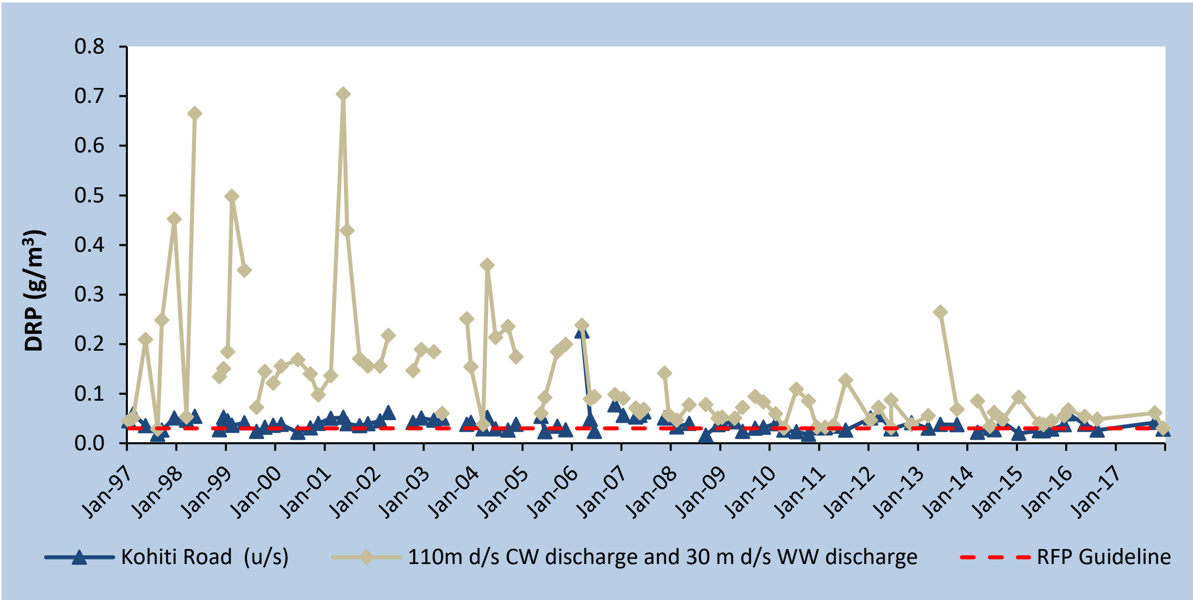

Figure 28: Daily DRP concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. The dashed red line represents RFP guideline for DRP.

4.2.2. Faecal coliforms

Between January 1997 and December 2017 increases in faecal coliforms concentrations (average increase = 465 /100ml; 46%) were measured between monitoring sites on the Inaha Stream immediately upstream and downstream of the point source discharges from the ORP. However, these increases were not statistically significant (Figure 29, Figure 30 and Appendix B).

Note: Neither the relevant resource consents or the RFP stipulate an instream limit for faecal coliforms that the available data can be assessed against.

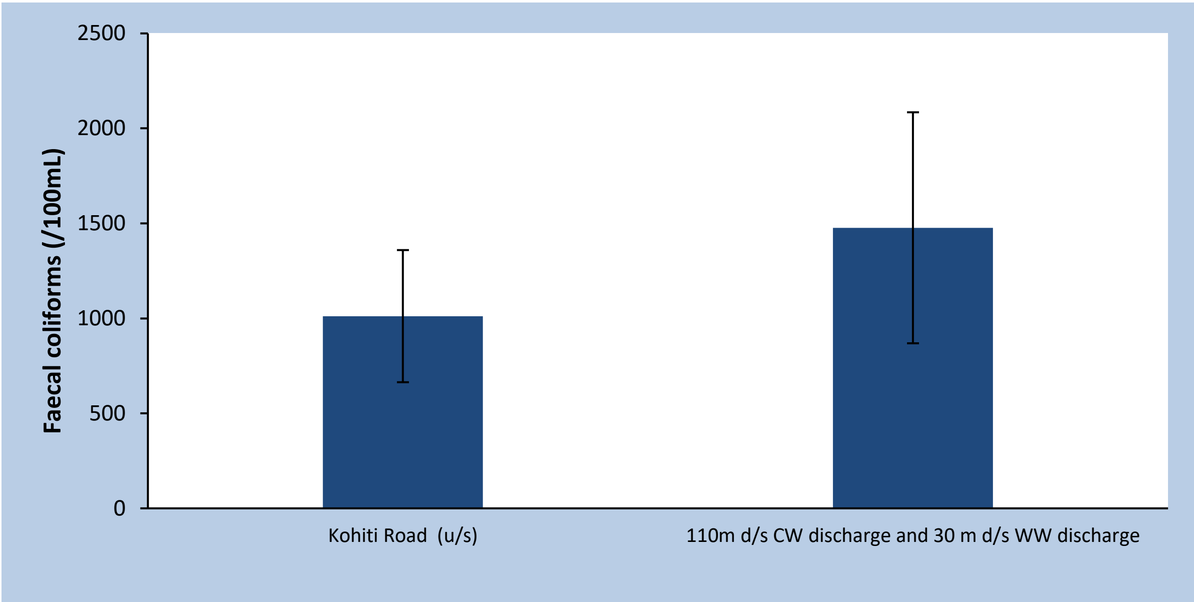

Figure 29: Mean faecal coliform concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

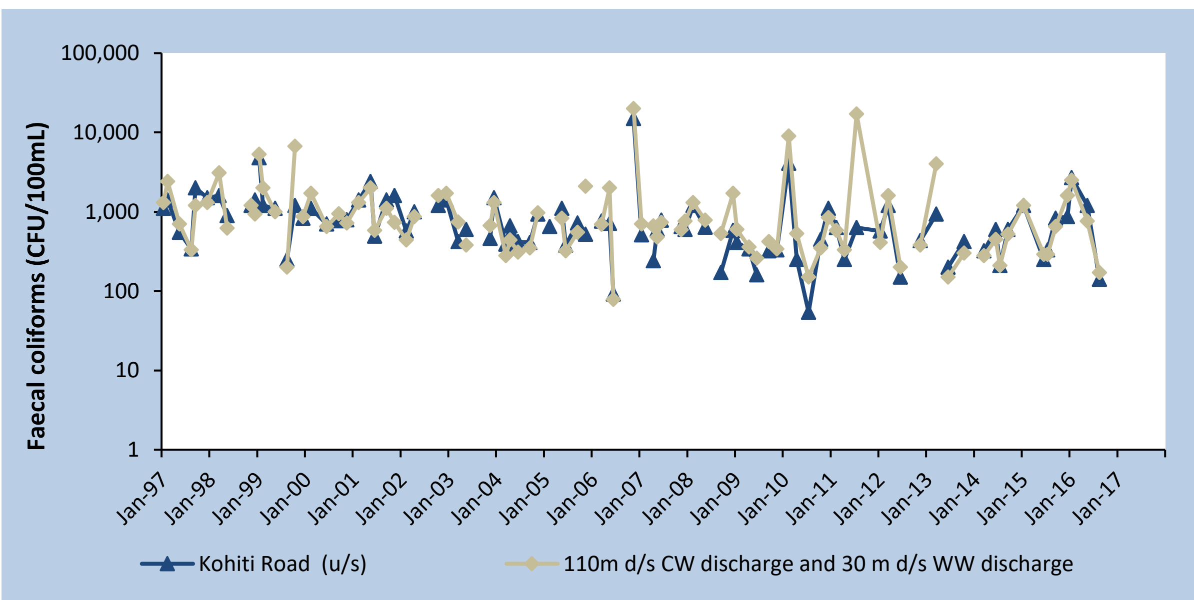

Figure 30: Daily faecal coliform concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP.

4.2.3. Biochemical oxygen demand

Between January 1997 and December 2017 marked and statistically significant, increases in $ScBOD_5$ concentrations (average increase = 0.2 g/m^3; 150%) were observed between monitoring sites on the Inaha Stream immediately upstream and downstream of the point source discharges from the ORP (Figure 31 and Appendix B).

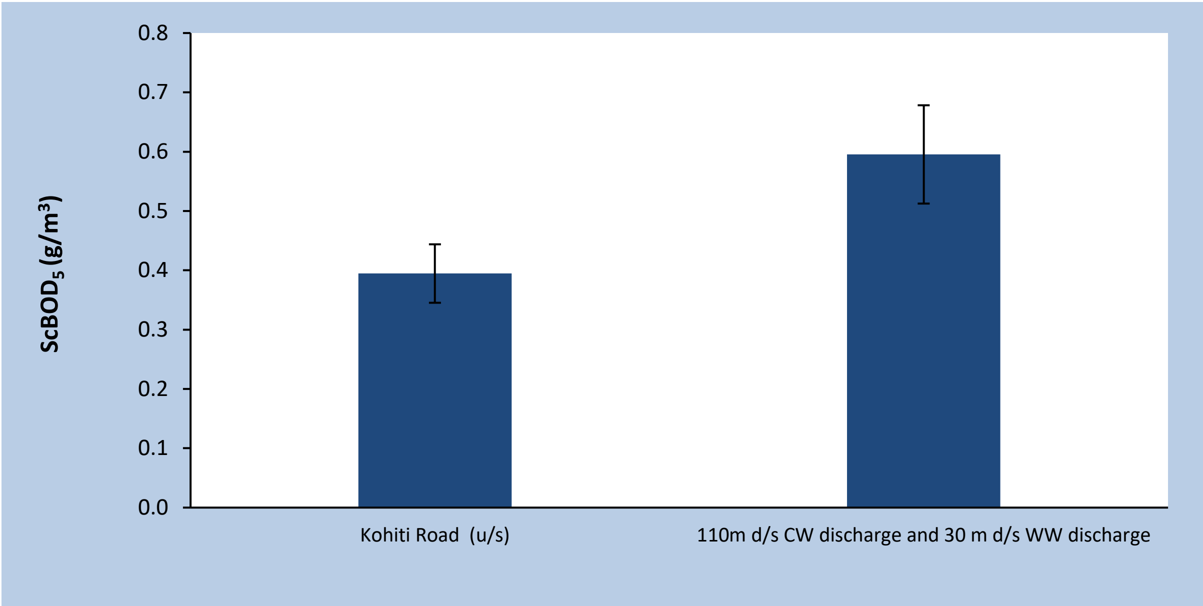

Figure 31: Mean $ScBOD_5$ concentrations (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

<u>*Assessment against RFP guidelines and consent conditions*</u>

The RFP sets one in-stream guideline for $ScBOD_5$:

- *After reasonable mixing, the contaminant, either by itself or in combination with other contaminants shall not cause the concentration of carbonaceous, filtered BOD to exceed 2 g/m^3.*

Resource Consent Number 2049-4 sets one in-stream limit for $ScBOD_5$ (condition 9(b)):

- *The discharge shall not cause or give rise to an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 g/m^3 at any point in the receiving waters below the mixing zone.*

$ScBOD_5$ concentrations in the Inaha Stream upstream and downstream of the ORP were compliant with the RFP guideline and the consent limit on all sampling occasions. (Figure 32).

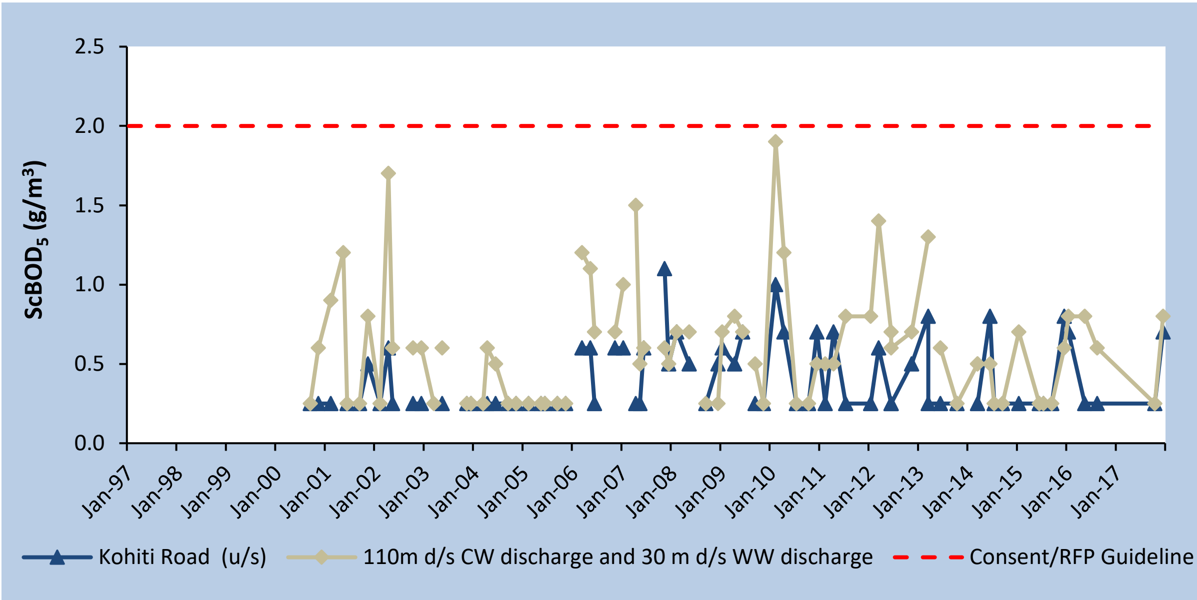

Figure 32: Daily ScBOD$_5$ concentrations (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. The dashed red line represents the RFP guideline and consent limit for ScBOD$_5$.

4.2.4. Turbidity

Between January 1997 and December 2017 only slight increases in turbidity (average increase = 1 NTU; 16%) were observed between monitoring sites immediately upstream and downstream of the point source discharges from the ORP (Figure 33, Figure 34 and Appendix B). However, these increases were statistically significant.

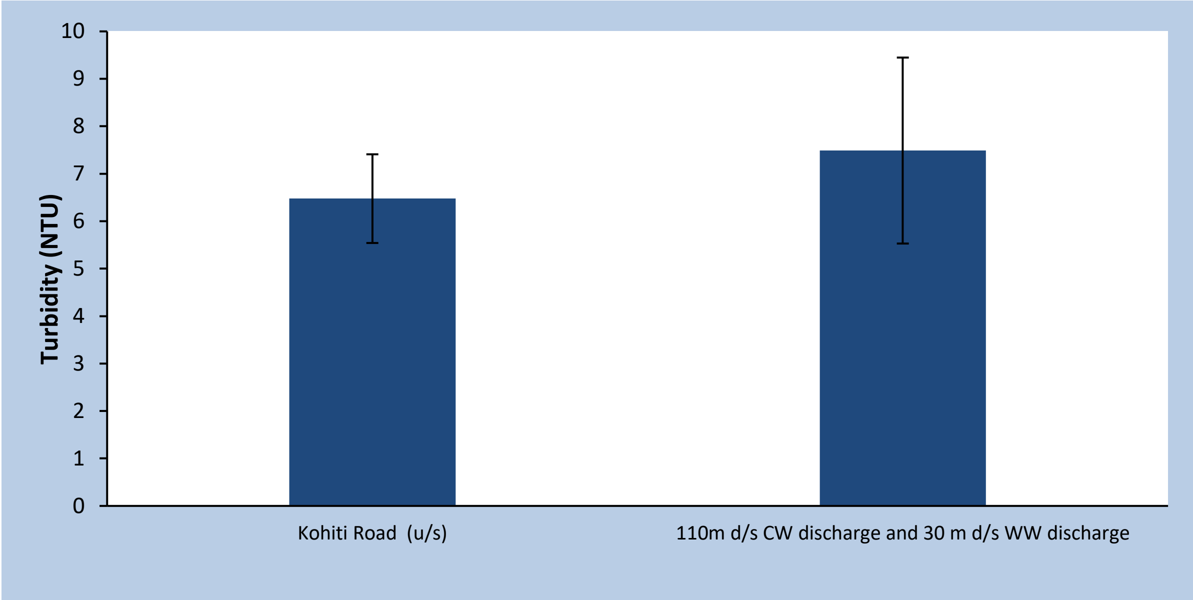

Figure 33: Mean turbidity (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

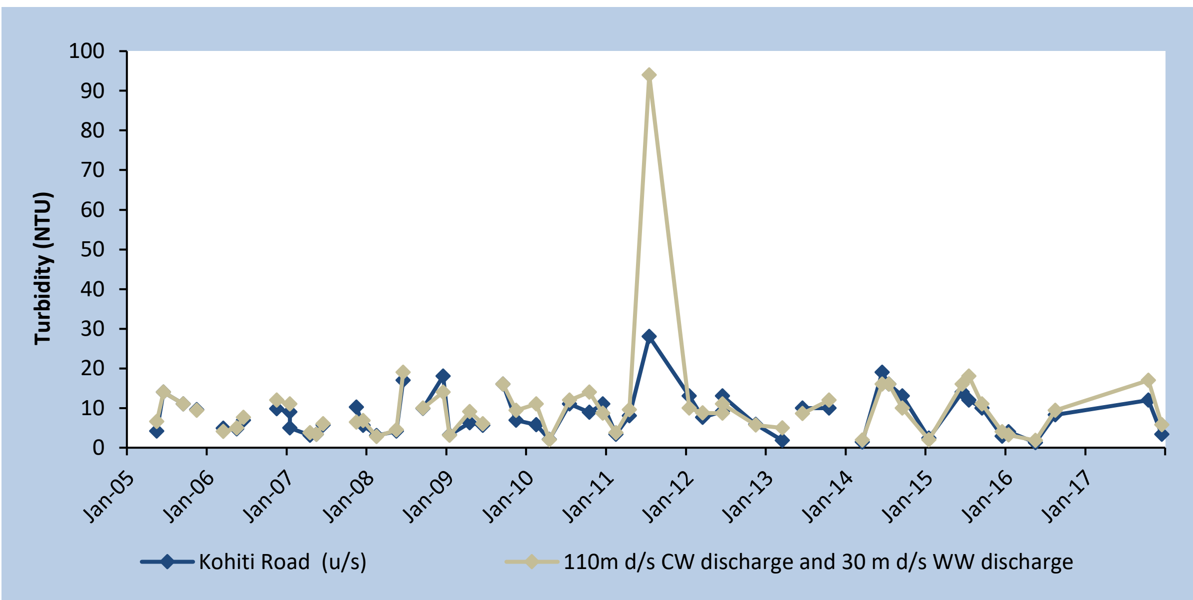

Figure 34: Daily records of turbidity (January 2005 – December 2017) at sites immediately upstream and downstream of the ORP

Note: Neither the relevant resource consents or the RFP stipulate an in-stream limit turbidity that the available data can be assessed against.

4.2.5. pH, temperature and dissolved oxygen

A difference in average pH was not observed between the upstream and downstream monitoring sites on the Inaha Stream (average change <0.01°C (0.1%); (Figure 35, Figure 36 and Appendix B). Statistically significant increases in temperature and decreases in DO saturations were observed downstream of the ORP (Figure 37, Figure 38 and Appendix B). However, the observed difference between sites was generally small (temperature average increase = 1.1 °C (8%); DO saturation average decrease = 1.8% sat. (2%)).

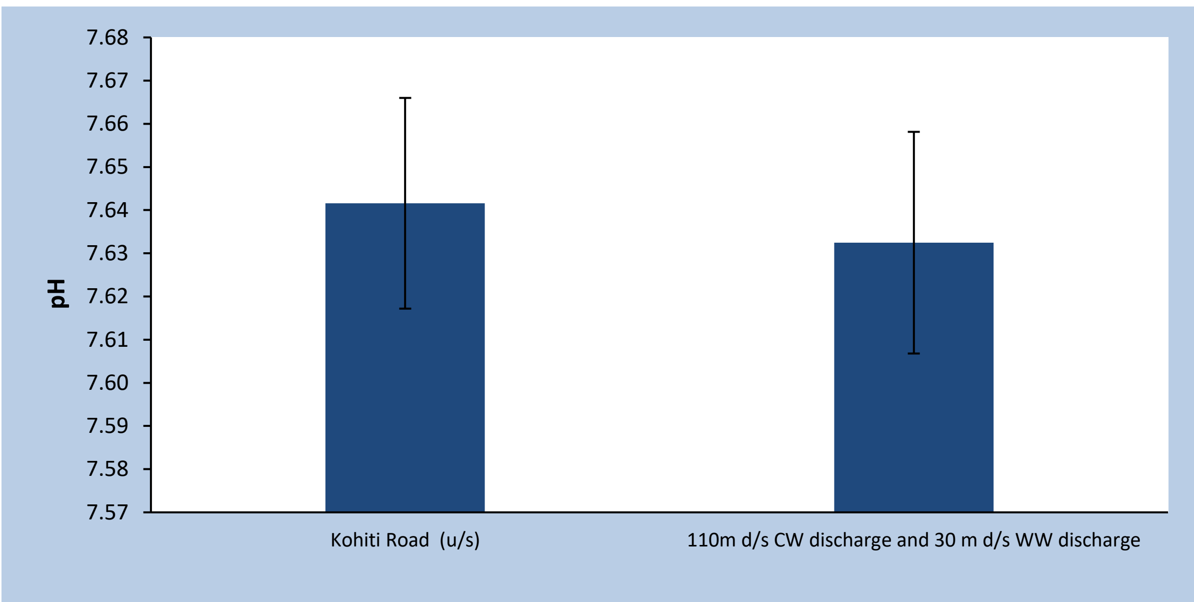

Figure 35: Mean pH (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

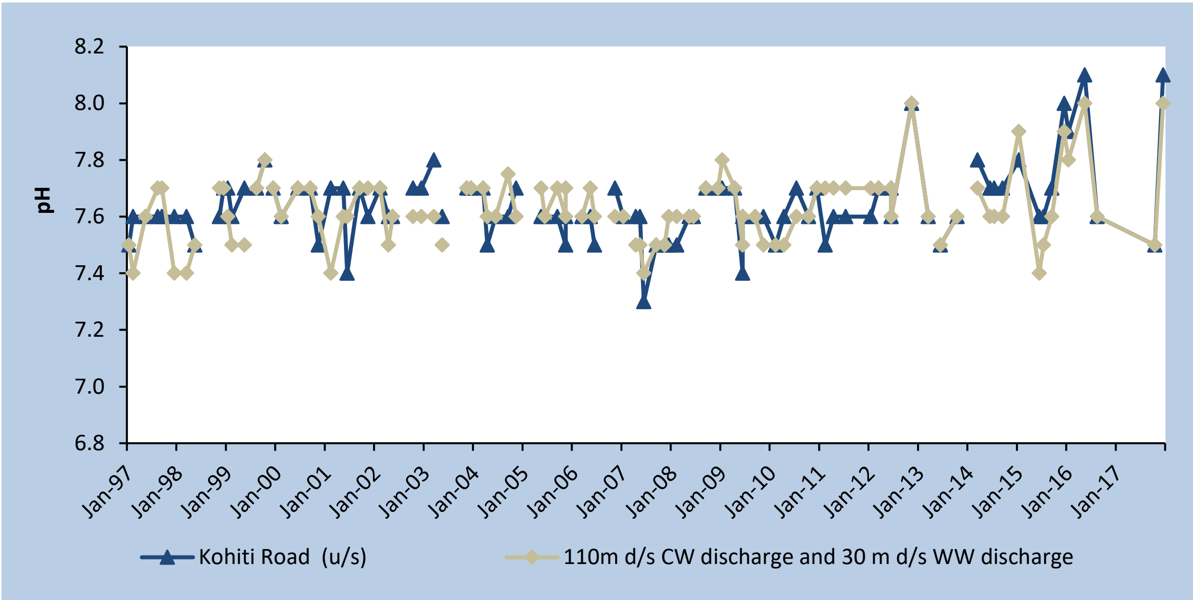

Figure 36: Daily records of pH (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP

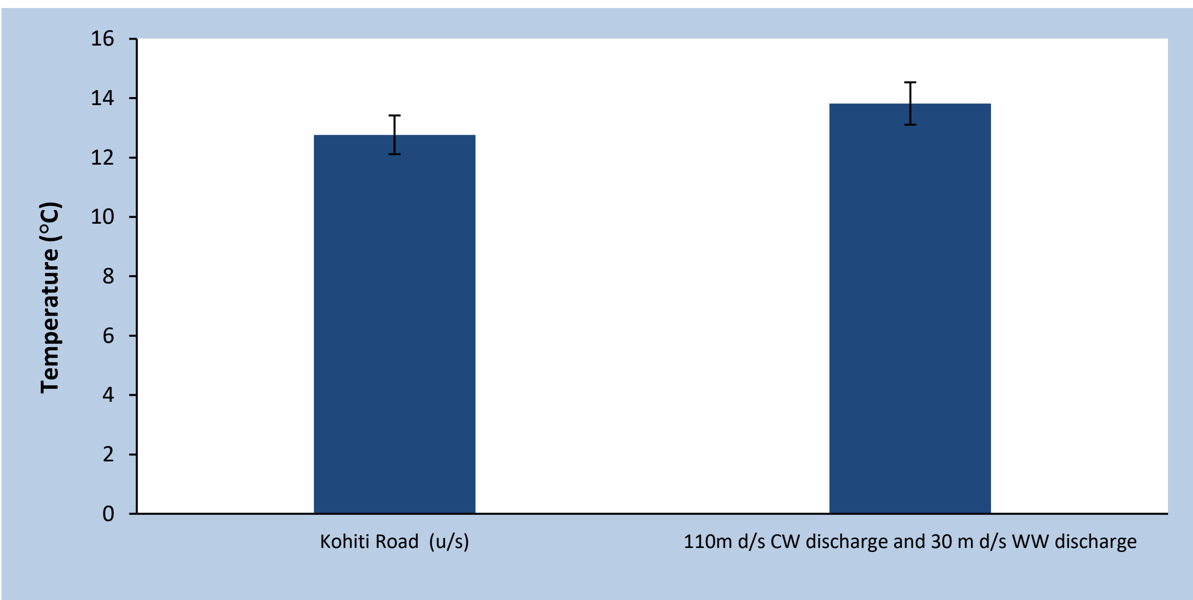

Figure 37: Mean temperature (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

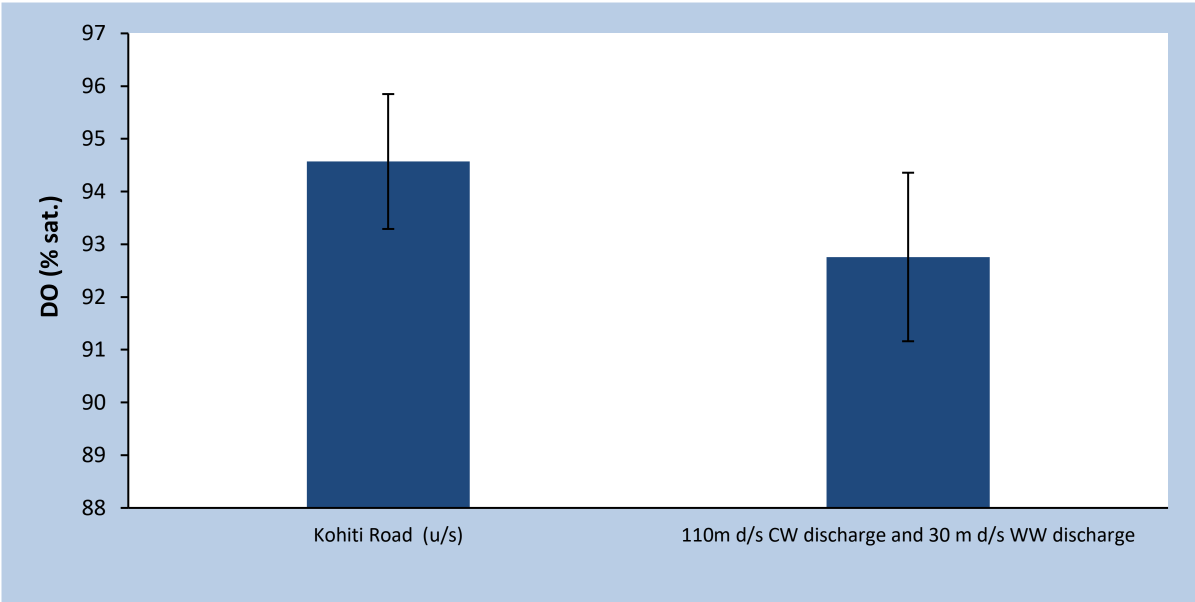

Figure 38: Mean DO saturation (± 95% CI) at sites immediately upstream and downstream of the ORP (January 1997 – December 2017).

<u>*Assessment against RFP guidelines and consent conditions*</u>

The RFP sets two in-stream guidelines for temperature and one guideline for DO:

- *After reasonable mixing, the contaminant, either by itself or in combination with other contaminants shall not cause:*
  - *The natural temperature of the water to change by more than 3° Celsius;*
  - *The natural temperature of the water to exceed 25° Celsius; or*
  - *The concentration of dissolved oxygen to fall below 80% of saturation,*

Resource Consent Number 2049-4 sets one in-stream limit each for pH, temperature and DO (condition 9):

- *The discharge shall not cause or give rise to any of the following effects, at any point in the receiving waters below the mixing zone:*
  - *A fall of more than 0.5 pH units;*
  - *A temperature rise of more than 3.0 degrees Celsius; or*
  - *A reduction in the dissolved oxygen concentration to below 80% of saturation concentration.*

The consent limit of no more than a 0.5 pH unit reduction between sites was complied with on all sampling occasions between 1997 and 2017 (Figure 39).

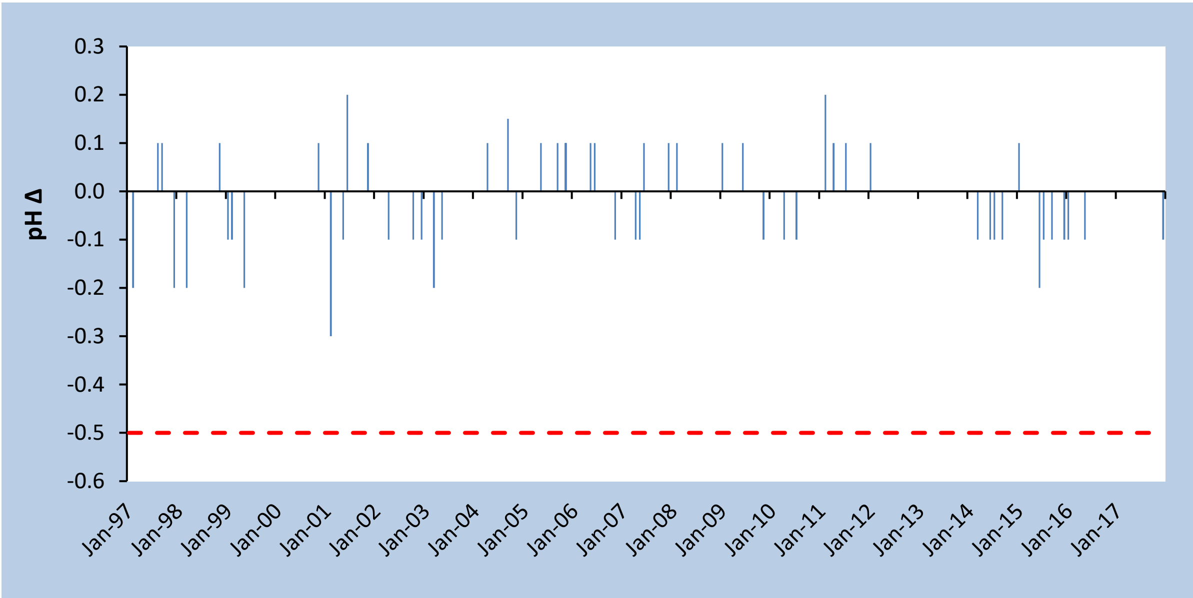

Figure 39: Change in pH between sites immediately upstream and downstream of the ORP (January 1997 – December 2017). The dashed red line represents the consent limit for pH change.

Water temperatures in the Inaha Stream were below the RFP guideline of 25°C on all sampling occasions upstream of the ORP, and only exceeded the guideline once downstream (26.0°C on the 21/02/2008) (Figure 40 and Appendix B). The RFP guideline and consent limit of no more than a 3°C change in temperature was also generally complied with, and was only breached on 6 sampling occasions (93% compliance) (Figure 41).

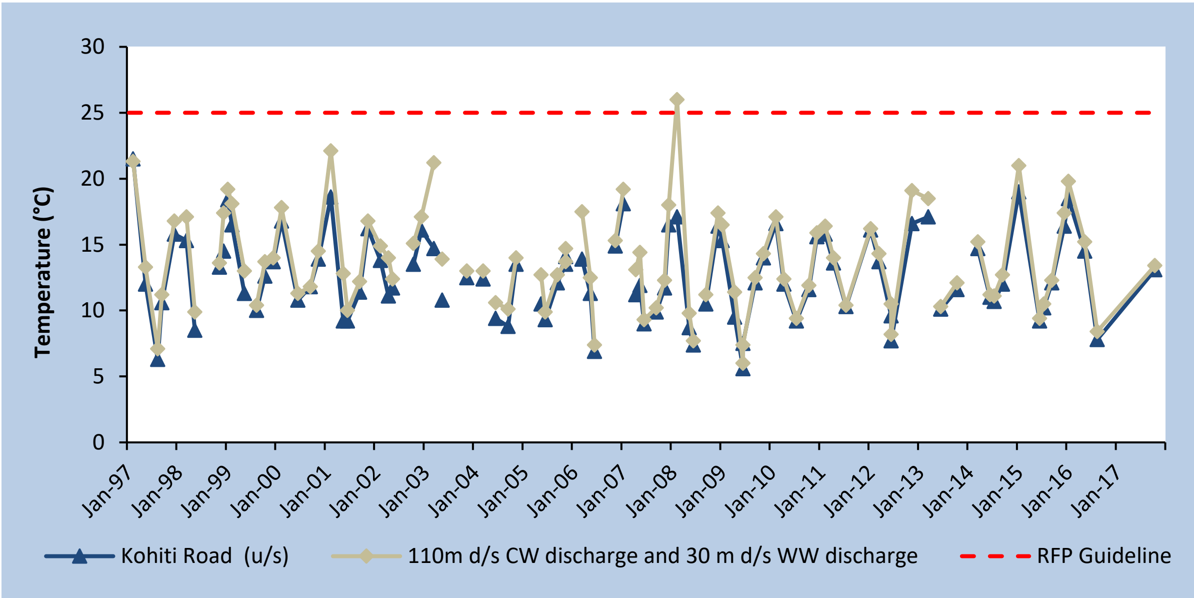

Figure 40: Daily temperature recordings (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. The dashed red line represents the RFP guideline for temperature.

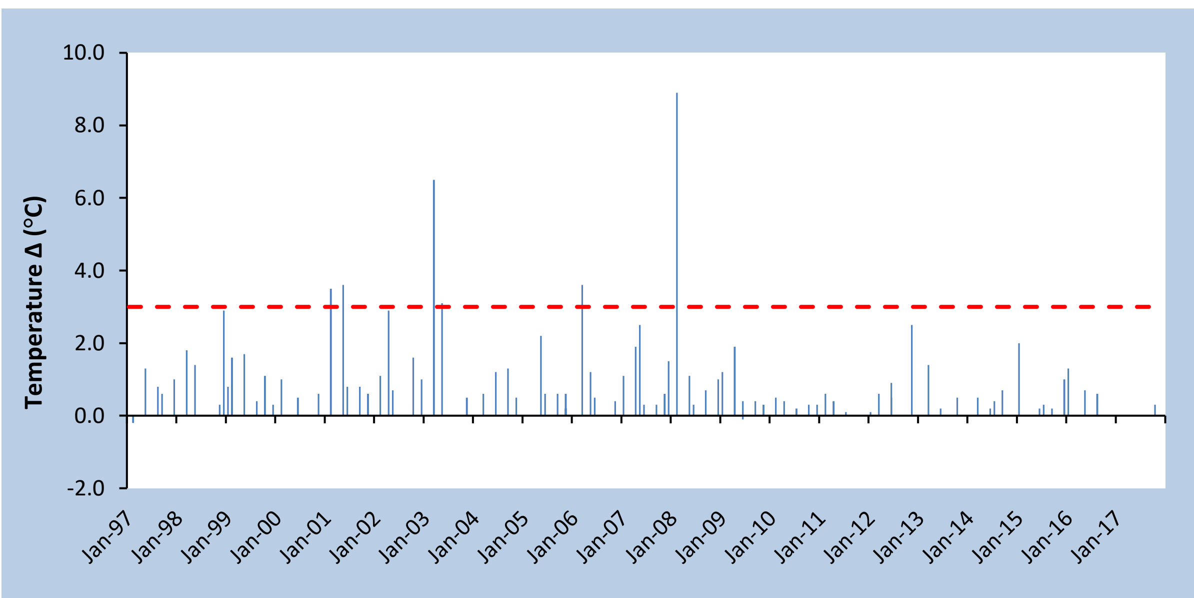

Figure 41: Change in temperature between sites immediately upstream and downstream of the ORP (January 1997 – December 2017). The dashed red line represents the RFP guideline and consent limit for temperature change.

In addition to the discrete temperature monitoring, TRC have continuously (at 15-minute intervals) monitored water temperature in the Inaha Stream upstream and downstream of the ORP since July 2014. These data also show that discharges from the plant are not causing the RFP guidelines and the consent limits for temperature to be exceeded. Since July 2014, water temperature has exceeded 25°C less than 0.4% of the time both upstream and downstream of the ORP discharges, and water temperature downstream of the plant has consistently been within 3°C of the upstream monitoring site (Table 9 and Figure 42). It is also worth noting that since July 2014, temperature has remained below the lethal limit for brown trout (30°C) at both sites (Figure 42).

Table 9: Summary of continuous temperature monitoring data collected in the Inaha Stream upstream and downstream of the ORP.

	U/S of ORP discharges	D/S of ORP discharges MCI
Number of measurements	138,296	
Number of measurements >25°C	453	490
% of measurements >25	0.33%	0.35%
Number of measurements when Δ between sites >3°C	0	
% of measurements when Δ between sites >3°C	0%	

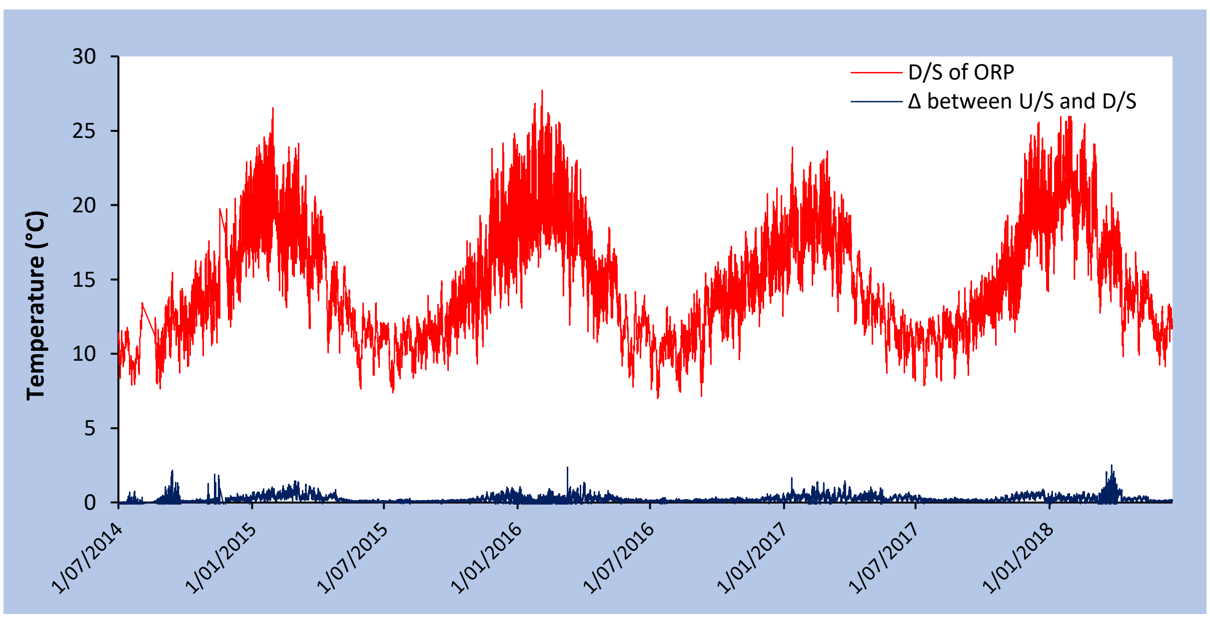

Figure 42: Temperature in the Inaha stream downstream of the ORP and the difference in temperature between the upstream and downstream monitoring sites between 01/07/2014 and 18/06/2018 (measurments taken every 15 minutes).

DO saturation in the Inaha Stream was generally compliant with the RFP guideline and consent limit of 80% both upstream and downstream of the ORP. DO saturation was above 80% on all but one sampling occasion at the upstream monitoring site (99% compliance), and all but six sampling occasions at the downstream site (94% compliance) (Figure 43 and Appendix B). It should be noted, however, that discrete DO data collected during the day does not provide an accurate representation of the range of DO conditions experienced at a site, and continuous DO monitoring would be needed to fully assess compliance with the RFP guideline.

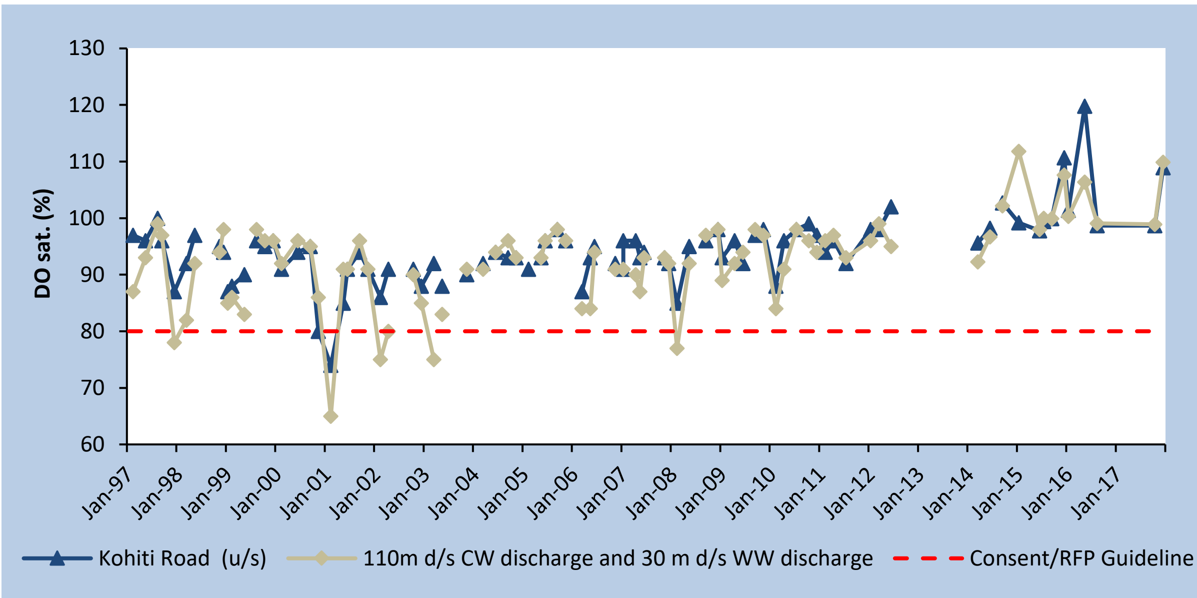

Figure 43: Daily DO saturation recordings (January 1997 – December 2017) at sites immediately upstream and downstream of the ORP. The dashed red line represents the RFP guideline for DO.

4.3. Relative contribution of different discharges from the ORP to changes in water quality in the Inaha Steam

The main driver of increased $ScBOD_5$, faecal coliforms and NH_4-N concentrations in the Inaha Stream downstream of the ORP appears to be the discharge of cooling/backwash water and stormwater. These discharges had a far greater influence on median, average and 75th percentile concentrations than the wastewater discharges (Figure 44, Figure 45 and Figure 46). The wastewater and the cooling/backwash water and stormwater discharges appeared to have a similar level of influence on downstream DRP, NNN and SIN concentrations (Figure 47, Figure 48 and Figure 49). That wastewater discharges have a relatively low level of effect on downstream water quality compared to the other discharges reflects the different discharge regimes from the plant. While cooling/backwash water and stormwater is discharged continuously, including during periods of low flows, wastewater is only discharged episodically, with no discharge when the dilution ratio is less than 1:300. Therefore, while wastewater discharges have significantly higher contaminant concentrations than the cooling/backwash/stormwater discharges (see Section 2.3.1), their potential to influence overall water quality in the Inaha Stream is lower.

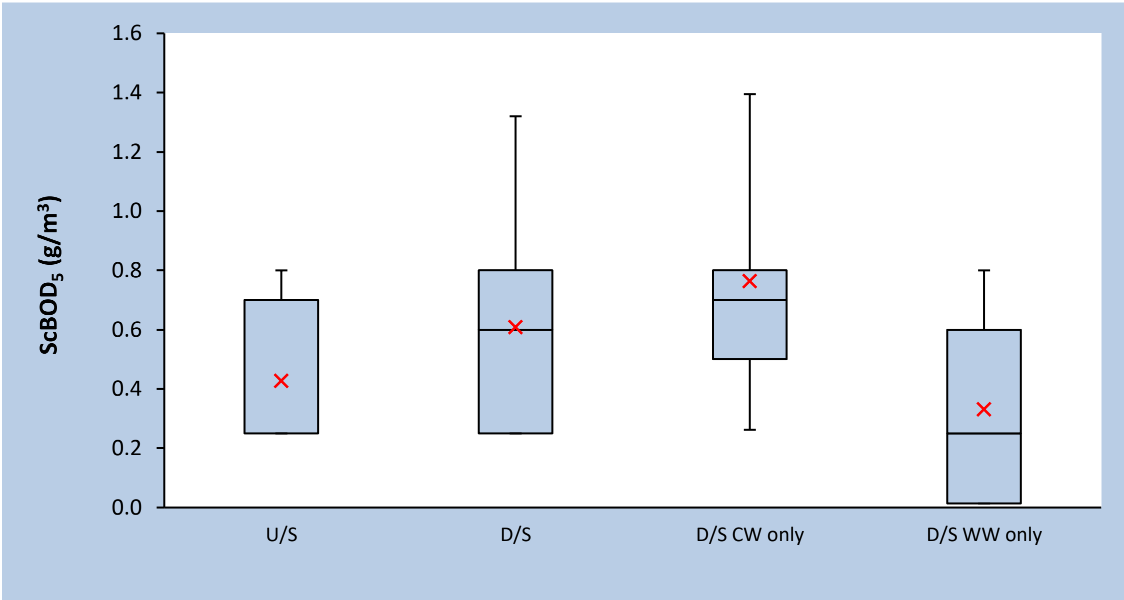

Figure 44: Current (July 2008 – July 2016) distribution of ScBOD5 concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

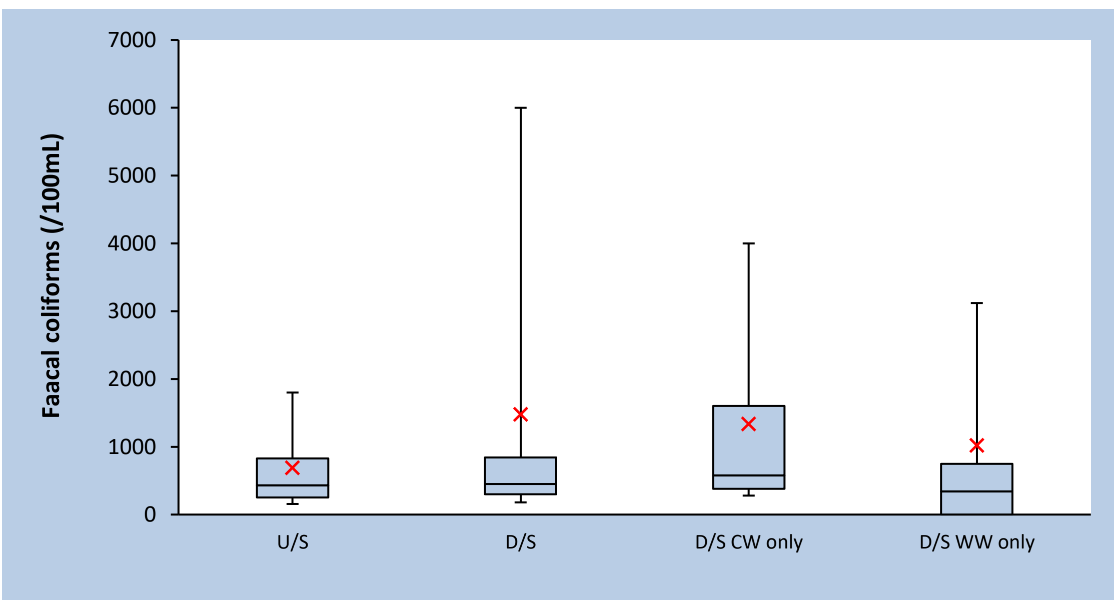

Figure 45: Current (July 2008 – July 2016) distribution of faecal coliform concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

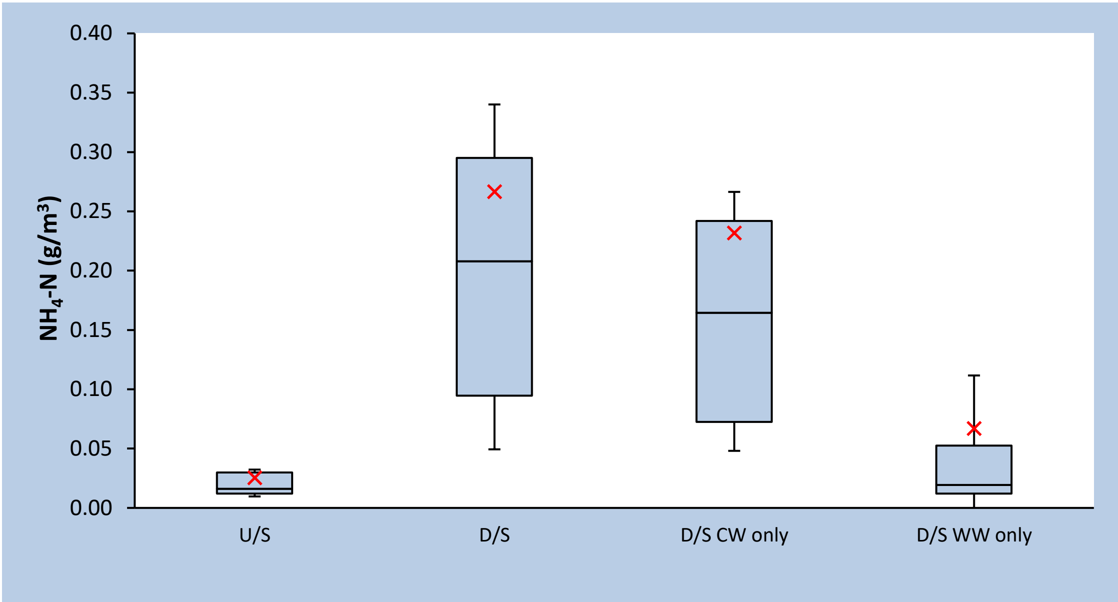

Figure 46: Current (July 2008 – July 2016) distribution of NH_4-N concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

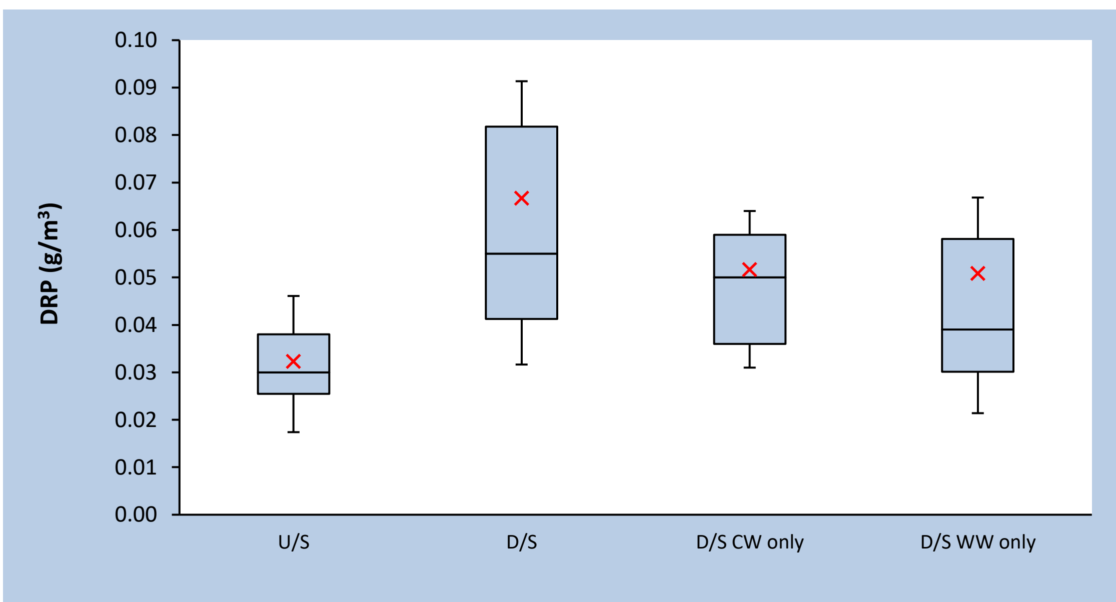

Figure 47: Current (July 2008 – July 2016) distribution of DRP concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

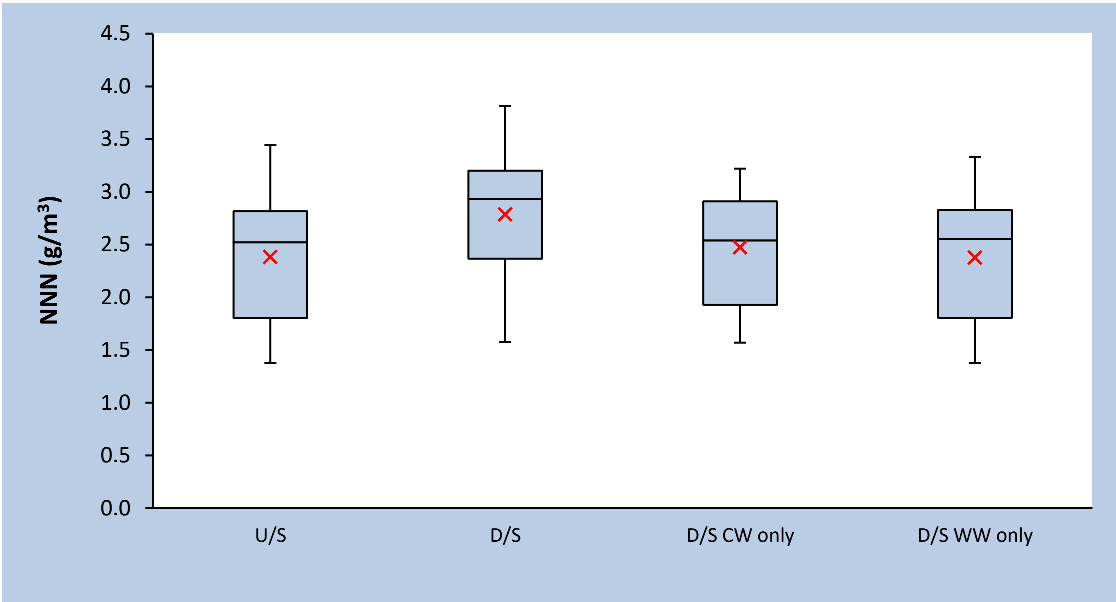

Figure 48: Current (July 2008 – July 2016) distribution of NNN concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

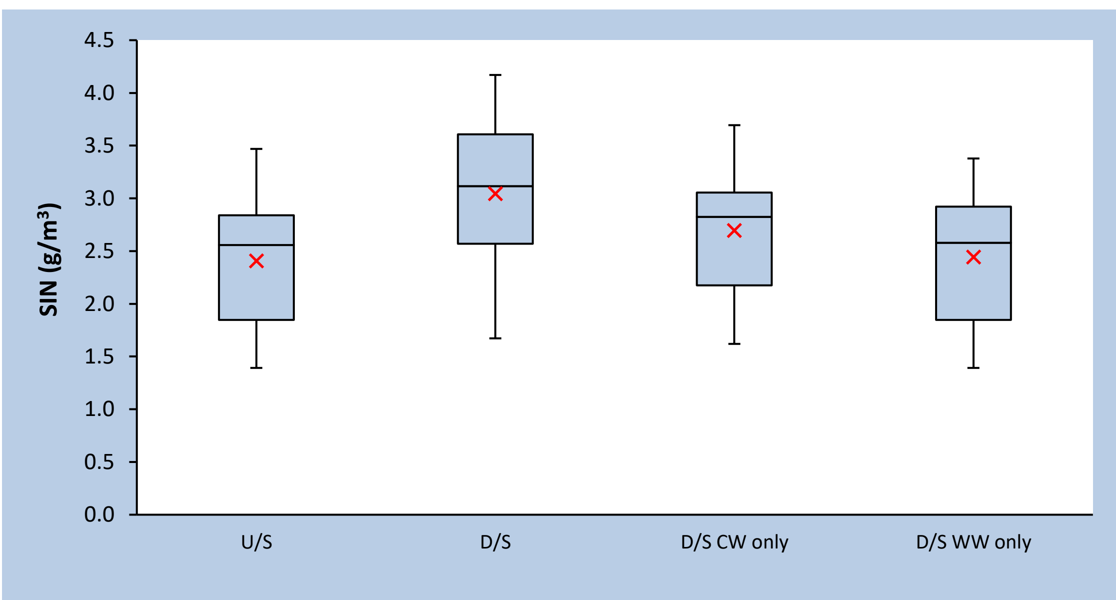

Figure 49: Current (July 2008 – July 2016) distribution of SIN concentrations in the Inaha Stream upstream and downstream of the ORP and what the distribution would be if the wastewater and cooling/backwash/stormwater discharges operated in isolation. The boxes represent the 25th and 75th percentiles, the whiskers represent the 5th and 95th percentiles, the line represents the median and the red cross represents the average.

4.4. Effects on aquatic ecology

4.4.1. Macroinvertebrate communities

All MCI and SQMCI scores in the Inaha Stream were indicative of fair water quality both upstream and downstream of ORP, except in March 2017 when the both indices at the downstream site were indicative of good water quality (Figure 50 and Figure 51). There was no consistent degradation in macroinvertebrate community health downstream of the discharge. In October 2015 and October 2016 MCI scores were slightly lower at the downstream site, while on the other four sampling occasions MCI was lowest upstream (Figure 50). SQMCI scores downstream of the ORP were the same as those recorded at upstream site in October 2015 and October 2016, but were lower in February 2016 and October 2017 and were higher in March 2017 and February 2018(Figure 51).

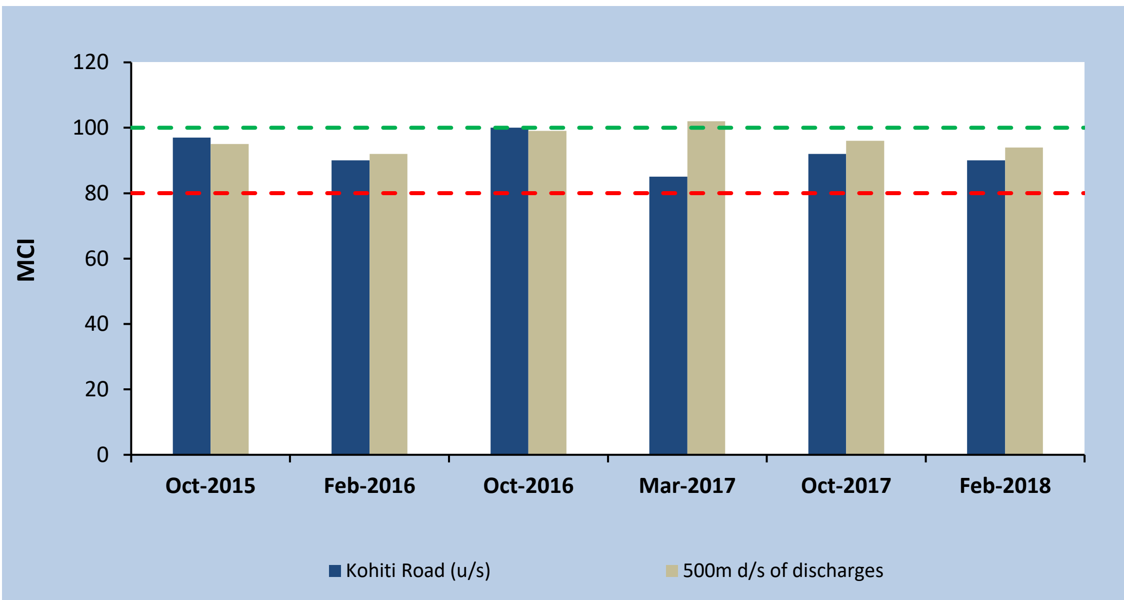

Figure 50: MCI for the sites sampled on the on the Inaha Stream upstream and downstream of the ORP between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

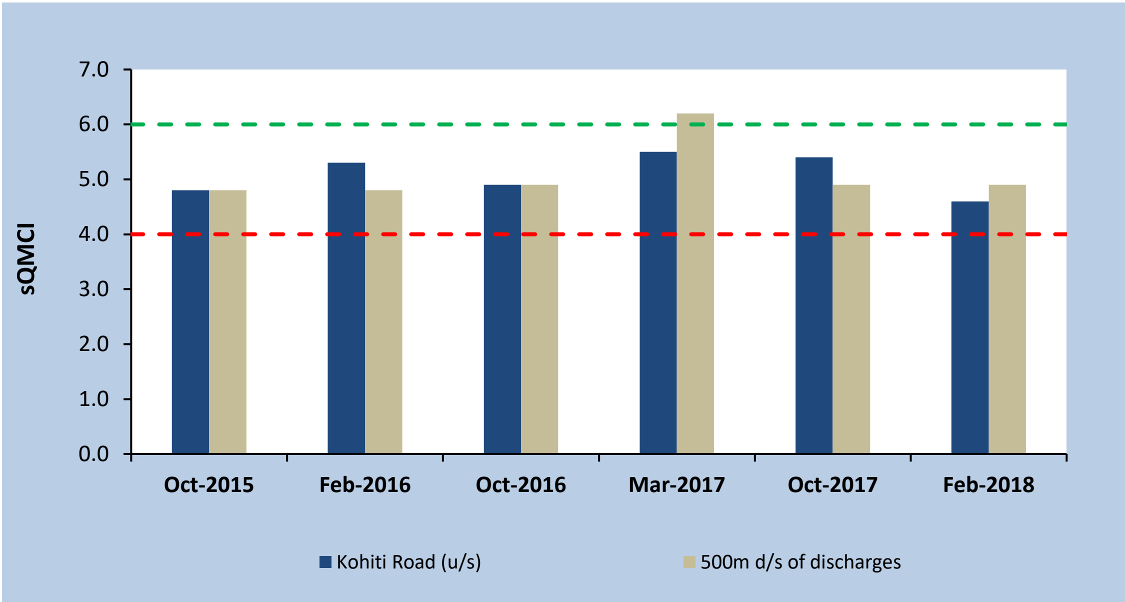

Figure 51: SQMCI for the sites sampled on the on the Inaha Stream upstream and downstream of the ORP between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

Consistent differences between the Number of Taxa and the percentage of EPT taxa at the upstream and downstream sites were also not observed. The Number of Taxa at the downstream site was higher than that recorded at the upstream site in October 2015 and October 2016, but was lower on the other four sampling occasions (Figure 52). The percentage of EPT taxa at the downstream site was similar to that recorded at the upstream site in October 2015 and February 2018, but was lower in February 2016 and higher in October 2016, March 2017 and October 2017 (Figure 53).

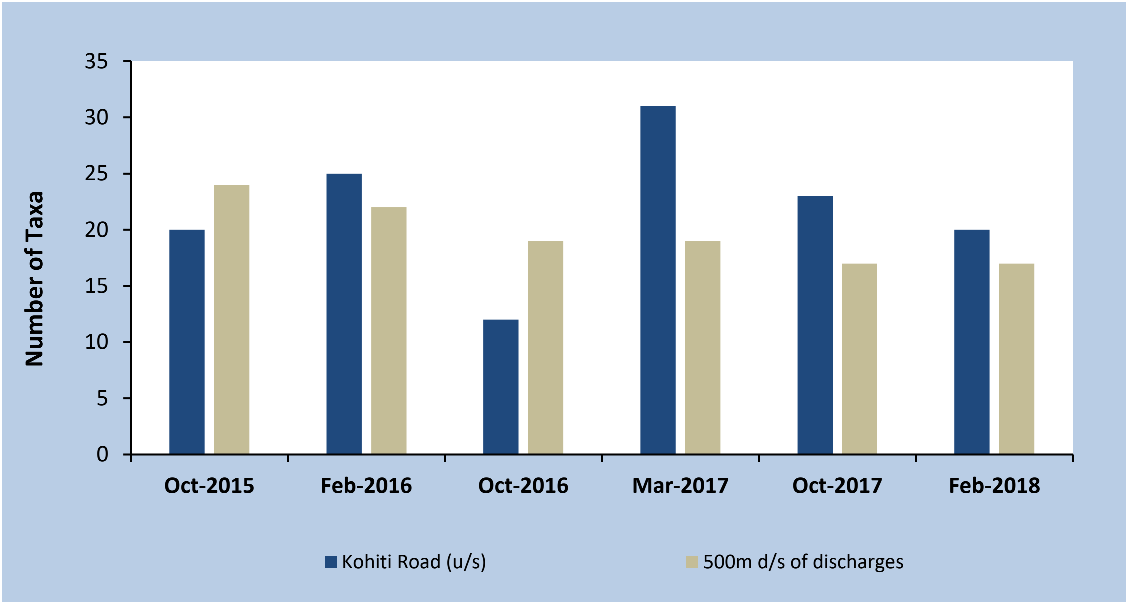

Figure 52: Number of Taxa for the sites sampled on the Inaha Stream upstream and downstream of the ORP between 2015 and 2018.

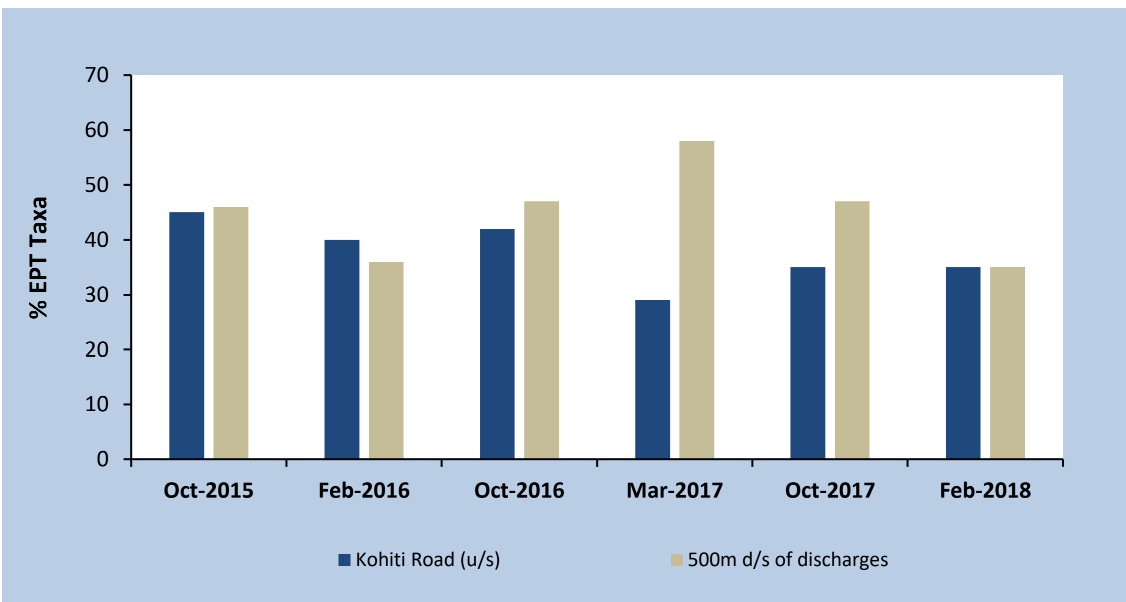

Figure 53: %EPT Taxa for the sites sampled on the Inaha Stream upstream and downstream of the ORP between 2015 and 2018.

Overall, the macroinvertebrate communities in the Inaha Stream are indicative of fair water quality both upstream and downstream of the point source discharges from the ORP, and there is no consistent evidence of a more than minor adverse effect on macroinvertebrate community health.

4.4.2. Periphyton

In hard-bottomed streams (i.e. with hard bed substrate such as gravel, cobbles and boulders), the risk of nuisance periphyton growth typically increases with SIN and DRP concentrations. In soft-bottomed streams (i.e. with bed substrate dominated by fine sediment such as sand and silts), periphyton is generally not able to grow and accumulate to nuisance levels due to a lack of substrate to attach to, and nutrient availability does not have a strong influence over macrophyte growth. The Inaha Stream in the immediate vicinity of the ORP is predominantly hard-bottomed, and shifts to a predominantly soft-bottomed substrate downstream of Normanby Road. To our knowledge, the only quantitative periphyton data available for the Inaha Stream, comes from Aquanet's own monitoring. In April 2018 and October 2018, we conducted periphyton cover sampling at a number of sites on the Inaha Stream. These results indicate that periphyton cover downstream of the ORP was not a significant issue on those dates (long filamentous cover <10%), and that point source discharges from the ORP were not having a substantive effect However, further monitoring is required to confirm those conclusions.

4.5. Summary of the effects of point source discharges

Point source discharges of treated wastewater and cooling/backwash water and stormwater are causing marked and statistically significant increases in NH_4-N, NNN, SIN, DRP and $ScBOD_5$ in the Inaha Stream below the ORP. The major driver of increased NH_4-N and $ScBOD_5$ appears to be the continuous discharge of cooling/backwash water and stormwater, while NNN, SIN, DRP are equally affected by wastewater discharges and cooling/backwash water and stormwater discharges.

It is important to note that since 2005 the frequency at which treated wastewater is discharged to the Inaha stream has been reduced to meet Condition 6 of Resource consent N. 2050-4, which stipulates that wastewater can only be discharged when there is a 300:1 dilution ratio in the Inaha Stream. This appears to have led to an improvement in downstream NH_4-N and DRP concentrations (Figure 20 and Figure 28). In recent years the frequency of wastewater discharges has decreased further (172 days in 2008/09 compared to 83 days in 2016/17 (Table 10)), and if this trend continues further improvements in water quality are likely.

Despite the significant increases in contaminant concentrations downstream of the ORP, there is no consistent evidence that point source discharges are having a significant adverse effect on aquatic life.

Table 10: Number of days per year in which treated wastewater was discharged to the Inaha Stream

Year (July – June	Days discharging
2008/2009	172
2009/2010	175
2010/2011	151
2011/2012	125
2012/2013	106
2013/2014	89
2014/2015	89
2015/2016	140
2016/2017	83

5. Effects of the discharge of treated wastewater from the ORP to land on the water quality of the Inaha Stream and it's Western Tributary

5.1. Inaha Stream

5.1.1. Effects on water quality

The discharge of treated wastewater from the ORP to land does not appear to have a significant effect on NH_4-N concentrations in the Inaha Stream. Upstream of where the point source discharges from the ORP enter the Inaha Stream, average NH_4-N concentrations increase in the irrigation area by just 0.02 g/m^3 (Figure 54). The point source discharges result in an additional increase of 0.7 g/m^3, but downstream concentrations only increase by a further 0.1 mg/L (Figure 54). Thus, while average NH_4-N concentrations increase by 0.812 g/m^3 within the irrigation area, only 15% of that is attributable to diffuse discharges. The remainder is the result of point source discharges. These results are supported by the findings of longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018, the results of which are presented in Appendix D.

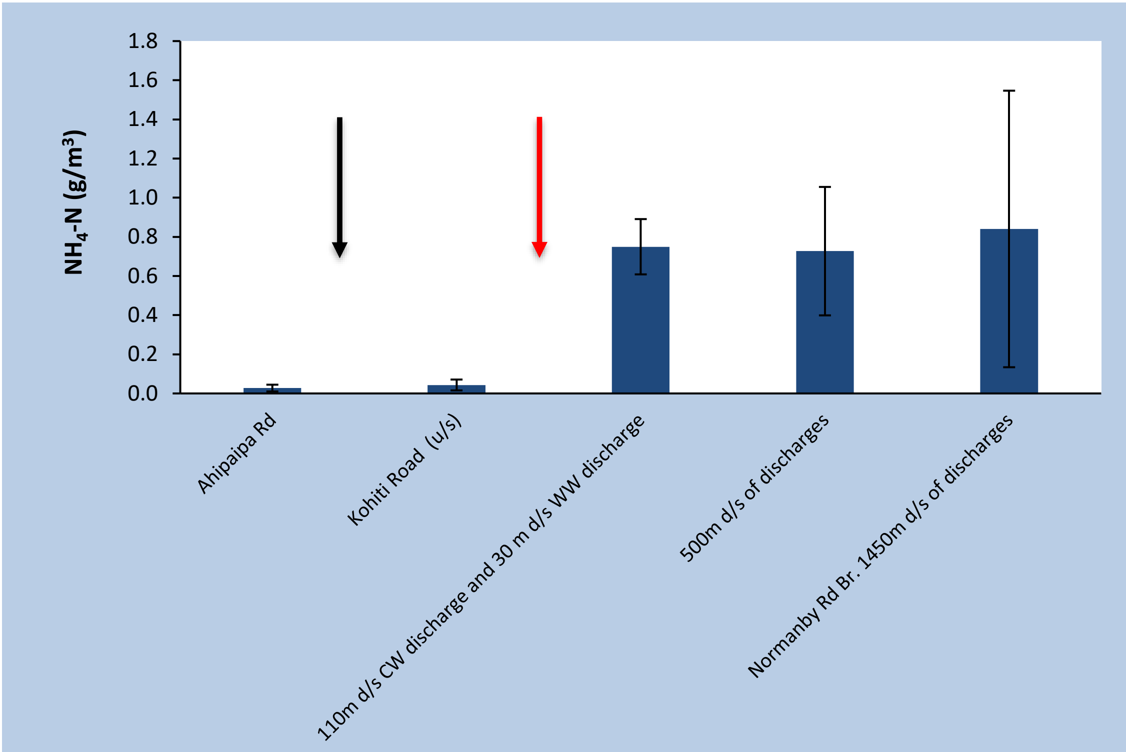

Figure 54: Mean NH_4-N concentrations (± 95% CI) in the Inaha Stream at sites upstream and downstream of the ORP irrigation area (January 1997 – December 2017). The black arrow depicts where the irrigation area starts and the red arrow depicts where the point source discharges from the ORP enter the Inaha Stream.

The discharge of treated wastewater to land does appear to have a significant effect on NNN concentrations in the Inaha Stream. Upstream of where the point source discharges from the ORP enter the Inaha Stream, average NNN concentrations increase in the irrigation area by 0.2 g/m^3 (Figure 55). The point source discharges result in an additional 0.5 g/m^3 increase. Downstream, concentrations then increase by a further 0.7 mg/L (Figure 55). Thus, 61% of the 1.42 g/m^3 increase in average NNN concentration within the irrigation area can be attributed to diffuse discharges; the remainder is the result of point sources.

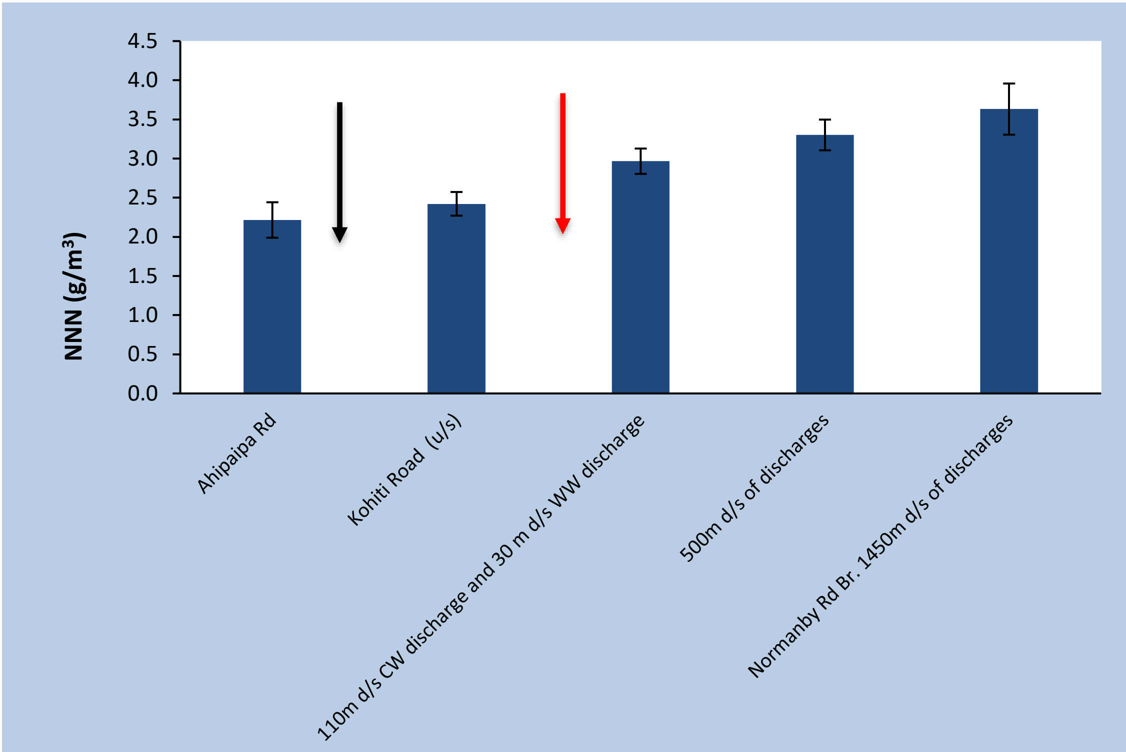

Figure 55: Mean NNN concentrations (± 95% CI) in the Inaha Stream at sites upstream and downstream of the ORP irrigation area (January 1997 – December 2017). The black arrow depicts where the irrigation area starts and the red arrow depicts where the point source discharges from the ORP enter the Inaha Stream

Current NNN concentrations in the Inaha Stream both upstream (at Ahipai Road) and downstream (at Normanby Bridge Road) of the ORP irrigation area were assigned to attribute state C under the NPS-FM 2014. Furthermore, since December 2011, median NNN concentrations at both sites, and 95th percentile concentrations at the downstream site have frequently been in attribute state C (Figure 56 and Figure 57). This suggests that at both sites, the growth of up to 20% of species (mainly sensitive species such as fish) may have been affected by nitrate toxicity sites, but there would have been no acute effects.

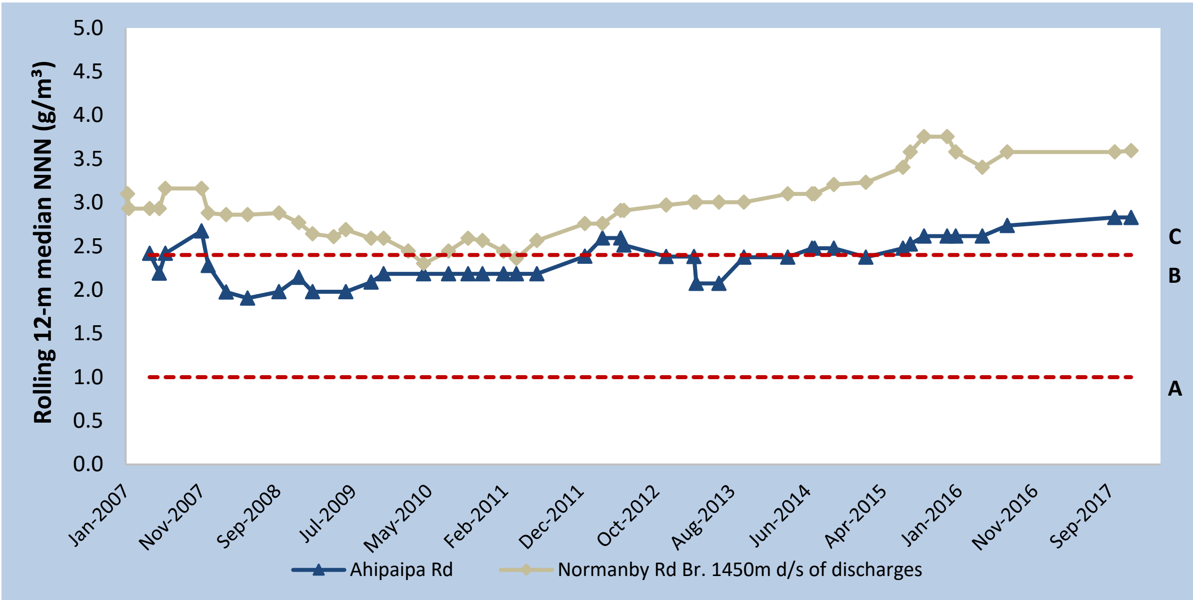

Figure 56: Rolling annual median NNN concentrations (January 2007 – December 2017) at sites on the Inaha Stream. NPS-FM 2014 attribute states (A & B) are indicated by the red lines.

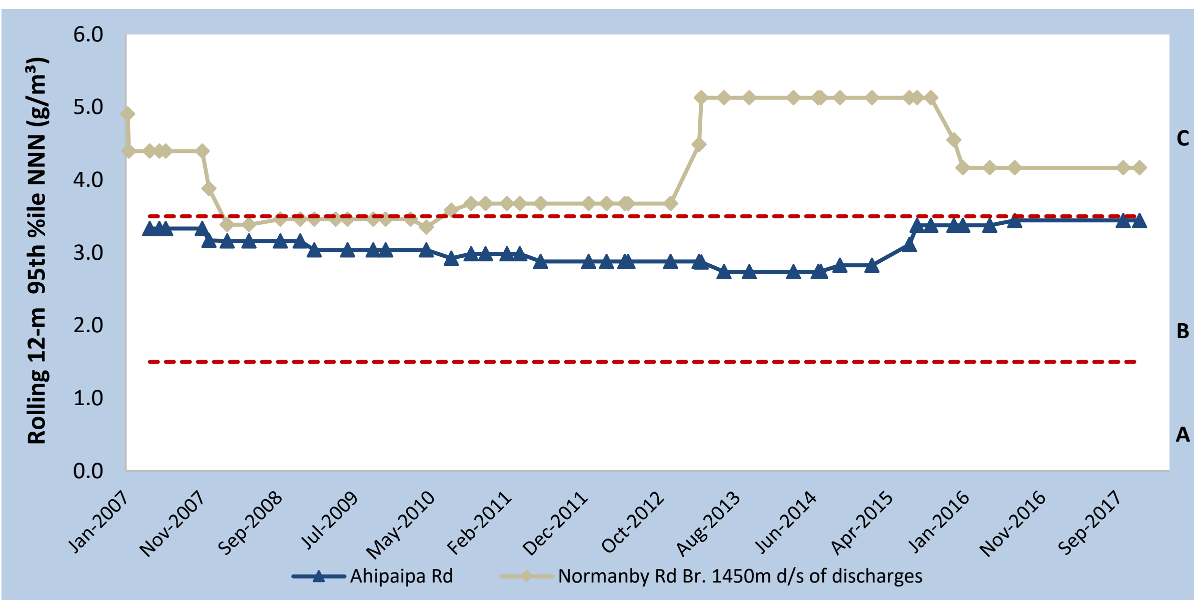

Figure 57: Rolling annual 95th percentile NNN concentrations (January 2007 – December 2017) at sites on the Inaha Stream. NPS-FM 2014 attribute states (A & B) are indicated by the red lines.

5.1.2. Effects on aquatic ecology

All MCI scores in the Inaha Stream were indicative of fair water quality both upstream and downstream of ORP irrigation area, except in March 2017 when scores at the downstream site were indicative of good water quality (Figure 58). SQMCI scores were indicative of fair or good water quality except in October 2016 when scores at the downstream site were indicative of poor water quality and February 2018 when scores at the upstream site were indicative of poor water quality (Figure 59). A consistent degradation in macroinvertebrate community health downstream of the irrigation area was not observed. MCI scores were lower at the downstream site on two sampling occasion, while on the other four sampling occasions MCI was lowest upstream (Figure 58). SQMCI was also higher at the downstream site on three of the six sampling occasions (Figure 59)

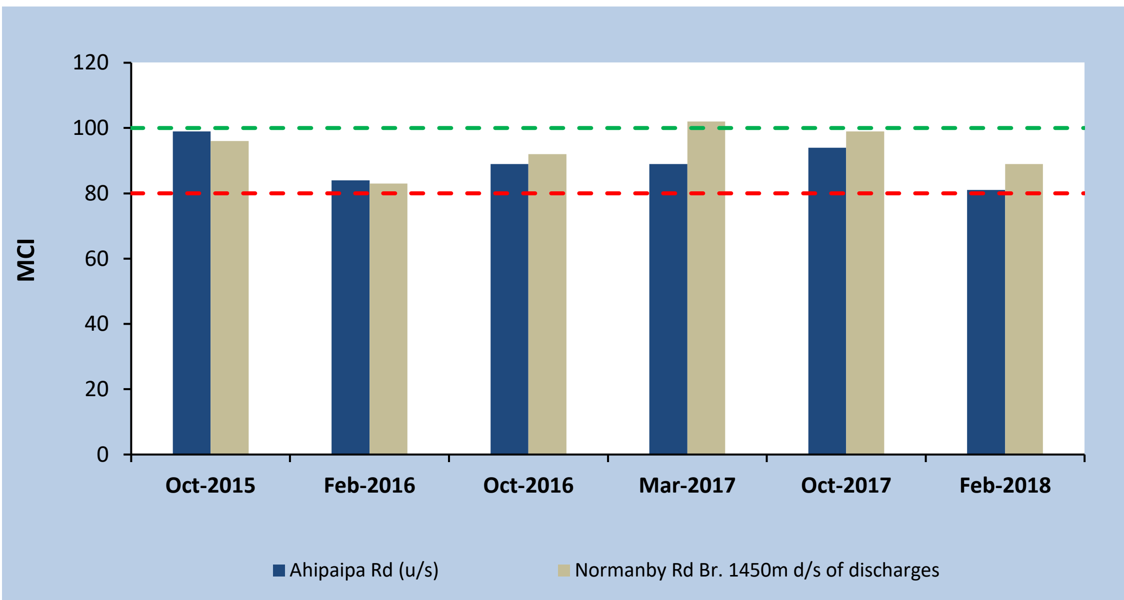

Figure 58: MCI for the sites sampled on the on the Inaha Stream upstream and downstream of the ORP irrigation area between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

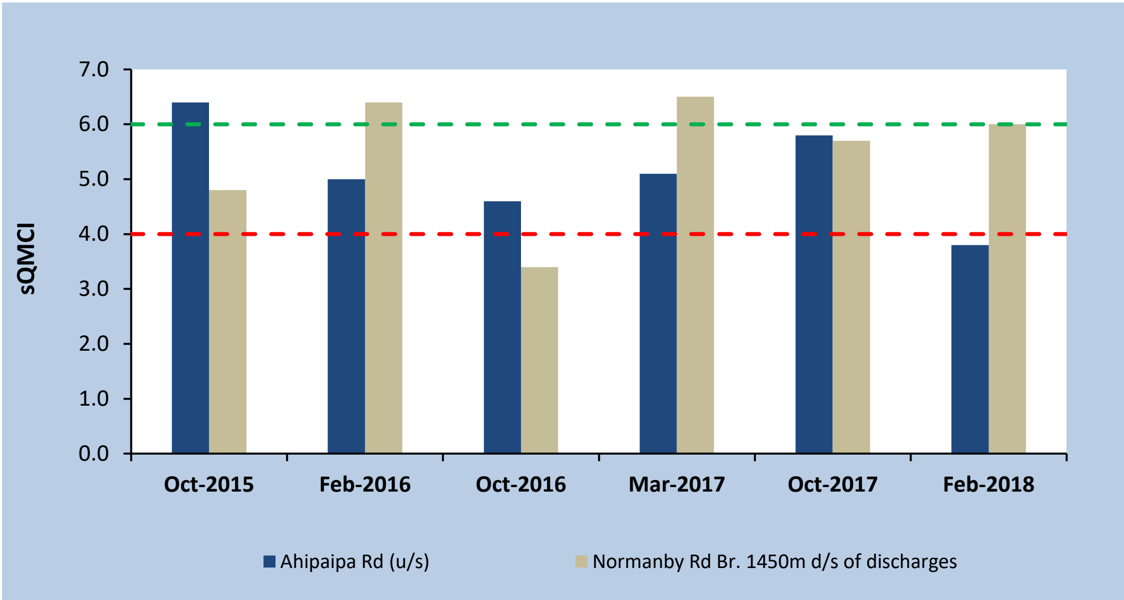

Figure 59: SQMCI for the sites sampled on the on the Inaha Stream upstream and downstream of the ORP irrigation area between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

Consistent differences between the Number of Taxa and the percentage of EPT taxa at the upstream and downstream sites were also not observed. The Number of Taxa at the downstream site was lower than that recorded at the upstream site in February 2016, October 2016, March 2017 and February 2018, but was similar in October 2015 and October 2017 (Figure 60). The percentage of EPT taxa at the downstream was lower than that recorded at the upstream site in October 2015 and February 2016 but was higher on the other four sampling occasions (Figure 61).

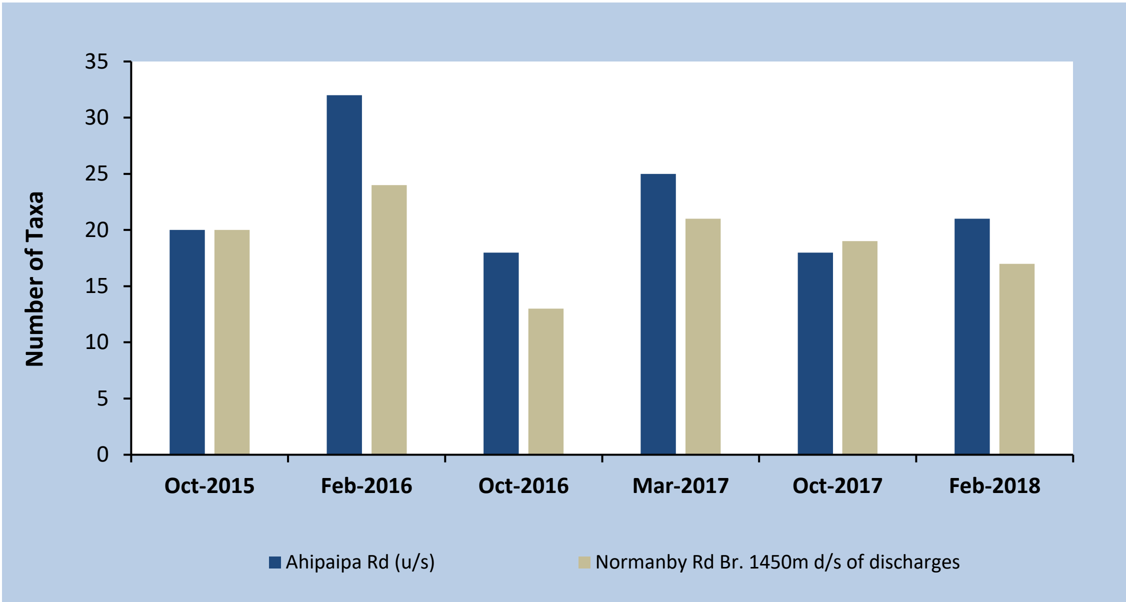

Figure 60: Number of Taxa for the sites sampled on the Inaha Stream upstream and downstream of the ORP irrigation area between 2015 and 2018.

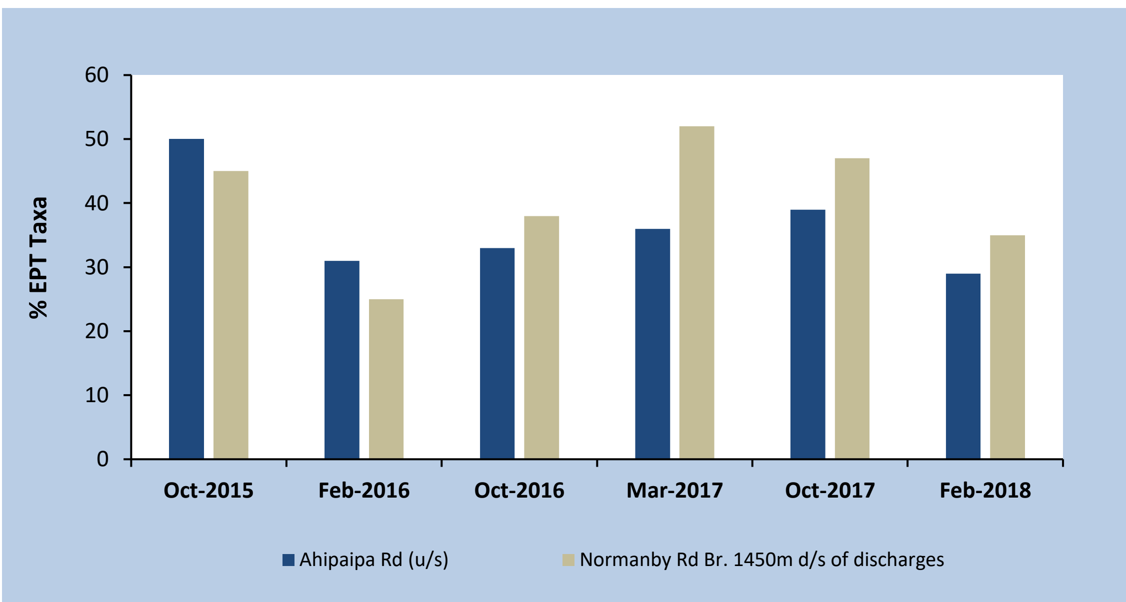

Figure 61: %EPT Taxa for the sites sampled on the Inaha Stream upstream and downstream of the ORP irrigation area between 2015 and 2018.

Overall, the macroinvertebrate communities in the Inaha Stream are indicative of fair to good water quality both upstream and downstream of the ORP irrigation area, and there is no consistent evidence of significant adverse effects.

5.2. Western Tributary

5.2.1. Effects on water quality

The discharge of treated wastewater from the ORP to land does not appear to have a significant effect on NH_4-N concentrations in the Western tributary, and average NH_4-N concentrations decrease in the irrigation area by 0.017 g/m^3 (51%)) (Figure 62). Conversely, the discharge of treated wastewater to land does have a significant effect on NNN concentrations the Western Tributary. Within the irrigation area, NNN concentrations increase by 1.11 g/m^3 (39%) (Figure 63). There are no point source discharges to this stream; thus, it is likely that this increase is entirely the result of diffuse discharges. As NNN concentrations do not increase between the upstream site and the site located 2,550 metres upstream of the Inaha Stream confluence, it is also unlikely that the small stream that enters above this site is a major contributor of nitrogen in the Western Tributary. These results are supported by the findings of longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018, the results of which are presented in Appendix D.

Rolling median and 95th percentile NNN concentrations at the most downstream site on the Western Tributary (250m u/s of Inaha conf.) frequently exceed the national bottom line for nitrate toxicity under the NPS-FM 2014 (Figure 64 and Figure 65). It would appear that discharge of treated wastewater to land is a driver of this, as concentrations at the sites within and upstream of the irrigation area were either in attribute state B or C (Figure 64 and Figure 65). It is also important to note that median and 95th percentile NNN concentrations at the sites within and downstream of the irrigation area have been increasingly rapidly since 2011 (Figure 64 and Figure 65).

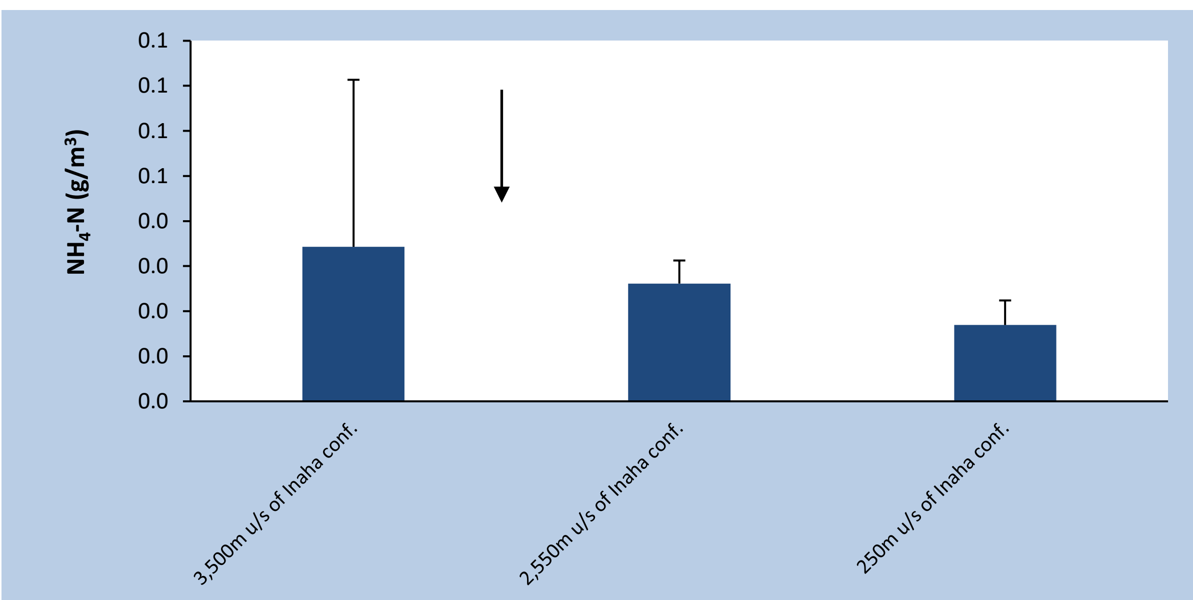

Figure 62: Mean NH_4-N concentrations (± 95% CI) in the Western tributary at sites upstream and downstream of the ORP irrigation area (January 1997 – December 2017). The black arrow depicts where the irrigation area starts.

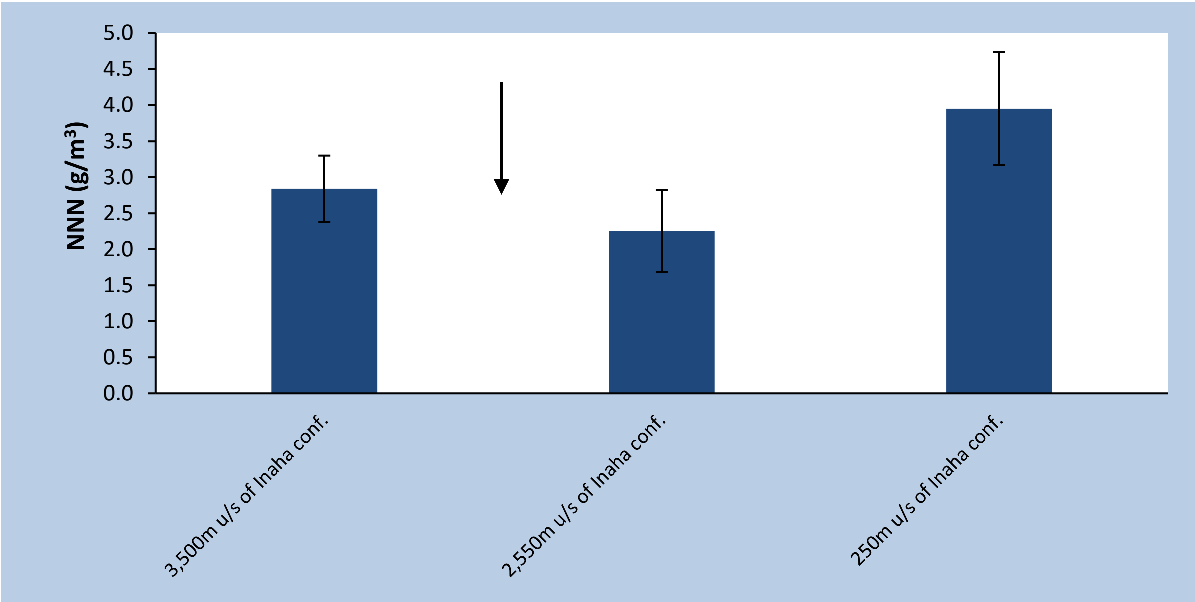

Figure 63: Mean NNN concentrations (± 95% CI) in the Western tributary at sites upstream and downstream of the ORP irrigation area (January 1997 – December 2017). The black arrow depicts where the irrigation area starts.

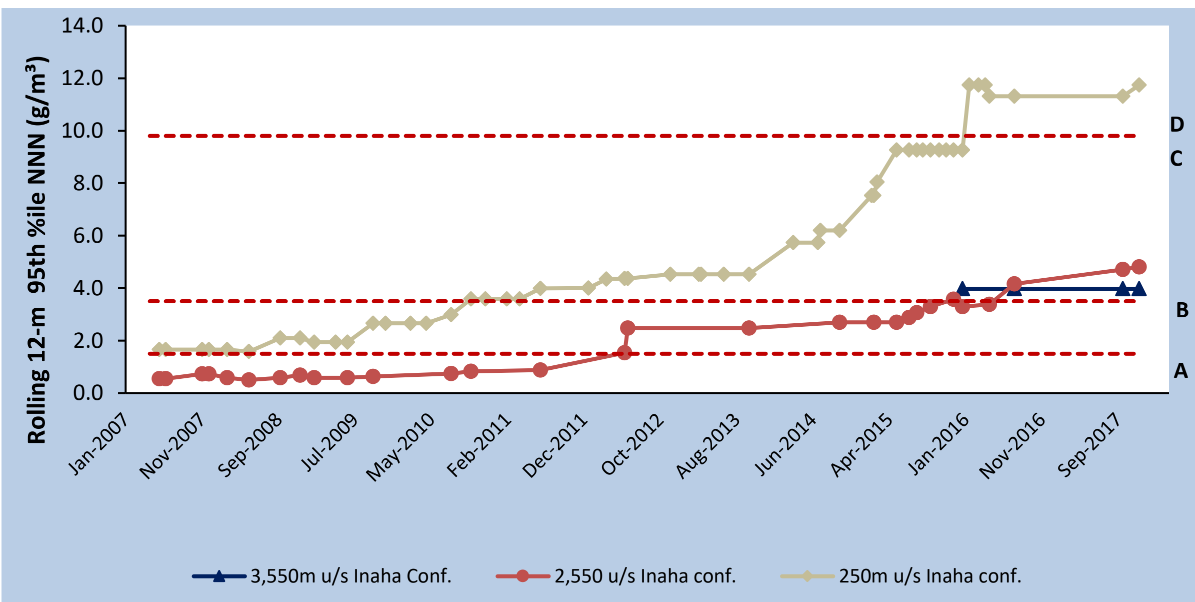

Figure 64: Rolling annual median NNN concentrations (January 2007 – December 2017) at sites on the Western tributary. NPS-FM 2014 Attribute States (A, B & C) are indicated by the red lines. The C/D threshold represents the national bottom line.

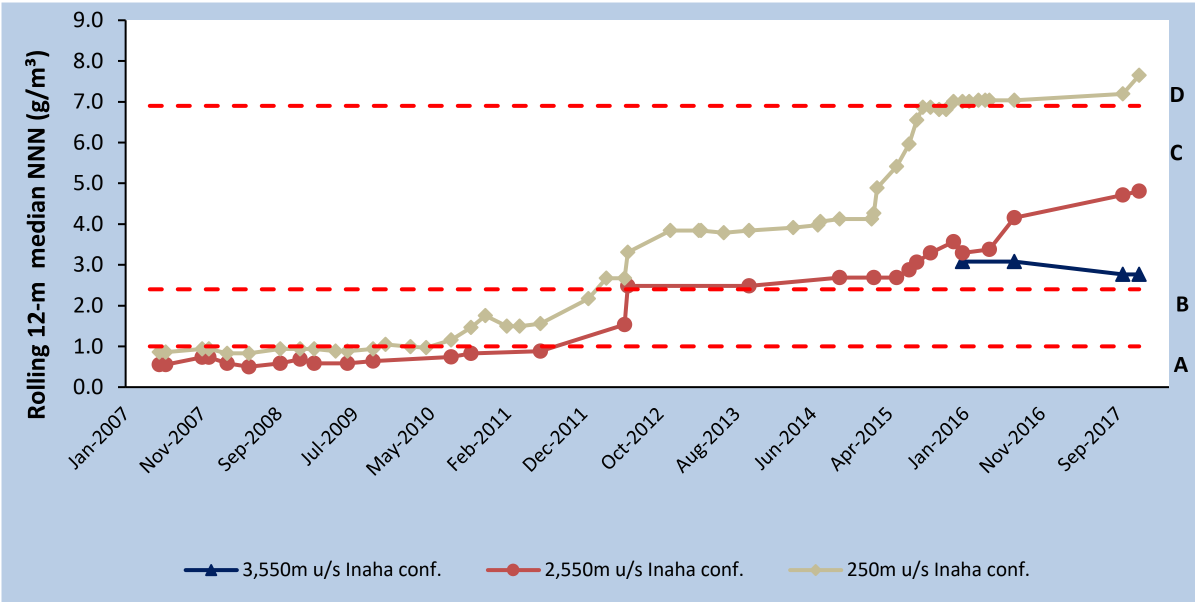

Figure 65: Rolling annual 95th percentile NNN concentrations (January 2007 – December 2017) at sites on the Western tributary. NPS-FM 2014 Attribute States (A, B & C) are indicated by the red lines. The C/D threshold represents the national bottom line.

5.2.1. Effects on aquatic ecology

All MCI and SQMCI scores in the Western Tributary downstream of the ORP irrigation area were indicative of fair water quality, while upstream scores were more varied and were indicative of poor to good water quality (Figure 66 and Figure 67). A consistent degradation in macroinvertebrate community health downstream of the irrigation area was not observed. MCI and SQMCI scores were lower at the downstream site on two sampling occasions, while on the other four sampling occasions both indices were lowest upstream (Figure 66 and Figure 67).

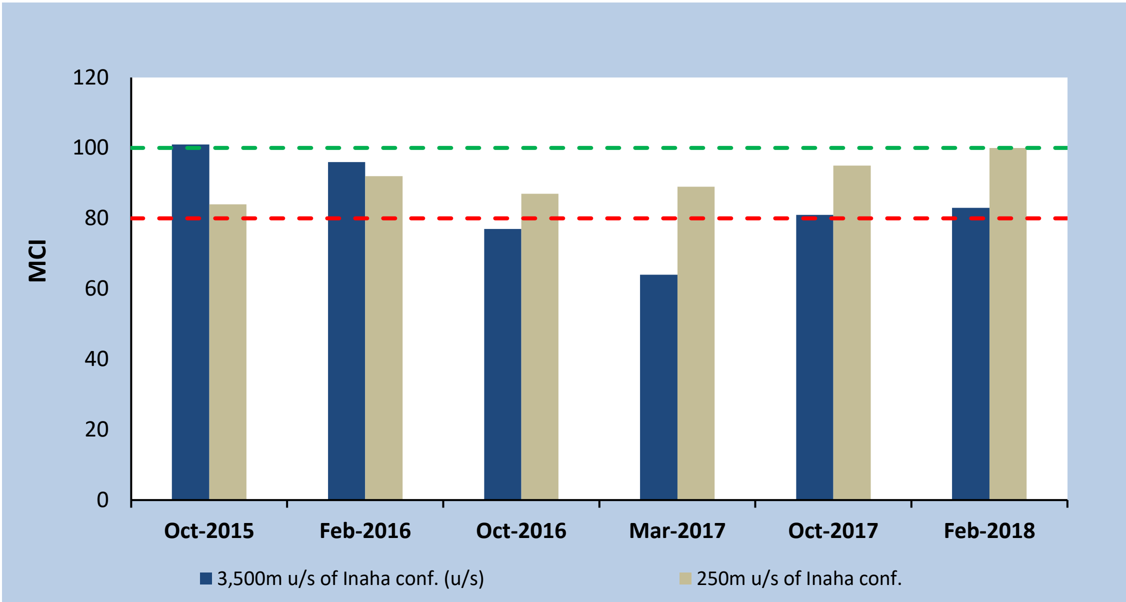

Figure 66: MCI for the sites sampled on the Western tributary upstream and downstream of the ORP irrigation area between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

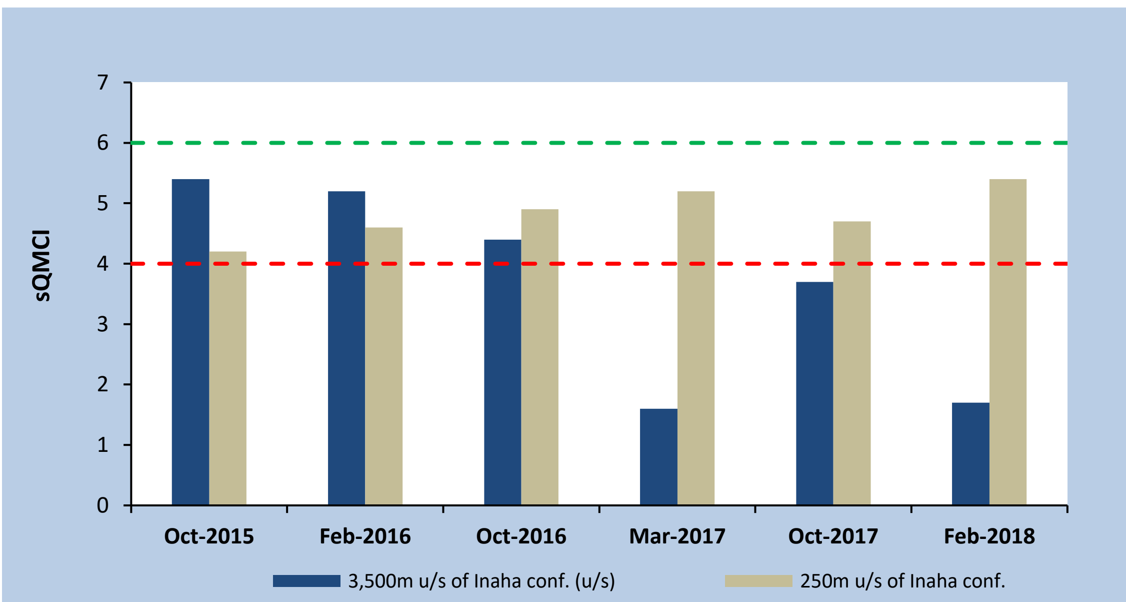

Figure 67: SQMCI for the sites sampled on the Western tributary upstream and downstream of the ORP irrigation area between 2015 and 2018. Thresholds indicative of good water quality are plotted as a dashed green line and those of fair water quality as a dashed red line.

Consistent differences between the Number of Taxa and the percentage of EPT taxa at the upstream and downstream sites were also not observed. Number of Taxa was lower at the downstream site on four sampling occasions but was higher on the other two sampling occasions, while the inverse was true for percentage of EPT taxa (Figure 68 and Figure 69).

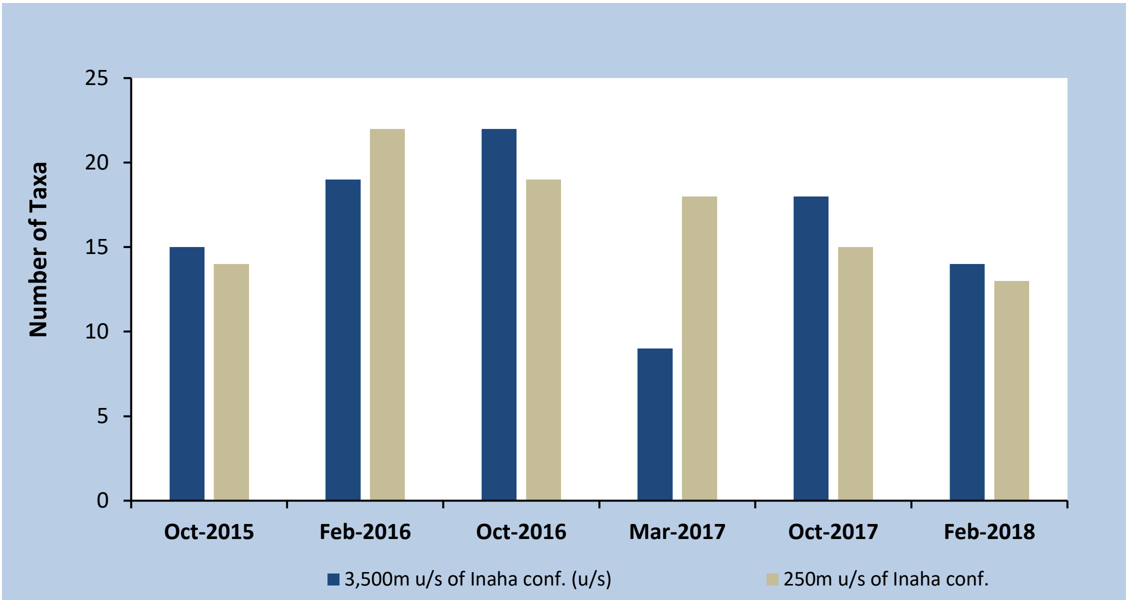

Figure 68: Number of Taxa for the sites sampled on the Western tributary upstream and downstream of the ORP irrigation area between 2015 and 2018.

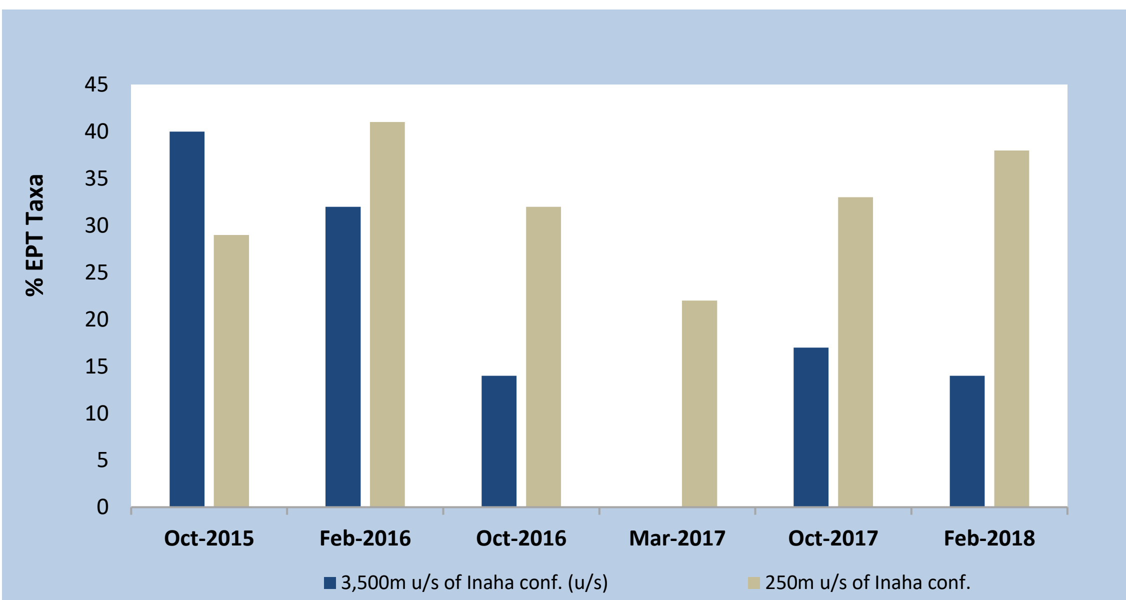

Figure 69: %EPT Taxa for the sites sampled on the Western tributary upstream and downstream of the ORP irrigation area between 2015 and 2018.

Overall, the macroinvertebrate communities in the Western tributary are indicative of fair water quality downstream of the ORP irrigation area, and poor to good water quality upstream. There is no consistent evidence of significant adverse effects between these sites.

6. Cumulative effects of all proposed activities, and required reduction in cumulative N-load to meet NPS-FM 2014 attribute states

6.1. Cumulative effects of all proposed activities

The discharges from the ORP are significantly degrading water quality in the Inaha Stream, but this degradation does appear not be adversely affecting aquatic life. Point source discharges of treated wastewater and cooling/backwash water and stormwater are significantly increasing in-stream NH_4-N, NNN, SIN, DRP and $ScBOD_5$ concentrations in the Inaha Stream. Increased NH_4-N and $ScBOD_5$ concentrations are mainly driven by the continuous discharge of cooling/backwash water and stormwater, while increases in NNN, SIN, DRP are a cumulative effect of wastewater, cooling/backwash water and stormwater discharges. The discharge of treated wastewater from the ORP to land further increases NNN concentrations downstream of where point source discharges enter the stream. Although they are significantly degrading water quality, neither point source nor diffuse discharges from the ORP appear to be affecting macroinvertebrate community health in the Inaha Stream, and consistent reductions in MCI, SQMCI, Number of Taxa and percentage EPT taxa were not detected immediately downstream of the point source discharges or the ORP irrigation area.

The land-based discharge of treated wastewater from the ORP is also significantly increasing NNN concentrations in the Western Tributary. As a result, concentrations frequently exceed the NPS-FM 2014 national bottom line for nitrate toxicity downstream of the irrigation area. There is, however, no evidence that degraded water quality is having a significant adverse effect on aquatic life in the Western tributary as MCI, SQMCI, Number of Taxa and percentage EPT taxa were not consistently reduced downstream of the irrigation area.

6.2. Reduction in cumulative N-load required to meet NPS-FM 2014 attribute state thresholds for nitrate toxicity

For NNN concentrations in the Inaha Stream below the irrigation area to meet the NPS-FM 2014 attribute state B thresholds for nitrate toxicity (current attribute state based on latest 30 datapoints = C), the cumulative (point source and diffuse discharge) N-load discharged from the ORP would need to reduce by 83% (Table 11). For NNN concentrations in the Western Tributary to meet the attribute state C thresholds (current attribute state based on latest 30 datapoints = D), N-load discharged from the ORP would need to reduce by 15% (Table 11). Attribute state B is not currently achievable in the Western Tributary without significant reductions in nitrogen input upstream of, as well as within, the ORP (Table 11).

Table 11: Required N load reduction required to meet the NPS-FM 2014 attribute state thresholds for nitrate toxicity.

Stream	Site	Location	Av. conc.	Med. conc.	95th %ile	Current attribute state	Reduction in av. input (B state)	Required reduction in av. input (C band)
Inaha	Ahipaipa Rd	Upstream of irrigation	2.2	2.6	3.4	C		
	Normanby Rd Br. 1450m d/s of discharges	Downstream of irrigation	3.8	3.8	5.1	C	83%	0%
Western trib.	3,500m u/s of Inaha conf.	Upstream of irrigation	2.8	3.1	4.0	C		
	250m u/s of Inaha conf.	Downstream of irrigation	8.2	7.7	11.7	D	117% (Not possible)	15%

7. Conclusions

From the monitoring data collected within, upstream and downstream of the discharges between July 1995 to December 2017 the following conclusions were made about the effects of **point source** wastewater cooling/backwash water and stormwater discharges from the ORP on water quality and freshwater ecology in the Inaha Stream:

- The available data indicates that concentrations of ammoniacal nitrogen, nitrate-nitrite nitrogen, soluble inorganic nitrogen, dissolved reactive phosphorus and soluble carbonaceous 5-day biochemical oxygen demand in the Inaha Stream were greater downstream of the ORP than upstream.
- The in-stream ammoniacal nitrogen, pH, temperature and dissolved oxygen saturation and soluble carbonaceous 5-day biochemical oxygen demand limits set out in the conditions of the existing resource consents were met.
- The Regional Freshwater Plan water quality guidelines were complied with as follows:
  - Water temperature and dissolved oxygen saturation generally met the guidelines upstream and downstream of the ORP;
  - The guideline for soluble carbonaceous 5-day biochemical oxygen demand was met in the Inaha Stream upstream and downstream of the ORP; and
  - Dissolved reactive phosphorus frequently did not comply with guidelines upstream and downstream of the ORP. However, the frequency and/or magnitude of non-compliance was greater at the downstream site.
- The macroinvertebrate communities in the Inaha Stream upstream and downstream the ORP are indicative of fair water quality, and the available MCI, SQMCI, Number of Taxa and Percentage EPT Taxa data do not indicate that point source discharges are having significant adverse effects.

- The NPS-FM 2014 assigns sites as follows:
  - Ammoniacal nitrogen concentrations were assigned to attribute state B at the upstream monitoring site and attribute state C at the downstream site
  - Nitrate-nitrate nitrogen concentrations were assigned to attribute state C at the upstream and downstream monitoring sites.
- The major driver of increased downstream ammoniacal nitrogen and 5-day biochemical oxygen demand appears to be the continuous discharge of cooling/backwash water and stormwater from the ORP, while nitrate-nitrite nitrogen, soluble inorganic nitrogen and dissolved reactive phosphorus are equally affected by wastewater discharges and cooling/backwash water and stormwater discharges.

From the monitoring data collected upstream and downstream of ORP irrigation area between July 1995 to December 2017 the following conclusions were made about the effects of **land-based wastewater discharges** from the ORP on water quality and freshwater ecology in the Inaha Stream and the Western Tributary.

- The discharge of treated wastewater from the ORP to land does not to have a significant effect on ammoniacal nitrogen concentrations in the Inaha Stream or the Western Tributary.
- The discharge of treated wastewater to land has a significant effect on nitrate-nitrite nitrogen concentrations in the Inaha Stream, and is responsible for up to 61% of the 1.42 g/m^3 average increase in concentration within the irrigation area.
- The discharge of treated wastewater to land also has a significant effect on nitrate-nitrite nitrogen concentrations in the Western Tributary. On average, nitrate-nitrite nitrogen concentrations increase by 1.11 g/m^3 (a 39% increase). As a result, the Western Tributary currently does not meet the national bottom line for nitrate toxicity under the NPS-FM 2014.
- Although the land-based discharge of wastewater from the ORP is significantly degrading water quality in the Inaha Stream and the Western Tributary, there is no consistent evidence of significant adverse effects on macroinvertebrate communities.

Nitrate concentrations in the Inaha Stream are currently in NPS-FM 2014 attribute state C upstream and downstream of the irrigation area. This means that nitrate toxicity affects the growth of up to 20% of species downstream. Should the objective be to maintain nitrate concentration in the Inaha Stream downstream of the ORP within attribute state B, then the cumulative (i.e. from all discharges to land and to water) nitrogen load discharged from the ORP would need to reduce by approximately 83%.

Nitrate concentrations in the Western Tributary are currently in NPS-FM 2014 attribute state C upstream of the irrigation area[1] and attribute state D downstream. The nitrogen load discharged from the ORP to land would need to be reduced by approximately 15% for the Western Tributary to meet the attribute state C threshold. Attribute state B is not currently achievable in the Western Tributary without significant reductions in nitrogen input upstream of, as well as within, the ORP.

Recommendations

It is recommended that future water quality monitoring is undertaken on monthly basis to allow for an unbiased assessment against the NPS-FM 2014 attribute states for ammonia and nitrate toxicity.

The available data indicates that the continuous cooling/backwash water discharge from the ORP picks up a significant contaminant load as it flows through the pond used to store the plant's fire water and stormwater. Thus, the effects of the ORP on water quality in the Inaha Stream may be significantly reduced by shifting the discharge so it no longer mixes with the plants pond water before entering the stream. However, an alternative method of cooling the discharge would also need to be implemented to prevent temperature from increasing in the stream.

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APPENDICES

Appendix A: Summary of discharge quality data

Table 1: Summary of effluent quality data from Pond 6 of TBP rendering plant, July 1995 to August 2016.

	NH_4-N (g/m^3)	NNN (g/m^3)	DRP (g/m^3)	FC (100 mL)	$ScBOD_5$ (g/m^3)	TSS (g/m^3)	Turbidity (NTU	PH	Temp (°C)
Average	204.3	22.2	30.2	1095.0	23.2	171.4	40.0	7.8	20.4
Min	1.7	0.7	0.4	3.5	0.7	36.0	11.0	6.8	7.2
5%ile	55.8	1.5	6.5	28.8	1.5	41.3	13.0	7.0	10.6
10%ile	77.4	1.6	10.5	70.1	1.6	51.3	14.0	7.2	12.2
20%ile	99.4	2.5	22.4	150.0	2.5	64.6	17.0	7.4	15.2
25%ile	110.5	2.8	23.4	192.5	2.8	73.3	17.3	7.5	16.1
50%ile (median)	186.0	6.4	32.4	375.0	6.3	130.0	20.0	8.0	20.7
75%ile	274.0	21.5	38.3	762.5	19.5	200.0	29.0	8.2	24.2
90%ile	379.8	54.3	44.2	1790.0	50.7	380.0	74.5	8.3	28.3
95%ile	421.7	62.3	45.5	4925.0	61.1	460.0	138.8	8.4	29.8
Max	570.0	490.0	53.6	20000.0	490.0	840.0	280.0	8.6	32.8
Std Dev	118.0	56.7	12.2	2611.9	62.2	139.6	57.8	0.5	5.7
95% C.I.	19.1	12.4	2.3	506.9	14.4	25.6	22.2	0.1	1.0
N. of Samples	147	80	109	102	72	114	26	141	128

Table 2: Summary of water quality data from the combined stormwater and cooling/backwash water discharges from the TBP rendering plant, August 2012 to August 2017.

	NH_4-N (g/m^3)	NNN (g/m^3)	DRP (g/m^3)	FC (100 mL)	BOD_5 (g/m^3)	TSS (g/m^3)	Turbidity (NTU	PH	Temp (°C)
Average	2.3	3.8	0.2	26012.6	13.8	27.8	13.3	7.5	18.7
Min	0.1	1.4	0.0	190.0	1.7	5.0	1.5	6.8	10.9
5%ile	0.5	1.9	0.0	208.0	1.7	5.4	2.0	7.0	10.9
10%ile	0.6	2.6	0.0	306.0	1.7	5.8	2.3	7.2	11.3
20%ile	0.7	3.1	0.0	358.0	2.2	6.0	4.1	7.2	12.1
25%ile	0.7	3.2	0.0	370.0	2.3	6.0	4.6	7.2	13.1
50%ile (median)	1.6	3.6	0.1	1300.0	3.0	8.0	7.8	7.4	19.9
75%ile	3.0	4.8	0.2	5000.0	7.2	21.0	11.0	7.7	23.6
90%ile	5.9	5.1	0.5	31600.0	23.6	64.8	42.1	7.8	26.0
95%ile	6.7	5.4	0.6	100000.0	77.2	102.4	45.9	8.0	27.6
Max	6.8	6.7	0.7	370000.0	120.0	140.0	48.0	8.7	31.3
Std Dev	2.0	1.3	0.2	84859.8	29.1	44.1	14.4	0.4	6.2
95% C.I.	0.9	0.6	0.1	38156.9	12.2	28.8	6.0	0.2	2.6
N. of Samples	22	17	17	19	22	9	22	22	22

Appendix B: Summary of Water quality results from sites sampled on the Inaha Stream and Western Tributary, 2004 to 2017.

Table 1: Inaha Stream, Ahipaipa Rd (u/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.4	931	0.055	0.027	2.2	2.1	0.008	9.5	91.3	7.6	12.6	19.8	7.8	26.7	0.0007
Min	0.3	110	0.016	0.002	0.2	0.4	0.002	5.8	64.0	7.4	5.6	16.9	1.0	21.7	0.0000
5%ile	0.3	179	0.022	0.005	0.6	0.4	0.002	7.4	79.6	7.4	7.6	17.3	1.7	22.3	0.0000
10%ile	0.3	200	0.026	0.006	1.0	0.6	0.003	7.9	83.7	7.4	9.0	17.6	2.1	22.6	0.0001
20%ile	0.3	246	0.027	0.008	1.5	1.0	0.003	8.4	87.4	7.5	9.9	18.2	3.0	23.1	0.0001
25%ile	0.3	273	0.029	0.009	1.8	1.0	0.004	8.9	88.8	7.5	10.1	18.3	3.2	24.2	0.0001
50%ile (median)	0.3	415	0.037	0.014	2.4	2.5	0.007	9.8	93.0	7.6	11.8	19.4	7.6	26.1	0.0002
75%ile	0.5	783	0.050	0.023	2.8	2.8	0.012	10.5	95.9	7.6	15.4	20.8	10.0	28.4	0.0004
90%ile	0.6	1,520	0.061	0.042	3.3	3.4	0.015	10.9	97.6	7.7	17.2	22.9	16.0	31.2	0.0008
95%ile	0.7	2,185	0.070	0.051	3.4	3.4	0.020	11.0	99.3	7.7	18.0	23.7	16.4	34.3	0.0010
Max	0.7	16,000	0.856	0.477	3.5	3.4	0.022	11.6	106.1	7.8	18.2	26.0	19.0	37.4	0.0097
Std Dev	0.2	2,246	0.112	0.065	0.8	1.1	0.006	1.3	7.5	0.1	3.2	2.1	5.0	3.7	0.0020
95% C.I.	0.1	623	0.030	0.017	0.2	0.5	0.003	0.3	2.1	0.0	0.9	0.6	1.3	1.0	0.0008
N. of Samples	11	50	54	54	54	17	17	54	48	54	54	54	54	54	22

Table 2: Inaha Stream, bridge 420m u/s of Kohiti Rd (u/s)

	$ScBOD_5$ (g/m³)	FC (100 mL)	DRP (g/m³)	NH_4-N (g/m³)	NNN (g/m³)	NO_3-N (g/m³)	NO_2-N (g/m³)	DO (g/m³)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m³)	NH_3-N (g/m³)
Average	0.3	681	0.039	0.026	2.6	2.7	0.008	10.0	94.3	7.6	12.5	22.6	6.3	27.2	0.0003
Min	0.3	100	0.015	0.002	0.3	1.6	0.003	7.2	78.0	7.3	5.6	16.8	1.2	22.4	0.0000
5%ile	0.3	164	0.021	0.004	1.1	1.6	0.004	8.3	86.0	7.5	7.8	17.5	2.0	23.2	0.0001
10%ile	0.3	204	0.025	0.005	1.6	1.7	0.005	8.8	89.0	7.5	9.0	18.0	2.4	23.5	0.0001
20%ile	0.3	296	0.027	0.007	2.0	2.4	0.007	9.0	91.0	7.6	9.4	18.7	2.8	23.9	0.0001
25%ile	0.3	335	0.028	0.008	2.0	2.5	0.007	9.2	91.3	7.6	10.2	18.9	3.3	24.4	0.0001
50%ile (median)	0.3	630	0.040	0.011	2.7	2.9	0.008	10.1	95.0	7.6	11.9	19.9	4.6	26.6	0.0002
75%ile	0.3	835	0.047	0.017	3.1	3.2	0.010	10.7	97.5	7.7	15.0	21.4	8.7	28.1	0.0003
90%ile	0.6	1,260	0.057	0.024	3.5	3.4	0.012	11.1	99.6	7.7	16.7	23.4	13.0	31.9	0.0006
95%ile	0.7	1,400	0.060	0.046	3.6	3.5	0.013	11.3	101.5	7.8	18.3	25.1	15.1	33.2	0.0006
Max	0.7	3,200	0.074	0.702	3.9	3.6	0.013	12.0	110.6	8.1	21.1	198.0	20.0	43.3	0.0007
Std Dev	0.2	500	0.013	0.082	0.8	0.6	0.003	1.0	5.2	0.1	3.3	20.1	4.4	4.0	0.0002
95% C.I.	0.1	113	0.003	0.018	0.2	0.3	0.002	0.2	1.2	0.0	0.7	4.4	1.0	1.3	0.0001
N. of Samples	30	75	78	79	74	15	11	78	74	79	76	79	79	39	15

Table 3: Un-named northern tributary, Inaha confluence (u/s)

	ScBOD5 (g/m3)	FC (100 mL)	DRP (g/m3)	NH_4-N (g/m3)	NNN (g/m3)	NO_3-N (g/m3)	NO_2-N (g/m3)	DO (g/m3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m3)	NH_3-N (g/m3)
Average	0.3	987	0.029	0.040	2.0	2.9	0.012	9.7	90.7	7.5	11.9	26.5	7.9	37.4	0.0007
Min	0.3	77	0.013	0.002	0.2	2.0	0.003	6.7	72.0	7.2	5.2	20.7	1.5	30.8	0.0000
5%ile	0.3	120	0.016	0.010	0.5	2.0	0.004	8.2	79.9	7.3	7.3	23.2	2.4	32.8	0.0001
10%ile	0.3	200	0.017	0.012	0.6	2.0	0.004	8.6	83.7	7.4	8.5	23.7	3.0	33.3	0.0001
20%ile	0.3	250	0.022	0.014	1.2	2.2	0.007	8.8	87.0	7.5	9.1	24.9	3.7	34.3	0.0002
25%ile	0.3	320	0.022	0.016	1.4	2.3	0.008	9.0	88.0	7.5	10.0	25.2	4.2	34.4	0.0002
50%ile (median)	0.3	760	0.026	0.023	2.1	2.7	0.012	10.0	92.0	7.6	11.5	26.3	6.2	36.5	0.0002
75%ile	0.3	1,400	0.033	0.029	2.5	3.5	0.015	10.4	94.8	7.6	13.6	27.7	11.0	39.6	0.0003
90%ile	0.6	2,200	0.043	0.046	3.3	3.8	0.017	10.8	96.1	7.7	16.6	30.0	14.7	43.1	0.0008
95%ile	0.6	2,700	0.048	0.072	3.7	4.0	0.019	11.1	97.4	7.7	17.0	31.2	16.0	43.9	0.0024
Max	0.7	4,000	0.071	0.568	4.2	4.2	0.022	11.7	104.4	7.7	18.1	33.3	31.0	46.0	0.0066
Std Dev	0.1	875	0.011	0.088	1.0	0.8	0.006	1.0	5.8	0.1	3.1	2.5	5.5	3.8	0.0016
95% C.I.	0.0	220	0.003	0.021	0.2	0.4	0.003	0.2	1.5	0.0	0.8	0.6	1.3	1.2	0.0008
N. of Samples	30	61	64	64	64	12	12	64	60	64	62	64	64	38	16

Table 4: Inaha Stream, Kohiti Rd (u/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.4	1,012	0.040	0.043	2.4	2.5	0.018	9.8	94.6	7.6	12.8	22.0	6.5	30.2	0.0010
Min	0.3	54	0.013	0.002	0.8	1.0	0.002	4.5	74.0	7.3	5.6	17.8	0.6	22.8	0.0001
5%ile	0.3	164	0.021	0.009	1.3	1.4	0.003	8.2	86.3	7.5	7.7	18.8	1.9	25.1	0.0001
10%ile	0.3	248	0.024	0.010	1.5	1.5	0.004	8.5	88.0	7.5	8.8	19.4	2.4	25.6	0.0001
20%ile	0.3	340	0.026	0.012	1.8	1.8	0.004	9.0	91.0	7.6	9.7	20.1	3.0	26.6	0.0002
25%ile	0.3	410	0.028	0.013	1.8	1.8	0.004	9.2	92.0	7.6	10.4	20.5	3.4	27.4	0.0002
50%ile (median)	0.3	650	0.038	0.016	2.5	2.6	0.006	9.9	95.0	7.6	12.3	21.8	4.7	29.7	0.0003
75%ile	0.6	1,200	0.046	0.024	2.9	3.0	0.010	10.6	97.6	7.7	15.6	23.3	9.2	32.3	0.0006
90%ile	0.7	1,500	0.054	0.047	3.4	3.5	0.020	11.2	99.7	7.7	16.7	25.0	13.0	35.8	0.0024
95%ile	0.8	2,240	0.059	0.086	3.6	3.7	0.035	11.4	102.5	7.8	18.1	26.4	16.0	37.2	0.0034
Max	1.1	15,000	0.226	1.380	3.8	3.7	0.518	12.2	119.8	8.1	21.5	30.6	28.0	40.3	0.0107
Std Dev	0.2	1,674	0.023	0.142	0.7	0.7	0.069	1.1	6.1	0.1	3.3	2.3	4.7	3.9	0.0021
95% C.I.	0.0	348	0.005	0.028	0.2	0.2	0.018	0.2	1.3	0.0	0.7	0.5	0.9	0.9	0.0008
N. of Samples	74	89	93	101	90	40	56	94	86	101	98	101	97	67	26

Table 5: Inaha Stream, 110m d/s cooling water discharge and 30 m d/s wastewater discharge (d/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.6	1,477	0.131	0.749	3.0	2.9	0.134	9.5	92.8	7.6	13.8	23.2	7.5	31.1	0.0059
Min	0.3	78	0.028	0.044	1.1	1.2	0.006	5.6	65.0	7.0	6.0	18.8	1.6	23.4	0.0004
5%ile	0.3	200	0.032	0.068	1.7	1.8	0.008	7.5	78.5	7.4	8.3	19.7	2.0	25.9	0.0005
10%ile	0.3	280	0.037	0.108	1.9	2.1	0.009	7.9	83.5	7.5	9.4	20.0	2.6	26.5	0.0008
20%ile	0.3	346	0.050	0.199	2.2	2.4	0.019	8.6	87.0	7.5	10.4	20.9	3.2	27.4	0.0011
25%ile	0.3	380	0.053	0.227	2.4	2.6	0.021	8.8	90.3	7.6	11.1	21.3	3.4	28.3	0.0012
50%ile (median)	0.6	700	0.086	0.537	3.1	2.9	0.044	9.7	94.0	7.6	13.5	22.6	4.9	30.8	0.0024
75%ile	0.7	1,300	0.158	0.956	3.5	3.3	0.122	10.4	97.0	7.7	16.7	24.7	9.4	33.2	0.0087
90%ile	1.2	2,160	0.247	1.710	3.9	3.8	0.360	10.8	99.2	7.8	19.1	26.9	14.0	37.5	0.0130
95%ile	1.3	4,780	0.391	2.063	4.0	3.9	0.576	11.2	101.7	7.8	20.6	28.7	16.0	38.5	0.0180
Max	1.9	20,000	0.704	4.540	4.6	3.9	1.060	11.9	111.8	8.1	26.0	31.2	94.0	41.1	0.0263
Std Dev	0.4	2,927	0.126	0.772	0.8	0.7	0.210	1.2	7.6	0.1	3.8	2.7	9.8	4.1	0.0065
95% C.I.	0.1	608	0.026	0.141	0.2	0.2	0.056	0.2	1.6	0.0	0.7	0.5	2.0	1.0	0.0025
N. of Samples	76	89	92	115	90	35	55	94	86	114	110	103	97	67	25

Table 6: Inaha Stream, 500m d/s of discharges (d/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.6	1,041	0.159	0.727	3.3	3.1	0.142	8.7	84.5	7.5	14.0	23.7	7.5	31.9	0.0058
Min	0.3	100	0.014	0.029	1.4	1.3	0.010	3.1	35.0	7.1	5.9	18.7	1.4	24.7	0.0003
5%ile	0.3	194	0.033	0.073	1.9	1.8	0.014	5.6	57.3	7.2	9.2	19.8	2.1	26.2	0.0006
10%ile	0.3	218	0.042	0.101	2.1	2.1	0.017	6.1	61.3	7.3	9.7	20.5	2.4	27.0	0.0007
20%ile	0.3	318	0.055	0.139	2.5	2.7	0.027	7.0	73.6	7.4	10.6	21.2	3.2	27.6	0.0017
25%ile	0.3	340	0.058	0.161	2.8	2.8	0.034	7.4	76.0	7.4	11.3	21.6	3.4	28.5	0.0017
50%ile (median)	0.6	530	0.086	0.321	3.2	3.1	0.056	9.0	88.1	7.5	13.7	23.0	4.7	31.2	0.0032
75%ile	0.8	900	0.177	0.681	3.8	3.5	0.155	10.1	94.0	7.6	16.9	25.0	9.1	33.8	0.0056
90%ile	1.0	1,840	0.281	1.318	4.3	3.9	0.327	10.7	98.0	7.7	19.1	28.2	12.8	39.5	0.0100
95%ile	1.2	3,240	0.440	2.227	4.7	4.1	0.557	11.2	100.3	7.8	20.6	29.6	16.0	40.7	0.0240
Max	3.8	15,000	2.380	14.600	7.1	4.4	1.030	11.7	130.2	8.2	24.0	41.9	120.0	49.2	0.0300
Std Dev	0.5	1,882	0.265	1.623	0.9	0.7	0.205	1.8	15.1	0.2	3.7	3.4	12.5	4.8	0.0076
95% C.I.	0.1	391	0.054	0.328	0.2	0.2	0.054	0.4	3.2	0.0	0.8	0.7	2.5	1.2	0.0033
N. of Samples	75	89	93	94	89	40	55	93	84	95	91	94	93	66	21

Table 7: Inaha Stream, Normanby Rd Br. 1450m d/s of discharges (d/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.6	1,031	0.192	0.840	3.6	3.2	0.102	9.1	89.3	7.6	14.0	24.4	7.4	33.3	0.0089
Min	0.3	71	0.012	0.010	1.4	1.4	0.004	5.7	59.0	7.1	6.1	18.8	1.2	23.8	0.0005
5%ile	0.3	154	0.034	0.020	2.0	1.6	0.007	7.2	75.0	7.3	9.4	20.1	2.2	26.4	0.0007
10%ile	0.3	204	0.041	0.036	2.3	2.2	0.013	7.4	77.0	7.4	9.9	20.6	2.7	27.2	0.0010
20%ile	0.3	262	0.052	0.047	2.8	2.6	0.023	7.6	80.0	7.4	10.7	21.5	3.0	28.2	0.0010
25%ile	0.3	310	0.063	0.057	2.8	2.7	0.028	8.0	81.0	7.5	11.3	21.8	3.3	29.5	0.0011
50%ile (median)	0.5	530	0.088	0.142	3.3	3.2	0.049	9.2	87.0	7.6	13.8	23.3	4.8	31.7	0.0018
75%ile	0.7	760	0.169	0.317	4.1	3.7	0.099	10.1	93.0	7.6	16.8	25.2	9.1	34.6	0.0045
90%ile	0.9	1,340	0.235	0.979	4.8	4.3	0.262	10.7	100.2	7.7	19.2	28.9	12.0	42.1	0.0119
95%ile	1.1	3,960	0.364	3.025	5.4	4.9	0.368	11.2	112.1	7.8	20.7	30.3	15.3	44.1	0.0163
Max	8.0	14,000	5.730	32.900	14.2	5.1	0.768	17.3	191.0	8.8	22.2	67.6	96.0	70.1	0.1276
Std Dev	0.9	2,043	0.596	3.531	1.6	0.9	0.140	1.6	15.9	0.3	3.6	5.5	10.1	6.8	0.0262
95% C.I.	0.2	424	0.121	0.706	0.3	0.3	0.037	0.3	3.4	0.1	0.7	1.1	2.0	1.6	0.0107
N. of Samples	75	89	93	96	90	40	55	94	85	96	93	96	96	66	23

Table 8: Inaha Stream, SH45 (d/s)

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.5	551	0.092	0.147	3.3	3.6	0.059	10.2	99.5	7.8	14.2	26.3	10.0	40.1	0.0020
Min	0.3	96	0.014	0.007	1.5	2.0	0.008	8.6	85.0	7.4	6.8	21.0	2.0	29.6	0.0004
5%ile	0.3	125	0.039	0.015	1.9	2.3	0.012	9.1	89.3	7.5	9.2	22.3	2.9	31.6	0.0005
10%ile	0.3	140	0.043	0.016	2.1	2.9	0.013	9.3	91.0	7.5	10.1	22.8	3.3	32.0	0.0005
20%ile	0.3	240	0.050	0.024	2.6	3.1	0.018	9.4	95.9	7.6	10.7	23.6	4.6	33.4	0.0007
25%ile	0.3	250	0.056	0.028	2.9	3.2	0.019	9.6	96.4	7.6	11.1	23.8	5.7	34.1	0.0007
50%ile (median)	0.3	420	0.074	0.060	3.3	3.4	0.034	10.1	98.0	7.8	14.0	25.2	9.0	38.5	0.0015
75%ile	0.7	645	0.102	0.125	3.8	4.0	0.068	10.7	103.2	7.9	16.9	28.4	13.0	44.6	0.0022
90%ile	0.8	840	0.177	0.208	4.6	4.5	0.115	11.2	108.5	8.1	18.8	32.3	16.6	50.3	0.0049
95%ile	0.9	1,100	0.226	0.397	4.8	4.7	0.194	11.3	112.8	8.2	19.8	33.8	19.2	56.6	0.0060
Max	1.1	4,700	0.284	2.400	5.7	5.5	0.328	11.8	115.4	8.5	20.9	36.2	44.0	59.6	0.0066
Std Dev	0.3	662	0.057	0.348	0.9	0.7	0.065	0.7	6.5	0.2	3.4	3.7	6.8	7.6	0.0018
95% C.I.	0.1	182	0.015	0.091	0.2	0.3	0.018	0.2	1.9	0.1	0.9	1.0	1.8	2.0	0.0007
N. of Samples	35	51	56	56	56	32	49	54	47	56	55	56	55	56	24

Table 9: Western Tributary, 3,500m u/s of Inaha confluence

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average		330	0.016	0.034	2.84	2.931	0.005	9.8	91.11	7.54	12.18	29.2	12.21	38.95	0.0004
Min		69	0.006	0.004	0.93	0.927	0.002	7.5	78.40	7.20	7.20	25.3	2.10	33.70	0.0000
5%ile		85	0.008	0.007	1.32	1.457	0.002	8.0	83.02	7.34	7.34	27.1	4.41	34.81	0.0001
10%ile		100	0.010	0.009	1.74	1.987	0.002	8.6	86.68	7.44	8.28	28.0	5.96	35.46	0.0001
20%ile		110	0.013	0.011	2.13	2.131	0.003	9.3	89.40	7.50	9.76	28.3	6.80	36.98	0.0001
25%ile		110	0.013	0.011	2.25	2.265	0.003	9.5	90.00	7.50	10.15	28.5	7.00	38.05	0.0001
50%ile (median)		270	0.015	0.015	2.86	3.076	0.005	10.0	91.10	7.60	12.40	29.3	10.00	38.85	0.0001
75%ile		430	0.019	0.021	3.47	3.764	0.006	10.6	93.60	7.60	14.15	30.4	15.50	40.68	0.0002
90%ile		800	0.022	0.028	3.87	3.902	0.006	10.7	94.52	7.60	15.88	30.7	22.20	41.65	0.0003
95%ile		830	0.023	0.116	3.94	3.984	0.007	10.8	96.48	7.63	16.59	30.8	23.90	42.78	0.0014
Max		860	0.024	0.279	4.07	4.066	0.007	11.1	99.30	7.70	17.50	30.8	26.00	44.60	0.0035
Std Dev		281	0.005	0.071	0.91	0.997	0.002	1.0	4.96	0.12	3.05	1.5	6.95	2.82	0.0009
95% C.I.		166	0.003	0.037	0.46	0.618	0.001	0.5	2.70	0.06	1.54	0.7	3.52	1.48	0.0005
N. of Samples	0	11	14	14	15	10	10	14	13	15	15	15	15	14	14

Table 10: Western Tributary, 2,550m u/s of Inaha confluence

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.4	724	0.017	0.026	2.25	4.394	0.006	9.5	90.39	7.53	13.16	29.5	4.43	46.19	0.0002
Min	0.3	23	0.006	0.007	0.07	2.184	0.001	7.0	74.00	7.30	5.50	18.9	0.68	39.10	0.0001
5%ile	0.3	69	0.008	0.008	0.15	2.372	0.002	7.4	78.50	7.30	7.16	24.6	1.38	39.22	0.0001
10%ile	0.3	77	0.010	0.008	0.21	2.561	0.003	8.0	80.50	7.40	8.54	25.6	1.50	40.40	0.0001
20%ile	0.3	113	0.013	0.014	0.49	3.269	0.004	8.5	84.00	7.40	9.88	26.9	2.14	42.70	0.0001
25%ile	0.3	120	0.014	0.016	0.59	3.679	0.004	8.6	84.75	7.40	10.20	27.4	2.28	43.80	0.0001
50%ile (median)	0.4	210	0.016	0.022	2.01	4.787	0.006	9.6	91.35	7.60	12.85	29.6	3.20	45.00	0.0002
75%ile	0.6	455	0.021	0.030	3.54	4.914	0.006	10.2	94.85	7.60	15.95	31.4	4.98	48.00	0.0003
90%ile	0.6	1480	0.024	0.044	4.93	5.438	0.008	11.3	96.10	7.60	18.43	33.7	8.30	50.50	0.0004
95%ile	0.6	2150	0.027	0.062	5.13	6.107	0.011	11.5	100.70	7.70	18.71	34.2	10.25	52.53	0.0004
Max	0.6	9700	0.028	0.076	6.79	6.775	0.015	12.5	123.00	7.90	19.00	39.1	21.00	64.20	0.0005
Std Dev	0.2	1684	0.006	0.016	1.84	1.381	0.004	1.2	9.22	0.12	3.67	3.5	3.91	5.09	0.0001
95% C.I.	0.1	558	0.002	0.005	0.57	0.902	0.003	0.4	3.01	0.04	1.14	1.1	1.21	1.92	0.0001
N. of Samples	10	35	39	39	40	9	9	37	36	40	40	40	40	27	14

Table 11: Western Tributary, 2,50m u/s of Inaha confluence

	$ScBOD_5$ (g/m^3)	FC (100 mL)	DRP (g/m^3)	NH_4-N (g/m^3)	NNN (g/m^3)	NO_3-N (g/m^3)	NO_2-N (g/m^3)	DO (g/m^3)	DO (% Sat)	PH	Temp (°C)	Conductivity (mS/m@20C)	Turbidity (NTU)	CL (g/m^3)	NH_3-N (g/m^3)
Average	0.4	632	0.013	0.017	3.95	5.812	0.006	9.8	94.56	7.59	13.69	34.3	7.07	57.28	0.0002
Min	0.3	23	0.004	0.002	0.24	2.293	0.001	7.5	78.40	7.20	5.00	21.4	0.93	38.20	0.0000
5%ile	0.3	45	0.005	0.004	0.60	3.257	0.001	7.8	80.90	7.32	7.73	25.2	1.70	43.25	0.0000
10%ile	0.3	50	0.007	0.005	0.66	3.665	0.002	8.5	84.53	7.40	9.50	26.7	2.10	44.70	0.0000
20%ile	0.3	85	0.008	0.007	0.94	4.033	0.003	9.1	88.60	7.40	10.38	28.9	2.60	47.00	0.0001
25%ile	0.3	135	0.008	0.008	1.06	4.099	0.003	9.2	89.00	7.48	11.45	29.6	3.20	47.25	0.0001
50%ile (median)	0.3	270	0.012	0.012	3.65	5.855	0.005	9.9	96.00	7.60	13.85	32.8	5.80	52.40	0.0002
75%ile	0.5	675	0.015	0.017	6.14	6.946	0.005	10.5	99.18	7.70	16.73	38.4	9.80	63.50	0.0003
90%ile	0.7	1000	0.018	0.027	8.07	8.051	0.010	10.9	102.30	7.80	17.60	43.9	15.00	77.04	0.0004
95%ile	0.8	2400	0.019	0.041	9.92	8.417	0.017	11.2	110.20	7.90	18.85	46.2	16.00	79.89	0.0007
Max	0.9	5800	0.096	0.109	13.00	9.785	0.022	11.6	117.50	8.30	19.80	73.6	20.00	102.00	0.0013
Std Dev	0.2	1096	0.012	0.022	3.20	1.909	0.005	1.0	8.34	0.20	3.46	8.0	4.85	13.84	0.0003
95% C.I.	0.2	301	0.003	0.005	0.78	0.907	0.002	0.3	2.31	0.05	0.85	2.0	1.22	4.14	0.0001
N. of Samples	10	51	56	60	64	17	19	55	50	64	64	64	61	43	25

Appendix C: Summary of Attribute States for Total Ammoniacal Nitrogen, and Nitrate from Appendix 2 of the National Policy Statement for Freshwater Management (2014).

Table 1: Attribute states for Ammonia (Toxicity) taken from Appendix 2 of the National Policy Statement for Freshwater Management (2014).

Value	Ecosystem health		
Freshwater Body Type	Lakes and Rivers		
Attribute	Ammonia (Toxicity)		
Attribute Unit	mg NH_4-N/L (milligrams ammoniacal-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median*	**Annual Maximum***	
A	≤ 0.03	≤ 0.05	99% species protection level. No observed effect on any species.
B	>0.03 and ≤ 0.24	>0.05 and ≤ 0.40	95% species protection level. Starts impacting occasionally on the 5% most sensitive species.
C	>0.24 and ≤ 1.30	>0.40 and ≤ 2.020	80% species protection level. Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species).
National Bottom Line	**1.30**	**2.20**	
D	>1.30	>2.20	Starts approaching acute impact level (i.e. risk of death) for sensitive species.

*Based on pH 8 and temperature of 20^{o}C

Compliance with the numeric attribute states should be undertaken after pH adjustment.

Table 2: Attribute states for Nitrate (Toxicity) taken from Appendix 2 of the National Policy Statement for Freshwater Management (2014) (updated September 2017).

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Nitrate (Toxicity)		
Attribute Unit	mg NO_3-N/L (milligrams nitrate-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median	**Annual 95th Percentile**	
A	≤ 1.0	≤ 1.5	High conservation value system. Unlikely to be effects even on sensitive species.
B	>1.0 and ≤ 2.4	>1.5 and ≤ 3.5	Some growth effect on up to 5% of species.
C	>2.4 and ≤ 6.9	>3.5 and ≤ 9.8	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.
National Bottom Line	**6.9**	**9.8**	
D	>6.9	>9.8	Impacts on growth of multiple species, and starts approaching acute impact level (i.e. risk of death) for sensitive species at higher concentrations (> 20 mg/l).

Note: This attribute measures the toxic effect of nitrate, not the trophic state. Where other attributes measure trophic state, for example periphyton, freshwater objectives, limits and/or methods for those attributes will be more stringent.

Appendix D: Summary of longitudinal water quality surveys conducted in April 2018 and October 2018 in the Inaha Stream and the Western Tributary.

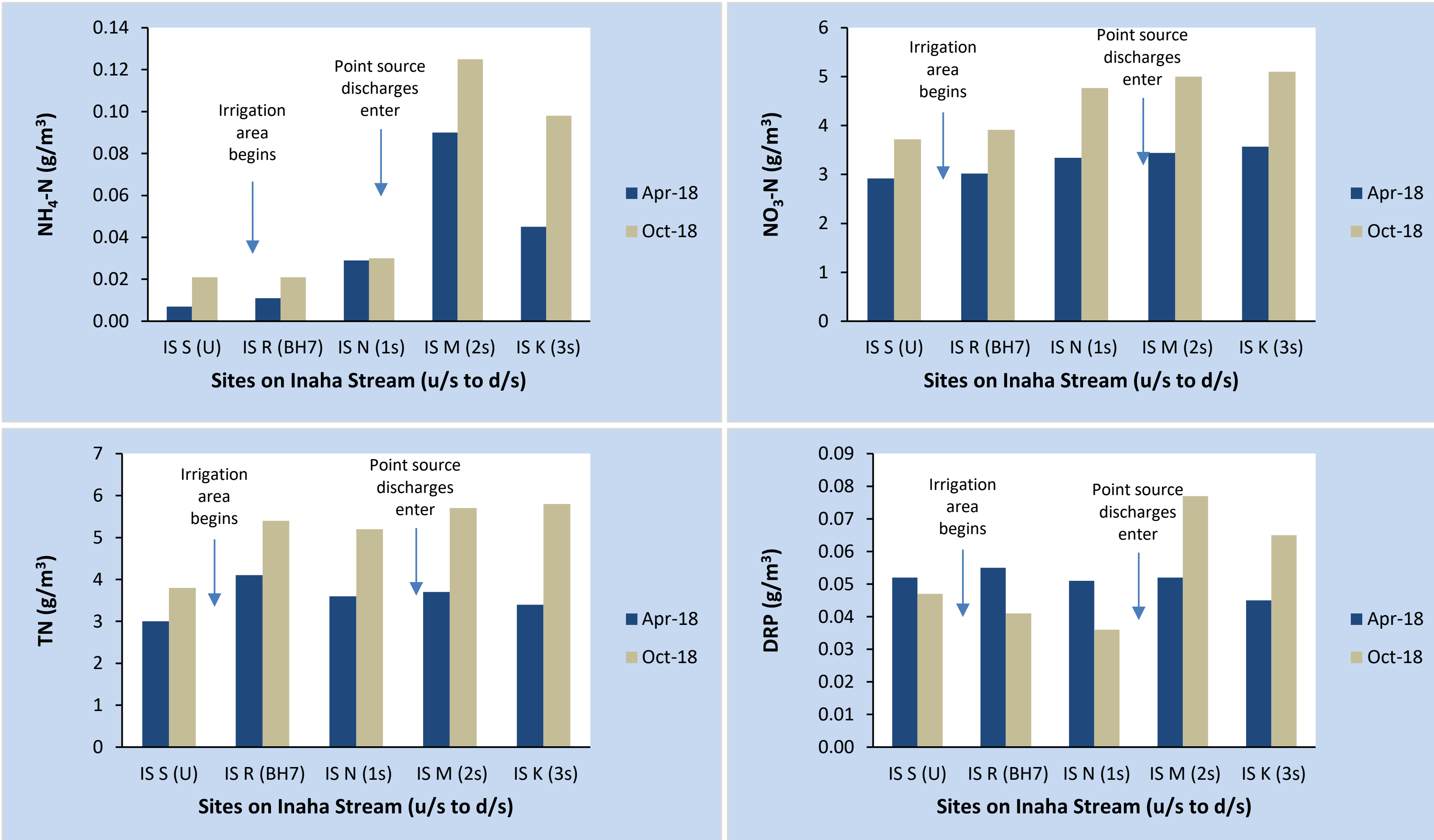


Figure 1: Concentration of key contaminants at sites on the Inaha Stream in April 2018 and October 2018. The location of major contaminant sources are depicted on the graphs, and site locations are provided in Figure 5 and Figure 6.

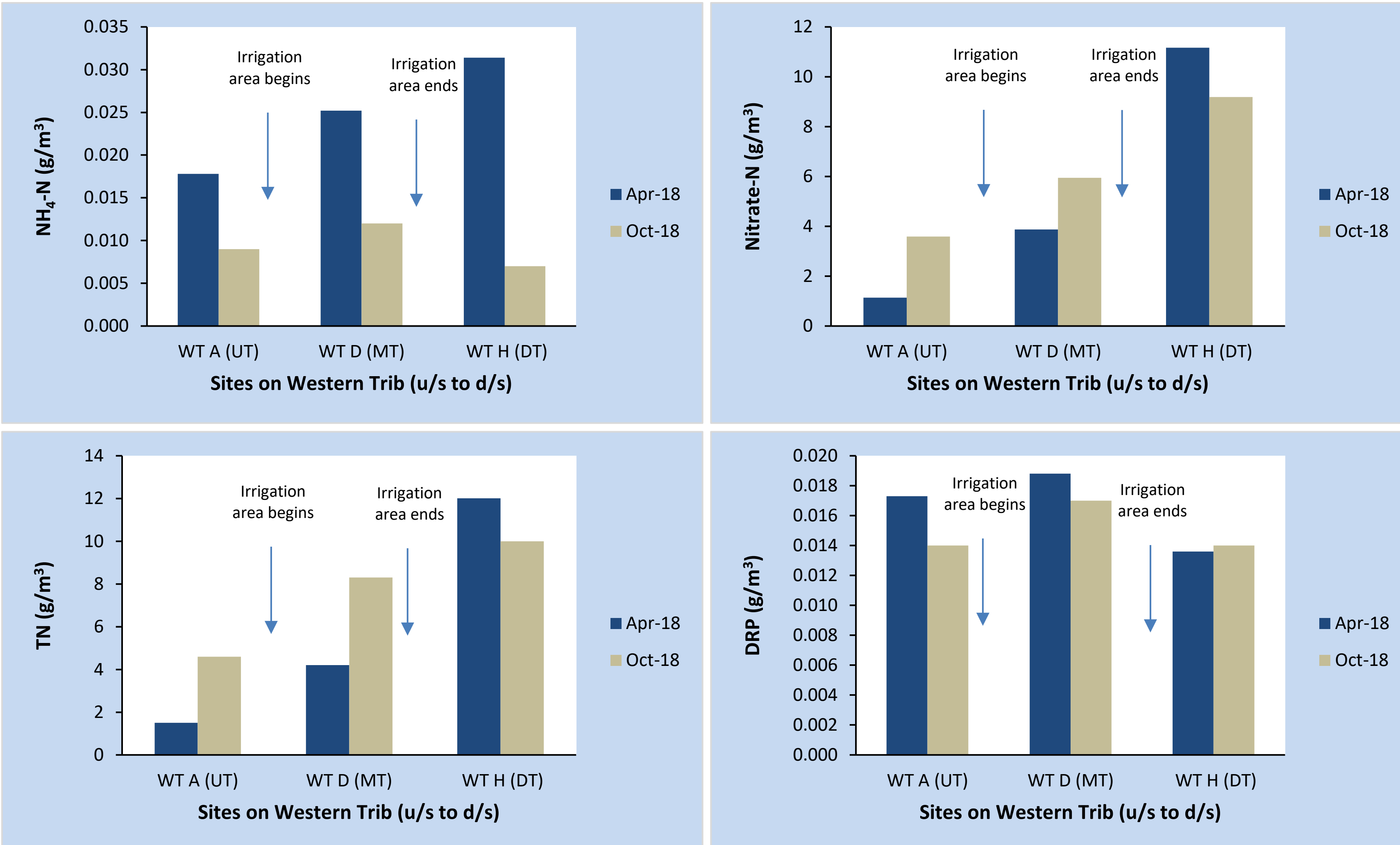


Figure 2: Concentration of key contaminants at sites on the Western Tributary in April 2018 and October 2018. The location of major contaminant sources are depicted on the graphs, and site locations are provided in Figure 5 and Figure 6.

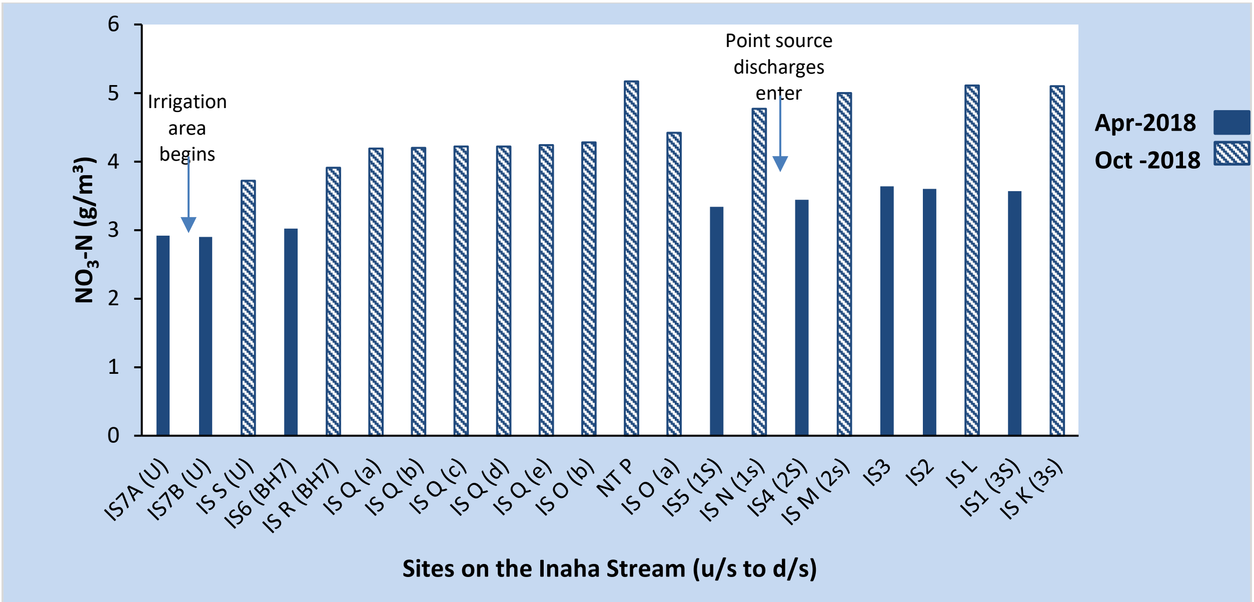


Figure 3: Concentration of NO_3-N at sites on the Inaha Stream in April 2018 and October 2018. The location of major contaminant sources are depicted on the graphs, and site locations are provided in Figure 5 and Figure 6.

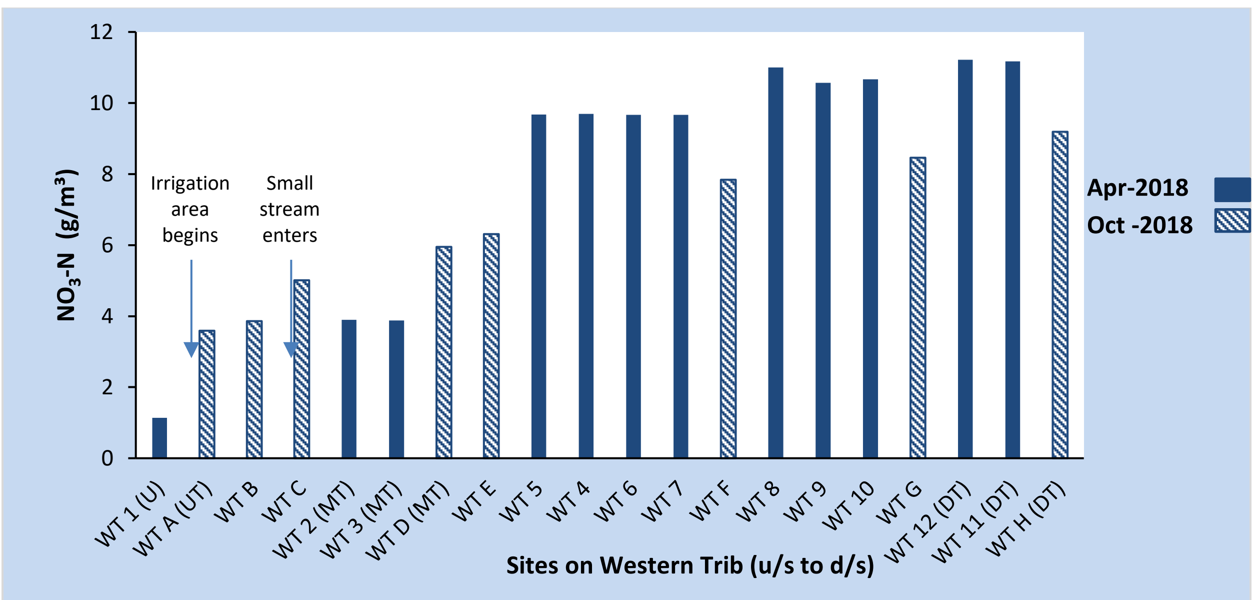


Figure 4: Concentration of NO_3-N at sites on the Western Tributary in April 2018 and October 2018. The location of major contaminant sources are depicted on the graphs, and site locations are provided in Figure 5 and Figure 6.

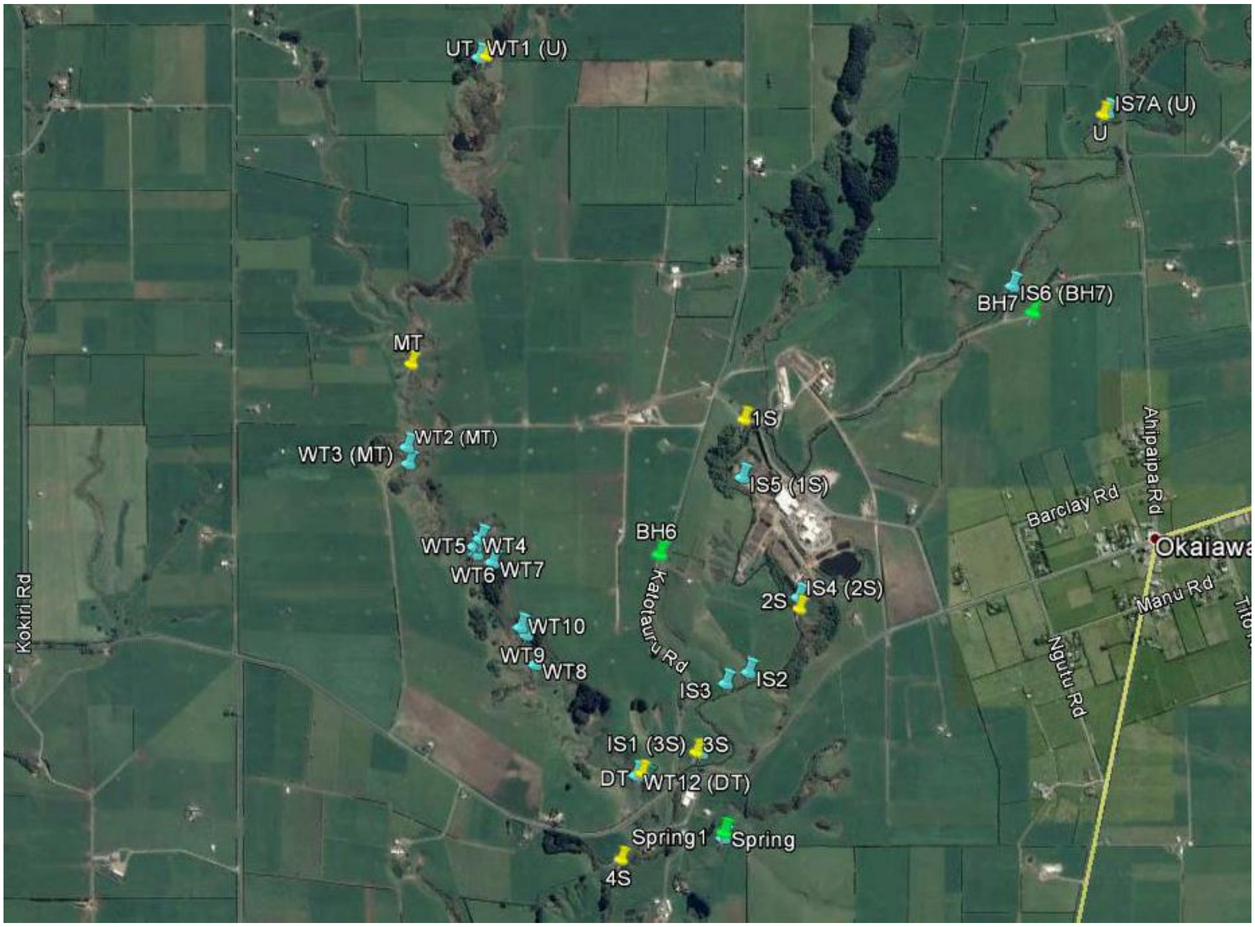


Figure 5: Sampling site locations in April 2018

Figure 6: Sampling site locations in October 2018

Appendix E: Assessment against the permitted activity thresholds in Rule 28 of the Regional Freshwater Plan for Taranaki

Background

In this report the water quality data collected downstream of the closed burial pits at Taranaki By-Products' Okaiawa Rendering Plant are assessed against the permitted activity thresholds set out in Rule 28 of the Regional Freshwater Plan for Taranaki.

Estimated groundwater travel patterns provided by PDP indicate that contaminants discharged to groundwater from the closed burial pits enter the Inaha Stream above the water quality site at the bridge 420 m u/s Kohiti Rd (INH000348). Accordingly, data collected from this site was used in this assessment, as are the results of longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018 (the location of sites samples in these surveys are provided in Figure 1 and Figure 2)

The relevant water quality thresholds set out in Rule 28 are:

- The discharge shall not cause the following limits to be exceeded in the receiving water after reasonable mixing:
    - unionised ammonia expressed as nitrogen $0.02gm^{-3}$;
- The discharge shall not cause the dissolved oxygen concentration of the receiving water to fall below 80% of saturation concentration after reasonable mixing;
- The discharge shall not cause the concentration of filtered carbonaceous biochemical oxygen demand to exceed $2.00gm^{-3}$ in the receiving water after reasonable mixing.

Rule 28 also stipulates that the discharge shall not cause the concentration of total zinc to exceed $0.05gm^{-3}$ in the receiving water after reasonable mixing. However, the burial pits are not expected to contain metals, therefore the total zinc threshold is not relevant to this activity. Accordingly, the zinc threshold is not considered in this assessment (note total zinc is not monitored in the Inaha Stream).

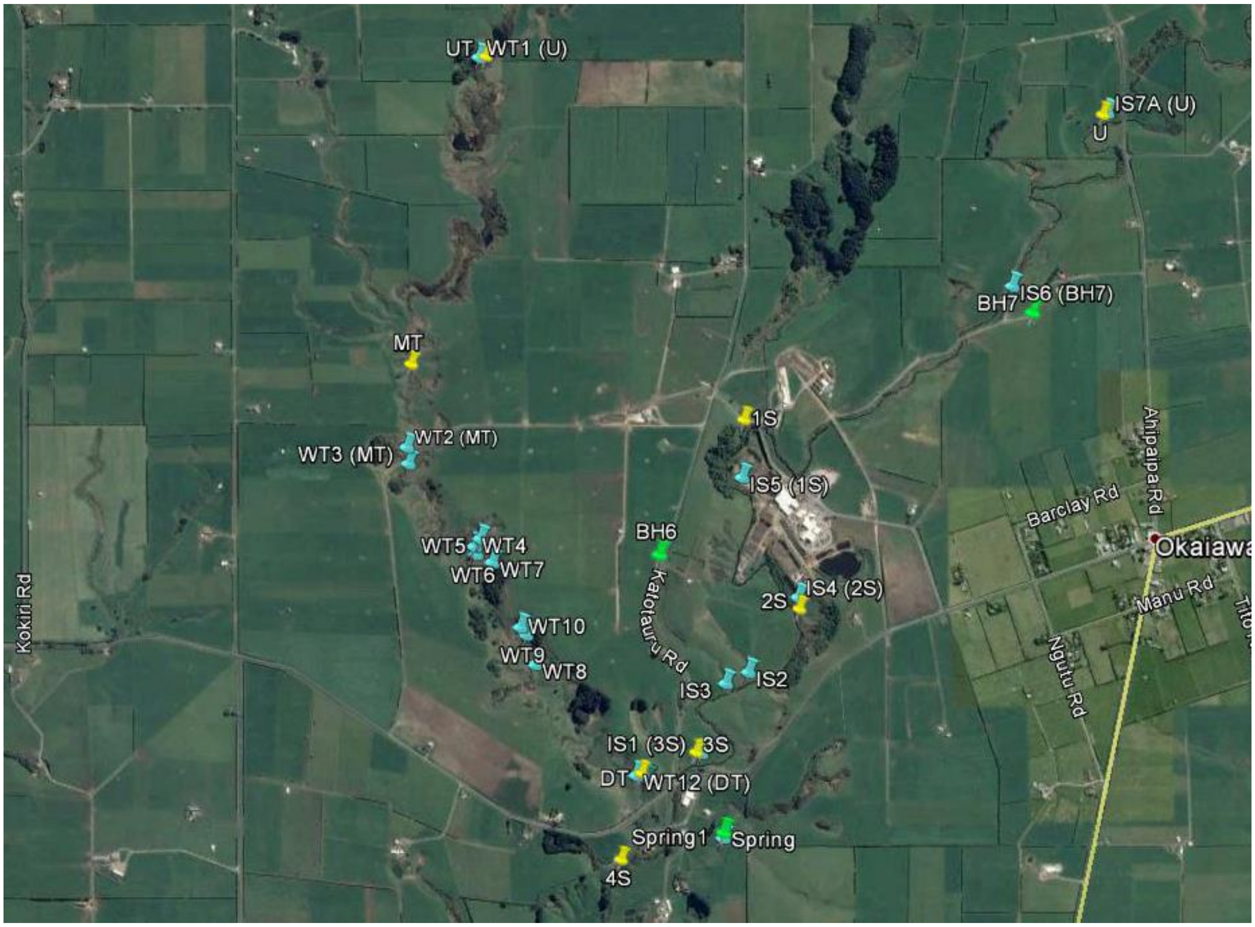


Figure 1: Location of sites sampled by Aquanet in April 2018.

Figure 2: Location of sites sampled by Aquanet in October 2018

Assessment

Unionised ammonia

The maximum unionised ammonia concentration recorded in the Inaha Stream downstream of the burial pits (@ INH000348) is 0.001 gm^{-3} (see Appendix B for full data summary). Consequently, there is no evidence to suggest that discharges from the burial sites are causing the 0.02 gm^{-3} threshold to be exceeded.

Longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018 also indicate that the risk of discharges from the burial sites causing the 0.02 gm^{-3} threshold to be exceeded is low. On both sampling occasions the maximum increase observed between sites upstream and downstream of the burial pits was 0.001 gm^{-3}

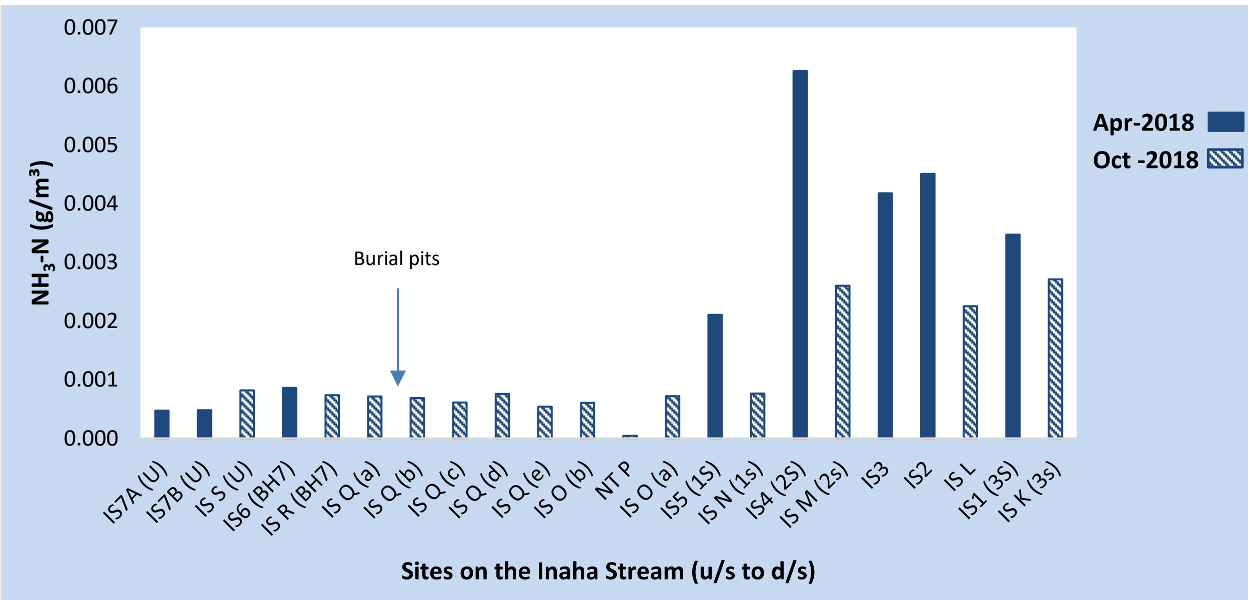


Figure 3: Concentration of NH_3-N at sites on the Inaha Stream in April 2018 and October 2018. The location of burial pits contaminant sources are depicted on the graphs, and site locations are provided in Figure 1 and 2.

Biochemical oxygen demand

Based on the available data, discharges from the burial sites are unlikely to be causing the 2.00 gm^{-3} threshold for filtered carbonaceous biochemical oxygen demand ($ScBOD_5$) to be breached. Indeed, recorded $ScBOD_5$ concentrations in the Inaha Stream downstream of the burial pits have never exceeded 2.00 gm^{-3}.

Dissolved oxygen

Based on the available data, discharges from the burial sites are not causing the 80% threshold for dissolved oxygen (DO) saturation to be breached. Observed DO saturation in the Inaha Stream downstream of the burial pits has only been below 80% once (28/02/2001 = 78%), and on this occasion it is unclear if low DO was driven by discharges from the burial pits, as upstream water quality was not measured (see Appendix B of Aquanet report for full data summary).

Previous DO monitoring has been conducted during the day when DO is highest, thus the available data may not represent the full range of oxygen conditions experiences in the Inaha Stream. However, given that the discharges from the burial pits do not appear to:

- Increase ammonia concentrations to the extent that the risk of nuisance algal or macrophyte blooms will be significantly increased; or
- Increased ScBOD5 concentrations

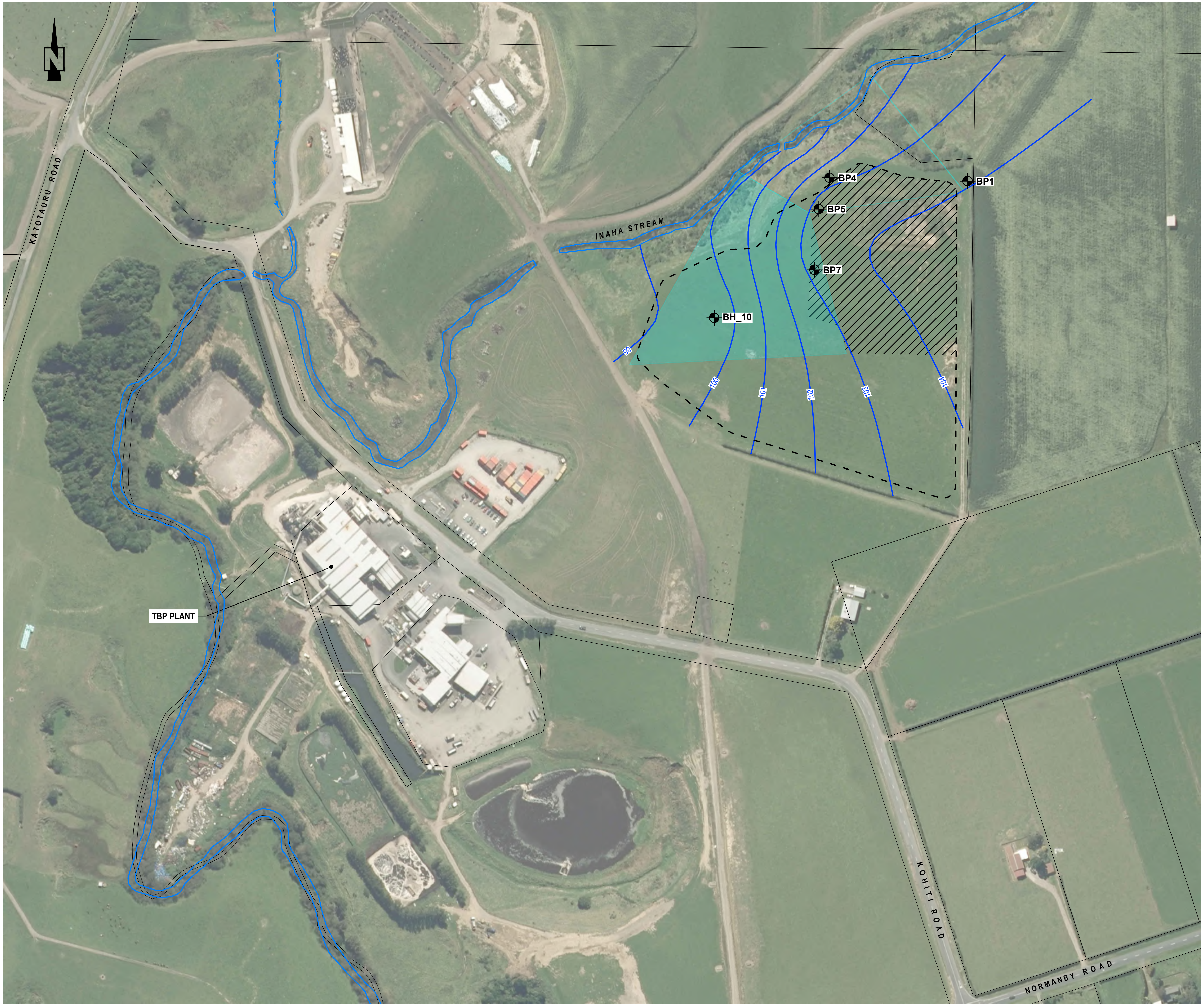
It is unlikely that they are causing dissolved oxygen to drop below 80% saturation.

Summary

Based on the available water quality data, it appears that discharges from the closed burial pits at the Okaiawa Rendering Plant are not causing the relevant Rule 28 water quality thresholds to be breached. However, TRC have agreed to conduct additional monitoring to confirm this.

Appendix 4

Solid Waste Burial Location Plan



KEY :

- MONITORING BORE [2]
- GROUNDWATER CONTOUR (m RL) [3]
- EXISTING BURIAL AREA
- PROPOSED BURIAL AREA
- ESTIMATED GROUNDWATER ZONE OF INFLUENCE
- PARCEL BOUNDARY [5]

NOTES:

1. AERIAL IMAGERY (FLOWN 2011-2012) PROVIDED UNDER LICENCE FROM TARANAKI REGIONAL COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. EXISTING MONITORING BORES DEPICTED DERIVED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf, BY GPS-it DATA MAPPING SOLUTIONS, DATED 03/05/2016.
3. GROUNDWATER CONTOURS BASED ON AVERAGES OF AVAILABLE MONITORING DATA FROM 2014 TO 2018.
4. STREAMS DERIVED FROM A COMPILATION OF INFORMATION SOURCED FROM SBT_TaranakiByProductsLtd_A4PAD.pdf AND LINZ.
5. PARCEL BOUNDARIES (AS AT 03/05/2020) DERIVED FROM LINZ DATA.

NO.	REVISION	DATE	APP.
A	ISSUED FOR REVIEW	JUL 20	

CLIENT :

TARANAKI BY-PRODUCTS LTD

PROJECT :

ASSESSMENT OF ENVIRONMENTAL EFFECTS

TITLE :

DISPOSAL LAYOUT PLAN

pdp solutions for your environment

PATTLE DELAMORE PARTNERS LTD

Auckland Tauranga Wellington Christchurch

SCALE 1:3,000 (A3)

0 50 100 150m

PROJECT NO. :	FIGURE NO. :	REVISION :
AJ467202	21	A

FILED : AJ467202D021.dwg

Appendix 5

Proposed Consent Conditions

Discharge Permit 2049-4 - To discharge up to 940 cubic metres/day of treated wastewater from a rendering operation and from a farm dairy into the Inaha Stream			
Original Condition		**Proposed Condition (underlines show additions, strikeouts show deletions)**	**General Comment / Reasons for the proposed change.**
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.	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.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
Special Conditions			
1	The mixing zone in each condition of this consent shall extend for a distance of 30 metres downstream of the point of discharge of treated wastewater.	The mixing zone in each condition of this consent shall extend for a distance of 30 metres downstream of the point of discharge of treated wastewater.	• Inconsistences with other mixing zones stated • Needs to reflect current monitoring locations • Distance confirmed by Aquanet to reflect the distance from the wastewater discharge
2	The boundaries of the mixing zone and site of discharge shall be as physically determined by the Chief Executive, Taranaki Regional Council.	~~The boundaries of the mixing zone and site of discharge shall be as physically determined by the Chief Executive, Taranaki Regional Council.~~	• Superfluous condition – delete
3	The point of discharge into the Inaha Stream shall be such that the discharge enters directly into a channel of the Inaha Stream in order to ensure that complete mixing occurs.	The point of discharge into the Inaha Stream shall be such that the discharge enters directly into a channel of the Inaha Stream in order to ensure that complete mixing occurs.	• Retain
4	The consent holder shall advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.	The consent holder shall advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.	• Retain
	The consent holder shall undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the Chief Executive, Taranaki Regional Council, upon request.	~~The consent holder shall undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the Chief Executive, Taranaki Regional Council, upon request.~~	• Delete – redundant – specified by conditions and management plan • Mgt plan can be updated if any changes are deemed necessary
6	A minimum dilution rate of 1:300 shall be maintained at the point of discharge to the Inaha Stream at all times.	A minimum dilution rate of 1:300 shall be maintained at the point of discharge to the Inaha Stream at all times, except in circumstances where spray irrigation of wastewater is not possible, and where a dilution rate of	• Addition proposed to rationalise / streamline conditions – condition is now combined with

		1:300 in the Inaha Stream cannot be maintained, the consent holder shall seek the permission of the Chief Executive, Taranaki Regional Council, prior to discharging wastewater to the Inaha Stream.	Condition 7 from existing Discharge Permit 3941-2 (discharge to land)
7a	No stick-water shall be discharged under this consent. Stick-water is defined as juices squeezed out of products that are rendered.	No stick-water shall be directly discharged to the Inaha Stream under this consent. Stick-water is defined as juices squeezed out of products that are rendered.	• Additions made for clarity • There may be dilute stick water added to the treatment ponds to form a combined discharge – (need to check with TBP / PDP)
7b	This consent allows the discharge of wastewater from up to 1,200 cows. Prior to this number being increased the consent holder must demonstrate, in writing, to the satisfaction of the Chief Executive Officer, Taranaki Regional Council, that the wastewater treatment system can treat the wastewater without breaching condition 9 of this consent.	~~This consent allows the discharge of wastewater from up to 1,200 cows. Prior to this number being increased the consent holder must demonstrate, in writing, to the satisfaction of the Chief Executive Officer, Taranaki Regional Council, that the wastewater treatment system can treat the wastewater without breaching condition 9 of this consent.~~	• Delete • Only relevant matter is effects associated with the discharge, not the number of cows • Deleted in favour of end of pipe standards to manage effects of discharges associated with dairy activity
8	The discharge shall cease when flows decrease in the Inaha Stream, as measured at the Kohiti Road gauging site, to below 100 litres/second.	The discharge shall cease when flows decrease in the Inaha Stream, as measured at the Kohiti Road gauging site, to below 100 litres/second.	• Retain
9	The discharge [in conjunction with any other discharges pertaining to the same property], shall not cause or give rise to any of the following effects, at any point in the receiving waters below the mixing zone: a) a fall of more than 0.5 pH units; b) an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 gm-3; c) a temperature rise of more than 3.0 degrees Celsius; d) a reduction in the dissolved oxygen concentration to below 80% of saturation concentration; e) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; f) any conspicuous change in the colour or visual clarity; g) any emission of objectionable odour; h) the rendering of fresh water unsuitable for consumption by farm animals; i) any significant adverse effects on aquatic life, habitats or ecology; j) any visible bacterial and/or fungal growths in the receiving water.	The discharge [in conjunction with any other discharges pertaining to the same property], shall not cause or give rise to any of the following effects, at any point in the receiving waters below the mixing zone: a) a fall of more than 0.5 pH units; b) an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 gm-3; c) a temperature rise of more than 3.0 degrees Celsius; d) a reduction in the dissolved oxygen concentration to below 80% of saturation ~~concentration~~; e) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials; f) any conspicuous change in the colour or visual clarity; g) any emission of objectionable odour; ~~h) the rendering of fresh water unsuitable for consumption by farm animals;~~ i) any significant adverse effects on aquatic life, habitats or ecology; j) any visible bacterial and/or fungal growths in the receiving water.	• Minor change made to reflect lack of certainty about what constitutes the rendering of freshwater unsuitable for consumption by livestock • There may be a need to add an advice note to set how compliance with clauses b and d will be assessed if/when the upstream site does not meet the limit (e.g. if DO sat is below 80% upstream of the discharge)
10	The discharge, in conjunction with any other discharges pertaining to the same property, shall not raise the total ammonia concentration [expressed as NH3] in the receiving waters at any point below the mixing zone above 1.5 gm-3 if the pH of the receiving water is below 7.75, or above 0.7 gm-3 if the pH of the receiving water lies between 7.75 and 8.00, or above 0.4 gm-3 if the pH of the receiving water is above 8.00	The discharge, in conjunction with any other discharges pertaining to the same property, shall not raise the total ammoniacal nitrogen concentration [expressed as NH_4-N~~3~~] in the receiving waters at any point below the mixing zone above 1.5 gm-3 if the pH of the receiving water is below 7.75, or above 0.7 gm-3 if the pH of the receiving water lies between 7.75 and 8.00, or above 0.4 gm-3 if the pH of the receiving water is above 8.00	• Minor amendment to the wording to reflect conventions used in recent documents • These thresholds are sourced from the TRC Regional Plan (Schedule 5) – it may be preferable to update these standards to reflect recent revisions to the ammonia toxicity guidelines eg. NPSFM 2017
11	The consent holder shall install a metal control gate on the discharge outlet, and install and operate a v-notch weir and stage board on the outlet, to the	The consent holder shall install a metal control gate on the discharge outlet, and install and operate a v-notch weir and stage board on the outlet, to the	• Retain

	satisfaction of the Chief Executive, Taranaki Regional Council; and shall keep records of the discharge rate during the exercise of this consent; such records to be made available to the Chief Executive, Taranaki Regional Council, upon request.	satisfaction of the Chief Executive, Taranaki Regional Council; and shall keep records of the discharge rate during the exercise of this consent; such records to be made available to the Chief Executive, Taranaki Regional Council, upon request.	
12	The consent holder shall install and maintain a stage board on the Kohiti Road Bridge and shall gauge the site for the purpose of providing a stream flow monitoring site, to the satisfaction of the Chief Executive, Taranaki Regional Council.	The consent holder shall ~~install and~~ maintain the ~~a~~ stage board installed on the Kohiti Road Bridge and shall gauge the site for the purpose of providing a stream flow monitoring site, to the satisfaction of the Chief Executive, Taranaki Regional Council.	• Update made to reflect that stage board was installed under previous consent
13	The consent holder shall maintain a wastewater disposal management plan [the management plan] for the wastewater treatment system, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, particularly the use of the spray irrigation system in combination with the pond discharge, which shall demonstrate the ability to comply with consent conditions and shall address the following matters: a) monitoring of the discharge wastewater; b) monitoring of the receiving water; c) management of the wastewater treatment system; d) minimisation of nutrients in the discharge wastewater; e) treatment and disposal of stickwater; f) mitigation of the effects of the discharge; g) guidelines for use of spray irrigation or discharge to surface water; and h) reporting on the exercise of the consent. An objective of the plan shall be to minimise discharges to surface water and to maximise discharges to land under consent 3941.	The consent holder shall maintain a wastewater disposal management plan [the management plan] for the wastewater treatment system, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, particularly the use of the spray irrigation system in combination with the pond discharge, which shall demonstrate the ability to comply with consent conditions and shall address the following matters: a) monitoring of the discharge wastewater; b) monitoring of the receiving water; c) management of the wastewater treatment system; d) minimisation of nutrients in the discharge wastewater; e) treatment and disposal of stickwater; f) mitigation of the effects of the discharge; g) guidelines for use of spray irrigation or discharge to surface water; and h) reporting on the exercise of the consent. ~~An objective of the plan shall be to minimise discharges to surface water and to maximise discharges to land under consent 3941.~~ Objectives of the plan shall be (but not limited to) 1. to maximise discharges to land; 2. to minimise discharges to surface water under consent [TBC]; and 3. To use and maintain good management practices to minimise adverse effects on the environment.	• Retain • Note an updated wastewater disposal management plan will be provided once sufficient data is available to determine management approach post VSEP upgrades • Update consent number reference when known • Revised objectives added to improve long term management of effects
14	The consent shall be exercised in accordance with the procedures set out in the wastewater disposal management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	The consent shall be exercised in accordance with the procedures set out in the wastewater disposal management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and all other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	• Retain
15	The consent holder shall advise the Taranaki Regional Council two months prior to any changes being made to the wastewater disposal management plan. Should the Taranaki Regional Council wish to review the wastewater disposal management plan, two months notice shall be provided to the consent holder. The consent holder shall review the plan annually and	The consent holder shall advise the Taranaki Regional Council two months prior to any changes being made to the wastewater disposal management plan. Should the Taranaki Regional Council wish to review the wastewater disposal management plan, two months notice shall be provided to the consent holder. The consent holder shall review the plan annually and shall	• Retain • Last review provided 21 June 2017

	shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 31 May each year.	provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 31 May each year.	
16	The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the wastewater treatment system.	The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the wastewater treatment system.	• Retain
17	The consent holder shall ensure that: a) the operation of the wastewater treatment system shall be carried out at all times in accordance with the requirements of the wastewater disposal management plan prepared as required in condition (13) above 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 wastewater disposal management plan, the maximum period between training sessions being 12 months. 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 wastewater disposal management plan.	The consent holder shall ensure that: a) the operation of the wastewater treatment system shall be carried out at all times in accordance with the requirements of the wastewater disposal management plan prepared as required in condition (13) above 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 wastewater disposal management plan, the maximum period between training sessions being 12 months. 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 wastewater disposal management plan.	• Retain
18	By the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by donating annually to the Taranaki Tree Trust $2100 [goods and services tax exclusive] for the purpose of providing riparian planting and management in the Inaha Stream catchment. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.	By the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by donating annually to the ~~Taranaki Tree Trust $2100~~[entity and amount to be confirmed] [goods and services tax exclusive] for the purpose of providing riparian planting and management in the Inaha Stream catchment. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.	• Taranaki Tree Trust no longer exists • Applicant comfortable with the concept, however wishes to ensure that donated funds are spent to benefit the Inaha stream and its catchment • Specifics to be developed in consultation with hapū and other stakeholders
19	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 2007, June 2011, and/or June 2017, 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.	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 ~~2007~~[TBC], June ~~2011~~[TBC], and/or June ~~2017~~[TBC], 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.	• Retain, with updates to review dates as necessary

Discharge Permit 2050-4 - To discharge up to 2,160 cubic metres/day of cooling water and backwash water from a rendering operation into an unnamed tributary of the Inaha Stream			
Original Condition		**Proposed Condition (underlines show additions, strikeouts show deletions)**	**General Comment / Reasons for the proposed change.**
General Conditions			
a)	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	• Retain / update to reflect current TRC practice

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.	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.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
Special Conditions			
1	THAT the consent holder shall undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the General Manager, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the General Manager, Taranaki Regional Council, upon request	~~THAT the consent holder shall undertake such monitoring of the activities licensed by this consent, as deemed reasonably necessary by the General Manager, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991. This monitoring information is to be forwarded to the General Manager, Taranaki Regional Council, upon request~~	• Deleted in favor of specific requirements identified in the proposed conditions
2	THAT the discharge shall not contain concentrations of any chemical, biological or physical contaminant [other than heat and suspended solids] greater than those found in the water abstracted from the Inaha Stream.	~~THAT the discharge shall not contain concentrations of any chemical, biological or physical contaminant [other than heat and suspended solids] greater than those found in the water abstracted from the Inaha Stream.~~	• Delete in favour of additional receiving water standards in condition 5 • Also note that issues has been detected with cooling water mixing with stormwater prior to discharge and picking up additional nutrient load – updates to stormwater management plan proposed to address this issue.
3	THAT the cooling water discharge to the Inaha Stream shall not exceed 35.0 degrees Celsius in temperature at the point of the discharge to the unnamed tributary of the Inaha Stream.	THAT the cooling water discharge to the Inaha Stream shall not exceed 35.0 degrees Celsius in temperature at the point of the discharge to the unnamed tributary of the Inaha Stream.	• Retain
4	THAT the cooling water discharge to the Inaha Stream shall not contain a concentration of suspended solids in excess of 100 gm-3	THAT the cooling water discharge to the Inaha Stream shall not contain a concentration of suspended solids in excess of 100 gm-3	• Retain
5	THAT after allowing for a mixing zone of 45 metres extending downstream of the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharge pertaining to the same property], shall not give rise to any of the following effects in the receiving waters: a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material; 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; and	THAT after allowing for a mixing zone of 110 metres extending downstream of the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharge pertaining to the same property], shall not give rise to any of the following effects in the receiving waters: a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material; 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; and g) an increase in temperature of more than 3.0 degrees Celsius. h) <u>a fall of more than 0.5 pH units;</u>	• Distance confirmed by Aquanet to represent the location of the cooling water discharge • deleted to address compliance assessment issues • Additional conditions added to manage effects

	g) an increase in temperature of more than 3.0 degrees Celsius;	i) an increase in filtered carbonaceous biochemical oxygen demand [20 degrees Celsius, 5-day test] to above 2.00 gm-3; j) raise the total ammoniacal nitrogen concentration [expressed as NH4-N] in the receiving waters at any point below the mixing zone above 1.5 gm-3 if the pH of the receiving water is below 7.75, or above 0.7 gm-3 if the pH of the receiving water lies between 7.75 and 8.00, or above 0.4 gm-3 if the pH of the receiving water is above 8.0	
6	THAT the consent holder shall operate and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a discharge temperature measuring device and shall keep records of the discharge temperature during the exercise of this consent; such records to be made available to the General Manager, Taranaki Regional Council, upon request.	THAT the consent holder shall operate and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a discharge temperature measuring device and shall keep records of the discharge temperature during the exercise of this consent; such records to be made available to the General Manager, Taranaki Regional Council, upon request.	• Retain
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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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.	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 ~~2001~~[TBC], June ~~2003~~[TBC], June ~~2005~~[TBC], June ~~2011~~ [TBC] and/or June ~~2017~~[TBC], 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.	• Retain, with updates to review dates as necessary

Water Permit 2051-4 - To take up to 2,160 cubic metres/day (50 litres/second) of water from the Inaha Stream for a rendering operation

	Original Condition	Proposed Condition (underlines show additions, strikeouts show deletions)	General Comment / Reasons for the proposed change.
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.		• Retain / update to reflect current TRC practice
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.		• Retain / update to reflect current TRC practice
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.		• Retain / update to reflect current TRC practice
Special Conditions			
1	That the means of taking water shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.	That the means of taking water shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.	• Retain

2	That a minimum flow of at least 25 litres/second shall be maintained in the stream at all times downstream of the point of abstraction.	That a minimum flow of at least 25 litres/second, or a flow equal to that upstream of the abstraction point if the upstream flow is less than 25 litres / second, shall be maintained in the stream at all times downstream of the point of abstraction.	• Compliance issue if stream gets below 25 l/s upstream – update made to address this
3	That the consent holder shall install and operate to the satisfaction of the Chief Executive, Taranaki Regional Council, an abstraction rate measuring device and shall keep records of the dates and daily quantities of water abstracted during the exercise of this consent; such records to he made available to the Chief Executive, Taranaki Regional Council, upon request.	That the consent holder shall ~~install~~ maintain and operate to the satisfaction of the Chief Executive, Taranaki Regional Council, an abstraction rate measuring device and shall keep records of the dates and daily quantities of water abstracted during the exercise of this consent; such records to he made available to the Chief Executive, Taranaki Regional Council, upon request.	• Change made to reflect that a flow recorder was installed in Jan 2015
	[new condition]	Within 12 months of the commencement of this consent, and every 2 years thereafter for the duration of this consent, the consent holder shall conduct an investigation to determine any discrepancy in the volume of water taken under this permit and the volume of water discharged under Discharge Permit [XXXX], for the purposes of confirming that the take of water under this permit is non-consumptive.	• Condition added to provide greater certainty that this take of water is non-consumptive – an assumption which has been used in the assessment of effects for this consent
	[new condition]	A report detailing the outcome of the assessment required by [Condition X] shall be provided to the Regulatory Manager, Taranaki Regional Council, within 3 months of the investigation being completed, and shall outline as a minimum: a) The investigation methodology used and data collected; and b) Confirmation that the take of water under this consent is non-consumptive; or c) If there is evidence of consumptive use of water, confirmation of the measures the consent holder shall take and the timeframe for implementing such measures to achieve a non-consumptive take of water under this permit.	• Condition added to provide greater certainty that this take of water is non-consumptive – an assumption which has been used in the assessment of effects for this consent
4	That the consent holder shall to the satisfaction of the Chief Executive, Taranaki Regional Council, monitor and keep daily records of the flows in the Inaha Stream at the Kohiti Road Bridge; such records to be made available to the Chief Executive, Taranaki Regional Council, upon request.	That the consent holder shall to the satisfaction of the Chief Executive, Taranaki Regional Council, monitor and keep daily records of the flows in the Inaha Stream at the Kohiti Road Bridge; such records to be made available to the Chief Executive, Taranaki Regional Council, upon request.	• Retain
5	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 2017, 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.	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 [TBC]~~2017~~, 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.	• Retain, with updates to review dates as necessary

Discharge Permit 3941-2: To discharge ~~up to 1400 cubic metres/day of treated~~[1] wastewater from a rendering operation and from a farm dairy via spray irrigation onto and into land, and to discharge emissions into the air, in the vicinity of the Inaha Stream and its tributaries

Original Condition	Proposed Condition (underlines show additions, strikeouts show deletions)	General Comment / Reasons for the proposed change.
General Conditions		

[1] Deletion of volume limit proposed as effects are better managed by a kg/ha/yr + mm/day limits – more land area available may mean that more (than 1400m^3) can be irrigated in one given day with the same or less effect providing nutrient loads are appropriately managed

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.		• Retain / update to reflect current TRC practice
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.		• Retain / update to reflect current TRC practice
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.		• Retain / update to reflect current TRC practice
Special Conditions			
1	The discharge authorised by this consent shall only occur on the land shown in the map labelled Figure 1 attached.	The discharge authorised by this consent shall only occur on the land shown in the map labelled Figure 1 attached.	• Retain • Provide 2015 map to go with this condition • Check if any updates to map required
2	Prior to the exercise of the consent, the consent holder shall provide, and subsequently shall maintain, a spray irrigation management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters: a) designated application areas; b) selection of appropriate irrigation methods for different types of terrain; c) application rate and duration; d) application frequency; e) farm management and operator training; f) soil and herbage management; g) prevention of runoff and ponding; h) minimisation and control of odour effects offsite; i) operational control and maintenance of the spray irrigation system; j) monitoring of the effluent [physicochemical]; k) monitoring of soils and herbage [physicochemical]; l) monitoring of groundwater beneath the irrigated area [physicochemical]; m) monitoring of drainage water downslope of the irrigated area [physicochemical]; n) monitoring of Inaha Stream and relevant tributaries; o) remediation measures; p) liaison with submitters to the consent, and interested parties; q) reporting monitoring data; r) procedures for responding to complaints; and	Within 6 months of the commencement ~~Prior to the exercise~~ of the consent, the consent holder shall submit an updated ~~provide, and subsequently shall maintain, a spray~~ land irrigation management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters: a) designated application areas; b) selection of appropriate irrigation methods for different types of terrain; c) application rate and duration; d) application frequency; e) farm management and operator training; f) soil and herbage management; g) prevention of runoff and ponding; h) minimisation and control of odour effects offsite; i) operational control and maintenance of the spray irrigation system; j) monitoring of the effluent [physicochemical]; k) monitoring of soils and herbage [physicochemical]; l) monitoring of groundwater beneath the irrigated area [physicochemical]; m) monitoring of drainage water downslope of the irrigated area [physicochemical]; n) monitoring of Inaha Stream and relevant tributaries; o) remediation measures; p) liaison with submitters to the consent, and interested parties; q) reporting monitoring data; r) procedures for responding to complaints; and	• Update condition to note that an updated plan will be provided • Land Irrigation Management Plan (new name + update throughout) – noting that stickwater will be injected, not irrigated (to manage odour), and this plan needs to cover that activity • Add monitoring for soil infiltration capacity and soil remediation procedures • Update with certification procedures for mgt plan • Revised objectives added to improve long term management of effects

	s) notification to the Council of non-compliance with the conditions of this consent. An objective of the plan shall be to maximise discharges to land and to minimise discharges to surface water under consent 2049.	s) notification to the Council of non-compliance with the conditions of this consent. Objectives of the plan shall be (but not limited to) 1. to maximise discharges to land; 2. to minimise discharges to surface water under consent [TBC]; and 3. To use and maintain good management practices to minimise adverse effects on the environment.	
3	The consent shall be exercised in accordance with the procedures set out in the spray irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	The consent shall be exercised in accordance with the procedures set out in the land~~spray~~ irrigation management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the Chief Executive, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	• Retain / update to reflect current TRC practice
4	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 31 May each year.	The land ~~spray~~ irrigation management plan described in special condition 2 of this consent shall be subject to review upon ~~two~~ three months notice by either the consent holder or the Taranaki Regional Council. Further, the consent holder shall review the spray irrigation management plan every two years ~~annually~~ and shall provide the reviewed plan to the Chief Executive, Taranaki Regional Council, by 31 May each year.	• Changes made to reduce administrative burden on all parties
5	The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the spray irrigation system. The officer shall be regularly trained on the content and implementation of the spray irrigation management plan, and shall be advised immediately of any revision or additions to the spray irrigation management plan.	The consent holder shall designate an officer with the necessary qualifications and/or experience to manage the spray irrigation system. The officer shall be regularly trained on the content and implementation of the spray irrigation management plan, and shall be advised immediately of any revision or additions to the spray irrigation management plan.	• Retain
6	The consent holder shall at all times adopt the best practicable option or options, as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise the adverse effects of the discharges on the environment. This shall include, but not be limited to the minimisation of total nitrogen concentration in the treated effluent.	~~The consent holder shall at all times adopt the best practicable option or options, as defined in Section 2 of the Resource Management Act 1991, to prevent or minimise the adverse effects of the discharges on the environment. This shall include, but not be limited to the minimisation of total nitrogen concentration in the treated effluent.~~	• Delete • New objectives added to all management plans to account for this goal
7	In circumstances where spray irrigation of wastewater is not possible, and where a dilution rate of 1:200 in the Inaha Stream cannot be maintained, the consent holder shall seek the permission of the Chief Executive, Taranaki Regional Council, prior to discharging wastewater to the Inaha Stream.	In circumstances where spray irrigation of wastewater is not possible, and where a dilution rate of 1:3~~2~~00 in the Inaha Stream cannot be maintained, the consent holder shall seek the permission of the Chief Executive, Taranaki Regional Council, prior to discharging wastewater to the Inaha Stream.	• Update dilution ratio for consistency with other conditions • However, need to align with discharge to water conditions – perhaps integrate both conditions – add this as a clause b to the condition in water discharge
Odour and spray effects			
8	The level of dissolved oxygen within the wastewater pond from which irrigation water is drawn shall be maintained above 1.0 gm-3 at all times.	The level of dissolved oxygen within the wastewater pond from which irrigation water is drawn shall be maintained above 1.0 gm-3 at all times.	• Retain
9	There shall be no offensive or objectionable odour as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.	There shall be no offensive or objectionable odour as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.	• Retain

10	There shall be no spray drift as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.	There shall be no spray drift as a result of the irrigation of treated wastewater at or beyond the boundary of the property or properties on which spray irrigation is occurring.	• Retain
Land effects			
11	The sodium adsorption ratio [SAR] of the wastewater shall not exceed 15.	The consent holder shall maintain the soil's natural infiltration capacity and structure. In particular, the irrigation of wastewater or biomass or other materials shall not result in an exchangeable sodium percentage (ESP) of the soil to exceed 10%. If the ESP exceeds 10%, action to remedy the elevated ESP shall be undertaken within one month of the consent holder becoming aware of the elevated ESP. Advice note: Action by the consent holder to remedy elevated ESP is likely to commence at a lower ESP, as set out in the Land Irrigation Management Plan, and as a guide is likely to commence at approximately 3-5% ESP	• This is a better measure of effect as it relates to the soil, rather than the wastewater • The SAR may vary on any given day, but not have any particular effect on soil – ESP a better measure of effect
12	There shall be no ponding of wastewater, and/or any direct discharge to a watercourse due to the exercise of this consent.	There shall be no significant ponding of wastewater and/or any direct discharge to a watercourse due to the exercise of this consent. Advice note: For the purposes of assessing compliance with this condition, significant ponding is deemed to occur if wastewater remains on an area of more than 10 square metres, 24 hours after being irrigated	• Retain with addition of an advice note to improve clarity / compliance assessments
13	The edge of the spray zone shall be at least: a) 25 metres from the banks of any watercourse; b) 50 metres from any bore, well or spring used for water supply purposes; c) 20 metres from any public road, except as detailed in f) and g) of this condition; d) 20 metres from any property boundary; e) 150 metres from any dwellinghouse or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; f) 200 metres from Normanby Road adjacent to the property described as Lots 3 & 4, Pt Lot 1 DP 2707, Lot 1 DP 3731, Blk IV, Waimate SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; and g) 50 metres from Ahipaipa Road adjacent to the properties described as Pt Lot 1 and Lot 2 DP 3322, Lot 2 DP12129, Blk IV, Waimate SD.	The edge of the spray zone shall be at least: a) 25 metres from the banks of any watercourse; b) 50 metres from any bore, well or spring used for water supply purposes; c) 20 metres from any public road, except as detailed in f) and g) of this condition; d) 20 metres from any property boundary; e) 150 metres from any dwellinghouse or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; f) 200 metres from Normanby Road adjacent to the property described as Lots 3 & 4, Pt Lot 1 DP 2707, Lot 1 DP 3731, Blk IV, Waimate SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance; g) 50 metres from Ahipaipa Road adjacent to the properties described as Pt Lot 1 and Lot 2 DP 3322, Lot 2 DP12129, Blk IV, Waimate SD. h) 150 metres from Te Aroha Marae i) 25 metres from urupa	• Separation from marae and urupa added following feedback from consultation hui – details to be conformed with Ngati Mahuhiakai

14	The effluent application rate shall not exceed 300 kg nitrogen/hectare/year except on land described as Pt Sec 154 Blk IV Waimate SD, where the effluent application rate shall not exceed 200 kg/nitrogen/hectare/year.	The effluent application rate shall not exceed 47 kg nitrogen/hectare/year except on land described as Pt Sec 154 Blk IV Waimate SD, where the effluent application rate shall not exceed 200 kg/nitrogen/hectare/year.	• Need further data on stickwater characteristics to develop numbers for this condition • TBP to continue collecting data through to late Feb – PDP to provide sampling methodology memo • Updated to reflect updated information from PDP on N loading rate.
15	The consent holder shall investigate, and report in writing on, options for upgrading the wastewater treatment system to reduce the concentration of ammonia in the wastewater prior to discharge; the report to be received by the Chief Executive, Taranaki Regional Council, not later than twelve months from the date the consent is granted. Any necessary works associated with the report on reduction of ammonia concentrations shall be completed within twelve months after the receipt of the report.	~~The consent holder shall investigate, and report in writing on, options for upgrading the wastewater treatment system to reduce the concentration of ammonia in the wastewater prior to discharge; the report to be received by the Chief Executive, Taranaki Regional Council, not later than twelve months from the date the consent is granted. Any necessary works associated with the report on reduction of ammonia concentrations shall be completed within twelve months after the receipt of the report.~~	• Delete – condition now redundant. Improvements through VSEP system and updated management plans will address
16	The average application rate shall not exceed 5 mm/hour.	~~The average application rate shall not exceed 5 mm/hour.~~ The average application rate shall not exceed 10 mm/hour and return period between applications shall be at least seven days and the application depth shall not exceed 25 mm at each application.	• Note that current equipment does not allow for an application rate as low as 5mm / hour. Some irrigation equipment is capable of achieving <10 mm/hr, but travelling irrigators can generally not achieve < 5mm/hr. • 10 mm/hr is well below the measured average saturated hydraulic conductivity (99 mm/hr) and similar to the measured average unsaturated hydraulic conductivity (8 mm/hr)
17	The return period between applications shall be at least seven days and the application depth shall not exceed 25 mm at each application.	Where a rate of less than 10 mm/hr cannot be achieved by irrigation equipment, ~~The return period between applications shall be at least seven days and~~ the application depth shall not exceed 15 mm at each application.	• The rate of 10mm/hour cannot be achieved on site with all existing equipment, only some plant • The revised condition manages application rate to achieve the same effect as a 5 mm/hour rate and 10 mm/hr rate, but in a manner achievable with current equipment.
Monitoring and liaison			
18	The consent holder shall site, install and maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, a minimum of nine monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge. The bores are to be sited in the following locations: upslope of the Kohiti Road and Katotauru Road irrigation areas (2), at the southern boundary of the western Normanby Road irrigation area (2), within the Normanby Road, Kohiti Road and Katotauru Road irrigation areas (3), at the southern boundary of the Katotauru irrigation area, and at the southern boundary of the Ahipaipa Road irrigation area. The spring	The consent holder shall maintain to the satisfaction of the Chief Executive, Taranaki Regional Council, a minimum of nine monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge. The bores are to be sited in the following locations: upslope of the Kohiti Road and Katotauru Road irrigation areas (2), at the southern boundary of the western Normanby Road irrigation area (2), within the Normanby Road, Kohiti Road and Katotauru Road irrigation areas (3), at the southern boundary of the Katotauru irrigation area, and at the southern boundary of the Ahipaipa Road irrigation area. The spring downslope of the Normanby	• Changes made to reflect that bores have been installed

	downslope of the Normanby Road irrigation area, and three bores in the vicinity of Inuawai Road shall also be monitored.	Road irrigation area, and three bores in the vicinity of Inuawai Road shall also be monitored.	
19	The consent holder shall undertake such baseline and operational monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council.	~~The consent holder shall undertake such baseline and operational monitoring of the activities licensed by this consent, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council.~~	• Not required – prefer to specify monitoring requirements in conditions • Any changes can be dealt with through management plan updates every 2 years
20	The consent holder and staff of the Regional Council shall meet as appropriate, quarterly or at such other frequency as the parties may agree, with representatives of Ngati Manuhiakai Hapu and other interested submitters to the consent, and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of the resource consent, in order to facilitate ongoing consultation.	The consent holder and staff of the Regional Council shall meet as appropriate, quarterly or at such other frequency as the parties may agree, with representatives of Ngati Manuhiakai Hapu and other interested submitters to the consent, and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of the resource consent, in order to facilitate ongoing consultation.	• Retain but confirm with Ngati Manuhiakai if this still works or should be modified.
21	The consent holder shall, where practicable, advise the Chief Executive, Taranaki Regional Council, and representatives of Ngati Manuhiakai Hapu, prior to discharge to Inaha Stream under consent 2049.	The consent holder shall, where practicable, advise the Chief Executive, Taranaki Regional Council, and representatives of Ngati Manuhiakai Hapu, prior to discharge to Inaha Stream under consent 2049.	• Comfortable with this in principle but suggest sits better as condition in water discharge consent – modify this to an advice note
Mitigation			
22	Should monitoring of the discharge under conditions 14 and 18 indicate contamination of local groundwater 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 spray irrigation management plan prepared under condition 2, or such action reasonably required by the Chief Executive, Taranaki Regional Council; b) shall review the spray 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.	The Consent Holder shall provide to TRC by [date TBC] each year an anticipated nutrient management budget for each farm (that is, for the whole farm) in which there is wastewater irrigation for the previous year. The nutrient management budget shall be based on the outputs of either Overseer or any other nutrient management planning tool that meets the following criteria: a) Be a Crown Research Institute, University or Industry developed model that has successfully completed commercial trials commensurate with climatic, terrain and soil conditions expected to be encountered in the Taranaki region. b) Be able to predict annual, seasonal or crop nutrient losses at either a paddock or total crop area scale with a margin of error no more than 30%. c) Have been calibrated against current versions of Overseer, or versions that are no more than 3 years old, and any departures from those models when using identical data sets documented and explained. d) Have product maintenance and support currently available as of the date of use or guaranteed for a period of one year.	• Condition replaced with nutrient management condition to better manage effects. • Contamination of groundwater is not a useful measure - too broad a term – some degree of nutrients entering groundwater is inevitable with land based irrigation system, level at which this constitutes contamination (and therefore triggers original condition) is ambiguous. Managing nutrients overall is more effective approach.
23	[new condition]	Stock shall be withheld from grazing pasture for a period of 14 days following wastewater irrigation	• Condition proposed to protect soils – risk of microbiological die off from grazing cattle shortly after irrigation activity • Also protects soil from pugging caused by stock accessing water-laden soils

Review			
23	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.	~~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.~~	• Redundant – condition not required for this
24	The Taranaki Regional Council may review conditions 7 and 14 of this consent within two weeks after the completion of works to be investigated under condition 15 of this consent, for the purpose of evaluating the appropriateness of the required dilution rate and application rate, and the effects of the discharge on the Inaha Stream and soil.	~~The Taranaki Regional Council may review conditions 7 and 14 of this consent within two weeks after the completion of works to be investigated under condition 15 of this consent, for the purpose of evaluating the appropriateness of the required dilution rate and application rate, and the effects of the discharge on the Inaha Stream and soil.~~	• No longer required
25	The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, and/or June 2007, for the purpose of assessing the need to increase the land area for wastewater disposal, reduce nitrogen loading to land and/or increase treatment at the wastewater treatment system to reduce the nitrogen concentration of the effluent.	The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June ~~2001~~[TBC], and/or June ~~2007~~[TBC], for the purpose of assessing the need to increase the land area for wastewater disposal, reduce nitrogen loading to land and/or increase treatment at the wastewater treatment system to reduce the nitrogen concentration of the effluent.	• Retain with updates to dates as necessary
26	The Taranaki Regional Council may, pursuant to section 128 of the Resource Management Act 1991, review any or all of the conditions of this consent by giving notice of review during June 2001, June 2003, June 2005, June 2007, June 2009, June 2011, June 2014 and/or June 2017, 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 that time.	The Taranaki Regional Council may, pursuant to section 128 of the Resource Management Act 1991, review any or all of the conditions of this consent by giving notice of review during June ~~2001~~[TBC], June [TBC]~~2003~~, June [TBC]~~2005~~, June [TBC]~~2007~~, June [TBC]~~2009~~, June ~~2011~~[TBC], June ~~2014~~[TBC] and/or June [TBC]~~2017~~, 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 that time.	• Retain with updates to dates as necessary

Discharge Permit 5426-1 / TRK995426 - To discharge up to 1,095 litres/second of stormwater from an animal rendering site into an unnamed tributary of the Inaha stream

	Original Condition	Proposed Condition (underlines show additions, strikeouts show deletions)	General Comment / Reasons for the proposed change.
General Conditions			
a)	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
Special Conditions			

1

THAT the consent holder shall advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.

THAT the consent holder shall advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.

- Retain

2

THAT the discharge shall not exceed the following parameters:

Component	Concentration
pH range	6-9
oil and grease	15 gm3
suspended solids	100 gm^3

This condition shall apply prior to the entry of the discharge into the receiving water at designated sampling point[s] approved by the General Manager, Taranaki Regional Council.

THAT the discharge shall not exceed the following parameters:

Component	Concentration
pH range	6-9
oil and grease	15 gm3
suspended solids	100 gm^3

This condition shall apply prior to the entry of the discharge into the receiving water at designated sampling point[s] approved by the General Manager, Taranaki Regional Council.

- Has been exceedances of suspended solids limit
- Retain

3

THAT after allowing for reasonable mixing, within a mixing zone extending 45 metres from the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharges pertaining to the same property], shall not give rise to any of the following effects in the receiving waters:

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 freshwater unsuitable for consumption by farm animals;
e) any significant adverse effects on aquatic life, habitats or ecology; and
f) any visible bacterial and/or fungal growths.

THAT after allowing for reasonable mixing, within a mixing zone extending 110 metres from the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharges pertaining to the same property], shall not give rise to any of the following effects in the receiving waters:

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 freshwater unsuitable for consumption by farm animals~~;
e) any significant adverse effects on aquatic life, habitats or ecology; and
f) any visible bacterial and/or fungal growths.

- Distance confirmed by Aquanet to represent the location of the stormwater water discharge
- d) deleted to address compliance assessment issues

4

THAT within three months of the granting of this consent, the consent holder shall prepare 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.

Within 6 months of the commencement of the consent, the consent holder shall provide, and subsequently shall maintain, a stormwater and spill management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the stormwater system and measures to address accidental spills, which shall demonstrate ability to comply with consent conditions and shall address the following matters:

a) ~~THAT within three months of the granting of this consent, the consent holder shall prepare~~ 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
b) Stormwater catchments/ areas and the design and mangaemetn of the stormwater collection and conveyance network;
c) identification of the areas/catchments of potentially contaminated stormwater, and the management of those areas;
d) Management of first flush stormwater from areas/catchments of potentially contaminated stormwater;

- Latest version dated November 2000
- Additional requirements included in revised condition to manage effects that have been observed from elevated nutrient levels in stormwater discharge – noting cooling water is also being affected by being combined with stormwater prior to discharge.

		e) Management of the stormwater/ firefighting pond to minimise contamination of stormwater discharges to the Inaha Stream; and f) Monitoring of stormwater discharge quality	
5	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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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.	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 2001, June [TBC]~~2003~~, June ~~2005~~[TBC], June [TBC]~~2011~~ and/or June [TBC]~~2017~~, 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.	• Retain with updates to dates as necessary

Discharge Permit 5495-1 – ~~To~~The emergency discharge ~~up to 200 tonnes/day~~ of wastes from meat rendering operations by burial into land in the vicinity of the Inaha Stream

	Original Condition	Proposed Condition (underlines show additions, strikeouts show deletions)	General Comment / Reasons for the proposed change.
General Conditions			
a)	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
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.	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.	• Retain / update to reflect current TRC practice
Special Conditions			
1	THAT by 1 November 2000, the consent holder shall provide a waste burial management plan, to the approval of the General Manager, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters: a) nature of wastes discharged; b) discharge control; c) waste cover; d) addition of hydrated lime to stabilise the wastes; e) minimisation and control of odour effects offsite; f) stormwater control; g) leachate management; h) monitoring of groundwater beneath the burial area [physicochemical];	THAT ~~by 1 November 2000,~~ the consent holder shall ~~provide~~ maintain a waste burial management plan, to the approval of the General Manager, Taranaki Regional Council, outlining the management of the system, which shall demonstrate ability to comply with consent conditions and shall address the following matters: a) conditions that constitute the need for emergency burial activity to occur; b) nature of wastes discharged; c) discharge control; d) waste cover; e) addition of hydrated lime to stabilise the wastes; f) minimisation and control of odour effects offsite; g) stormwater control; h) leachate management;	• Retain with amendment to: - Include identification of emergency conditions which constitute emergency burial situations - include monitoring of the surface water quality of the Inaha Stream.

	i) site re-instatement and after care (including maintaining the integrity of the cover material); j) site contouring; k) reporting monitoring data; l) procedures for responding to complaints; and m) notification to the Council of non-compliance with the conditions of this consent.	i) monitoring of groundwater beneath the burial area [physicochemical]; j) the location and installation timing of groundwater monitoring bores; k) site re-instatement and after care (including maintaining the integrity of the cover material); l) site contouring; m) reporting monitoring data; n) procedures for responding to complaints; and o) notification to the Council of non-compliance with the conditions of this consent; p) quarterly monitoring of the surface water quality of the Inaha Stream; and q) actions the consent holder will take in the event that monitoring required under the waste burial management plan shows a material effect on surface water quality caused by burial activity.	
2	THAT the consent shall be exercised in accordance with the procedures set out in the waste burial management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the General Manager, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	THAT the consent shall be exercised in accordance with the procedures set out in the waste burial management plan, and the consent holder shall subsequently adhere to and comply with the procedures, requirements, obligations and other matters specified in the management plan, except by the specific agreement of the General Manager, Taranaki Regional Council. In case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.	• Retain
NEW		THAT the maximum volume of offal to be buried is 500 tonnes/year, calculated as a rolling five-year average.	• New condition to recognize: ○ The significant reduction in burial of waste from the existing 200 tonnes/day allowance to 500 tonnes/year to manage the effects of leachate from the burial activity based on advice from PDP and taking into account operational requirements to respond to an emergency; and ○ the proposal to calculate the volume based on a 5 yearly rolling average in recognition that a single emergency event may require more than 500 tonnes of material to be buried.
NEW		THAT the consent shall only be exercised in the areas identified on the map referenced as "AJ467202 Figure 21 Revision A" dated July 2020 and attached to these conditions.	• New condition limiting the location of any burial activity to those area identified on the specific plan to give certainty to Council and iwi.
3	THAT the waste burial management plan described in special condition 1 of this consent shall be subject to review upon two months notice by either holder the Taranaki Regional Council.	THAT the waste burial management plan described in special condition 1 of this consent shall be subject to review upon two months notice to the consent holder from the Taranaki Regional Council.	• Retain but amend wording to ensure condition is clear
4	THAT the consent holder shall designate an officer with the necessary qualifications and/or experience to manage the waste burial site. The officer shall be regularly trained on the content and implementation of the burial management plan, and shall be	THAT the consent holder shall designate an officer with the necessary qualifications and/or experience to manage the waste burial site. The officer shall be regularly trained on the content and implementation of the burial management plan, and shall be advised immediately of any revision or additions to the burial management plan.	• Retain

	advised immediately of any revision or additions to the burial management plan.		
5	THAT the disposal pit[s] shall not intercept shallow groundwater.	THAT the disposal pit[s] shall not intercept shallow groundwater.	• Retain
6	THAT the disposal pits shall be constructed when required in general accordance with the information supplied by the applicant in support of application 1084.	THAT the disposal pits shall be constructed when required in general accordance with the information supplied by the applicant in support of application ~~1084~~.[TBC]	• Retain
7	THAT the consent holder shall notify the Council of the commencement to construct additional disposal pits outside of the disposal area indicated in the map supporting the application.	~~THAT the consent holder shall notify the Council of the commencement to construct additional disposal pits outside of the disposal area indicated in the map supporting the application.~~	• Delete. All burial activity to occur within the identified disposal area as shown on map referenced as "AJ467202 Figure 21 Revision A" dated July 2020.
8	THAT an officer of the Council is to inspect all constructed disposal pits prior to disposal operations.	~~THAT an officer of the Council is to inspect all constructed disposal pits prior to disposal operations.~~	• Propose deletion due to the time sensitive, emergency nature of future burial activities.
9	THAT special conditions 1 to 4 shall apply after 1 November 2000 when the disposal pit required by special condition 6 is constructed and also for all subsequent disposal pits.	~~THAT special conditions 1 to 4 shall apply after 1 November 2000 when the disposal pit required by special condition 6 is constructed and also for all subsequent disposal pits.~~	• Now redundant. Delete
10	THAT the discharged material shall be covered within a period of four hours or less so as to avoid the generation of offensive offsite odours.	THAT the discharged material shall be covered within a period of four hours or less so as to avoid the generation of offensive offsite odours.	• Retain
11	THAT at the completion of the disposal operation a low permeability, clean, compacted soil cover with a minimum thickness of 1.0m be placed over the discharged wastes	THAT at the completion of the disposal operation a low permeability, clean, compacted soil cover with a minimum thickness of 1.0m be placed over the discharged wastes	• Retain
12	THAT the cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area to the satisfaction of the General Manager, Taranaki Regional Council.	THAT the cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area to the satisfaction of the General Manager, Taranaki Regional Council.	• Retain
13	THAT the disposal site shall be rehabilitated and pasture re-established to the satisfaction of the General Manager, Taranaki Regional Council.	THAT the disposal site shall be rehabilitated and pasture re-established to the satisfaction of the General Manager, Taranaki Regional Council.	• Retain
14	THAT there shall not be any irrigation of effluent under resource consent 3941 or resource consent 2466 onto the disposal area.	THAT there shall not be any irrigation of effluent under resource consent 3941 or resource consent ~~2466~~ [TBC] onto the disposal area.	• Retain with updates to date as necessary
15	THAT the exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.	THAT the exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.	• Retain
16	THAT the consent holder shall install and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a minimum of eight monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge.	THAT the consent holder shall install and maintain, to the satisfaction of the General Manager, Taranaki Regional Council, a minimum of ~~eight~~ twelve monitoring bores for the purpose of determining groundwater quality in the vicinity of the discharge. Advice note: The detail of the location and proposed installation timing of any new bores shall be detailed in the waste burial management plan required by Condition 1.	• New bore installed in 11 May 2015, replacing two damaged bores. • Additional bores recommended to be installed to monitor groundwater from any new burial activity. The location and timing of installation of these bores to be specified within the waste burial management plan.

17	THAT 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 resources of monitoring.	THAT 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 resources of monitoring.	• Retain
18	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 2001, June 2003, June 2005, 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 consent, which was either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.	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 2001, June 2003, June 2005, 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 consent, which was either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.	• Retain

Appendix 6

Technical Memo VSEP System – PDP, December 2019

Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	VSEP System	**PROJECT**	Taranaki By-Products Land Treatment of Wastewater
CLIENT	**Taranaki By-Products Ltd**	**PROJECT NO**	AJ467202M004
CLIENT CONTACT	Paul Drake	**PREPARED BY**	Lenka Craft and Daryl Irvine
CLIENT WORK ORDER NO/ PURCHASE ORDER		**SIGNATURE**	
		DATE	22 January 2020

Introduction

Taranaki-By Products Ltd (TBP) operates an inedible protein recovery plant on Kohiti Road near Okaiawa. An edible protein recovery plant, owned by Taranaki Bio-Extracts Ltd (TBE), shares the site and a dairy farm is run on adjacent land owned by TBP. The wastewater from the two plants and dairy farm effluent is combined and treated in an onsite biological treatment facility before it is discharged onto company owned dairy farmland under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, with a portion discharged to the Inaha Stream under TRC Resource Consent No. 2049-4 (when soil conditions do not allow all wastewater to be irrigated).

To assist with reducing stickwater loads from the TBE plant and to reduce wastewater loads from the TBP plant, Taranaki By-products has installed Vibratory Shear Enhanced Processing (VSEP) technology within the TBE and TBP plants. VSEP systems utilise vibrating membrane filtration systems to provide filtration at varying grades to concentrate solids and associated contaminants, for reuse back in the processing plant. The combined investment in both VSEP systems is $2.8M plus GST.

This technical memorandum has been prepared to provide a summary of the VSEP systems installed in each plant, how the VSEP systems are being utilised and the projected reductions in wastewater and stickwater (Zealgrow) loads.

Taranaki Bio-Extracts VSEP System Summary

The VSEP system installed in the TBE plant was installed in late 2018 and is utilised to concentrate stickwater for recycle of concentrate back into the plant dryer, for product recover, and for generation of water for reuse in the processing plant. The VSEP system in the TBE plant utilises both nano filtration and reverse osmosis (RO) to achieve this.

The stickwater that was previously generated from the TBE plant was registered as a fertiliser, with a trading name “Zealgrow”, and was spread to land on neighbouring farms and the TBP wastewater irrigation farm. The installation of the VSEP system means that the volumes of stickwater being spread to land have significantly reduced, from an average of around 300 m^3 per week, reducing to an average of around 100 m^3 per week (refer to **Figure 1**). The remaining stickwater that is required to be spread to land, occurs during cleaning process of the VSEP systems.

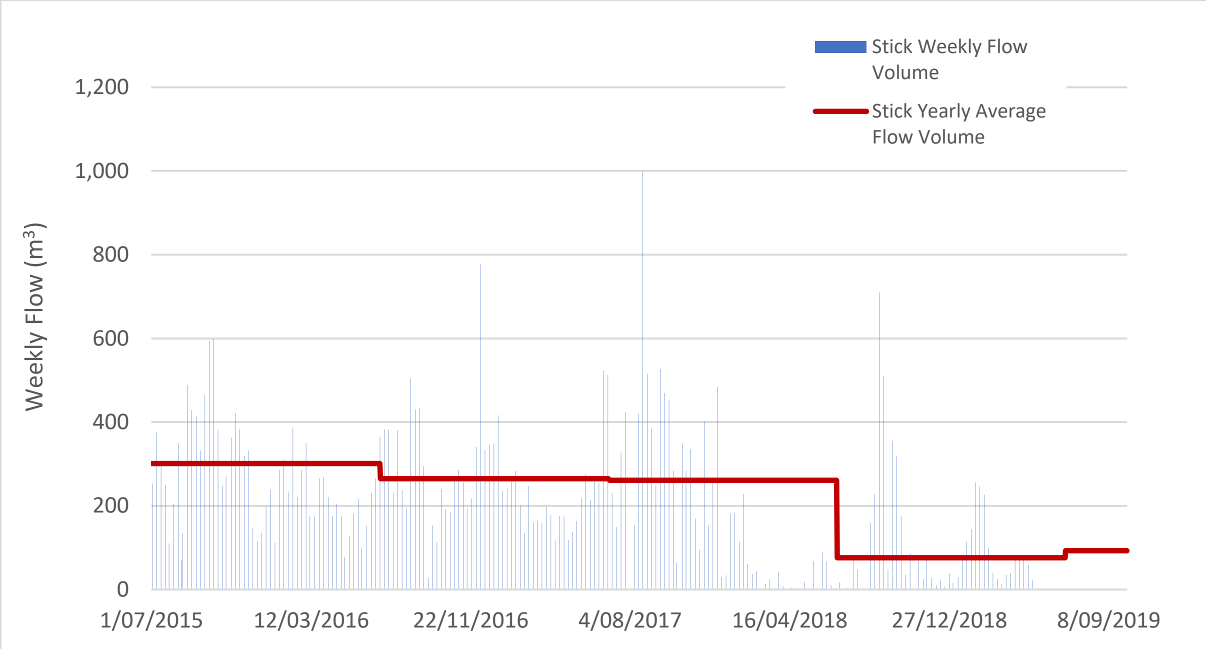


Figure 1: Weekly Stick Water Volumes

Taranaki By-Products VSEP System Summary

TBP is currently (October 2019) in the process of commissioning a new VSEP system for treatment of part of the TBP plant wastewater (approximately 400 m^3/d to 500 m^3/d). The system is being installed to generate water for use in the site boiler, generate concentrate for product recovery and to reduce the organic load on the wastewater treatment plant.

The VSEP system consists of three vibrating filter packs (VFP) and one RO system, and has been designed for future expansion to six VFPs and two RO systems. A process overview is provided in **Appendix A.** Wastewater enters the system after the dissolved air flotation (DAF) unit and passes through two of the VFP's in parallel which removes ~70% of the water as permeate. The concentrate is mixed and passed through the third VFP which removes a further ~50% of the water as permeate. The concentrate from the third VFP is sent to the DAF float sludge dewatering unit. The three permeate streams are combined and sent to the RO system which removes a further ~70% of water as RO permeate that is used in the plant boilers. The concentrate stream from the RO system is recycled back to the VSEP inlet feed.

Wastewater generated in the TBP plant varies in character and consists of floor drains, raw material bin drains, stickwater and condensates. Approximately 1,000 m^3/d of wastewater is generated from the TBP plant (ranging from around 600 m^3/d to 1,400 m^3/d). Based on an assumed daily average of 450 m^3/d of wastewater being treated through the VSEP system, approximately 45% of the wastewater from the TBP plant will be diverted through the VSEP system, with the remainder continuing to the wastewater treatment pond (refer to **Figure 2**).

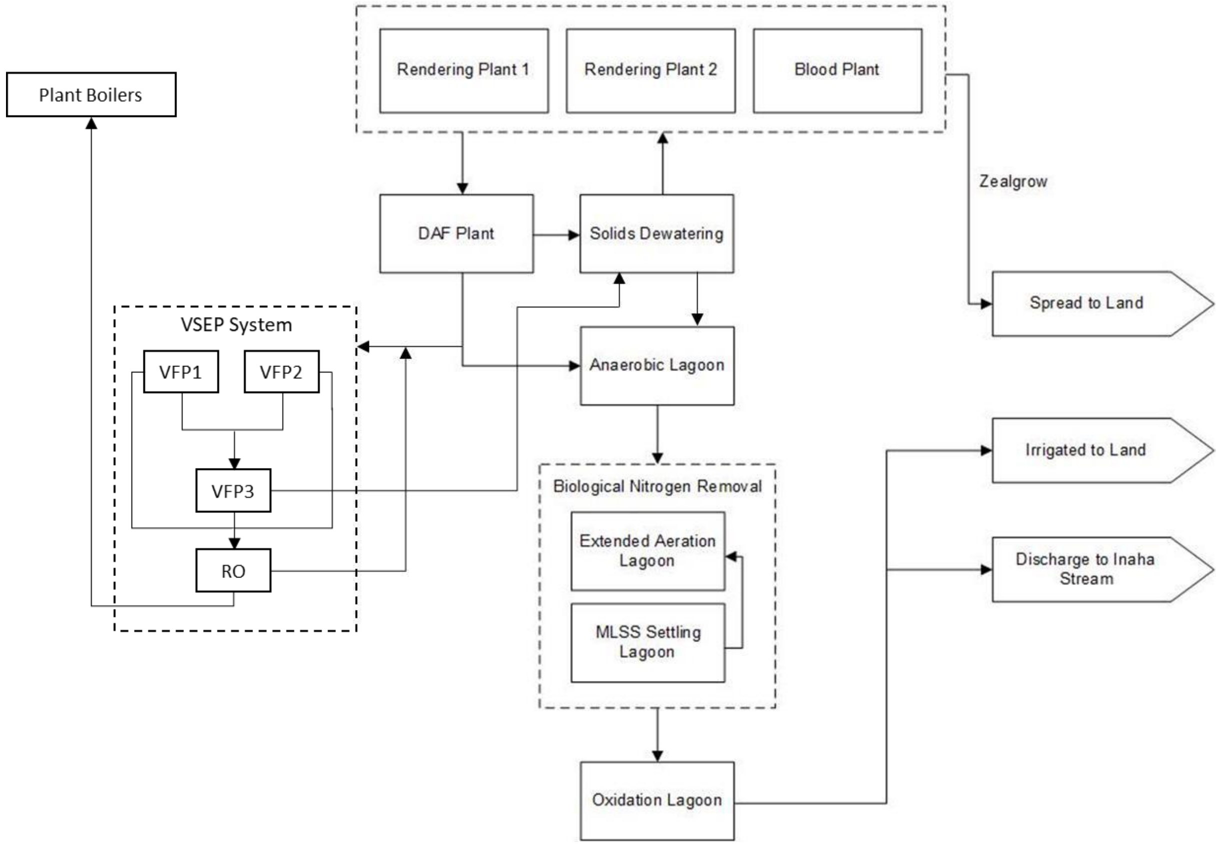


Figure 1: Wastewater Treatment with VSEP System Process Flow Diagram

Initial testing of the VSEP system indicated a feed rate of ~25 m^3/hr producing approximately 10 m^3/hr to 16 m^3/hr of RO permeate that is sent to the plant boilers. No raw wastewater testing has been provided, however, based on monitoring at a similar rendering plant, wastewater from the DAF has an estimated nitrogen composition of ~50% inorganic nitrogen and ~50% organic nitrogen. Due to the concentrate likely being dewatered, most inorganic nitrogen will be returned to the waste stream entering the DAF, while it is expected that approximately 90% of the organic nitrogen removed in the VSEO system will be retained in the dewatered concentrate.

Based on 45% of wastewater being treated with an estimated 90% recovery of organic nitrogen, it is estimated that the nitrogen load entering the wastewater treatment system may reduce by 20%. TBP has advised that to run the VSEP system, polymer cannot be utilised in the DAF plant prior to the VSEP system due to risk of blinding of the membranes. The removal of polymer from the DAF system may result in reduced nitrogen removal from the DAF, and this may off set the nitrogen removed by the VSEP system meaning that the actual total reduction of nitrogen in the discharge remains unclear at this stage until the system is fully commissioned and operational. It is noted however the significant reduction in stickwater volumes (associated with the TBE system) remains an ongoing benefit.

An additional prefiltration system is currently being installed to overcome a filter blinding issue encountered during commissioning, however, the plant is expected to be operational in the very near future.

TECHNICAL MEMORANDUM

This memorandum has been prepared by Pattle Delamore Partners (PDP) on the specific instructions of Taranaki By-Products Limited for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

This memorandum has been prepared by PDP on the basis of information provided by Taranaki By-Products Limited and Syngineering Technology Pty Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

Appendix A: VSEP Overview

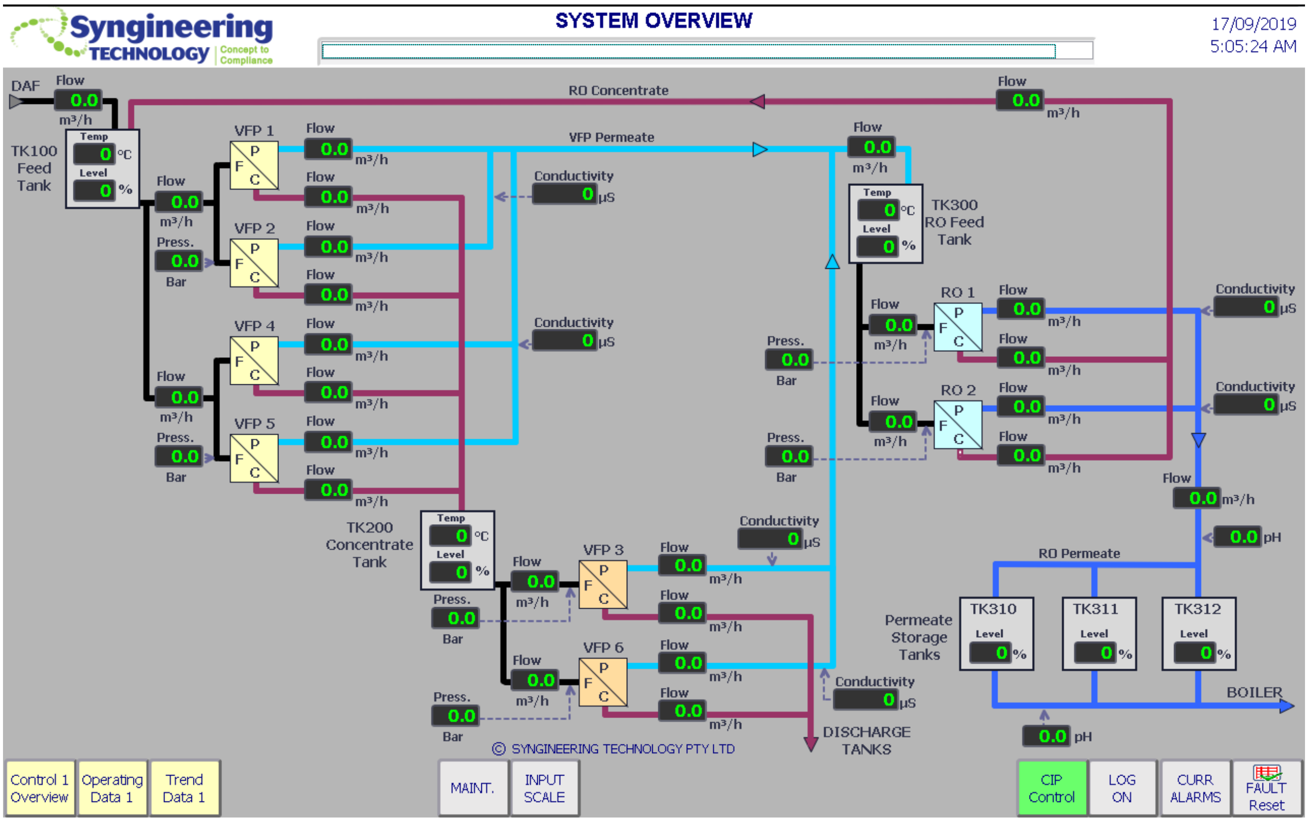
General Overview of Syngineering Technology's approach to processing DAF Waste Water.

The current system installed at Taranaki By Product consists of three Vibrating Filter Packs (VFP) and one Reverse Osmosis System (RO). The system has been designed for future expansion to six Vibrating Filter Packs (VFP) and two Reverse Osmosis System's (RO).

The VFP's and RO units are essentially doing the same thing removing water to create "*Permeate*" from the feed water "*Feed*" and producing a concentrated stream "*Concentrate*". The vibration of the VFP's creates a shear wave on the surface of the filter membrane prevented solids from adhering to the membrane surface and allowing the water to pass through.

The DAF Water is passed through the first two VFP's in parallel removing around 70% of the water creating the *Permeate* Stream and the *Concentrate* from VFP1 and 2 is passed to VFP3 for further water removal, where a further 50% of water is removed. All three *Permeate* streams are mixed together in a tank to be further processed by the RO unit. The *Concentrate* from VFP3 is sent to the plant evaporator.

The RO unit processes the *Permeate* Stream from all three VFP's removing a further 70% of the water creating the *RO Permeate* Stream to be used in the plant Boilers. The Concentrate from the RO unit is returned to the DAF water feed stream.



Appendix 7

Stormwater

Management Plan 2020

Stormwater & Spill

Management Plan

Taranaki By-Products Limited

Updated February 2020

Table of Contents

Figures

Appendices

1.0 Introduction

This stormwater and spill management plan ("Stormwater & Spill Management Plan") describes the stormwater management controls appropriate for the factory at Okaiawa and procedures to be undertaken to prevent spillage or accidental discharge of contaminants in accordance with Taranaki Regional Council Resource Consent No 5426-1 ("resource consent") (Appendix 1).

This plan also describes the countermeasures necessary to remedy and/or mitigate any accidental spillage or discharge of contaminants into the stormwater system.

1.1 Requirements of Management Plan

The requirements of this management plan is outlined in Condition 4 of the Resource Consent 5426-1, which states that a contingency plan is prepared outlining the measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants into the stormwater system.

1.2 Purpose of Stormwater & Spill Management Plan

The purpose of this stormwater management plan is to describe the best management practices and the spill prevention plan to ensure that the contaminants not authorised by the discharge permit are not allowed to be discharged into Inaha Stream.

1.3 General Responsibilities

The Taranaki By-Products Plant Manager has the ultimate responsibility for the operation of the factory and associated facilities.

The Plant Manager is Mr Paul Drake and can be reached on 06-272 6720 during normal working hours and on 0274 464 930 during after hours.

The Taranaki Regional Council is the regulatory authority that deals with compliance matters.

Taranaki Regional Council can be reached on 06 765 7127 during business hours. The pollution hotline is 0800 736 222 for After Hours Inspectorate Officer.

1.4 Structure of Management Plan

The management plan is divided into five sections. These are outlined below:

Section 1.0 Introduction outline and consent requirements;

Section 2.0 Best management procedures that are adopted to ensure that spills are prevented into the stormwater system;

Section 3.0 Spill prevention and control measures;

Section 4.0 Summary of reporting requirements; and

Section 5.0 Summary of Health and Safety requirements

1.5 Related Documents

1. Wastewater Treatment System Management Plan
2. Irrigation Management Plan
3. Solid Wastes Management Plan
4. Air Discharge Management Plan
5. Resource Consents
6. Assessment of Environmental Effects of Stormwater Discharge

2.0 Best Management Practices

Best management practices shall form part of the factory's stormwater management controls and shall be employed to reduce stormwater contamination (and the potential for contamination).

Best management practices can be simple and low cost (such as keeping work areas clean and free of debris), or costly (such as installing structural controls). Most best management practices are preventive and have been implemented at Taranaki By-Products Ltd factory as prudent practices or as requirements of the resource consent conditions.

The best management practices minimise the impact of activities that potentially contribute contaminants to stormwater discharges.

The Taranaki by-Products site management staff is responsible for ensuring that best management practices are followed.

2.1 Non-Stormwater Discharges to Drains

Use the following procedures to check non-stormwater discharges.

1. Maintain the storm drain system.
2. Eliminate unauthorised discharges to the storm drain system.
3. Visually inspect each discharge point every month.
4. Keep surface grates clean.
5. Interrupt high-debris flows with straw bales (these require periodic replacement).
6. Check integrity of wooden covers and grates and repair or replace with metal structures, as appropriate.

The following non-stormwater discharges can be considered as authorised by the discharge permit. These include fire hydrant flushing; drinking fountain water; atmospheric condensates; air conditioning and compressor condensate; landscape watering; ground water; and foundation or footing drainage.

All other non-stormwater discharges are "unauthorised" and are prohibited. Examples of "unauthorised" non-stormwater discharges include illegal connections to the storm drain; treated wastewater, meal bagging areas washes, washing of vehicles, tools, and equipment; and power washing of buildings.

All other discharges shall be directed to the wastewater treatment ponds. Figure 1 provides an overview of the site stormwater catchment system layout.

A floating boom is located across the outlet of the of the Fire Water reservoir and this allows for the capture of floatable materials.

Other silt traps and containment points are highlighted on the attached map as larger sumps within the Drainage Plan

The south side of the factory roof storm water is directed to the fire reservoir discharge

In 2019 a silt / sand trap was installed at the storm water inlet to the fire reservoir, has a manual control valve. All stormwater that enters the trap will be directed to the wastewater treatment system. After the first initial rain has flushed through to the pod system and the storm water is clear the water will then be directed back to the fire reservoir.

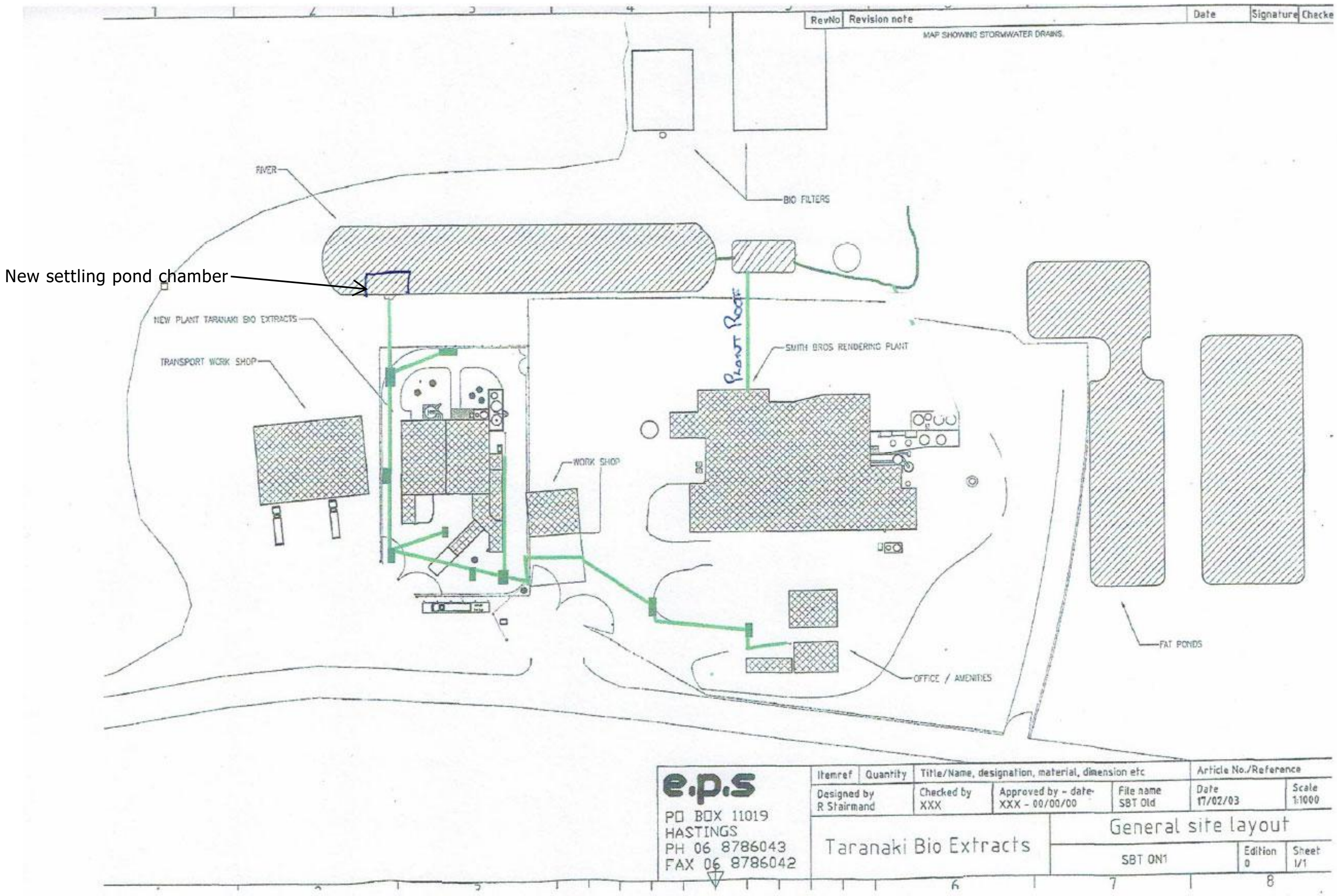
An overflow line does exist however this must be manually opened after inspection of the quality of stormwater being discharged

2.2 Vehicle and Equipment Fuelling

Fuelling operations are conducted at Jackson's Transport Ltd at the site for fleet vehicles, mobile equipment, and stationary equipment. The majority of the fuelling is conducted from a dedicated fuel tank and pumping facility. To prevent fuel spills and leaks and reduce their impact on the site stormwater, follow the practices listed below:

1. Provide a designated fuelling area.
2. Discourage topping off and unattended fuelling.
3. Post fuelling instructions.
4. Implement the Spill Prevention, Control, and Countermeasures Plan (discussed in Section 3.0) in the event of a spill or release.
5. Provide 24-hour spill response capability.

Figure 1. Site Stormwater Catchment System Layout



2.2 Vehicle and Equipment Washing and Steam Cleaning

Steam cleaning is done as part of a routine truck washing maintenance procedure or as required. Wastewater is generated from facility maintenance and cleaning of vehicles. To prevent or reduce the discharge of pollutants to stormwater from on-site vehicle and equipment washing and steam cleaning, follow the practices listed below.

1. Wash trucks in the Truck Wash Area only.
2. All truck wash water shall enter the wastewater system only.
3. Washing of personal vehicles on-site is prohibited unless used for company purposes.

2.3 Vehicle and Equipment Maintenance and Repair

Vehicle and equipment maintenance and repair work are performed indoors whenever possible. Equipment is serviced at factory workshops or off-site. Types of equipment repaired include pre-breakers, presses, cooking vessels, centrifuges, dryers, pumps, and compressors.

Large units and equipment located near storm drain systems are managed in bunded areas or in areas where any leaks are contained. These include evaporators, cooling towers and pump systems.

To prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair operations, follow the practices listed below:

1. Do not pour material down drains or hose down work areas unless within the factory;
2. Perform equipment and vehicle maintenance in designated areas to prevent discharges to the storm drain system. This applies to on-site contract fleet as well.
3. Routinely inspect external vehicles and equipment for leaks.
4. Clean small spills with rags or absorbent and use damp mops for general clean up. For larger spills, follow the spill response countermeasures described in Section 3.0 in this plan.
5. Collect and properly manage (recycle or dispose of) used grease, oil, oil filters, antifreeze, cleaning solutions, lead-acid batteries, hydraulic and transmission fluids, and tyres.

2.4 Transportation and Outdoor Loading/Unloading of Material

The primary on-site locations for loading and unloading are raw material reception area inside the rendering plant, in front of the rendering plant, the meal loading bay, the workshop facility and office block. To prevent or reduce the discharge of pollutants to stormwater from transportation and outdoor loading and unloading of material, follow the practices listed below:

1. Prevent storage of hazardous material outside unless covered.
2. Ensure all raw materials are unloaded inside the building.
3. Provide forklift training to relevant staff

4. Comply with Land Transport Safety packaging requirements for off-site transportation of hazardous waste.
5. Clean-up minor spills immediately.
6. Ensure loading and tie-down requirements are met.
7. Park tank trucks or delivery vehicles away from unprotected storm drains or manholes, or provide temporary protection.

2.5 Outdoor Container Storage of Liquids

Outdoor liquid storage includes product and waste storage in tanks, containers, and drums. These are potential sources of stormwater pollution. To prevent or minimize liquid releases, follow the practices listed below:

1. Protect materials from rainfall, run-on, run-off, and wind dispersal by using one or more of the following practices (where practical):
   - Store material indoors.
   - Outdoor containers shall be covered.
   - Minimise stormwater run-on by enclosing the area.

2. Regularly remove and properly dispose of water that collects in bunded areas by discharging to wastewater treatment system.

2.6 Waste Handling and Disposal

Waste generated at Taranaki By-Products Ltd includes process waste, cooling water, by-products wastes, and hazardous vehicle waste. Process wastewater (such as rendering plant general waste stream, discarded chemicals and chemical solutions; and secondary containment wastewater) are managed to prevent direct releases to the ground. To prevent the discharge of pollutants to stormwater from waste handling and disposal, follow the practices listed below (where practical):

1. Provide bunded areas for chemical hazardous waste containers.
2. Implement Spill Prevention, Control, and Countermeasures in the event of a spill or release.
3. Use only approved waste containers supplied by chemical company.
4. DO NOT MIX chemical wastes, especially waste acids.
5. Minimise spills and fugitive losses from waste handling systems.

Direct all wastewater to the on-site lagoon wastewater treatment system.

2.7 Employee Training

1. Train employees on how to minimise spills and fugitive losses from waste handling systems.
2. Train employees on proper procedures.
3. Provide forklift training.

3.0 Spill Prevention, Control and Countermeasures

3.1 General

A spill is an unintentional and uncontrolled release of material into the environment.

This section applies to spills of hazardous material and waste. Once a hazardous material has been spilled it is considered a hazardous waste, and must be handled, and disposed of accordingly.

For help with emergency spills (as defined in this section), dial 111. Report all spills no matter how minor to Taranaki By-Products Ltd Plant Manager 06-272 6720 ext 1 or 0274464930

3.2 Training

Staff working with hazardous material (acids etc) or waste must know how to prevent spills through proper storage, handling, use, and disposal. The Environmental Coordinator shall use a simple Task/Hazard Survey, to determine whether the staff is familiar with the safe use of hazardous material and to determine required training for personnel.

No one may use a hazardous material, operate machinery or equipment where hazardous materials is utilised or generated, or handle hazardous waste without prior training.

3.3 Spill Identification

Spill-response actions depend on the spill identification. Before responding to a spill, evaluate the spill according to the extent of the spill. Determine potential or immediate hazards to Taranaki By-Products Ltd personnel and visitors, the general public, and the environment by evaluating the following:

- Quantity of spilled material
- Flammability of spilled material
- Toxicity, corrosiveness, and reactivity of spilled material
- Presence of secondary containment
- Potential for spilled material to enter surface or domestic water systems via a storm drain
- Proximity to the site boundary
- Potential for property damage
- Approximate cleanup time and personnel required
- Extent of injuries, if any.

3.4 Spill Response

Do not attempt to clean up an emergency spill unless all of the following criteria have been met:

1. You have been trained to do so.
2. You have received instruction from the management

The appropriate spill response is based on the extent of the spill. Figure 2 provides a simplified flow chart of the response process for emergency spills, major spills, and minor spills.

If it is safe to do so, the first person responding to a major spill should take the following actions immediately:

1. Stop the source of the spill.
2. If the spilled material is flammable, eliminate ignition sources.
3. Protect storm drains, floor drains, and sink drains, if necessary.
4. Contain the spill by surrounding the perimeter of the spill with containment material such as absorbent pads.
5. Close off the stormwater discharge into the Inaha Stream. The rear stormwater overflow drain (previously used for peak rain events) in the vicinity of the meal load out area has now been isolated. This drain can be opened in the event of very heavy rainfall events, but only after inspection of the area has been undertaken.
6. Arrange for pump out of the stormwater system into the wastewater treatment ponds if spill has entered the stormwater system.
7. When using absorbent material or soil, dispose of contaminated material appropriately.
8. Call out ORICA to undertake chemical spill containment.
9. Report the spill to the Plant Manager or make sure someone else does.
10. Advise Taranaki Regional Council using Pollution Hotline telephone number
11. Complete a Spill Report.

3.5 Spill Contingency and Incident Monitoring

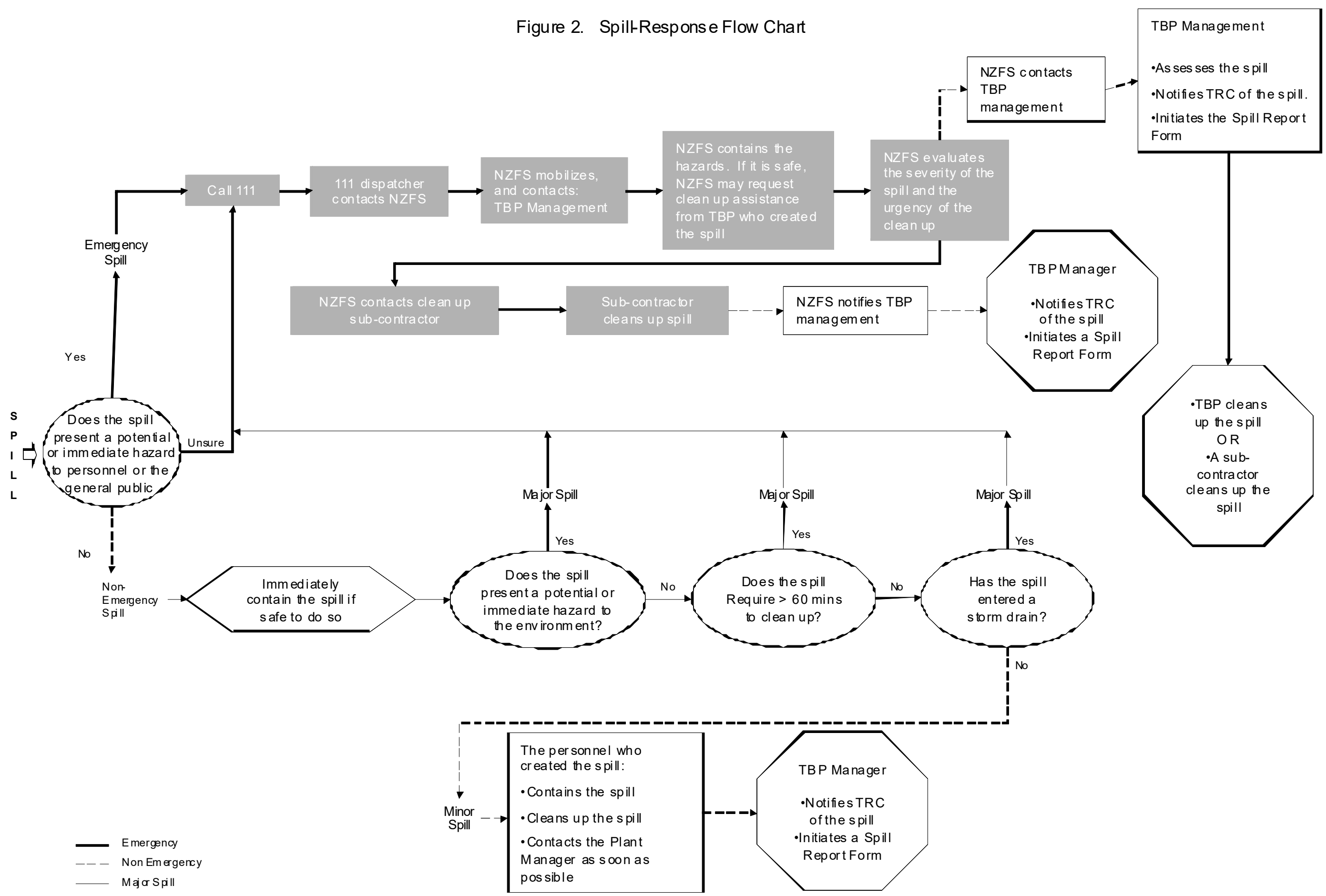
Any discharge as a result of a spill event shall be recorded. When discharges to stormwater system occur as a result of spill, Taranaki Regional Council shall be advised. The extent of spill shall be estimated.

3.6 Spill Control and Cleanup Equipment

Cleanup equipment for spills must be appropriate to the material and activities of the site and be readily available to all personnel. Cleanup equipment typically consists of the following:

1. Appropriate spill response equipment for the specific hazards in the area
2. Material Safety Data Sheets (MSDS) [see Appendix 3]
3. Absorbent material
4. Shovels (non-sparking for flammable material)
5. Brooms
6. Hazardous waste containers
7. Safety equipment
8. Eyewash equipment
9. Shower
10. Fire extinguisher
11. Personnel protective equipment (gloves, gumboots, splash aprons)

Figure 2. Spill Response Flow Chart



4.0 Reporting

The Stormwater & Spill Management Plan is developed to ensure that any adverse effects on the receiving environment from the Taranaki By-Products operations are prevented.

The monitoring of the spills shall be recorded and reported appropriately:

1. Fill in Spill Report each time a spill occurs
2. Submit the Spill Response actions to the Taranaki Regional Council
3. Prepare a list of Corrective Actions to prevent further similar spill events.

5.0 Health and Safety

5.1 General

Work practices at the site shall comply with all regulations set out under the Health and Safety in Employment (HSE) Act 1992 and its amendments. Some of the areas of note for health and safety awareness are outlined below.

5.2 Storage Facilities

1. All storage areas must be protected from spills.
2. All chemical storage areas shall comply with labelling and storage bunds
3. Chemical storage areas shall be provided with spill kits and fire extinguishers where appropriate.

5.3 Machinery Use

1. Prevent unnecessary machinery near chemical storage areas.
2. Ensure access is provided for forklift around storage areas to remove chemicals during spill.

Appendix 1 - Resource Consent for Stormwater Discharge

TRK995426

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	TARANAKI BY-PRODUCTS LIMITED PO BOX 172 HAWERA
Consent Granted Date:	31 May 1999

CONDITIONS OF CONSENT

Consent Granted:	TO DISCHARGE UP TO 1,095 LITRES/SECOND OF STORMWATER FROM AN ANIMAL RENDERING SITE INTO AN UNNAMED TRIBUTARY OF THE INAHA STREAM AT OR ABOUT GR: Q21:119-858, Q21:120-858 AND Q21:121-858	
Expiry Date:	1 June 2019	
Review Date[s]:	June 2001, June 2003, June 2005, June 2011 and June 2017	
Site Location:	KOHITI ROAD OKAIAWA	
Legal Description:	LOTS 1 & 2 DP6457 BLK IV WAIMATE SD	
Catchment:	INAHA	351.000
Tributary:	UNNAMED TRIBUTARY	

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

TRK995426

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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 advise the Taranaki Regional Council prior to making any change in the processes undertaken at the site which could significantly alter the nature of the discharge.

2. THAT the discharge shall not exceed the following parameters:

Component	Concentration
pH range	6-9
oil and grease	15 gm^{-3}
suspended solids	100 gm^{-3}

   This condition shall apply prior to the entry of the discharge into the receiving water at designated sampling point[s] approved by the General Manager, Taranaki Regional Council.

3. THAT after allowing for reasonable mixing, within a mixing zone extending 45 metres from the confluence of the unnamed tributary with the Inaha Stream, the discharge [in conjunction with any other discharges pertaining to the same property], shall not give rise to any of the following effects in the receiving waters:

   (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 freshwater unsuitable for consumption by farm animals;

   (e) any significant adverse effects on aquatic life, habitats or ecology; and

   (f) any visible bacterial and/or fungal growths.

4. THAT within three months of the granting of this consent, the consent holder shall prepare 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.

TRK995426

5. 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 2001, June 2003, June 2005, June 2011 and/or June 2017, 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 31 May 1999

For and on behalf of
TARANAKI REGIONAL COUNCIL

____
DIRECTOR—RESOURCE MANAGEMENT

Appendix 2 - Spill Report Form

CONTINGENCY and INCIDENT EVENT RECORD

Date: ____________________

Description of the incident and steps taken to rectify the incident:

____

____

____

Problems: ____________________

Cause of Problems: ____________________

What did you do: ____________________

Future Actions: ____________________

Time incident occurred: ____________________

Time incident rectified: ____________________

Did the incident halt operations: ____________________

If so, time operations resumed: ____________________

Other comments:

____

____

____

____

____

____

____

____

Details of Complainant if applicable ____________________ Name ____________________ Address

Logged By ____________________ Name ____________________ Signature

Appendix 3

Safety Data Sheets

Folders containing comprehensive files of all Material Safety Data Sheets are held in the following areas:

- Plant Managers office
- Operations office
- Staff amenities room

Copies are not included here due to the constant updating that occurs to these documents.

Appendix 4

Emergency Contact List / Contractors

South Taranaki District Council (Sid) 0274 7411792

Environmental Manager (Rowan) 021 864 684

Engineering Manager (Paul) 027 488 3340

Plant Manager (Paul) 027 4464 930

Appendix 8

Technical Memo AEE Alternative Options – PDP, December 2019

TECHNICAL MEMORANDUM

INVESTIGATION	AEE Alternative Options	**PROJECT**	Taranaki By-Products Land Treatment of Wastewater
CLIENT	**Taranaki By-Products Ltd**	**PROJECT NO**	AJ467202M003
CLIENT CONTACT	Paul Drake	**PREPARED BY**	Lenka Craft and Daryl Irvine
CLIENT WORK ORDER NO/ PURCHASE ORDER		**SIGNATURE**	
		DATE	16 December 2019

Introduction

Taranaki-By Products Ltd (TBP) operates an inedible protein recovery plant on Kohiti Road near Okaiawa. An edible protein recovery plant, owned by Taranaki Bio-Extracts Ltd, shares the site and a dairy farm is run on adjacent land owned by TBP. The wastewater from the two plants and dairy farm effluent is combined and treated in an onsite biological treatment facility before it is discharged onto company owned dairy farmland under Taranaki Regional Council (TRC) Resource Consent No. 3941-2, with a portion discharged to the Inaha Stream under TRC Resource Consent No. 2049-4 (when soil conditions do not allow all wastewater to be irrigated). Both discharge consents expired on 1 June 2019 and TBP continue to operate under s.124 of the Resource Management Act. To assist with renewal of the discharge to land consent, No. 3941-2, a technical assessment of environmental effects (AEE) of the wastewater irrigation activity has been prepared by Pattle Delamore Partners Limited (PDP).

In support of the application, and in response to Point 8 of the request for further information from Taranaki Regional Council dated 15 February 2019, this technical memorandum provides a high level assessment of alternative options for the continued dual land irrigation / surface water system operated by TBP.

AEE Alternatives to Wastewater Management

The existing operation at site implements two methods that complement each other to manage the disposal of wastewater; with discharge to land via irrigation, occurring year-round, and discharge to surface water via a portion discharged to the Inaha Stream during winter when the soil is wetter and has less capacity to receive additional hydraulic loads.

Three alternatives to this system have been considered for the site which could allow for the cessation of all discharges to surface water. These are:

- Storage of wastewater to avoid discharge to surface water with increased irrigation to land;
- Piping and discharge to Hawera wastewater treatment facility;
- Piping and discharge to marine environment.

Each option is assessed below.

<u>Option 1: Onsite Storage with Increased Irrigation</u>

The site could cease (or significantly reduce) surface water discharges by constructing a wastewater storage lagoon, to store treated wastewater over the wetter, winter period, and increase irrigation to land when soil conditions allow.

This option would require approximately 40,000m^3 of storage, and significant capital investment, estimated at a very rough order cost of $4.7M plus 30% contingency to construct the storage facility.

The advantage of irrigating wastewater to land is that it enables the renovation of nutrients in a soil/pasture system, providing an added level of treatment and utilising a nutrient source, while avoiding the environmental, cultural, social, recreational and other effects that can be associated with surface water discharges.

This option would, taking into account the storage of wastewater while soil conditions reduce or prevent irrigation, increase actual hydraulic loading rates on land owned by TBP by 18 – 22% and nitrogen loading by 7 – 13%. We also note the risks associated with increased storage time (including odour). While the wastewater has been treated in a biological treatment system, there is still a potential odour risk associated with storage. Mitigation measures, such as mechanical aeration in the lagoon, would be required.

We further note that the existing discharges to the stream are managed such that discharges only occur during high flows in the Inaha Stream (through a required dilution rate on the conditions of consent, refer to the assessment by Aquanet Consulting). In comparison, the discharges to land result in lag time and long duration diffuse discharges to surface water at all flow conditions.

This option is not considered to offer a practical alternative to the proposed continuation of the dual land / surface water discharge system given the high costs associated with implementation and limited benefits.

Option 2: Pipe and Discharge to the Hawera Wastewater Treatment Plant

Wastewater could be sent to the Hawera wastewater treatment facility located approximately 15 km from site. The Hawera wastewater treatment plant consists of an oxidation lagoon based treatment plant with a marine discharge to the Tasman Sea, combined with the Fonterra Whareroa discharge.

This option would require significant capital investment, estimated at a very rough order cost of $5.7M plus 30% contingency, to construct the pipe network and pump station. There would also be ongoing trade waste charges and pipeline maintenance costs. This option is only viable if the Hawera treatment plant can handle the additional capacity and local council agree to accept it. The system would not be able to process the remaining volumes of Zeal Grow, therefore TBP would still be required to dispose of this proportion of the waste, currently to land.

Based on the very high cost and potential restriction on discharging to the Hawera system, this is not considered to be a feasible option.

Option 3: Pipe and Discharge to the Marine Environment

Wastewater could be discharged to the marine environment approximately 8.5 km from site. Constructing the discharge network would require significant capital investment, with a very rough order cost estimate of $4.2M plus 30% contingency, plus the cost of the marine discharge structure. There is significant uncertainty around the required structure and cost associated with a marine discharge at this coastal location. Due to the potential variable nature of the marine coastline it is difficult to provide a cost estimate for a marine discharge pipeline and structure but the costs could run into the tens of millions of dollars.

This option does not make use of the land for additional nutrient management. Treatment will still be required to meet discharge conditions and the discharge would not be able to contain the Zeal Grow, therefore TBP would still be required to dispose of this proportion of the waste via land.

Due to the extremely high potential cost and uncertainty associated with this option, it is not considered to offer a feasible alternative.

Conclusion
TBP has already invested heavily in installing treatment and irrigation systems for the existing wastewater management system over many years. Due to large additional capital investments required for the assessed alternative options, the existing investments made to purchase land and pursue land-based irrigation as much as possible, along with the uncertainty associated with Options 2 and 3, the existing method of wastewater management, including irrigation to land with a proportion discharged to surface water, is assessed as the most practicable option for the site.

Appendix 9

Technical Memo in response to s.92 request for additional information – Aquanet December 2019

Date: 12/12/2019

To: Simon Bendall

Traverse Environmental Ltd.

Okaiawa Rendering Plant resource consent applications: Aquanet response to S.92 request for additional information

1 Background

The purpose of this memorandum is to provide a technical response to Point 2, Point 6 and Point 7 of Taranaki Regional Council's (TRC's) request for further information on the Okaiawa Rendering Plant resource consent applications.

2 Point 2

2.1 Request

[Please provide] an evaluation of the dilution rate (300:1) adopted for the discharge of wastewater into the Inaha Stream. The evaluation should include the appropriateness of the current dilution rate and any alternative dilution rates considered by the applicant.

2.2 Response

The proposed dilution rate of 300:1 exists with the existing consent conditions held by Taranaki By-Products (TBP) and is proposed to continue to apply in the replacement consent.

In assessing the appropriateness of this rate, we have considered a number of factors including the degree to which this dilution rate is currently managing instream effects in the Inaha Stream. We refer to our assessment of environmental effects report included with the original application.

As one way of determining appropriateness of this dilution rate, we have considered any potential effects on kākahi (freshwater mussels), which have been found in the Inaha Stream (although to our knowledge not downstream of the Plant). Kākahi are particularly sensitive to ammonia toxicity and so provide a good indicator species when considering the effects of a discharge of this nature.

Recent advice from Dr Chris Hickey of NIWA suggests that to protect kākahi from chronic toxicity effects, unionised ammonia (NH_3-N) needs to be managed at so that 95th percentile concentrations do not exceed the NPS-FM attribute state B median concentration threshold (9.2 ppb) (Hickey, 2018). To determine the dilution ratio required to achieve this we have estimated 95th percentile NH_3-N concentrations in the Inaha Stream at a range of dilution ratios (100-600), based on:

- An assumed continuous discharge;
- The 95th percentile total ammoniacal nitrogen (NH_4-N) concentration recorded in the treated wastewater by TRC between July 1995 and August 2016 (421.7 g/m^3);
- The average NH_4-N concentration recorded in the Inaha Stream upstream of the discharge at Kohiti Rd by TRC between January 1997 and December 2017 (0.043 g/m^3); and
- The estimated ratio of NH_4-N and NH_3-N in the Inaha Stream downstream of the discharge based on average pH (7.6) and temperature (13.8 °C).

The results of this analysis show that if future discharge NH_4-N concentrations were to reflect those observed between 1995 and 2016, then a dilution ratio of roughly 1:500 (Figure 1) would be needed to ensure that 95th percentile NH_3-N concentrations in the Inaha Stream do not exceed the kākahi protection threshold downstream of the discharge.

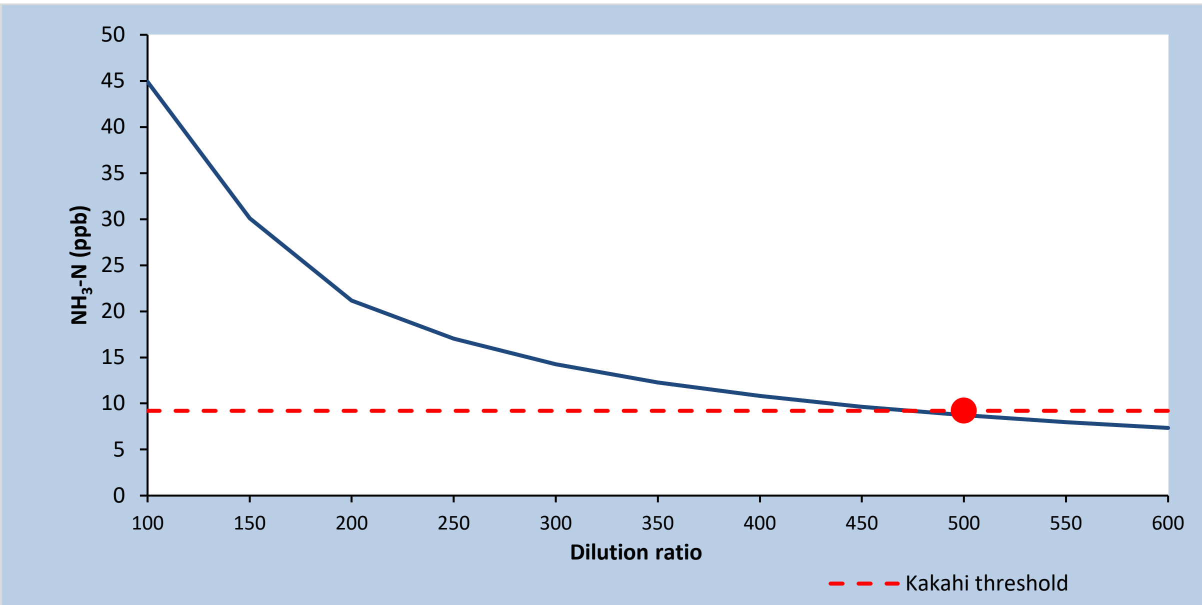


Figure 1: Expected (based on measured discharge quality data between 1995 and 2016) 95th percentile NH_3-N concentration in the Inaha Stream at different dilution ratios compared to the threshold for the protection of kākahi from ammonia toxicity.

While the data collected since 1995 indicates a 1:300 dilution ratio is not appropriate, discharge quality has improved since records began. Analysis of effluent quality collected by TBP between July 2015 and June 2019 shows that over that period NH_4-N concentrations did not exceed 272 g/m^3. TBP have indicated that the current treatment system is able to keep ammonia below that level, and that an NH_4-N limit of 275 g/m^3 is achievable (noting that TBP are continuing to implement improvements, including through the addition of a VSEP filter system, the details of which we understand are being provided as a separate component of the response to further information). When this value is used to predict 95th percentile NH_3-N concentration in the Inaha Stream at different dilutions (100-600) it appears that a 1:300 ratio should protect kākahi from toxicity effects (Figure 2).

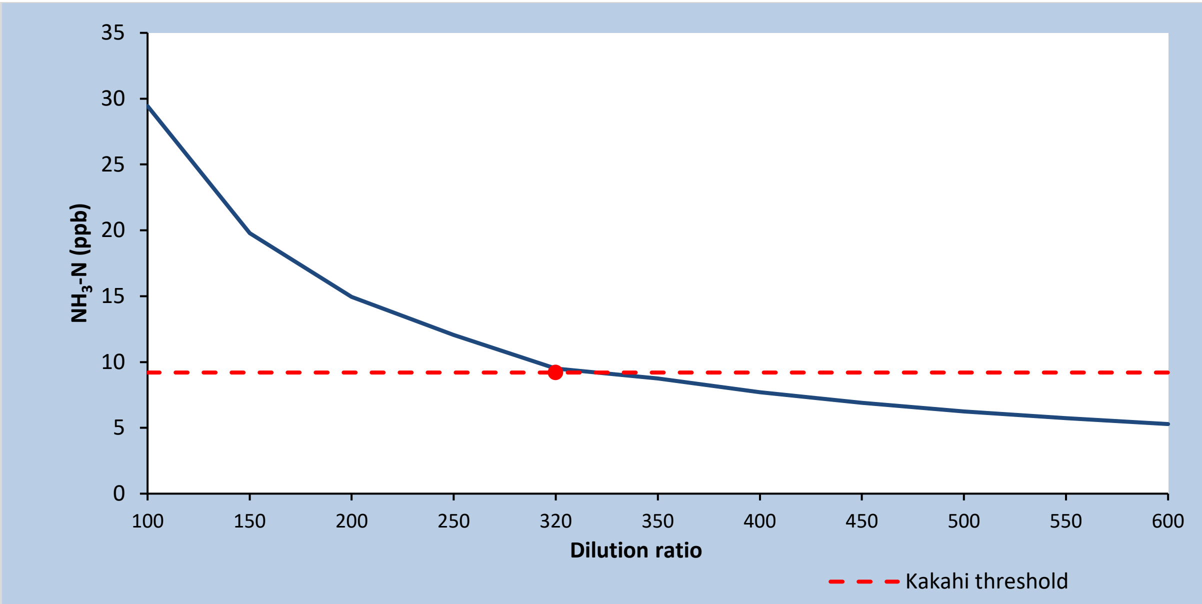


Figure 2: Expected (based on an NH_4-N limit of 275 g/m^3) 95th percentile NH_3-N concentration in the Inaha Stream at different dilution ratios compared to the threshold for the protection of kākahi from ammonia toxicity.

2.2.1 Summary and recommendations

- The 1:300 dilution ratio should protect kākahi (a useful indicator species given its low tolerance for NH_4-N) from ammonia toxicity effects provided that a limit is placed on NH_4-N in the discharge.
- It is recommended that the effluent limit for NH_4-N be set at 275 g/m^3. It should apply as a 95th percentile (consistent with the instream threshold for kākahi protection), and compliance should be assessed in accordance with the NZ Municipal Wastewater Monitoring Guidelines (e.g. no more than 2 exceedances in 12 samples).

3 Point 6

3.1 Request

[Please provide] details of the discharge from the existing burial pits ('closed landfill'). A resource consent will be required unless you can demonstrate that the discharges to land from any previous burials will meet the permitted activity standards - noting that the receiving water is the groundwater in the vicinity of the pits.

3.2 Background to permitted activity standards

Rule 28 stipulates the discharge of leachate from closed landfills to water shall not give rise to any of the following effects in the receiving water after reasonable mixing:

- The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
- any conspicuous change in the colour or visual clarity;
- any emission of objectionable odour;
- the rendering of fresh water unsuitable for consumption by farm animals;
- any significant adverse effects on aquatic life.

Rule 28 also sets out the following water quality thresholds, which are the primary consideration of this assessment:

- The discharge shall not cause the following limits to be exceeded in the receiving water after reasonable mixing:
  - unionised ammonia expressed as nitrogen 0.02 g/m^3;
  - total zinc 0.05 g/m^3
- The discharge shall not cause the dissolved oxygen concentration of the receiving water to fall below 80% of saturation concentration after reasonable mixing;
- The discharge shall not cause the concentration of filtered carbonaceous biochemical oxygen demand to exceed 2.00g/m^3 in the receiving water after reasonable mixing.

3.3 Effects on surface water (already provided in Appendix E of the Aquanet report)

3.3.1 Background

Estimated groundwater travel patterns provided by PDP (Figure 3) indicate that contaminants discharged to groundwater from the closed burial pits enter the Inaha Stream above the water quality monitoring site at the bridge 420 m u/s Kohiti Rd (INH000348). Accordingly, data collected from this site were used in this assessment, as are the results of longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018 (the location of sites sampled in these surveys are provided in Figure 4 and Figure 5).

Rule 28 stipulates that the discharge shall not cause the concentration of total zinc to exceed 0.05g/m^3 in the receiving water after reasonable mixing. However, the burial pits are not expected to contain metals, therefore the total zinc threshold is not relevant to this activity. Accordingly, the zinc threshold is not considered in this assessment (note total zinc is not monitored in the Inaha Stream).

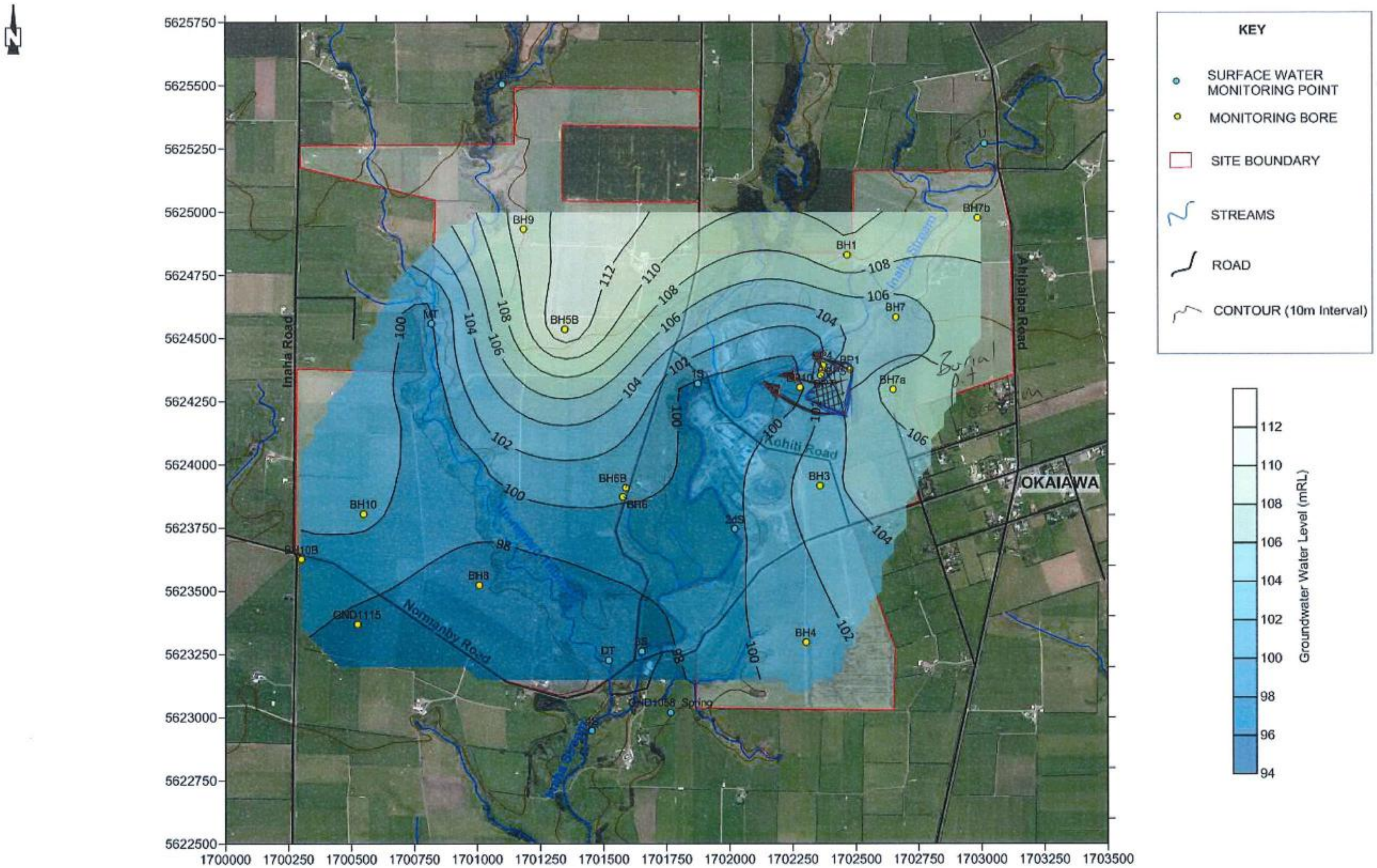


Figure 3: Sketch detailing PDP's estimation as to the groundwater flow direction from the burial pits.

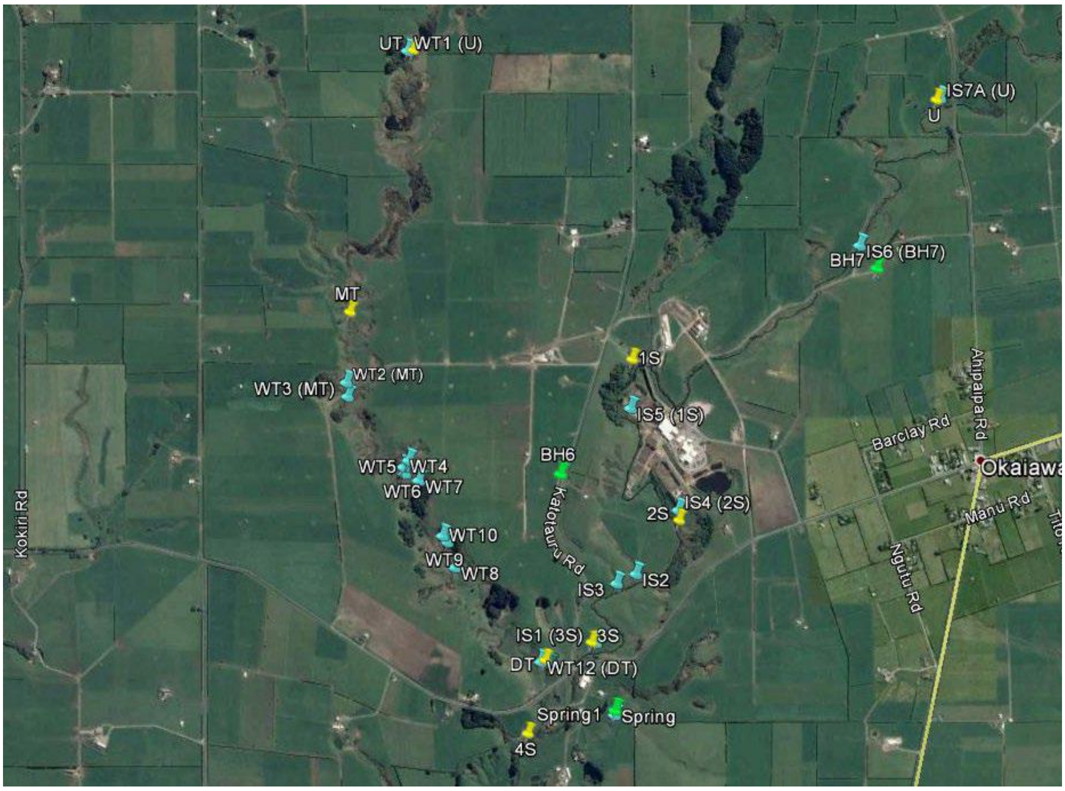


Figure 4: Location of sites sampled by Aquanet in April 2018.

Figure 5: Location of sites sampled by Aquanet in October 2018

3.3.2 Assessment

Unionised ammonia (NH_3-N)

The maximum NH_3-N concentration recorded in the Inaha Stream downstream of the burial pits (@ INH000348) is 0.001 g/m^3 (see Appendix B of Aquanet report for full data summary). Consequently, there is no evidence to suggest that discharges from the burial sites are causing the 0.02 g/m^3 threshold to be exceeded.

Longitudinal water quality surveys undertaken by Aquanet in April 2018 and October 2018 also indicate that the risk of discharges from the burial sites causing the 0.02 gm$^{/3}$ threshold to be exceeded is low. On both sampling occasions the maximum increase observed between sites upstream and downstream of the burial pits was 0.001 g/m^3.

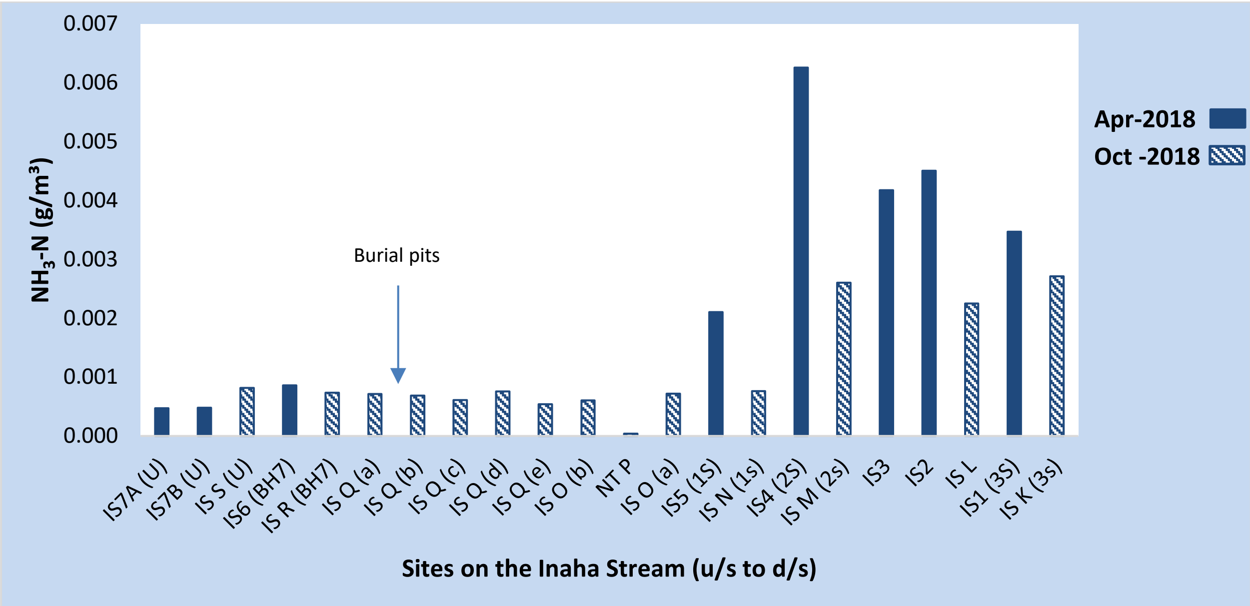


Figure 3: Concentration of NH_3-N at sites on the Inaha Stream in April 2018 and October 2018. The location of burial pits contaminant sources are depicted on the graphs, and site locations are provided in Figure 1 and 2.

Biochemical oxygen demand

Based on the available data, discharges from the burial sites are unlikely to be causing the 2.00 g/m^3 threshold for filtered carbonaceous biochemical oxygen demand ($ScBOD_5$) to be breached. Indeed, recorded $ScBOD_5$ concentrations in the Inaha Stream downstream of the burial pits have never exceeded 2.00 g/m^3.

Dissolved oxygen

Based on the available data, discharges from the burial sites are not causing the 80% threshold for dissolved oxygen (DO) saturation to be breached. Observed DO saturation in the Inaha Stream downstream of the burial pits has only been below 80% once (28/02/2001 = 78%), and on this occasion it is unclear if low DO was driven by discharges from the burial pits, as upstream water quality was not measured (see Appendix B of Aquanet report for full data summary).

Previous DO monitoring has been conducted during the day when DO is highest. Thus, the available data may not represent the full range of oxygen conditions experienced in the Inaha Stream. However, given that the discharges from the burial pits do not appear to increase ammonia concentrations to the extent that the risk of nuisance algal or macrophyte blooms will be significantly increased, or increase ScBOD5 concentrations, it is unlikely that they are causing dissolved oxygen to drop below 80% saturation.

3.3.3 Summary

Based on the available water quality data, it appears that discharges from the closed burial pits at the Okaiawa Rendering Plant are not causing the relevant Rule 28 water quality thresholds to be breached in the Inaha Stream and are unlikely to be giving rise to the effects described in the first clause of that rule.

3.4 Effects on groundwater

TRC have advised us that the permitted activity standards in Rule R28 apply in groundwater as well as surface water. As the standards in Rule 28 are generally set for the protection of surface water values, to date most of the prescribed parameters have not been monitored in the groundwater near the burial pits. Consequently, this assessment is based solely on ammonia.

3.4.1 Assessment

The available groundwater monitoring data suggests that the Rule 28 permitted activity standard for NH_3-N is not being met in groundwater near the burial pits. Since August 2017 NH_3-N concentrations at two monitoring bores near the pits, BP4 and BP7 (Figure 7), have consistently exceeded 0.02 g/m^3, with the maximum concentrations recorded in both bores more than 20 times greater than the permitted activity standard (Figure 6).

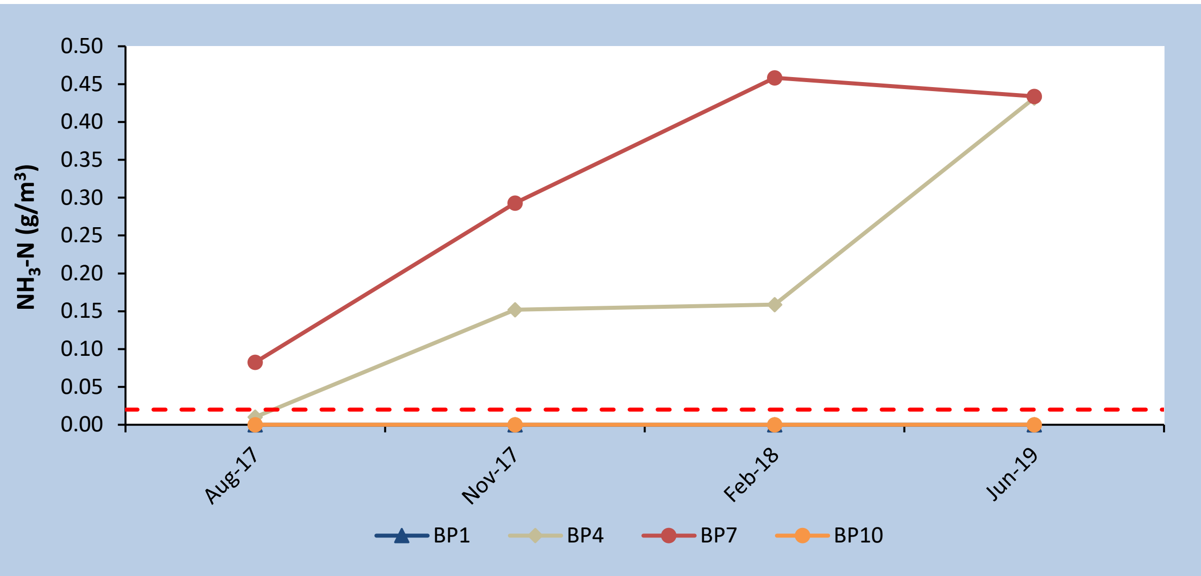


Figure 6: NH_3-N concentrations recorded in TRC monitoring bores near the burial pits between August 2017 and June 2019. The red dashed line represents the permitted activity standard.

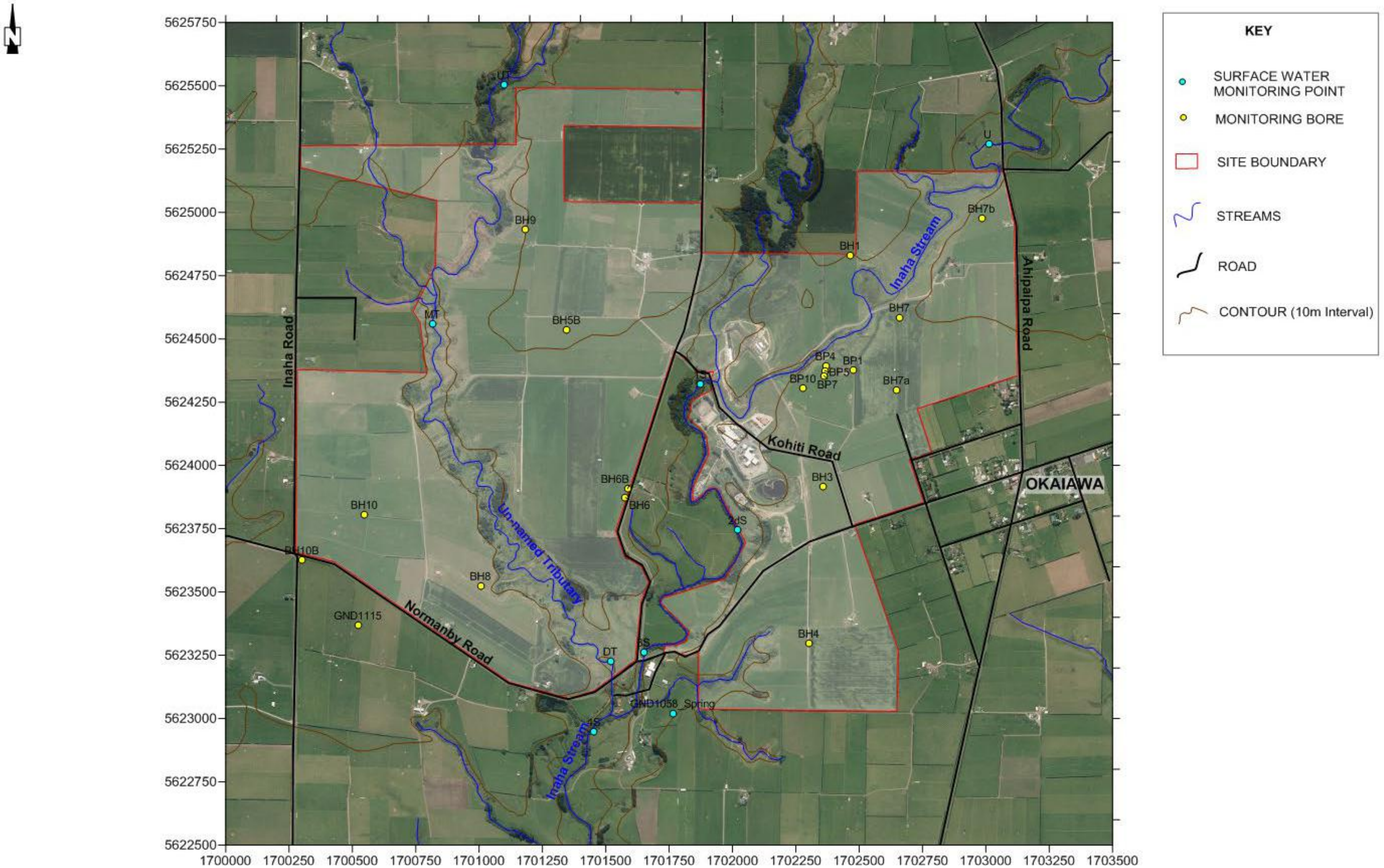


Figure 7: Monitoring bore locations.

3.4.2 Comment on effects

It is important to note that all of the standards set out in Rule 28 apart from (d) are specifically set for the protection of aquatic life and aesthetics[1]; we suggest that these matters have no applicability to groundwater. Thus, while the Rule 28 standards may be intended to apply in groundwater, from an effects perspective non-compliance is only relevant when contaminated groundwater enters a surface water body. As groundwater contaminated by the burial pits are not causing the Rule 28 standards to be breached in the Inaha Stream (Section 3.3.2), and to the best of our knowledge groundwater in the vicinity of the pits is not used for stock or drinking water, the effects of the discharge from the burial pits to groundwater are likely negligible.

We understand that TBP will be seeking a consent for this activity in order to meet the stated requirements of the rule. However, we suggest that this rule is clarified in future to either set groundwater-specific standards, or if surface water standards are to be used, clarify how compliance with those standards should be assessed.

4 Point 7

4.1 Request

[Please provide] Information on the difference between the rate of take and the rate of discharge from the fire pond 'i.e. the reduction of flow'.

4.2 Response

We note that flow information is not available to confirm discharge volumes from the fire pond as the discharge is not metered.

Regarding how the system operates, we have been advised by TBP that water is taken from the Inaha Stream and used for cooling water in the rendering plant, before being discharged into the fire pond in order for the temperature to be reduced prior to discharge into the Inaha Stream. The take is continuous, and the cooling system is closed. Thus, all of the water that is taken from the stream is discharged to the fire pond, with no losses or lag up to that point. The fire pond also receives water additional to the cooling water discharge from undefined sources (likely groundwater and springs). The cooling water, combined with the water from undefined sources, is discharged to the Inaha Stream roughly five metres downstream of the abstraction point.

Small volumes of water are intermittently pumped from the fire pond by TBP for use in plant operations and wash down, and we expect that some losses occur though evaporation from the fire pond. However, the undefined water sources to the pond mean that even when this is occurring, the amount of water discharged to the Inaha Stream is likely to be greater than or equal to the amount abstracted.

An indicative schematic of the cooling water/fire pond system is provided in Figure 8.

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[1] While zinc does affect drinking water quality, the standard set in Rule 28 is 20 times less than the NZ drinking water standard, and it is far too restrictive to have been set for the protection of drinking water supply bores.

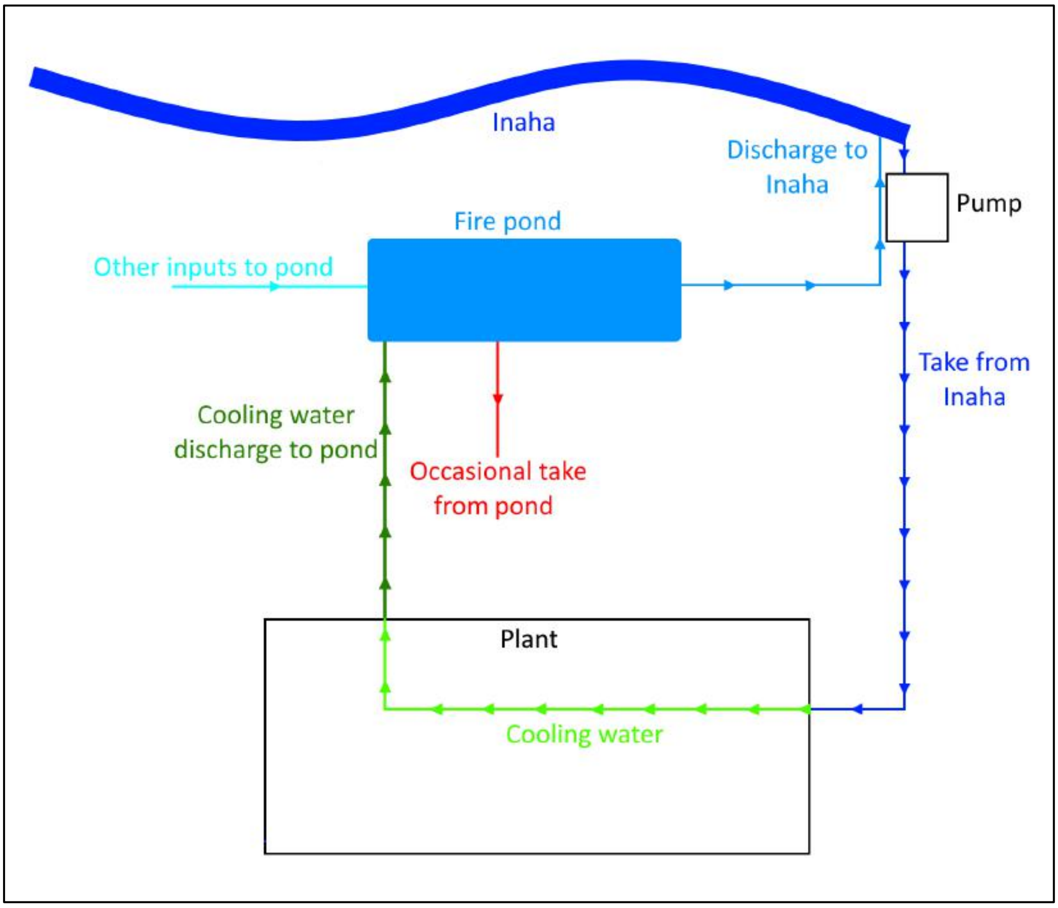

Figure 8: Diagram of how water abstracted from the Inaha Stream moves through the cooling and fire pond systems.

From our observations, abstraction from the Inaha Stream does not result in a reduction in flow in the Stream, as the take is more than offset by the discharge from the fire pond. We have considered various options to meter at different points in the system to provide flow data to confirm this. However, while the water take is metered, there are various practical difficulties and cost implications with monitoring the total discharge. Given the very small volume differences that are likely to exist between the take and discharge (our observations suggest that the discharge is likely higher than the take), we consider that the benefits of monitoring the discharge point (or other points in the system) do not outweigh the costs.

If useful, we have recorded video of the cooling water discharge to the fire pond (representing the total take from the Inaha) and the discharge to the Inaha Stream to visually show the difference between the rate of take and the discharge. The video shows a noticeable increase in the discharge volume (associated with natural contributions of groundwater to the fire pond) compared with the rate of take from the Inaha. This video can be provided to the Council by request.

5 References

Hickey, C. 2018. Interpretation of total ammonia guidelines. NIWA memorandum addressed to Keith Hamill and Olivier Ausseil. NIWA, Hamilton.

Prepared by:

Michael Greer (PhD)
Senior Scientist – Freshwater
Aquanet Consulting Ltd

Land & Water House
441 Church Street
Palmerston North

14 Lombard Street
Level 1
Wellington

Appendix 10

Ngāti Manuhiakai
Mitigation Agreement

Dated 3 December 2019

MITIGATION AGREEMENT

between

NGĀTI MANUHIKAI HAPŪ

and

TARANAKI BY PRODUCTS LIMITED

MITIGATION AGREEMENT

1. THE PARTIES

NGĀTI MANUHIAKI HAPŪ (the "**Hapū**")

And

TARANAKI BY PRODUCTS LIMITED ("**TBP**")

(each a "**Party**" and together the "**Parties**")

2. NGĀTI MANUHIAKI HAPŪ

Ko Aotea te Waka

Ko Taranaki te Maunga

Te rere o Kapuni me Inaha nga awa

Ko Ngāti Manuhiakai te hapū

Ko Nga Ruahinerangi te iwi

3. TARANAKI BY PRODUCTS

3.1 TBP owns and operates the Okaiawa rendering plant on Kohiti Road, Okaiawa.

3.2 The company has been operating at the site since 1936 and employs over 105 people.

4. RESOURCE CONSENT RENEWAL

4.1 TBP are seeking to renew six of the thirteen resource consents held to enable the ongoing operation of the rendering plant. The six consents that require renewal are:

(a) Discharge of treated wastewater to land (spray irrigation)

(b) Discharge of treated wastewater to the Inaha Stream (used when land option not available e.g. wet winter conditions)

(c) Take of water from the Inaha Stream (non-consumptive take used for cooling)

(d) Discharge of cooling water to the Inaha Stream

(e) Discharge of storm water to the Inaha Stream

(f) Burial of waste to land (used when plant in emergency shutdown)

4.2 Applications to renew these consents were lodged by TBP with the Taranaki Regional Council on 30 November 2018.

5. PURPOSE OF THIS AGREEMENT

5.1 Since April 2018, the Parties have been in discussions specifically to assess the actual and potential cultural and environmental effects associated with the ongoing operations of the rendering plant.

5.2 This agreement captures the outcome of those discussions, and the agreed approach to avoid, remedy or mitigate effects of concern to Hapū.

6. PARTNERING APPROACH

6.1 The Parties wish to record their desire to establish and maintain a long-term relationship based on mutual trust, openness and respect for each other's needs and values.

6.2 The over-arching principle which shall govern and guide the relationship between the parties and their respective consultants, contractors and subcontractors shall be based on a Partnering Approach which recognises and comprises the following objectives and principles:

(a) the establishment of a relationship based on honesty and mutual trust;

(b) the shared intention to achieve (by constructive and harmonious working together) an optimising of the Parties' respective benefits;

(c) transparency, openness, promptness, consistency and fairness in all dealings and communications between the parties and their agents and representatives; and

(d) respectful and non-adversarial dealings between the Parties and constructive mutual steps both to avoid differences and to identify resolutions.

6.3 The Parties agree to act in accordance with the objectives and principles of the Partnering Approach at all times.

7. SITES OF SIGNIFICANCE TO HAPŪ

7.1 The Parties acknowledge that waahi tapu sites exist within and surrounding the area of operations for TBP, and that at the time of signing this agreement TBP have been advised by Hapū of the presence and location of three waahi tapu sites.

7.2 TBP records its commitment that it will continue to take all reasonable steps to ensure that no degradation, harm or disturbance of known waahi tapu occurs as a result of its operations.

7.3 TBP further records its commitment to treat in full confidence any information shared by Hapū regarding the location, name or nature of waahi tapu sites.

8. MONITORING PROTOCOL

8.1 The Parties agree to develop a Inaha Stream Monitoring Protocol within 18 months of this agreement being signed.

8.2 The purpose of the Inaha Stream Monitoring Protocol shall be to record the monitoring practices the Parties agree for the Inaha Stream.

8.3 In developing the Inaha Stream Monitoring Protocol, the Parties shall explore, among other matters:

(a) Opportunities for Hapū members to attend, observe and/or participate in Inaha Stream monitoring activity undertaken by TBP staff and/or contractors;

(b) Opportunities for further training in freshwater monitoring for Hapū members;

(c) Opportunities for information and knowledge exchange between Hapū and TBP;

(d) Opportunities to incorporate cultural monitoring in TBP activities;

8.4 The Parties affirm that nothing in the Inaha Stream Monitoring Protocol shall affect TBP's ability to meets its legal obligations under the Resource Management Act 1991, the Health and Safety at Work Act 2015 or any other legislation or legal requirement.

9. SPRAY DRIFT

9.1 The Parties acknowledge that TBP has proffered an acceptable condition of consent in relation to the management of spray drift, as follows:

"The edge of the spray zone shall be at least:

a) 25 metres from the banks of any watercourse;

b) 50 metres from any bore, well or spring used for water supply purposes;

c) 20 metres from any public road, except as detailed in f) and g) of this condition;

d) 20 metres from any property boundary;

e) 150 metres from any dwellinghouse or place of public assembly unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance;

f) 200 metres from Normanby Road adjacent to the property described as Lots 3 & 4, Pt Lot 1 DP 2707, Lot 1 DP 3731, Blk IV, Waimate SD, unless the written approval of the occupier has been obtained to allow the discharge at a lesser distance;

g) 50 metres from Ahipaipa Road adjacent to the properties described as Pt Lot 1 and Lot 2 DP 3322, Lot 2 DP12129, Blk IV, Waimate SD.

h) 150 metres from Te Aroha Marae

i) 25 metres from urupa"

9.2 Hapū record that a primary concern is the ongoing safety of drinking water at Te Aroha Marae, which operates a roof-water collection system.

9.3 For the purposes of confirming that the proposed irrigation setback from Te Aroha Marae is effective, TBP agree to undertake sampling of Te Aroha Marae's drinking water at least twice annually during the irrigation season. The monitoring shall be undertaken in such a manner so as to test whether TBP's irrigation activity is affecting the quality of water collected from the roof of Te Aroha Marae.

9.4 The frequency of monitoring required by Clause 9.3 may be altered by agreement of the Parties.

10. BURIAL ACTIVITY

10.1 TBP have sought to renew an existing resource consent held for the burial of solid waste on site. This activity is only required in an emergency situation when the rendering plant is unable to process material, and that process material must be disposed of.

10.2 Hapū record their concerns with this activity, and seek that no burial activity is undertaken on site in a way that may, in the short or longer term, affect waterways.

10.3 TBP confirm that due to investment in plant systems, including the development of back up processes and redundancy planning, no further burial activity will take place in connection with usual plant operations.

10.4 TBP further confirm that:

(a) Any future burial activity may only occur in connection with a catastrophic and unforeseen event, such as a substantial earthquake, fire or other disaster; and

(b) Should such an event take place, any burial activity will be minimised as far as possible and managed in such a way that any effects on waterways are avoided, remedied or mitigated.

11. TE KOPANGA SPRING

11.1 The Parties wish to record and acknowledge that the site that has come to be known locally as "Shearer's Spring" should correctly be referred to as "Te Kopanga Spring"

12. RIPARIAN PLANTING

12.1 The Parties acknowledge that TBP makes an annual donation to support riparian planting. This donation is made in accordance with the following existing condition of consent:

> *By the agreement of the consent holder, the consent holder shall mitigate the effects of the discharge by donating annually to the Taranaki Tree Trust $2100 [goods and services tax exclusive] for the purpose of providing riparian planting and management in the Inaha Stream catchment. The amount shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.*

12.2 The Parties agree that TBP shall proffer a similar condition in the replacement consents, with the amount of the donation being $3,100 [goods and services tax exclusive], adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation.

12.3 The Parties further agree to seek the following from Taranaki Regional Council:

(a) Confirmation that the annual donations made to date by TBP has been spent on riparian planting and management in the Inaha Stream catchment as required by the Condition;

(b) That any funds previously donated and not spent for this purpose are directed towards riparian planting in the Inaha Catchment at the earliest opportunity; and

(c) That in future, all funds donated in accordance with this condition are spent for the benefit of the Inaha Stream and that such spending is reported to the Parties.

13. ANNUAL MEETING

13.1 The Parties agree to meet annually, or more or less as may be agreed by the Parties, in order to:

(a) Review environmental performance of the rendering plant;

(b) Raise any matters or issues for discussion;

(c) Confirm the ongoing protection of sites of significance to Hapū

13.2 The meetings shall be held at Te Aroha Marae, or at an alternative location as may be directed by Hapū.

14. DISPUTE RESOLUTION

14.1 As part of the Partnering Approach discussed in clause [6] of this agreement, the Parties agree to use best endeavours to seek to understand and resolve any issues that may arise from time to time. Any dispute in relation to this agreement will be resolved in accordance with **Schedule One** to this agreement.

15. SUPPORT FOR THE CONSENT RENEWAL APPLICATIONS

15.1 Hapū agree that, taking into account the steps to be taken by the Parties under this agreement the applications for resource consent lodged by TBP in November 2018, and subsequent updates made, the actual and potential cultural effects will be appropriately avoided, remedied or mitigated.

15.2 On that basis, the Parties record their agreement that the renewal of resource consents held by TBP and the associated ongoing operation of the rendering plant is acceptable to and supported by Hapū.

SIGNED for and on behalf of)
TARANAKI BY PRODUCTS LIMITED:)
)

SIGNED for and on behalf of)
NGĀTI MANUHIAKI HAPŪ:)
)
)

SCHEDULE ONE – DISPUTE RESOLUTION

Dispute resolution process:

A. Subject to clause 13, no Party may commence any proceedings relating to any dispute between the Parties unless the Party has taken all reasonable steps to comply with this clause 13.

B. Any party who claims that a dispute has arisen under or in relation to this agreement must give written notice to the other party specifying the nature of the dispute.

C. On receipt of such notice by the other party, the parties to this agreement:

   i. Must co-operate and use their best endeavours to resolve the dispute expeditiously; and

   ii. Must, if they do not within seven days of the receipt of the notice (or such further period as they may agree in writing) resolve the dispute, refer the dispute to mediation.

D. The mediation shall be conducted by a mediator and at a fee agreed by the Parties.

E. Failing agreement between the Parties, the mediator shall be selected and the mediators fee shall be determined by the President of the Arbitrators and Mediators Institute of New Zealand.

Appendix 11

Ngāti Manuhiakai

Support Letter

From: Ferinica Foreman [mailto:ferinica.f@gmail.com]
Sent: Tuesday, 21 July 2020 1:29 AM
To: Paul Drake
Cc: Kiri Erb; Maria Robinson; Ferinica Foreman
Subject: Ngati Manuhiakai Hapu

NGATI MANUHIAKAI HAPU

Ferinica Hawe-Foreman
0273758880
ferinica.f@gmail.com
ngatimanuhiakai@gmail.com

19 July 2020

Taranaki By Products Ltd
c/- Paul Drake
pauldrake.tbp@xtra.co.nz

Tena koe Paul,

RE: TARANAKI BY PRODUCTS RESOURCE CONSENT RENEWAL

Thank you for the ongoing updates on the progress with the renewal of resource consent especially on seeking our feedback in regards to the challenges you have faced concerning the consent to bury waste to land from an email dated 11 March 2020.

Due to the Covid-19 Lockdown our Hapu only reconvened their normal meetings in June 2020.

Ngati Manuhiakai Hapu had queries and asked if we could be permitted to have an onsite visit to Taranaki By Products which we felt we needed a more informed look at the processes that occur at the plant. During the three and a half hour visit, (plant closed due to maintenance) we had our questions answered and were able to view the mechanics of the operation. We thank you.

We acknowledge we signed an Agreement with Taranaki By Products dated 3 December 2019 and we the Hapu of Ngati Manuhiakai agree to the renewing of the resource consents below;

TBP are seeking to renew six of the thirteen resource consents held to enable the ongoing operation of the rendering plant. The six consents that require renewal are:
(a) Discharge of treated wastewater to land (spray irrigation)
(b) Discharge of treated wastewater to the Inaha Stream (used when land option not available e.g. wet winter conditions)
(c) Take of water from the Inaha Stream (non-consumptive take used for cooling)
(d) Discharge of cooling water to the Inaha Stream (e) Discharge of storm water to the Inaha Stream (f) Burial of waste to land (used when plant in emergency shutdown).

We have seen, heard and felt your willingness to engage with us, and that you take an active and responsible role in ensuring the whenua and taiao are cared for. We look forward to continuing and strengthening our ongoing relationship with Taranaki By Products.

Nga mihi nui,

Ferinica Hawe-Foreman
Taimana o Ngati Manuhiakai Hapu