Greymouth Petroleum Acquisition Company Ltd Kaimiro Production Station Monitoring Programme- Annual Report 2016-2017

Technical Report 2017-54

ISSN: 1178-1467 (Online)
Document: 1954287 (Word)
Document: 1984711 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

March 2018

Executive summary

Greymouth Petroleum Acquisition Company Limited (GPL) operates the Kaimiro Production Station located at Inglewood, in the Waiongana catchment, and the associated Ngatoro-A and Ngatoro-B producing wellsites at Inglewood, in the Waitara catchment. This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

GPL holds seven resource consents relating to production activities at the sites which include a total of 116 conditions setting out the requirements that the Company must satisfy. GPL holds one consent to allow it to take and use water, three consents to discharge treated stormwater and wastewater into the Mangaoraka and Ngatoro Streams, and three consents to discharge emissions into the air.

During the monitoring period, Greymouth Petroleum Acquisition Company Ltd demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included six inspections of the Kaimiro Production Station, six inspections at the Ngatoro A and B wellsites, an annual inspection of the associated wellsites, 12 water samples collected for physicochemical analysis, two biomonitoring surveys of receiving waters, and two ambient air quality surveys.

Results of samples collected of the discharge and receiving waters were within the limits prescribed by the consents and, along with the results of biomonitoring carried out in the Mangaoraka Stream, indicated that the discharges were not having a significant adverse effect on the downstream water quality.

There were no adverse effects on the environment resulting from the exercise of the air discharge consents. Ambient air quality monitoring at the Kaimiro Production Station showed that levels of carbon monoxide, combustible gases, PM10 particulates and nitrogen oxides were all below levels of concern at the time of sampling. No offensive or objectionable odours were detected beyond the boundary during inspections and there were no complaints in relation to air emissions from the site.

During the period under review, GPL demonstrated an overall high level of both environmental performance and administrative compliance with the resource consents. There were no unauthorised incidents recorded by the Council in relation to GPL's activities. The Kaimiro Production Station and associated wellsites were well managed and maintained.

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

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance remains at a high level.

This report includes recommendations for the 2017-2018 year.

Table of contents

List of tables

List of figures

List of photos

1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Greymouth Petroleum Acquisition Company Ltd (GPL). GPL operates the Kaimiro Production Station situated on Upland Road at Inglewood, in the Waiongana catchment. GPL also operates the Ngatoro-A and Ngatoro-B producing wellsites. The Ngatoro-A wellsite is located on Upper Dudley Road and the Ngatoro-B wellsite is located on Bedford Road. Both of these sites are at Inglewood, in the Waitara catchment. A further 23 wellsites are monitored annually in conjunction with the Kaimiro Production Station.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to abstractions and discharges of water within the Waiongana and Waitara catchments, and the air discharge permits held to cover emissions to air from the sites.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 13th combined annual report by the Council for the Company.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by GPL in the Waiongana and Waitara catchments;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at the Kaimiro and Ngatoro sites.

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

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

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

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

1.1.3 The Resource Management Act 1991 and monitoring

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

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;

b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

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

e. risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

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

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

For example:

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

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

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

Administrative performance

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

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

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

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

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

1.2 Process description

1.2.1 Kaimiro Production Station

The Kaimiro Production Station (Photo 1) was commissioned in 1985. The production station separates and treats oil and gas from wells in the Kaimiro and Ngatoro fields. Oil is piped to the Omata tank farm and gas is piped into the national grid. Wellsites associated with the Kaimiro Production Station are as follows: Kaimiro: B, C, D, F, G, H, J, K, L, M, O; Ngatoro: A, B, C, D, E, F. G; Ngatoro South; York-A; Salisbury; Goldie; Windsor; Radnor and Surrey.

The site's BTEX vapour incinerator was replaced in October 2007 with a more efficient unit. A new gas compressor was commissioned in June 2008 and upgrades made to all existing compressor PLC control systems. These measures have resulted in a significant sustained improvement in plant energy efficiency at the Kaimiro site.

Photo 1 Kaimiro Production Station

Stormwater from the Kaimiro Production Station passes through a separator system and a skimmer pit before discharging to an unnamed tributary of the Mangaoraka Stream. All chemical storage is contained within bunds and isolated from the stormwater system.

1.2.2 Ngatoro producing wellsites

Photo 2 Ngatoro-A wellsite

Ngatoro-A (Photo 2) was established in July 1992. The site consists of five wells (Ngatoro-1, -6, -7, -8, and -14), storage facilities for recovered oil and a bunded earth flare pit. In July 1999 the north-east skimmer pit at the site was decommissioned. The south-west skimmer pit now receives all treated stormwater, treated production water and treated wastewater from oil well drilling and production operations. Recovered oil and gas is piped off site to the Kaimiro Production Station, consequently flaring has been reduced.

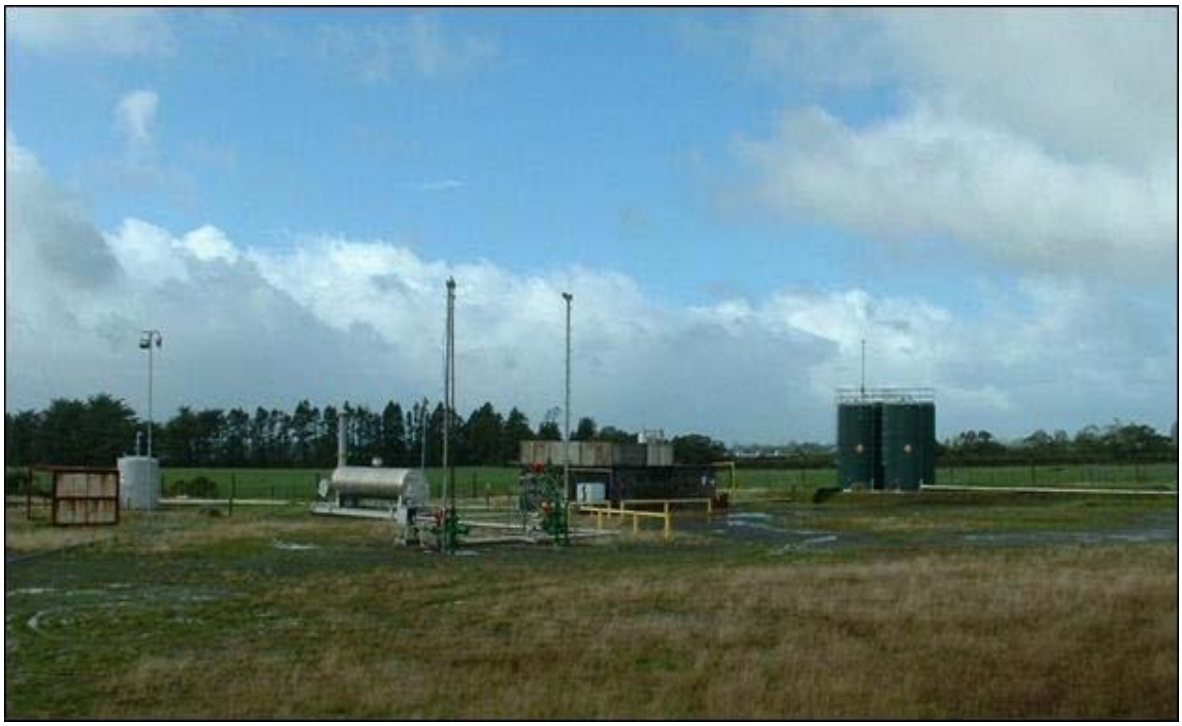

Photo 3 Ngatoro-B wellsite

The Ngatoro-B site (Photo 3) was established in 1991 and consists of four wells (Ngatoro-2, -5, -9 and -11), storage facilities for recovered oil and a bunded earth flare pit. Produced water is piped to Kaimiro and re-injected. There are two sumps with a combined capacity of 1,290 m^3 to which stormwater and wastewater are directed, and a skimmer pit with a 243 m^3 capacity is used for treatment prior to discharge to an unnamed tributary of the Ngatoro Stream. Produced gas and liquids are piped to the Kaimiro Production Station for processing.

2 Kaimiro Production Station

2.1 Resource consents

2.1.1 Water abstraction permit

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14.

GPL holds water abstraction permit **5384-2** to take groundwater from the Matemateaonga Formation for use in enhanced hydrocarbon recovery activities at the Kaimiro-O wellsite. This permit was first issued by the Council on 18 September 1998 under Section 87(e) of the RMA. It was renewed on 24 July 2014 and is due to expire on 1 June 2032.

Condition 1 sets limits on the volume and rate of abstraction.

Condition 2 requires that the bore is labelled.

Conditions 3 to 7 deal with installation of a water meter and datalogger, recording and provision of data, accuracy of the equipment, access, and repairs and maintenance.

Condition 8 requires the consent holder to adopt the best practicable option to prevent or minimise adverse environmental effects.

Conditions 9 and 10 deal with lapse and review of the consent.

The permit is attached to this report in Appendix I.

2.1.2 Water discharge permit

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

GPL holds water discharge permit **1334-3** to cover discharge of treated stormwater from the Kaimiro Production Station into an unnamed tributary of the Mangaoraka Stream in the Waiongana Catchment. This permit was issued by the Council on 10 January 2002 under Section 87(e) of the RMA. It was transferred to GPL on 10 April 2002. An application for change of consent conditions was approved on 5 September 2012 to remove three redundant conditions relating to operational and management planning. A further change of consent was approved on 8 April 2014 to increase the catchment area, move the discharge point and increase the discharge chloride limit to 230 g/m^3. It is due to expire on 1 June 2020.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise adverse effects of the discharge on any waterbody.

Condition 2 imposes a limit on the stormwater catchment size.

Condition 3 requires site specific details relating to contingency planning for the site.

Condition 4 requires all stormwater be directed through a stormwater treatment system.

Condition 5 requires that design, management and maintenance of the stormwater system be undertaken in accordance with information submitted in the application.

Condition 6 requires that hazardous substance storage areas be bunded with drainage to appropriate recovery systems, and not to the stormwater catchment.

Conditions 7, 8 and 9 impose limits on contaminants in the discharge, and stipulate effects the discharge shall not give rise to in the unnamed tributary of the Mangaoraka Stream.

Condition 10 requires that the consent holder prepare and annually maintain a contingency plan in relation to spillages at the site.

Condition 11 requires that the Council be advised of reinstatement of the site.

Condition 12 provides for review of the consent.

The permit is attached to this report in Appendix I.

2.1.3 Air discharge permit

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

GPL holds air discharge permit **4048-3** to cover discharge of emissions into the air from the flaring of hydrocarbons arising from hydrocarbon production and hydrocarbon processing operations together with miscellaneous emissions at the Kaimiro Production Station. This permit was first issued by the Council on 20 June 1995 under Section 87(e) of the RMA. It was transferred to GPL on 10 April 2002 and renewed on 10 January 2008. The current permit covers emissions from Kaimiro Production Station only and is due to expire on 1 June 2026. Separate air discharge permits were issued for the associated wellsites.

Condition 1 limits the duration of flaring during well testing.

Conditions 2, 3 and 4 specify the requirements for notification prior to flaring and before undertaking alterations to equipment or processes which may substantially alter the nature or quantity of the discharge.

Conditions 5 to 10 stipulate the required equipment and processes for undertaking flaring, and limit the substances which may be flared to gases from the well stream.

Conditions 11 to 16 stipulate limits on contaminants and effects from flaring and any other emissions from the production station.

Conditions 17 to 21 specify the requirements for the recording and reporting of information relating to flaring and the details of any measures undertaken to reduce or mitigate emissions from the production station.

Condition 22 provides for review of the consent.

The permit is attached to this report in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report.

2.2 Monitoring programme

2.2.1 Introduction

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

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

The monitoring programme for the Kaimiro Production Station site consisted of four primary components.

2.2.2 Programme liaison and management

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

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

2.2.3 Site inspections

The Kaimiro Production Station site was visited six times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

2.2.4 Chemical sampling

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

The treated stormwater discharge from the production station was sampled twice, along with two sites in the unnamed tributary of the Mangaoraka Stream. Samples were analysed for hydrocarbons, suspended solids, conductivity, pH, turbidity and chloride.

The Council also undertook sampling of the ambient air quality outside the boundary of the site. Passive absorption discs were placed at two sites on one occasion to measure nitrogen oxides. A multi-gas meter was also deployed on one occasion in the vicinity of the plant, with monitoring consisting of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases).

2.2.5 Biomonitoring surveys

Two biological surveys were performed in the unnamed tributary of the Mangaoraka Stream to determine whether or not the discharge of treated stormwater from the site had had a detrimental effect upon the communities of the stream.

2.3 Results: water

2.3.1 Inspections

Six inspections were carried out at the Kaimiro Production Station, along with an annual inspection at the associated wellsites in the 2016-2017 year. The following was found during the inspections:

31 August 2016

The production station site was neat and tidy at the time of the inspection. The skimmer pits were clear of contaminants and there were no visual effects of the discharge to the nearby tributary.

No flaring was evident and no smoke or odours were noted.

8 September 2016

The site inspection was undertaken during adverse weather conditions, with extreme southerly winds and squally showers. Stormwater was being directed through the skimmer pits for treatment and ring drains were clear. The consent holder was asked to check the silt cloth filament in the ring drain just prior to the skimmer pit as it appeared to need reattaching.

No flaring was occurring and there were no smoke or odours noted.

29 September 2016

The site was inspected following reasonably heavy rainfall over the preceding 12 to 18 hours. All ring drains and bunds were clear of contamination and the skimmer pits were operating in a satisfactory manner. There were no adverse effects of discharge observed in the nearby tributary. Full drums of oil were securely contained in a bund while empty drums were awaiting removal.

No flaring was occurring.

16 January 2017

The site was found to be neat and tidy. The stormwater system was checked and found to be working as per design and specifications. The contents of the skimmer pits were clear.

No flaring, smoke or any other off site effects were noted during the inspection.

21 February 2017

Inspection of the site was undertaken during a period of fine weather. All ring drains and bunds were clear of obstructions and contaminants, and the water quality within the skimmer pits was good with aquatic species present in the ponds indicating good water quality.

No flaring was being undertaken during the inspection and no smoke or odours were noted.

22 May 2017

The production station site was neat and tidy at the time of the inspection. Bunds and ring drains were in place and effectively directing all site groundwater and stormwater through the skimmer pits before discharging to the stream. The bulk drum store was observed to be fully bunded.

No flaring was noted.

20 June 2017

An annual inspection of the wellsites associated with the Kaimiro Production Station (as listed in section 1.2.1) was undertaken to assess the integrity of the wellsite stormwater systems, deepwell injection sites, mix-bury-cover areas, silt and sediment controls, flaring pits, and any other contingencies as covered by special conditions in the resource consents that are held for the various purposes.

At all sites the stormwater systems were inspected and found to be fit for purpose as the sites currently exist. Should additional drilling, workover, or exploratory activity be undertaken at any of the sites then some extra works, predominantly pertaining to size and lining of skimmer pits, would need to be undertaken to bring the sites up to current accepted standards within the Oil and Gas industry.

The sites were all well maintained, plant pests had been sprayed and general housekeeping was good. It was noted that the flare pits were generally well sited and most had not recently been used. Sediment controls were in place at most sites, revegetation of these sites lessens silt issues, but in one or two instances some minor redeployment of the silt and sediment controls would increase effectiveness. Some storage of site chemicals and wastes needed to be either reviewed, or the items removed off site. The Council officer discussed some minor works to be undertaken with the consent holder during the inspection.

2.3.2 Results of discharge monitoring

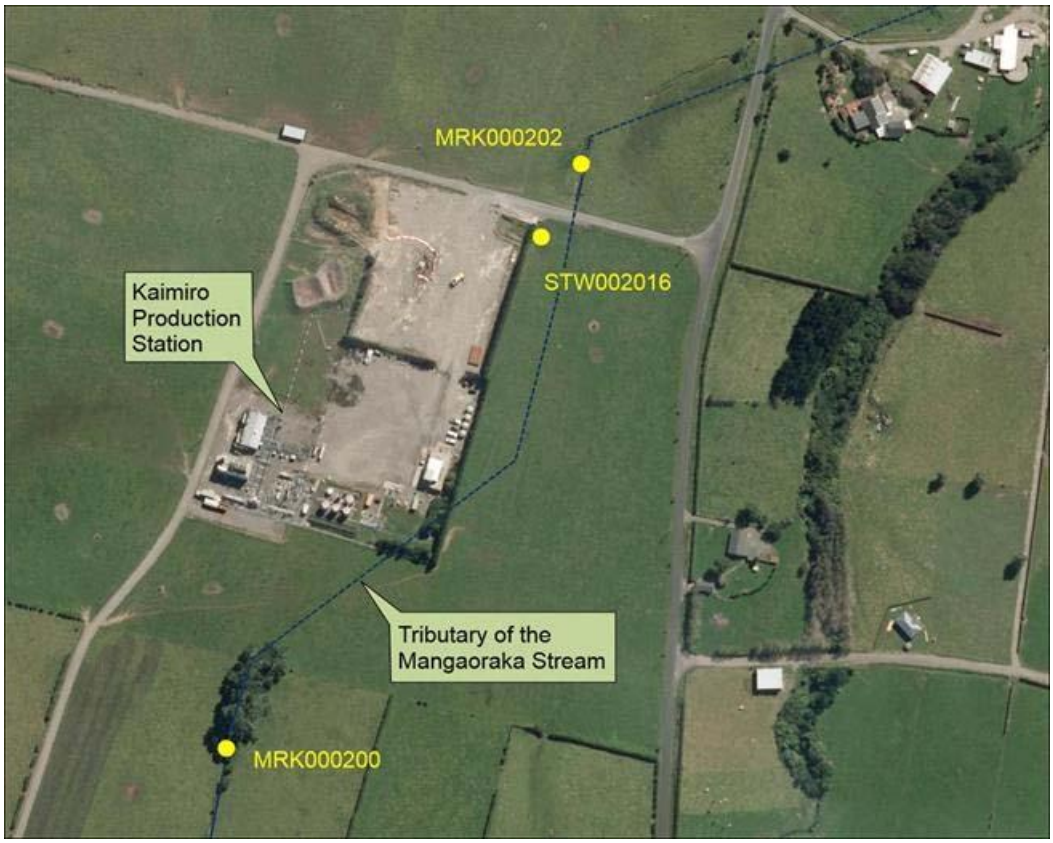

Figure 1 Water quality monitoring sites in relation to the Kaimiro Production Station

Sampling of the discharge from the Kaimiro Production Station was undertaken twice during the 2016-2017 monitoring period (the sample collected on 12 July was a catch up sample, delayed due to unsuitable weather conditions and laboratory availability). Table 1 below presents the results along with the limits stipulated by consent 1334-3. The sampling sites are shown in Figure 1.

Chloride, hydrocarbons, pH and suspended solid concentrations all complied with consent conditions.

Table 1 Physicochemical results for discharge from the Kaimiro Production Station (TRC site code STW002016)

Parameter	Units	12 May 2017	12 July 2017	Consent limits
Chloride	g/m^3	7.4	5.5	230
Conductivity	mS/m	5.3	3.8	-
Hydrocarbons	g/m^3	<0.5	<0.5	15
pH		6.8	6.8	6.5 – 8.5
Suspended solids	g/m^3	8	26	100
Temperature	Deg. C	12.2	6.0	-
Turbidity	NTU	10	26	-

2.3.3 Results of receiving environment monitoring

2.3.3.1 Chemical

Chemical water quality sampling of the unnamed tributary of the Mangaoraka Stream was undertaken in conjunction with discharge monitoring. These results are presented in Table 2, and the sampling sites are shown in Figure 1.

The results complied with the limits set by consent conditions for chloride and temperature increase.

Table 2 Results of receiving environment monitoring of an unnamed tributary of the Mangaoraka Stream in relation to the Kaimiro Production Station

Parameter	Units	Consent limits	12 May 2017		12 July 2017	
			Upstream MRK000200	Downstream MRK000202	Upstream MRK000200	Downstream MRK000202
Chloride	g/m³	50	9.8	9.6	6.0	6.0
Conductivity	mS/m	-	9.3	9.0	5.7	5.2
Hydrocarbons	g/m³	-	<0.5	<0.5	<0.5	<0.5
pH		-	6.3	6.4	6.3	6.4
Suspended solids	g/m³	-	3	5	10	11
Temperature	Deg. C	<2°C increase	13.7	13.5	8.0	7.6
Turbidity	NTU	-	3.3	5.6	6.3	9.6

2.3.3.2 Biomonitoring

The Council's 'kick-sampling' technique was used at three sites, on 28 February and 27 April 2017, to collect benthic macroinvertebrates from two unnamed tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station. This has provided data to assess any potential impacts the consented discharges have had on the macroinvertebrate communities of the stream. Samples were processed to provide number of taxa (taxa richness), MCI and $SQMCI_s$ scores for each site.

Taxa richness is the most robust index when determining whether a macroinvertebrate community has been exposed to toxic discharges. Macroinvertebrates when exposed to toxic discharges may die and be swept downstream or may deliberately drift downstream as an avoidance mechanism (catastrophic drift). The MCI is a measure of the overall sensitivity of the macroinvertebrate community to organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_s$ takes into account relative abundances of taxa as well as sensitivity to pollution. Significant differences in taxa richness, MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Most of the previous surveys undertaken in relation to the Kaimiro Production Station stormwater discharge have shown that the larger tributary of the Mangaoraka Stream (sites 1 and 3) supports higher taxonomic richnesses and healthier macroinvertebrate communities than the smaller tributary receiving the Production Station discharges. Iron oxide deposition is often noted at this site, and was present on both sampling occasions. The results of the summer survey were in partial agreement with these previous results, with site 2 having the lowest MCI and $SQMCI_s$ scores of the sites, but similar taxonomic richness to sites 1 and 3. The MCI score for site 2 was significantly lower than for site 1, but similar to that for site 3. MCI scores were significantly higher than historic medians at sites 1 and 2, but not site 3. Further, this survey found the

highest recorded MCI score to date at site 1. In contrast, the $SQMCI_s$ score for both sites 1 and 2 was significantly lower than that for site 3, while there was no significant difference between sites 1 and 2. $SQMCI_s$ scores were significantly higher than median for all three sites. Taxonomic richnesses of 16 taxa were recorded at sites 1 and 2, while 14 taxa were recorded at site 3. This is similar to median values for site 2, but substantially lower than median taxa richnesses for sites 1 and 3. These recorded taxa richness was the lowest value recorded to date at site 1, and equal to the lowest value recorded to date at site 3. These reduced taxonomic richnesses do not provide any indication of detrimental impacts caused by discharges from Kaimiro Production Station, as site 1, the 'control' site, which is upstream of all discharges, was affected while site 2, which is located in the tributary receiving the discharge, had a similar to median taxonomic richness.

In the Autumn survey site 2 had the lowest taxonomic richness, MCI and $SQMCI_s$ scores of the sites. All three of these metrics were significantly lower at site 2 compared to sites 1 and 3. MCI scores were an insignificant nine to ten units higher than historic medians at all three sites. In contrast, the $SQMCI_s$ showed significant differences between all sites, with site 3 recording a value significantly higher than site 2, and site significantly lower than site 1. Further, the $SQMCI_s$ score at site 1 was the highest score recorded to date at this site, reflecting the numerical dominance of the 'moderately sensitive' mayfly taxa in the community recorded at this site. Taxonomic richnesses of 16, 9 and 14 taxa were recorded at sites 1-3 respectively, and these values were lower than respective median scores for each site. The recorded taxa richness was equal to the lowest value recorded to date at site 3. However, when taken together with the higher than usual MCI scores and $SQMCI_s$ scores, this indicates that although fewer taxa have been recorded in the most recent survey, the taxa which are present include some which are more 'sensitive' to organic pollution. Overall, these results do not provide any evidence of detrimental impacts caused by discharges from Kaimiro Production Station, as site 2, which is located in the tributary receiving the discharge, had a similar to median taxonomic richness.

In general, both surveys found low taxonomic richness and higher than usual MCI and $SQMCI_s$ scores. These results provide no evidence that discharges from the Kaimiro Production Station have had any recent detrimental effects on the macroinvertebrate communities of these two unnamed tributaries of the Mangaoraka Stream.

The full Biomonitoring reports are attached in Appendix II.

2.4 Results: Air

2.4.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in section 2.3.1 above. On all occasions air discharges complied with consent conditions.

2.4.2 Results of discharge monitoring

2.4.2.1 Carbon monoxide and combustible gases

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately 65 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The monitoring sites used in the year under review are shown in Figure 2.

Figure 2 Air monitoring sites at Kaimiro Production Station for 2016-2017

Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.

The details of the sample run are summarised in Table 3 and the data from the sample run are presented graphically in Figure 3.

The consents covering air discharges from the Kaimiro Production Station have specific limits related to particular gases. Special condition 13 of consent 4048-3 sets a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m^3 for an eight hour average or 30 mg/m^3 for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 6.4 mg/m^3 while the average concentration for the entire dataset was 0.23 mg/m^3, which comply with consent conditions. This is in line with the pattern found in previous years.

Table 3 Results of carbon monoxide and LEL monitoring at Kaimiro Production Station

Component		30 August to 1 September 2017
Max	CO (ppm)	5.60
	LEL (%)	0.10
Mean	CO (ppm)	0.20
	LEL (%)	0.00
Min	CO (ppm)	0.00
	LEL (%)	0.00

Notes:

(1) the instrument records in units of ppm. At 25°C and 1 atm, 1ppm CO = 1.145 mg/m^3

(2) because the LEL of methane is equivalent to a mixture of approximately 5% methane in air, then the actual concentration of methane in air can be obtained by dividing the percentage LEL by 20.

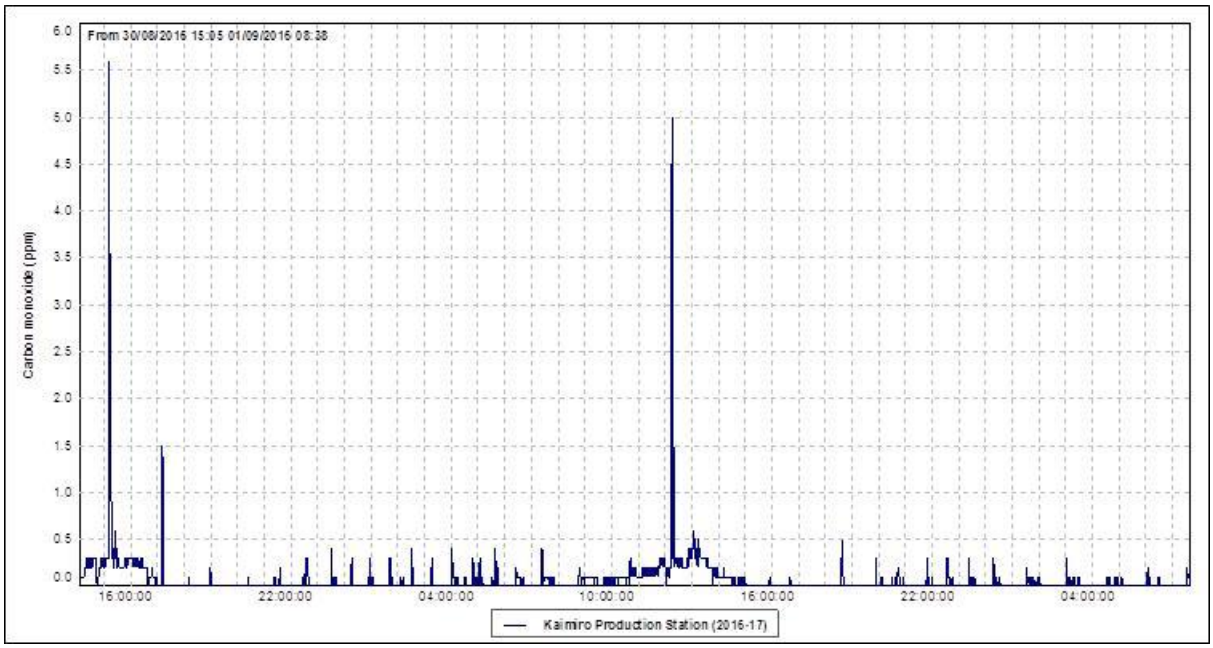

Figure 3 Ambient CO levels in the vicinity of Kaimiro Production Station

Lower Explosive Limit (LEL) gives the percentage of the lower explosive limit, expressed as methane that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Kaimiro Production Station reach any more than a trivial level.

2.4.2.2 PM10 particulates

In September 2004 the Ministry for the Environment enacted National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 particulates is 50 µg/m^3 (24-hour average).

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs, significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a DustTrak PM10 monitor was deployed on one occasion in the vicinity of Kaimiro Production Station. The deployment lasted approximately 65 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations. The location of the DustTrak monitor during the sampling run is shown in Figure 2. The results of the sample run are presented in Figure 4 and Table 4.

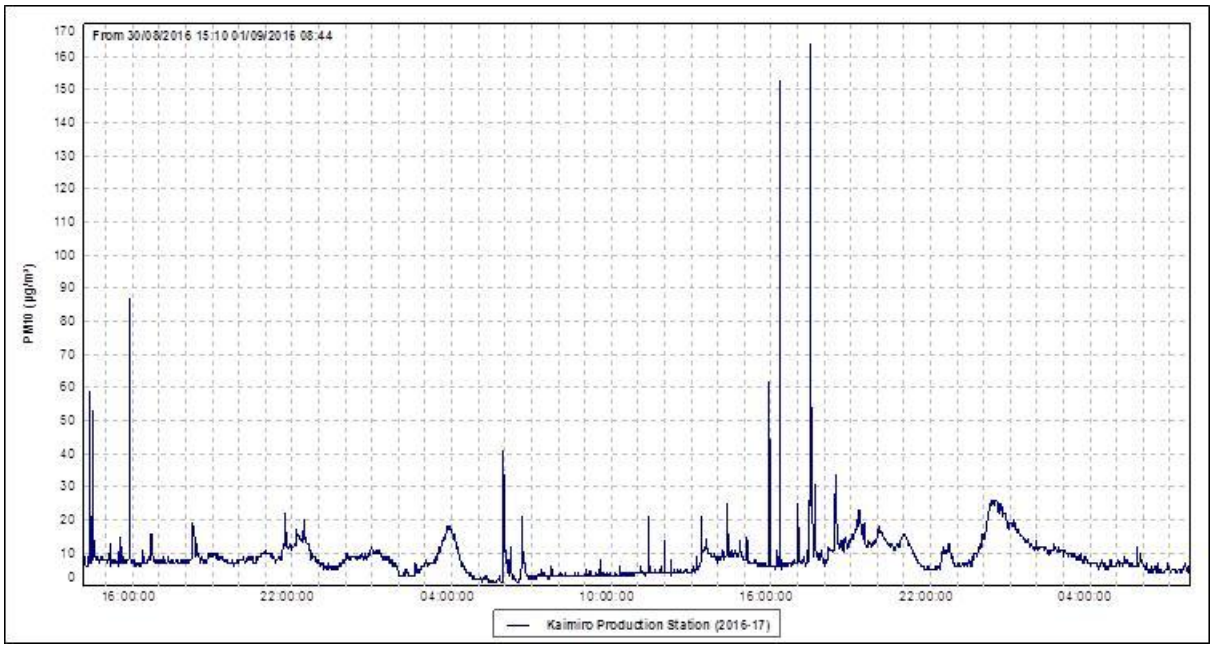

Figure 4 PM10 concentrations (µg/m³) at Kaimiro Production Station

Table 4 Daily averages of PM10 results from monitoring at Kaimiro Production Station

	30 August to 1 September 2017 (65 hours)	
24 hr. set	Day 1	Day 2
Daily average	7.06 µg/m³	9.06 µg/m³
NES	50µg/m³	

During the 65 hour run, from 30 August to 1 September 2017, the average recorded PM10 concentration was 7.06 µg/m³ for the first 24 hour period and 9.06 µg/m³ for the second 24 hour period. These daily averages equate to 14.1% and 18.1%, respectively, of the 50 µg/m³ value that is set by the NES. Background levels of PM10 in the region have been found to be typically around 11 µg/m³.

2.4.2.3 Nitrogen oxides

From 2014 onwards, the Council implemented a coordinated region-wide compliance monitoring programme to measure nitrogen oxides (NOx). The programme involves deploying measuring devices at 24 NOx monitoring sites (including two sites in the vicinity of Kaimiro Production Station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The consent covering air discharges from the Kaimiro Production Station has specific limits related to particular gases. Special condition 14 of consent 4048-3 sets a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 200 µg/m³ for a one hour average or 100 µg/m³ for a 24 hour average exposure.

NOx passive adsorption discs were placed at two locations in the vicinity of the Kaimiro Production Station on one occasion during the year under review (Figure 2). The discs were left in place for a period of 21 days. The calculated average one hour and 24 hour theoretical maximum NOx concentrations found at Kaimiro Production Station during the year under review equate to 5.21 µg/m³ and 2.71 µg/m³, respectively. The results show that the ambient ground level concentration of NOx is well below the limits set out by consent 4048-3.

The full air monitoring reports are attached in Appendix III.

2.4.3 Summary of flaring volumes reported by GPL

A summary of flaring volumes at Kaimiro Production Station is provided in Figure 5.

Flaring occurred in most months during the year with no smoke emissions or complaints recorded. The high amount of flaring in September 2016 was due to the plant being on recycle mode with shutdowns at Methanex. No flaring occurred at any of the wellsites associated with the Kaimiro Production Station.

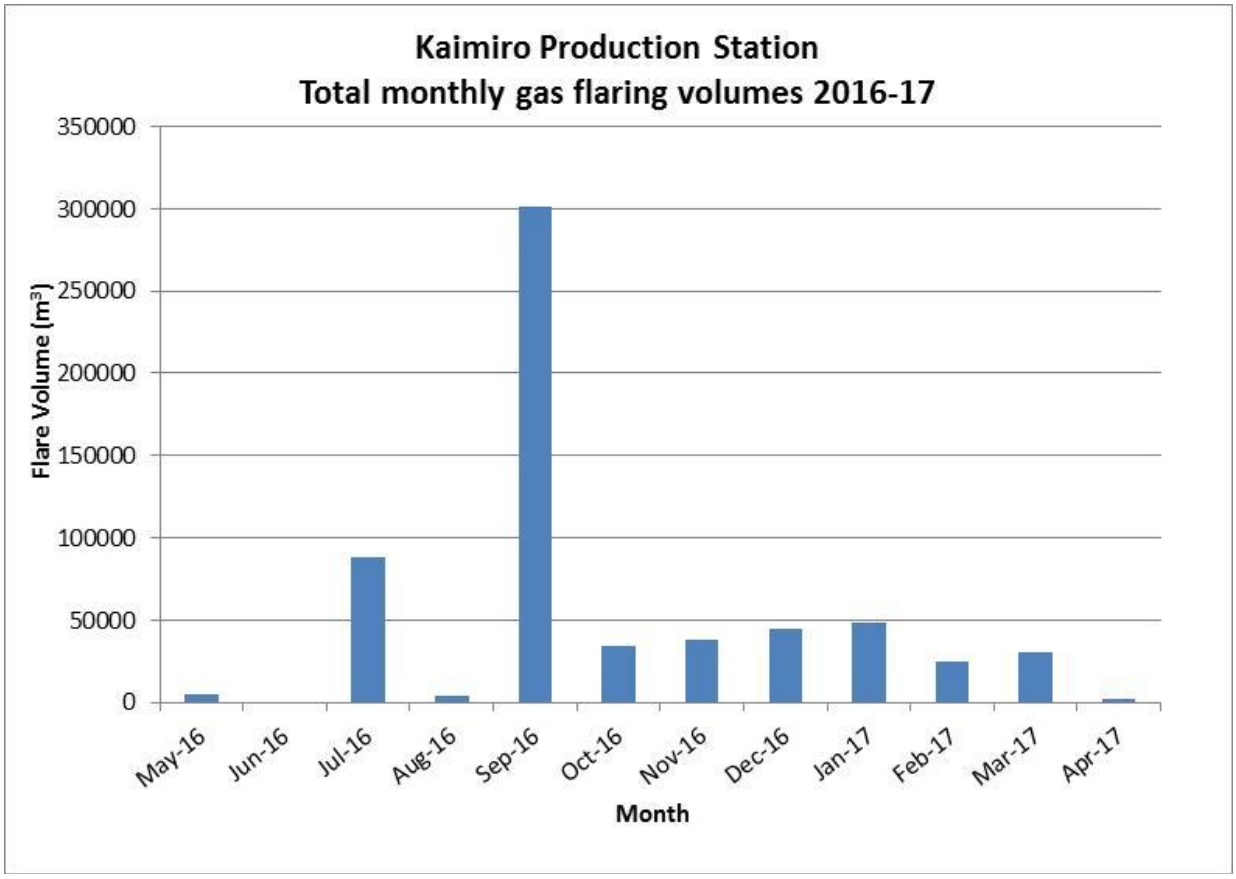

Figure 5 Summary of monthly gas flaring volumes at Kaimiro Production Station

2.5 Investigations, interventions, and incidents

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

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

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

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3 Ngatoro A and B wellsites

3.1 Resource consents

3.1.1 Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

GPL hold water discharge permit **4073-3** to discharge treated stormwater from hydrocarbon exploration and production operations at the Ngatoro-A wellsite, onto land and into an unnamed tributary of the Ngatoro Stream. This permit was issued by the Council on 30 June 2016 under Section 87(e) of the RMA. It is due to expire on 1 June 2021.

There are 15 special conditions attached to the consent.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise adverse environmental effects.

Condition 2 sets limits on the catchment area size.

Condition 3 requires the consent holder to notify Council of any significant site works.

Condition 4 requires the consent holder to maintain and regularly update a contingency plan in relation to spills at the site.

Conditions 5 and 6 relate to the design, management, and maintenance of the stormwater system.

Conditions 7 to 9 deal with skimmer pit capacity, lining and installation.

Conditions 10 to 13 set out water quality standards for the discharge and receiving waters.

Condition 14 requires reinstatement of the site when no longer in use.

Condition 15 provides for review of the consent.

GPL also holds water discharge permit **3951-3** to discharge treated wastewater and treated stormwater from hydrocarbon exploration and production operations at the Ngatoro-B wellsite into an unnamed tributary of the Ngatoro Stream in the Waitara catchment. This permit was issued by the Council on 23 April 2009 under Section 87(e) of the RMA and is due to expire on 1 June 2027.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise adverse effects of the discharge on the environment.

Condition 2 imposes a limit on the stormwater catchment size.

Condition 3 requires written notification to the Council prior to commencement of site works and drilling operations.

Condition 4 requires that the consent holder prepare and maintain a contingency plan in relation to spillages at the site.

Condition 5 requires that management and maintenance of the stormwater system be undertaken in accordance with information submitted in the application.

Condition 6 requires all stormwater be directed through the stormwater treatment system.

Condition 7 requires that hazardous substance storage areas be bunded with drainage to appropriate recovery systems, and not to the stormwater catchment.

Conditions 8, 9 and 10 impose limits on contaminants in the discharge, and stipulate effects the discharge shall not give rise to in the receiving water.

Condition 11 requires that the Council be advised of reinstatement of the site.

Conditions 12 and 13 are lapse and review provisions.

The permits are attached to this report in Appendix I.

3.1.2 Air discharge permit

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

GPL holds air discharge permit **7295-1** to cover discharge of emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Ngatoro-A site. This permit was issued by the Council on 12 May 2008 under Section 87(e) of the RMA and is due to expire on 1 June 2027.

Twenty two special conditions are attached to the consent regarding: information and notification (Council and neighbourhood notification, alteration to plant equipment or processes); emissions from the site (regard to wind speed, solid and liquid separation and recovery, best practicable option, offensive odour or smoke, vapour recovery systems, smoke opacity, noxious gases, other contaminants); recording and reporting information (gas stream analysis, visible smoke log, flaring log, annual air discharge report); and lapse of consent and review of conditions.

GPL also holds air discharge permit **7220-1** to cover discharge of emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Ngatoro-B site. This permit was issued by the Council on 9 May 2008 under Section 87(e) of the RMA and is due to expire on 1 June 2027.

The 22 special conditions attached to the consent are identical to those for consent 7295-1 above.

The permits are attached to this report in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consents which are appended to this report.

3.2 Monitoring programme

3.2.1 Introduction

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

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

The monitoring programme for the Ngatoro wellsites consisted of three primary components.

3.2.2 Programme liaison and management

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

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

3.2.3 Site inspections

The Ngatoro A and B sites were visited six times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

3.2.4 Chemical sampling

The Council undertook sampling of both the discharges from the Ngatoro-A wellsite and the water quality upstream and downstream of the discharge point and mixing zone.

The discharge from Ngatoro-A was sampled twice during the year. The sample was analysed for hydrocarbons, suspended solids, conductivity, pH, chloride, turbidity and temperature.

The Ngatoro Stream tributary which receives discharges from the Ngatoro-A site was sampled twice at two sites, and the samples were analysed for hydrocarbons, suspended solids, conductivity, pH, chloride, turbidity and temperature.

3.3 Results: Water

3.3.1 Inspections

Six inspections were carried out at the Ngatoro A and B sites in the 2016-2017 year. The following was found during the inspections:

31 August 2016

The Ngatoro-A and B sites were unmanned at the time of the inspection and were observed from outside the perimeter fences. No effects of any stormwater discharge from the sites were evident in the receiving waters. The skimmer pits were clear of any hydrocarbon traces.

No flaring, smoke or odours were noted.

8 September 2016

The site inspection was undertaken during adverse weather conditions, with extreme southerly winds and squally showers. All stormwater was being directed through skimmer pits for treatment and the ring drains were clear.

No flaring, smoke or odours were noted.

29 September 2016

The sites were inspected following reasonably heavy rainfall over the proceeding 12 to 18 hours. Both Ngatoro sites were secure. The skimmer pits were clear of all contamination and the nearby streams appeared to be unaffected by any discharge.

No flaring was observed.

16 January 2017

The stormwater systems at the two Ngatoro sites were checked and found to be working as per the design and specifications. The contents of the skimmer pits were clear. The sites were clear of contaminants about the well heads and within bunds and around the operational areas.

No flaring, smoke, or any other off site effects were noted.

21 February 2017

A site visit was undertaken during a period of fine weather. The stormwater systems were inspected, all ring drains and bunds were clear of obstructions and contaminants. The skimmer pits were clear, with aquatic species present in the ponds indicating good water quality.

No flaring was being undertaken either of the sites, and no odours or smoke were evident.

22 May 2017

The Ngatoro-A and B sites were unmanned at the time of the inspection. The skimmer pits were clear of contaminants and the stormwater discharges did not appear to be having any effect on the nearby receiving waters.

No flaring was occurring at either site.

3.3.2 Results of discharge monitoring

The location of water quality sampling sites in relation to both Ngatoro-A and Ngatoro-B sites are shown in Figure 6.

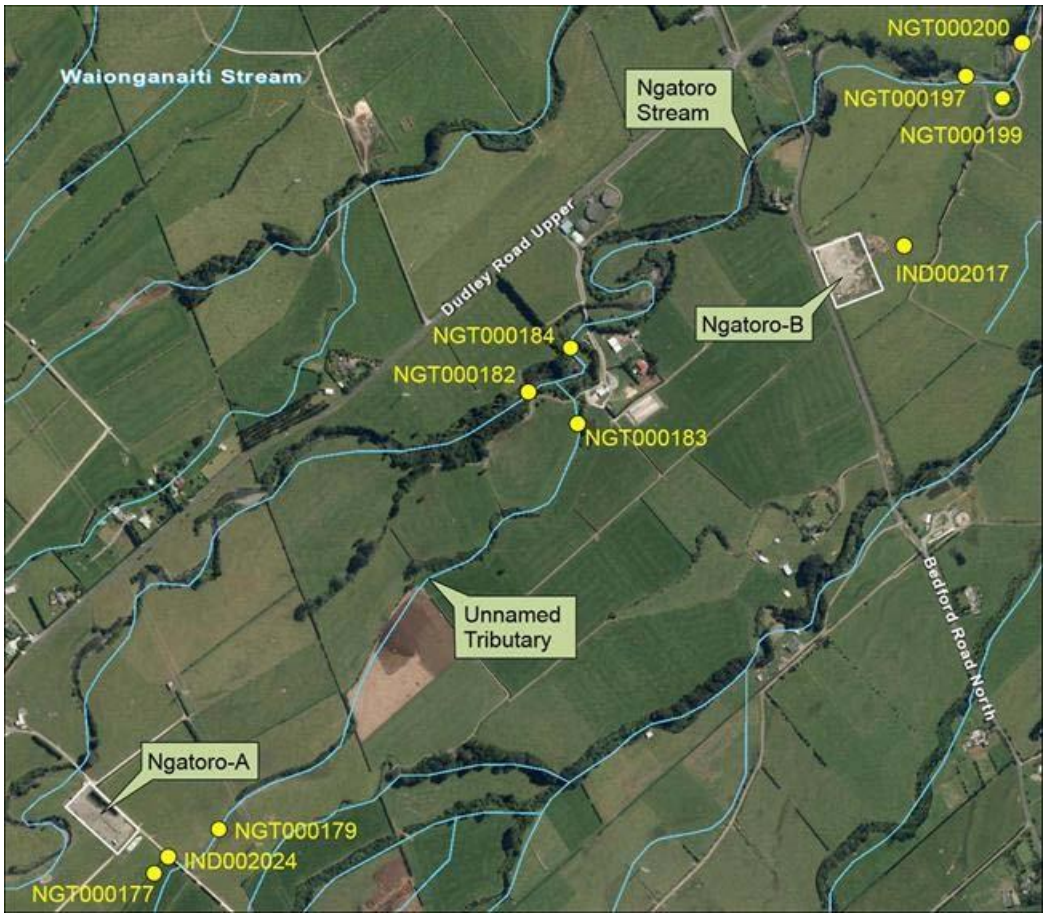

Figure 6 Water quality monitoring sites in relation to the Ngatoro wellsites

Chemical water sampling of the discharge from Ngatoro-A was undertaken twice during the 2016-2017 monitoring period (the sample collected on 12 July 2017 was a catch up sample, delayed due to unsuitable weather conditions and laboratory availability). Table 5 presents the results along with the consent limits.

Table 5 Results of discharge monitoring from Ngatoro-A (site IND002024) during the period under review

Parameter	Units	Date		Consent limits
		12 May 2017	12 July 2017	
Chloride	g/m³	10.0	6.0	
Conductivity	mS/m	8.0	4.1	
Hydrocarbons	g/m³	<0.5	<0.5	15
pH		7.0	6.9	6.0 - 9.0*
Suspended solids	g/m³	2	17	100
Temperature	Deg. C	12.1	6.1	
Turbidity	NTU	3.6	13	

*pH may exceed 9.0 if due to photosynthetic activity within the skimmer pits

Levels of hydrocarbons, pH and suspended solids in the discharge all complied with resource consent conditions. The chloride concentration in the discharges was significantly lower than previous years because GPL no longer discharges treated production water via the stormwater system.

3.3.3 Results of receiving environment monitoring

Chemical water quality sampling of the receiving environment was undertaken in conjunction with discharge monitoring. The results are presented in Table 7 below. Table 6 sets out the water quality standards relating to consent 4073-3.

Table 6 Water quality standards of the discharge and below the mixing zone at Ngatoro-A according to consent 4073-3

Parameter	Units	Must not exceed
BODCF	g/m³	2
Chloride	g/m³	50
Temperature	Deg. C	2°C increase

Table 7 Results of receiving environment monitoring in relation to Ngatoro-A

Parameter	Units	Consent limits	12 May 2017		12 July 2017	
			Upstream NGT000177	Downstream NGT000179	Upstream NGT000177	Downstream NGT000179
Chloride	g/m³	50	11.1	11.1	8.5	8.2
Conductivity	mS/m	-	8.2	9.0	5.6	5.3
Hydrocarbons	g/m³	-	<0.5	<0.5	<0.5	<0.5
pH		-	6.7	6.8	6.6	6.7
Suspended solids	g/m³	-	7	5	16	18
Temperature	Deg. C	<2°C increase	12.9	12.8	6.9	6.9
Turbidity	NTU	-	6.7	5.7	11	8.7

The results indicate that the discharge was having minimal effect on the water quality of the Ngatoro Stream at the times of sampling (refer to the difference between the upstream NGT000177 and downstream NGT000179 site results). Chloride levels and temperature below the mixing zone were within consent limits on both occasions.

3.4 Results: Air

3.4.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in section 3.3.1 above. On all occasions air discharges complied with consent conditions.

3.5 Investigations, interventions, and incidents

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

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

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

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

4 Discussion

4.1 Discussion of site performance

Inspections of the Kaimiro and Ngatoro sites during the 2016-2017 monitoring year found that they were well managed and the stormwater systems were maintained to a satisfactory standard. Emissions to air were well controlled.

4.2 Environmental effects of exercise of consents

4.2.1 Kaimiro Production Station

Results of samples collected of the discharge and receiving waters were within the limits prescribed by the consents and, along with the results of biomonitoring carried out in the Mangaoraka Stream, indicated that the discharges were not having a significant adverse effect on the downstream water quality.

There were no adverse environmental effects recorded as a result of the exercise of the air discharge permit at the Kaimiro Production Station. Measurements of ambient air quality at the site showed that the concentrations of carbon monoxide, nitrogen oxide, volatile organic compounds and combustible gases were below levels of concern.

4.2.2 Ngatoro producing wellsites

Results of samples collected of the discharge and receiving waters were within the limits prescribed by the consents and indicated that the discharges were not having a significant adverse effect on the downstream water quality.

Flaring was not undertaken at Ngatoro-A or Ngatoro-B during the monitoring period.

4.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 8-14.

4.3.1 Kaimiro Production Station

Table 8 Summary of performance for consent 1334-3

Purpose: ***To discharge treated stormwater from the Kaimiro Production Station site into an unnamed tributary***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option to prevent effects on environment	Site inspections	Yes
2. Maximum stormwater catchment	Site inspections	Yes
3. Contingency plan provided prior to commencement	Received	Yes

Purpose: *To discharge treated stormwater from the Kaimiro Production Station site into an unnamed tributary*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Site water directed for treatment through stormwater treatment system	Site inspections	Yes
5. Design, management and maintenance of stormwater system in accordance with application	Site inspections	Yes
6. Hazardous storage areas bunded with drainage to sumps	Site inspections	Yes
7. Limits on contaminants in the discharge	Sample collection	Yes
8. Limits on chloride, BODCF and temperature increase below mixing zone	Sample collection	Yes
9. Effects on receiving water below mixing zone	Inspection, sample collection and biomonitoring	Yes
10. Annual preparation and maintenance of contingency plan relating to spills at the site	Updated plan provided in May 2016	Yes
11. Council advised prior to reinstatement of the site	Site not reinstated during period under review	N/A
12. Provisions for review of consent conditions	No further provision for review prior to expiry	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 9 Summary of performance for consent 4048-3

Purpose: *To discharge emissions into the air from the flaring of hydrocarbons*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Limit on flaring duration	Site inspections and company logs	Yes
2. Neighbours notified prior to flaring	Information provided to neighbours	Yes
3. Council notified of continuous flaring	Notifications received	Yes

Purpose: *To discharge emissions into the air from the flaring of hydrocarbons*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. Consultation prior to alteration to plant equipment or processes	Site inspections and liaison with consent holder	Yes
5. Regard given to wind conditions during flaring	No complaints received from neighbours	Yes
6. Gas treated by liquid and solid separation and recovery	Site inspections	Yes
7. No liquid or solid hydrocarbons combusted through gas flare	Site inspections	Yes
8. Flare only used to dispose of substances from the well stream	Site inspections	Yes
9. Hydrocarbon storage vessels fitted with vapour recovery systems	Site inspections	Yes
10. Best practicable option to prevent effects on environment	Site inspections	Yes
11. No offensive odour or smoke at boundary of site	Site inspections	Yes
12. Limit on smoke opacity	Site inspections	Yes
13. Limit on carbon monoxide emissions	Ambient gas monitoring	Yes
14. Limit on nitrogen dioxide emissions	Ambient gas monitoring	Yes
15. No discharge of contaminant that is hazardous, toxic or noxious beyond boundary	Site inspections and ambient gas monitoring	Yes
16. No discharge of contaminant that exceeds specific WES limits	Ambient gas monitoring	Yes
17. Record of smoke emitting incidents	Annual air report received	Yes
18. Provision of flaring logs to Council	Flaring logs received	Yes
19. Maintenance of flaring logs	Flaring logs received	Yes
20. Provision of annual air emissions report	Report received	Yes

Purpose: *To discharge emissions into the air from the flaring of hydrocarbons*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
21. Analysis of gas and crude oil stream	Not requested during period under review	N/A
22. Provisions for review of consent conditions	Optional review scheduled in June 2020 if required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 10 Summary of performance for consent 5384-2

Purpose: *To take groundwater from the Matemateaonga Formation*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Total volume abstracted not to exceed 550 m^3/day or 6.4 L/s	Review of data provided by consent holder	Yes
2. Bore to be labelled	Site inspections	Yes
3. Installation and maintenance of water meter and datalogger	Site inspections	Yes
4. Provision of data annually by 31 July	Data provided	Yes
5. Documentation proving equipment has been installed and is accurate	Certification achieved	Yes
6. Water meter and datalogger to be accessible to Council staff	Site inspections	Yes
7. Council to be notified if equipment breaks down	No issues during the period	Yes
8. Best practicable option to prevent or minimise adverse environmental effects	Site inspections and liaison with consent holder	Yes
9. Lapse of consent		N/A
10. Provisions for review of consent conditions	Optional review scheduled in June 2020 if required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

4.3.2 Ngatoro-A wellsite

Table 11 Summary of performance for consent 4073-3

Purpose: *To discharge treated stormwater from hydrocarbon exploration and production operations at the Ngatoro-A wellsite, onto land and into an unnamed tributary of the Ngatoro Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option to prevent effects on environment	Site inspections	Yes
2. Maximum stormwater catchment	Site inspections	Yes
3. Consent holder to notify Council of site works or well drilling operations	No works during period under review	Yes
4. Consent holder to maintain and regularly update a contingency plan	Updated plan provided in May 2016	Yes
5. Design, management and maintenance of stormwater system in accordance with application	Site inspections	Yes
6. All discharge from the site to flow through a perimeter drain and skimmer pit	Site inspections	Yes
7. Skimmer pit capacity at least 102m^3	Site inspections	Yes
8. Skimmer pits to be lined with an impervious material and be fitted with a shut off valve	Site inspections	Yes
9. Perimeter drains and skimmer pits to be installed before any site works commence	Site inspections	Yes
10. Limits on contaminants in the discharge	Sample collection	Yes
11. pH may exceed 9.0 if due to photosynthetic activity in the skimmer pits	Sample collection	Yes
12. Limits on chloride, BOD and temperature increase below mixing zone	Sample collection	Yes
13. Effects on stream below mixing zone	Inspections and sample collection	Yes
14. Council advised prior to reinstatement of the site	Site not reinstated during period under review	N/A
15. Provisions for review of consent conditions	Optional review scheduled in June 2019 if required	N/A

Purpose: *To discharge treated stormwater from hydrocarbon exploration and production operations at the Ngatoro-A wellsite, onto land and into an unnamed tributary of the Ngatoro Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 12 Summary of performance for consent 7295-1

Purpose: *To discharge emissions into the air during flaring*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Council notified of continuous flaring	No flaring at site during monitoring period	N/A
2. Neighbours notified prior to flaring	No flaring at site during monitoring period	N/A
3. Consultation prior to alteration to plant equipment or processes	Site inspections	Yes
4. Regard given to wind conditions during flaring	No flaring at site during monitoring period	N/A
5. Gas treated by liquid and solid separation and recovery	Site inspections	Yes
6. Notify Council of any failure to maintain liquid and solid separation	No flaring at site during monitoring period	N/A
7. No liquid or solid hydrocarbons combusted through gas flare	No flaring at site during monitoring period	N/A
8. Best practicable option to prevent effects on environment	No flaring at site during monitoring period	N/A
9. Flare only used to dispose of substances from the well stream	No flaring at site during monitoring period	N/A
10. No offensive odour or smoke at boundary of site	No flaring at site during monitoring period	N/A
11. Hydrocarbon storage vessels fitted with vapour recovery systems	Site inspections	Yes
12. Limit on smoke opacity	No flaring at site during monitoring period	N/A
13. Limit on carbon monoxide emissions	No flaring at site during monitoring period	N/A

Purpose: *To discharge emissions into the air during flaring*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
14. Limit on nitrogen dioxide emissions	No flaring at site during monitoring period	N/A
15. No discharge of contaminant that is hazardous, toxic or noxious beyond boundary	No flaring at site during monitoring period	N/A
16. No discharge of contaminant that exceeds specific WES limits	No flaring at site during monitoring period	N/A
17. Analysis of gas and crude oil stream	No flaring at site during monitoring period	N/A
18. Record of smoke emitting incidents	No flaring at site during monitoring period	N/A
19. Maintenance of flaring logs	No flaring at site during monitoring period	N/A
20. Provision of annual air emissions report	Report received	Yes
21. Lapse of consent	Consent exercised within lapse period	N/A
22. Provisions for review of consent conditions	Optional review scheduled in June 2021 if required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

4.3.3 Ngatoro-B wellsite

Table 13 Summary of performance for consent 3951-3

Purpose: *To discharge treated stormwater and wastewater*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option to prevent effects on environment	Site inspections	Yes
2. Maximum stormwater catchment	Site inspections	Yes
3. Notification prior to site works or drilling activities	Notification received	Yes
4. Contingency plan provided to Council	Update of plan received May 2016	Yes
5. Activity undertaken in accordance with application	Site inspections	Yes

Purpose: *To discharge treated stormwater and wastewater*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
6. All stormwater and waste water to be directed through treatment system	Site inspections and sampling	Yes
7. Hazardous substance areas to be isolated from the stormwater system	Site inspections	Yes
8. Limits on contaminants in the discharge	Not assessed during period under review	N/A
9. Limit on temperature increase below the mixing zone	Not assessed during period under review	N/A
10. Effects on receiving water below mixing zone	Inspections	Yes
11. Reinstatement to the satisfaction of the Council	Site not reinstated during the period under review	N/A
12. Lapse of consent	Consent exercised within lapse period	N/A
13. Review provisions	Optional review scheduled in June 2021 if required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 14 Summary of performance for consent 7220-1

Purpose: *To discharge emissions to air*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Council notified of continuous flaring	No flaring at site during monitoring period	N/A
2. Neighbours notified prior to flaring	No flaring at site during monitoring period	N/A
3. Consultation prior to alteration to plant equipment or processes	Site inspections	Yes
4. Regard given to wind conditions during flaring	No flaring at site during monitoring period	N/A
5. Gas treated by liquid and solid separation and recovery	Site inspections	Yes
6. Notify Council of any failure to maintain liquid and solid separation	No flaring at site during monitoring period	N/A

Purpose: *To discharge emissions to air*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
7. No liquid or solid hydrocarbons combusted through gas flare	No flaring at site during monitoring period	N/A
8. Best practicable option to prevent effects on environment	No flaring at site during monitoring period	N/A
9. Flare only used to dispose of substances from the well stream	No flaring at site during monitoring period	N/A
10. No offensive odour or smoke at boundary of site	No flaring at site during monitoring period	N/A
11. Hydrocarbon storage vessels fitted with vapour recovery systems	Site inspections	Yes
12. Limit on smoke opacity	No flaring at site during monitoring period	N/A
13. Limit on carbon monoxide emissions	No flaring at site during monitoring period	N/A
14. Limit on nitrogen dioxide emissions	No flaring at site during monitoring period	N/A
15. No discharge of contaminant that is hazardous, toxic or noxious beyond boundary	No flaring at site during monitoring period	N/A
16. No discharge of contaminant that exceeds specific WES limits	No flaring at site during monitoring period	N/A
17. Analysis of gas and crude oil stream	No flaring at site during monitoring period	N/A
18. Record of smoke emitting incidents	No flaring at site during monitoring period	N/A
19. Maintenance of flaring logs	No flaring at site during monitoring period	N/A
20. Provision of annual air emissions report	Report received	Yes
21. Lapse of consent	Consent exercised within lapse period	N/A
22. Provisions for review of consent conditions	Optional review scheduled in June 2021 if required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 15 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2011-12	1334-3, 4048-3, 5384-1, 6218-1	4			
	4073-2, 7295-1	2			
	3951-2, 7220-1	2			
2012-13	1334-3		1		
	4048-3, 5384-1, 6218-1	3			
	4073-2, 7295-1	2			
	3951-37220-1	2			
2013-14	1334-3			1	
	4048-3, 5384-1, 6218-1	3			
	4073-2		1		
	7295-1	1			
	3951-3, 7220-1	2			
2014-15	1334-3, 4048-3, 5384-2	3			
	4073-2, 7295-1	2			
	3951-3, 7220-1	2			
2015-16	1334-3, 4048-3, 5384-2	3			
	4073-2, 7295-1	2			
	3951-3, 7220-1	2			
Totals		35	2	1	

During the year, the Company demonstrated a high level of both environmental performance and administrative compliance with the resource consents as defined in Section 1.1.4. There were no unauthorised incidents recorded by the Council in relation to GPL's activities. The Kaimiro Production Station and associated wellsites were well managed and maintained.

4.4 Recommendations from the 2015-2016 Annual Report

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

THAT monitoring of consented activities at the Kaimiro and Ngatoro sites in the 2016-2017 year continue at the same level as in 2015-2016.

This recommendation was implemented.

4.5 Alterations to monitoring programmes for 2017-2018

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

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

- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

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

It is proposed that for 2017-2018 that monitoring of consented activities at the Kaimiro and Ngatoro sites in the 2017-2018 year continue at the same level as in 2016-2017.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to adjust this baseline programme should the need arise if potential or actual non-compliance is determined at any time during 2017-2018.

5 Recommendations

1. THAT in the first instance, monitoring of consented activities at the Kaimiro and Ngatoro sites in the 2017-2018 year continue at the same level as in 2016-2017.

2. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODCF	Filtered carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
Bund	A wall around a tank to contain its contents in the case of a leak.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
LEL	Lower Explosive Limit. The percentage of the lower explosive limit, expressed as methane, that is detected in the air sampled.
m^2	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NES	National Environmental Standards
NO_x	Nitrogen oxides
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The

	scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM_{10}	Relatively fine airborne particles (less than 10 micrometre diameter, respectively).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

For further information on analytical methods, contact the Council's laboratory.

Bibliography and references

Taranaki Regional Council (2017): *Greymouth Petroleum Kaimiro Production Station Monitoring Programme Annual Report 2015-2016*. Technical Report 2016-18.

Taranaki Regional Council (2016): *Greymouth Petroleum Kaimiro Production Station Monitoring Programme Annual Report 2014-2015*. Technical Report 2015-108.

Taranaki Regional Council (2015): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2013-2014*. Technical Report 2014-69.

Taranaki Regional Council (2014): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2012-2013*. Technical Report 2013-89.

Taranaki Regional Council (2013): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2011-2012*. Technical Report 2012-64.

Taranaki Regional Council (2012): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2010-2011*. Technical Report 2011-62.

Taranaki Regional Council (2011): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2009-2010*. Technical Report 2010-108.

Taranaki Regional Council (2010): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2008-2009*. Technical Report 2009-57.

Taranaki Regional Council (2009): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2007-2008*. Technical Report 2008-104.

Taranaki Regional Council (2007): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2006-2007*. Technical Report 2007-26.

Taranaki Regional Council (2006): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2005-2006*. Technical Report 2006-15.

Taranaki Regional Council (2005): *Greymouth Petroleum Kaimiro and Ngatoro Production Stations Monitoring Programme Annual Report 2004-2005*. Technical Report 2005-11.

Taranaki Regional Council (2004): *NZOG & Greymouth Petroleum Ngatoro Production Stations Monitoring Programme Annual Report 2003-2004*. Technical Report 2004-20.

Taranaki Regional Council (2004): *Greymouth Kaimiro Production Station Monitoring Programme Annual Report 2003-2004*. Technical Report 2004-78.

Taranaki Regional Council (2003): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 2002-2003*. Technical Report 2003-77.

Taranaki Regional Council (2003): *Greymouth Petroleum Acquisitions Company Limited Monitoring Programme Annual Report 2002-2003*. Technical Report 2003-68.

Taranaki Regional Council (2002): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 2001-2002*. Technical Report 2002-37.

Taranaki Regional Council (2002): *Fletcher Challenge Energy Monitoring Programmes Annual Report 2001-2002*. Technical Report 2002-47.

Taranaki Regional Council (2001): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 2000-2001*. Technical Report 2001-24.

Taranaki Regional Council (2001): *Fletcher Challenge Energy Taranaki Ltd Monitoring Programme Annual Report 2000-2001*. Technical Report 01-83.

McWilliam H (2000): *Biomonitoring of the Ngatoro Stream sampled in relation to a wastewater discharge from the Ngatoro-A production site, October 1999*. TRC report HM199.

Taranaki Regional Council (2000): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 1999-2000*. Technical Report 2000-20.

Taranaki Regional Council (2000): *Fletcher Challenge Energy Taranaki Ltd Monitoring Programme Annual Report 1999-2000*. Technical Report 00-24.

Taranaki Regional Council (1999): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 1998-99*. Technical Report 99-23.

Taranaki Regional Council (1999): *Fletcher Challenge Energy Taranaki Ltd Monitoring Programme Annual Report 1998-1999*. Technical Report 99-16.

Taranaki Regional Council (1998): *New Zealand Oil and Gas Production Stations (Ngatoro A and B) Annual Report 1997-98*. Technical Report 98-86.

Taranaki Regional Council (1998): *Fletcher Challenge Energy Taranaki Ltd Air and Water Monitoring Report 1997/98*. Technical Report 98-61.

Taranaki Regional Council (1997): *New Zealand Oil and Gas Production Stations (Ngatoro 1 and 2) Annual Report 1996-97*. Technical Report 97-90.

Taranaki Regional Council (1997): *Fletcher Challenge Energy Taranaki Ltd Air and Water Monitoring Report 1996/97*. Technical Report 97-51.

Taranaki Regional Council (1996*): New Zealand Oil and Gas Production Stations (Ngatoro 1 and 2) Annual Report 1995-96*. Technical Report 96-42.

Taranaki Regional Council (1996): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1995/96*. Technical Report 96-60.

Taranaki Regional Council (1995): *New Zealand Oil and Gas Production Stations (Ngatoro 1 and 2) Annual Report 1994-95*. Technical Report 95-62.

Taranaki Regional Council (1995): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1994/95*. Technical Report 95-54.

Taranaki Regional Council (1994): *New Zealand Oil and Gas Production Stations (Ngatoro 1 and 2) Annual Report 1993-94*. Technical Report 94-75.

Taranaki Regional Council (1994): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1993/94*. Technical Report 94-73.

Taranaki Regional Council (1993): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1992/93*. Technical Report 93-35A.

Taranaki Regional Council (1992): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1991/92*. Technical Report 92-25.

Taranaki Regional Council (1991): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1990/91*. Technical Report 91-25.

Taranaki Regional Council (1990): *Petrocorp Exploration Ltd Air and Water Monitoring Report 1989/90*. Technical Report 90-14.

Appendix I

Resource consents held by Greymouth Petroleum Acquisition Company Ltd

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

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Acquisition Company Limited P O Box 3394 Fitzroy NEW PLYMOUTH 4341
Decision Date (Change):	8 April 2014
Commencement Date (Change):	8 April 2014 (Granted: 10 January 2002)

Conditions of Consent

Consent Granted:	To discharge treated stormwater from the Kaimiro Production Station site into an unnamed tributary of the Mangaoraka Stream in the Waiongana catchment
Expiry Date:	1 June 2020
Review Date(s):	June 2014
Site Location:	Kaimiro Production Station, Upland Road, Inglewood
Legal Description:	Lot 4 DP 436344 (Discharge source) Lot 2 DP 19651 (Discharge site)
Grid Reference (NZTM)	1699783E–5664369N
Catchment:	Waiongana
Tributary:	Mangaoraka

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on any water body.

2. The maximum stormwater catchment area shall be no more than 25,000 m^2.

3. Prior to the exercise of this consent, the consent holder shall provide for the written approval of the Chief Executive, Taranaki Regional Council, site specific details relating to contingency planning for the production site.

4. All site water to be discharged under this permit shall be directed for treatment through the stormwater treatment system for discharge in accordance with the specific conditions of this permit.

5. The design, management and maintenance of the stormwater system shall be generally undertaken:

   - in accordance with the stormwater management plan submitted to Taranaki Regional Council on 16 August 2012, in response to the request for further information for application 7156; and

   - as amended by the stormwater design report submitted with the application for consent 1334-3.2, prepared by BTW Company Limited and dated 28 February 2014.

   These plans shall be followed at all times. If changes are proposed, the consent holder shall advise the Taranaki Regional Council one month prior to the changes to the plan.

6. Any above ground hazardous substances storage areas shall be bunded with drainage to sumps, or other appropriates recovery systems, and not to the stormwater catchment.

7. Constituents of the discharge shall meet the standards shown in the following table.

Constituent	Concentration
pH (range)	6.5 – 8.5
suspended solids	100 gm^{-3}
total recoverable hydrocarbons (infrared spectroscopic technique)	15 gm^{-3}
chloride	230 gm^{-3}

   This condition shall apply before entry of the treated stormwater, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

8. After allowing for reasonable mixing, within a mixing zone extending 15 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary of the Mangaoraka Stream:

   a. an increase in temperature of more than 2 degrees Celsius; and
   b. filtered carbonaceous biochemical oxygen demand shall not exceed 2.00 gm^{-3}; or
   c. shall not cause the chloride concentration to exceed 50 gm^{-3}

9. After allowing for reasonable mixing, within a mixing zone extending 15 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary of the Mangaoraka Stream:

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

10. The consent holder shall prepare annually and maintain a contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants, and procedures to be carried out should such a spillage or discharge occur.

11. The Chief Executive, Taranaki regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality.

12. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2008 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 8 April 2014

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Consent Granted Date:	23 April 2009

Conditions of Consent

Consent Granted:	To discharge treated wastewater and treated stormwater from hydrocarbon exploration and production operations into an unnamed tributary of the Ngatoro Stream a tributary of the Manganui River in the Waitara catchment at or about (NZTM) 1702355E-5660948N
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2021
Site Location:	Ngatoro-B wellsite, Bedford Road, Inglewood [Property owner: GD & CJ Alexander]
Legal Description:	Pt Sec 127 Moa Dist Blk VIII Egmont SD
Catchment:	Waitara
Tributary:	Manganui Ngatoro

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

General conditions

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

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

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

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

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.

2. Stormwater discharged shall be collected from a catchment area of no more than 12,000 m^2.

3. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 7 days prior to any site works commencing, and again in writing at least 7 days prior to any well drilling operation commencing. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

4. The consent holder shall maintain a contingency plan that, to the satisfaction of the Chief Executive, Taranaki Regional Council, details measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

5. The management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the consent application [application 5221].

6. All stormwater and wastewater shall be directed for treatment through the stormwater treatment system before being discharged.

7. Any above ground hazardous substances storage areas shall be bunded with drainage to sumps, or other appropriate recovery systems, and not to the stormwater catchment.

8. Constituents in the discharge shall meet the standards shown in the following table.

Constituent	**Standard**
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm^{-3}
total recoverable hydrocarbons	Concentration not greater than 15 gm^{-3} [as determined by infrared spectroscopic technique]
chloride	Concentration not greater than 50 gm^{-3}

This condition shall apply prior to the entry of the treated stormwater into the receiving waters at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

9. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to an increase in temperature of more than 2 degrees Celsius.

10. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to any of the following effects in the receiving water:

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

11. The consent holder shall advise the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

12. This consent shall lapse on 30 June 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2021, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 23 April 2009

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Acquisition Company Limited P O Box 3394 NEW PLYMOUTH 4341
Consent Granted Date:	10 January 2008

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the flaring of hydrocarbons arising from hydrocarbon production and processing operations, together with miscellaneous emissions, at the Kaimiro Production Station at or about 2609726E-6225978N
Expiry Date:	1 June 2026
Review Date(s):	June 2014, June 2020
Site Location:	Upland Road, Inglewood
Legal Description:	Pt Sec 115 Tarurutangi Dist Blk III Egmont SD

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

General conditions

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

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

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

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

Special conditions

Duration

1. Flaring of gas from each well during well testing shall not occur on more than 30 days.

Information and notification

2. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to all residents within 1000 metres of the site of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and complaints received.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, whenever the continuous flaring of hydrocarbons [other than purge gas] is expected to occur for more than five minutes in duration. Notification shall be no less than 24 hours before the flaring commences. Notification shall include the consent number and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable if the consent holder does not have access to email.

4. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other site emissions, including but not limited to the recovery of produced gas, other than as authorised by this consent , without prior consultation with the Chief Executive, Taranaki Regional Council.

Emissions from the site

5. Other than for the maintenance of a pilot flare flame, the consent holder shall have regard to the prevailing and predicted wind speed and direction at the time of initiation of, and throughout, any episode of flaring so as to minimise offsite effects.

6. All gas that is flared must first be treated by effective liquid and solid separation and recovery to ensure that smoke emission during flaring is minimised.

7. No liquid or solid hydrocarbons shall be combusted through the gas flare system.

8. Only substances originating from the well stream and treated as outlined by conditions 6 and 7 shall be combusted within the flare pit.

9. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.

10. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare or any other emissions to air from the Kaimiro Production Station.

11. There shall not be any offensive odour or smoke at or beyond the boundary of the property where the production station is located.

12. The opacity of any smoke emissions shall not exceed a level of 1 as measured on the Ringelmann Scale.

13. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare so that, whether alone or in conjunction with any other emissions from the production station, the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 milligrams per cubic metre [mg/m^3] [eight-hour average exposure], or 30 mg/m^3 one-hour average exposure] at or beyond the boundary of the property.

14. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare so that, whether alone or in conjunction with any other emissions from the production station, the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 micrograms per cubic metre [$\mu g/m^3$][24-hour average exposure], or 200 $\mu g/m^3$ [1-hour average exposure] at or beyond the boundary of the of the property.

15. The consent holder shall control emissions to the atmosphere, from the production station and flare, of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides so that, whether alone or in conjunction with any other emissions from the production station, is not hazardous or toxic or noxious at or beyond the boundary of the property.

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

a) by more than 1/30th of the relevant Occupational Threshold Value-Time Weighted Average, or by more than the Short Term Exposure Limit at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or
b) if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

Recording and reporting information

17. Each time there is visible smoke as a result of the exercise of this consent, the consent holder shall record the time, duration and cause. The consent holder shall make the record available to the Chief Executive, Taranaki Regional Council, upon request.

18. Each month, the consent holder shall supply to the Chief Executive, Taranaki Regional Council a record of flaring information in relation to the production station, and each wellsite. The flaring information supplied shall comprise: the type and amount of material flared [including any gas used to maintain a pilot flame], the date this was flared, the reason why flaring was undertaken, and an indication of whether smoke was produced from the flaring events.

19. The consent holder shall record and maintain a log of all continuous flaring events longer than five minutes duration, and any intermittent flaring lasting for an aggregate of ten minutes or longer in any 120-minute period. The log shall contain the date, the start and finish times of the flaring event, the quantity and type of material flared, and the reason for flaring. The log shall be made available to the Chief Executive, Taranaki Regional Council, upon request, and summarised annually in the report required under condition 20.

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

i) detailing any energy efficiency measures implemented on the site;
ii) detailing smoke emissions as required under condition 17;
iii) detailing any measures undertaken or proposed to reduce smoke emissions;
iv) detailing any measures undertaken or proposed to reduce flaring;
v) addressing any other issue relevant to the minimisation or mitigation of emissions from the flare;
vi) detailing any complaints received and any measures undertaken to address complaints; and
vii) reviewing all options and technological advances relevant to the reduction or mitigation of any discharge to air from the site, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances.

21. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and condensate stream from the field, covering sulphur compound content and the content of carbon compounds of structure C_6 or higher number of compounds.

Review

22. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent within six months of receiving a report prepared by the consent holder pursuant to condition 20 of this consent, and/or by giving notice of review during the month of June 2014 and/or June 2020, for any of the following purposes:

    a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time;
    b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge;
    c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant;
    d) taking into account any Act of Parliament, regulation, national policy statement or national environmental standard which relates to limiting, recording, or mitigating emissions of gases which are products of combustion, and which is relevant to the air discharge from the Kaimiro Production Station.

Signed at Stratford on 10 January 2008

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Acquisition Company Limited PO Box 3394 New Plymouth 4341
Decision Date:	30 June 2016
Commencement Date:	30 June 2016

Conditions of Consent

Consent Granted:	To discharge treated stormwater from hydrocarbon exploration and production operations at the Ngatoro-A wellsite, onto land and into an unnamed tributary of the Ngatoro Stream
Expiry Date:	1 June 2021
Review Date(s):	June 2019
Site Location:	Ngatoro-A wellsite, 561 Dudley Road, Inglewood
Grid Reference (NZTM)	1701212E-5659859N
Catchment:	Waitara
Tributary:	Manganui Ngatoro

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.

2. Stormwater discharged shall be collected from a catchment area of no more than 7000 m^2.

3. At least 5 working days prior, the consent holder shall advise the Chief Executive, Taranaki Regional Council of the date of each of the following events:

   a) commencement of any site works (site works includes the introduction of a drilling rig, drilling equipment or any other associated equipment for the purpose of drilling, testing, well stimulation or well workover that may introduce contaminants to the site);
   b) commencement of any well drilling operation; and
   c) recommencement of any site works or drilling operations following a period of inactivity exceeding 30 days.

   If any of these events is rescheduled or delayed, the consent holder shall immediately provide further notice advising of the new date.

   Any advice given in accordance with this condition shall include the consent number and the wellsite name and be emailed to worknotification@trc.govt.nz.

4. The consent holder shall maintain and regularly update a contingency plan that details measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. The plan shall be approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity prior to any discharge from the site.

5. Subject to the other conditions of this consent the design, management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the application for this consent.

6. All discharges from the site, including from any containment pit or hydrocarbon combustion facility (e.g. flare pit, thermal oxidiser), shall flow to a perimeter drain and skimmer pit. Perimeter drains shall be designed, including by having a positive grade and low permeability, to ensure that runoff flows directly to a skimmer pit without ponding.

7. The skimmer pit system shall have a combined capacity of no less than 102 m^3 including a 'freeboard' of no less than 59 m^3, and be designed to retain any hydrocarbons that enter them.

8. All skimmer pits and any other stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls, and all skimmer pits shall have a valve that can be shut off to prevent any discharge from the site.

9. Perimeter drains and skimmer pits necessary to comply with the conditions of this consent shall be installed before any site works commences. Site works includes the introduction of a drilling rig, drilling equipment or any other associated equipment or facilities to the site for any purpose other than for the construction of the site.

10. Subject to condition 11 the constituents in the discharge shall meet the standards shown in the following table.

Constituent	Standard
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm^{-3}
total recoverable hydrocarbons	Concentration not greater than 15 gm^{-3} [as determined by infrared spectroscopic technique]

This condition shall apply before the entry of the treated stormwater into the receiving environment at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

11. The pH may exceed 9.0 if the exceedance is a result photosynthetic activity within the skimmer pits, but in any case the discharge shall not result in the pH of the receiving water increasing by more than 0.5 pH units after allowing for a mixing zone of 25 metres.

12. After allowing for a mixing zone of 25 metres from the point of discharge into the unnamed tributary of the Ngatoro Stream, the discharge shall not cause any of the following effects in the receiving water:

    a) an increase in the temperature of more than 2 degrees Celsius;

    b) the filtered carbonaceous biochemical oxygen demand to exceed 2 gm^{-3}; or

    c) the chloride concentration to exceed 50 gm^{-3}.

13. After allowing for a mixing zone of 25 metres from the point of discharge into the unnamed tributary of the Ngatoro Stream, the discharge shall not give rise to any of the following effects in the receiving water:

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

14. The consent holder shall advise the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise adverse effects on stormwater quality. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

15. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2019 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 30 June 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix II

Biomonitoring reports

To	Job Manager, Callum MacKenzie
From	Technical Officer, Katie Blakemore
Document	1850273
Report No	KB015
Date	13 Apr 2017

Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station, February 2017

Introduction

This was the first of two biomonitoring surveys scheduled to be undertaken in the 2016-2017 monitoring year for the Kaimiro Production Station of Greymouth Petroleum (previously owned by Fletcher Challenge Energy Taranaki Limited). This first survey is usually completed in spring period, however due to exceptionally wet weather conditions during the spring this was not possible. A second survey is scheduled for autumn 2017.

The Taranaki Regional Council has undertaken surveys since January 1985 in the tributaries of the Mangaoraka Stream that receive stormwater and wastewater from the production station area. During 1987 and 1988 oil seepage to these streams disrupted the aquatic communities. Biomonitoring was not undertaken for nearly four years following the oil seepage period, until 1992. The results of surveys performed since the 1998-99 monitoring year are discussed in the references at the end of this report.

Methods

This survey was undertaken on 28 February 2017 at three sites in two unnamed tributaries of the Mangaoraka Stream. Figure 1 shows the location of these sampling sites. Site 1 is the 'control' site which is located in a major tributary of the Mangaoraka Stream, upstream of the confluence with a more minor tributary. Site 2 is situated in the minor tributary which receives the stormwater discharge from the production station and site 3 is approximately 50 metres downstream of the confluence of this tributary (Table 1).

Table 1 Biomonitoring sites in two tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station

Site number	Site code	Grid reference (NZTM)	Location	Altitude (masl)
1	MRK000198	E1700117 N5664652	Major tributary approx. 50m u/s of confluence with minor tributary	240
2	MRK000204	E1700054 N5664636	Minor tributary (receives discharge) 150m d/s of Upland Road	240
3	MRK000207	E1700171 N5665679	Major tributary approx. 50m d/s of confluence with minor tributary	240

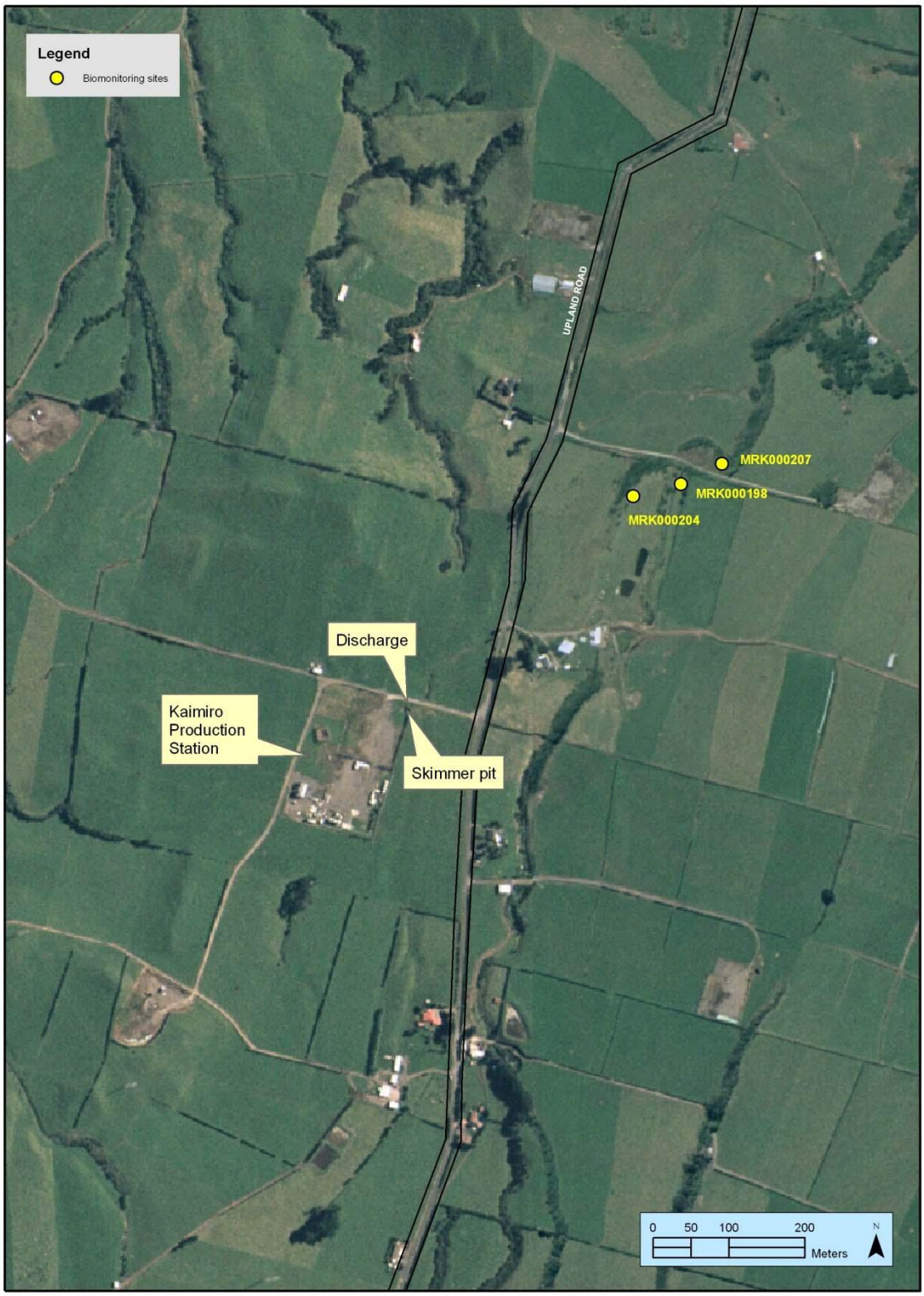

Figure 1 Biomonitoring sites in two unnamed tributaries of the Mangaoraka Stream related to the Kaimiro Production Station

The Council's standard '400ml kick-sampling' technique was used at sites 1, 2 and 3 (Table 1). The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded based on the abundance categories in Table 2.

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	>499

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. However, other physical variables such as sedimentation, temperatures, water velocity, and dissolved oxygen levels may also affect the MCI values because the taxa that are able to tolerate extremes in these variables generally have lower sensitivity scores. More 'sensitive' communities inhabit less polluted waterways. A gradation of biological water quality conditions based upon MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985; Boothroyd and Stark, 2000) (Table 3).

Table 3 Macroinvertebrate community health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985 and Boothroyd and Stark, 2000)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

A semi-quantitative MCI value (SQMCIs) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

Unlike the MCI, the SQMCIs is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

Results

Site habitat characteristics and hydrology

This February 2017 survey followed a period of ten days since a fresh of 3x median flow and 25 days since a fresh of 7x median flow. The survey followed an exceptionally wet spring and summer, with sixteen freshes in excess of 7x median flow and 24 freshes in excess of 3x median flow since 1 October 2016. There was a steady low flow at sites 1 and 2, and a swift low flow at site 3 at the time of the survey. Water temperatures ranged from 16.0 -16.3°C at the time of the survey.

Substrate at sites 1 and 2 was predominantly cobble, boulder and coarse gravel, with some fine gravel, silt and sand also present. Site 3 had predominantly bedrock substrate, with some coarse gravel, woody debris and root mat also present. There was a silt coating on the streambed at sites 1 and 2 but not at site 3. Site 2 had some embedding of cobbles and gravels.

Site 1 had widespread long filamentous periphyton which was not present at any other site, while periphyton mats were absent at all sites. Moss was absent from the streambed at site 1, widespread at site 2 and patchy at site 3, while leaves were absent from the streambed at sites 1 and 2 and patchy at site 3. Woody debris was present at sites 2 and 3 but absent at site 1. Macrophytes were present on the stream edges only at site 1 but absent at sites 2 and 3. Overhanging vegetation and undercut banks were present at all three sites. Sites 1 and 2 had partial shading of the streambed, while site 3 had complete shading.

Macroinvertebrate communities

Most past surveys have shown that the larger tributary supports richer macroinvertebrate communities, including abundances of 'sensitive' mayflies. These results reflect the good habitat conditions normally provided by faster-flowing, stony-bedded streams on the upper to mid reaches of the ring plain. The smaller tributary has tended to support communities with lower numbers of taxa and smaller proportions of 'sensitive' taxa. This in part has been due to the slower flow and/or iron oxide deposition on the more sedimented streambed of this tributary.

Table 4 provides a summary of the results from previous surveys sampled in relation to the Kaimiro Production Station discharges along with current survey results.

Table 4 Number of taxa, MCI and SQMCIs values for two unnamed tributaries of the Mangaoraka Stream, sampled in relation to the Kaimiro Production Station on 28 February 2017 and a summary of historical data for these sites.

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Feb 2017	Median	Range	Feb 2017	Median	Range	Feb 2017
1	59	27	18-37	16	97	83-110	115	3.5	1.9-5.7	4.6
2	55	15	3-26	16	81	55-103	98	2.3	1.2-4.1	4.4
3	59	24	14-33	14	99	71-111	106	4.2	1.7-6.3	5.8

The full results of the current survey are presented in Table 5.

Table 5 Macroinvertebrate communities in two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station on 28 February 2017

Taxa List	Site Number	MCI score	1	2	3
	Site Code		MRK000198	MRK000204	MRK000207
	Sample Number		FWB17137	FWB17138	FWB17139
NEMERTEA	Nemertea	3	-	R	-
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	A	C	-
	Lumbricidae	5	R	-	C
MOLLUSCA	*Potamopyrgus*	4	A	-	R
CRUSTACEA	Isopoda	5	-	-	R
	Paranephrops	5	-	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	A	A
	Zephlebia group	7	A	R	A
PLECOPTERA (STONEFLIES)	*Acroperla*	5	-	-	R
COLEOPTERA (BEETLES)	Elmidae	6	C	-	C
	Hydraenidae	8	R	-	-
	Ptilodactylidae	8	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	R	-	-
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	-	-	A
	Hydrobiosis	5	C	R	R
	Hydropsyche (Orthopsyche)	9	R	R	R
	Psilochorema	6	R	R	-
	Oeconesidae	5	R	-	-
	Pycnocentria	7	C	R	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	C	R
	Eriopterini	5	-	R	-
	Limonia	6	-	R	-
	Orthocladiinae	2	C	A	-
	Polypedilum	3	-	-	R
	Paradixa	4	-	R	R
	Austrosimulium	3	-	R	-
ACARINA (MITES)	Acarina	5	-	-	R
No of taxa			16	16	14
MCI			115	98	106
SQMCIs			4.6	4.4	5.8
EPT (taxa)			7	6	6
%EPT (taxa)			44	38	43
'Tolerant' taxa	'Moderately sensitive' taxa		'Highly sensitive' taxa		
R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant					

Site 1

A relatively low taxa richness of 16 taxa was recorded at this 'control' site at the time of the survey. This is the lowest taxa richness recorded at this site to date (Table 4) and is nine taxa less than was recorded in the previous survey (Figure 2). The macroinvertebrate community at the time of sampling was characterised by three taxa, two 'tolerant taxa [oligochaete worms and snail (*Potamopyrgus*)] and the 'moderately sensitive mayfly (*Zephlebia*) (Table 5).

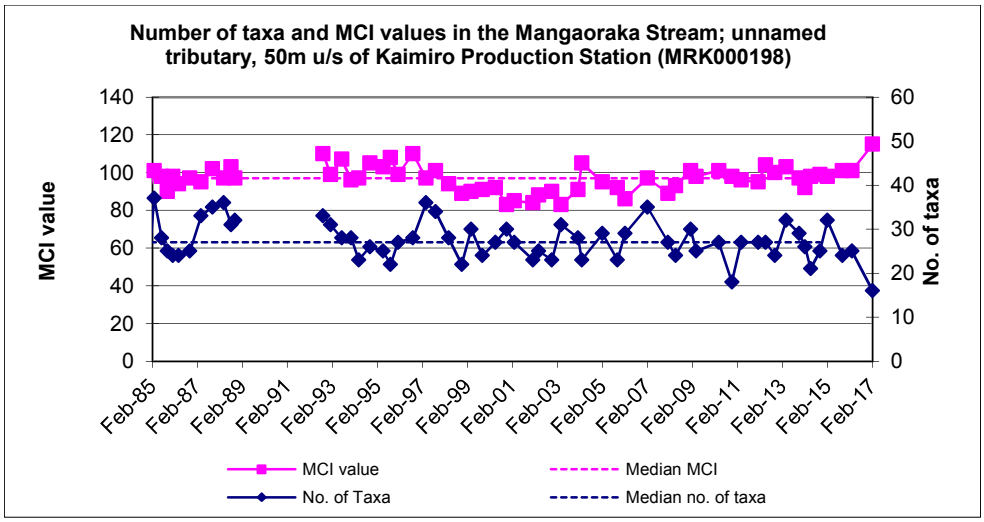

Figure 2 MCI scores and taxa richness at site 1, 50m upstream of Kaimiro Production Station tributary confluence (MRK000198)

The MCI score of 115 units indicated 'good' macroinvertebrate community health and was significantly (Stark 1998) higher than both the median MCI score for this site of 98 units and the previously recorded score of 101 units (Table 4, Figure 2). This score is the highest score recorded to date at this site (Table 4, Figure 2). The $SQMCI_s$ score of 4.6 units was significantly higher than both the median score of 3.5 units and the previously recorded score of 3.2 units.

Site 2

A low taxa richness of 16 taxa was recorded at the time of this survey. This is one taxon higher than the median score of 15 for this site (Table 4, Figure 3), but is substantially lower than the previous result of 26 taxa (which is the highest score recorded to date for this site) (Figure 3). The macroinvertebrate community at the time of sampling was characterised by one 'moderately sensitive' taxon [mayfly (*Austroclima*)] and one 'tolerant' taxon (oligochaete worms) (Table 5).

The recorded MCI score of 98 units indicated 'fair' macroinvertebrate community health. This score is a significant (Stark 1998) 17 units higher than the median score of 81 units for this site and 15 units higher than the previous score of 83 units (Table 4, Figure 3). The $SQMCI_s$ score of 4.4 units is significantly higher than the median $SQMCI_s$ score of 2.3 units for this site and the previous score of 1.9 units. Furthermore, the current score is the highest score recorded at this site to date (Table 4).

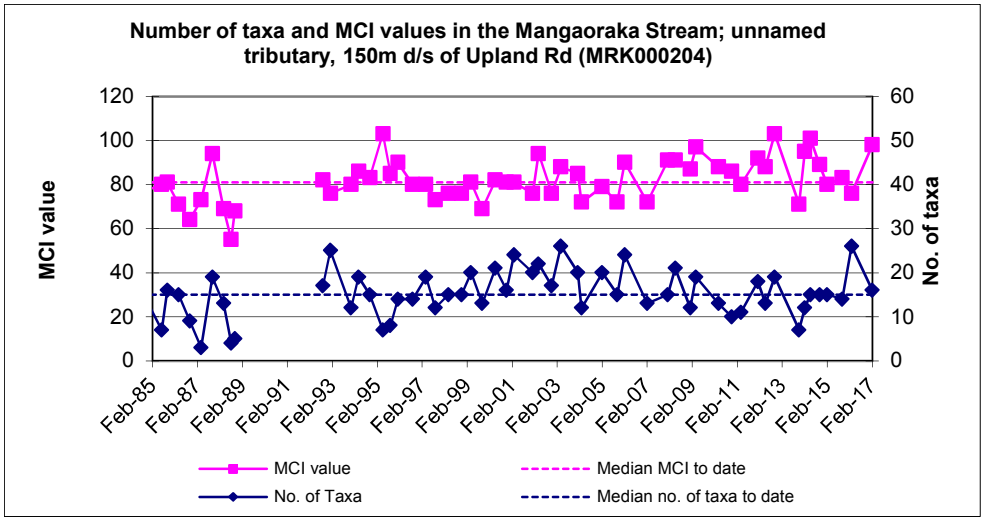

Figure 3 MCI scores and taxa richness at site 2, Kaimiro Production Station tributary 150m downstream of Upland Rd (MRK000204)

Site 3

A low taxa richness of 14 taxa was recorded in this survey. This is nine taxa less than the previously recorded score and ten taxa less than the median taxa richness for this site (Table 4, Figure 4). The macroinvertebrate community at the time of sampling was characterised by three taxa, two 'moderately sensitive' mayflies (*Austroclima* and *Zephlebia*) and one tolerant caddisfly (*Hydropsyche* - formerly *Aoteapsyche*).

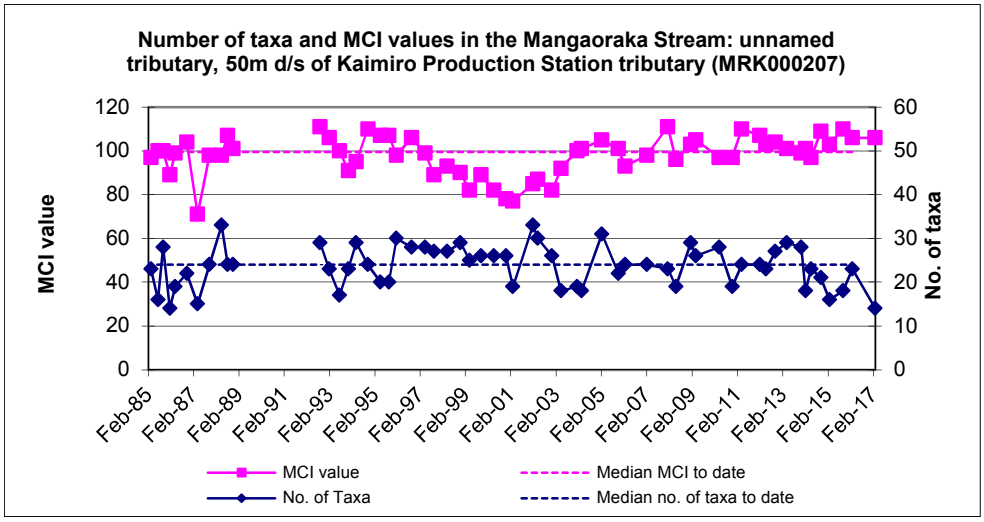

Figure 4 MCI scores and taxa richness at site 3, 50m downstream of Kaimiro Production Station tributary confluence (MRK000207)

The recorded MCI score of 106 units categorises the site as having 'good' macroinvertebrate community health. This is not significantly different from the median MCI score of 99 units for this site and is equal to the previously recorded score at this site (Table 4, Figure 4). The $SQMCI_s$ score of 5.8 units was significantly higher (Stark 1998) than both the median score for this site of 4.2 units and the previously recorded score of 4.8 units (Table 4).

Discussion and conclusions

The Council's 'kick-sampling' technique was used at three sites to collect benthic macroinvertebrates from two unnamed tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station. This has provided data to assess any potential impacts the consented discharges have had on the macroinvertebrate communities of the stream. Samples were processed to provide number of taxa (taxa richness), MCI and $SQMCI_s$ scores for each site.

Taxa richness is the most robust index when determining whether a macroinvertebrate community has been exposed to toxic discharges. Macroinvertebrates when exposed to toxic discharges may die and be swept downstream or may deliberately drift downstream as an avoidance mechanism (catastrophic drift). The MCI is a measure of the overall sensitivity of the macroinvertebrate community to organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_s$ takes into account relative abundances of taxa as well as sensitivity to pollution. Significant differences in taxa richness, MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Most of the previous surveys undertaken in relation to the Kaimiro Production Station stormwater discharge have shown that the larger tributary of the Mangaoraka Stream (sites 1 and 3) supports higher taxonomic richnesses and healthier macroinvertebrate communities than the smaller tributary receiving the Production Station discharges. Iron oxide deposition is often noted at this site, and was present on this sampling occasion. The results of this summer survey are in partial agreement with these previous results, with site 2 having the lowest MCI and $SQMCI_s$ scores of the sites, but similar taxonomic richness to sites 1 and 3. The MCI score for site 2 was significantly lower (Stark 1998) than for site 1, but similar to that for site 3. MCI scores were significantly higher than historic medians at sites 1 and 2, but not site 3. Further, this survey found the highest recorded MCI score to date at site 1. In contrast, the $SQMCI_s$ score for both sites 1 and 2 was significantly lower than that for site 3, while there was no significant difference between sites 1 and 2. $SQMCI_s$ scores were significantly higher than median for all three sites.

Taxonomic richnesses of 16 taxa were recorded at sites 1 and 2, while 14 taxa were recorded at site 3. This is similar to median values for site 2, but substantially lower than median taxa richnesses for sites 1 and 3. These recorded taxa richness was the lowest value recorded to date at site 1, and equal to the lowest value recorded to date at site 3. These reduced taxonomic richnesses do not provide any indication of detrimental impacts caused by discharges from Kaimiro Production Station, as site 1, the 'control' site, which is upstream of all discharges, was affected while site 2, which is located in the tributary receiving the discharge, had a similar to median taxonomic richness.

In general, this survey found low taxonomic richness and higher than usual MCI and $SQMCI_s$ scores. These results provide no evidence that discharges from the Kaimiro Production Station have had any recent detrimental effects on the macroinvertebrate communities of these two unnamed tributaries of the Mangaoraka Stream.

Summary

A macroinvertebrate survey was performed at three sites in two unnamed tributaries of the Mangaoraka Stream in relation to stormwater discharges from the Kaimiro Production Station. All three sites had similar taxonomic richness, while site 2 had significantly lower MCI scores than site 1, but similar to site 3. $SQMCI_s$ scores were similar at sites 1 and 2, while site 3 had a significantly higher score than either of these sites. This most likely reflects poorer habitat quality due to sediment and iron oxide deposition in the minor tributary where site 2 was located compared to the major tributary where sites 1 and 3 were located.

Taxonomic richness at sites 1 and 3 were lower than medians for these sites, while site 2 had similar to median taxonomic richness. MCI scores were significantly higher than median at sites 1 and 2, but similar to median at site 3. $SQMCI_s$ scores were similar to medians for all sites. Overall there is no evidence that discharges from the Kaimiro Production Station have had any recent detrimental effects on the macroinvertebrate communities of these two unnamed tributaries of the Mangaoraka Stream.

References

Blakemore, K 2016: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2016. TRC report KB004.

Colgan, B, 2003: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2003. TRC Report BC005.

Dunning KJ, 2001a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2000. TRC report KD28.

Dunning KJ, 2001b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2001.TRC report KD55.

Dunning KJ, 2002a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2002. KD96.

Dunning KJ, 2002b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2002. TRC report KD120.

Hope KJ, 2006: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2005. TRC report KH057.

Hope KJ, 2006: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2006. TRC report KH075.

Fowles, CR and Hope, KJ, 2005: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2005. TRC report CF378.

Fowles, CR and Jansma, B, 2008a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2008. TRC report CF459.

Fowles, CR and Jansma, B, 2008b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2008, CF464.

Fowles, CR and Jansma, B, 2014: Post-well drilling biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2014. CF617.

Fowles, CR and Moore, SC, 2004: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2004. CF320.

Fowles, CR and Smith, K, 2013: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2012. CF583

Fowles, CR and Thomas, BR, 2014: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2013. CF614.

Fowles, CR and Thomas, BR, 2014: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2014. CF615.

Jansma B, 2007: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2007. TRC report BJ019.

Jansma B, 2009a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2009. TRC report BJ077.

Jansma B, 2009b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2009. TRC report BJ078.

Jansma B, 2010: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2010. TRC report BJ099.

Jansma B, 2011a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2010 TRC report BJ150.

Jansma B, 2011b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2011 TRC report BJ151.

Jansma B, 2013: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2013 TRC report BJ221.

McWilliam H, 1999a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 1998. HM153.

McWilliam H, 1999b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 1999. HM165.

McWilliam H, 2000: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 1999. HM200.

Moore, SC, 2004: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2004. SM589.

Smith K, 2012: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2012. TRC report KS013.

Smith K, 2012: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2012. TRC report KS014.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Sutherland DL, 2015a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2014. TRC report DS018.

Sutherland DL, 2015b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2015. TRC report DS019.

Sutherland DL, 2015c: Biomonitoring of tow unnmaed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2015.

TRC, 2015: Some statistics from the Taranaki Regional Council database (Esam) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 30 September 2016. Technical Report 2015-105.

To	Job Manager, Callum MacKenzie
From	Technical Officer, Katie Blakemore
Document	1905029
Report No	KB022
Date	26 July 2017

Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station, April 2017

Introduction

This was the second of two biomonitoring surveys scheduled to be undertaken in the 2016-2017 monitoring year for the Kaimiro Production Station of Greymouth Petroleum (previously owned by Fletcher Challenge Energy Taranaki Limited.

The Taranaki Regional Council has undertaken surveys since January 1985 in the tributaries of the Mangaoraka Stream that receive stormwater and wastewater from the production station area. During 1987 and 1988 oil seepage to these streams disrupted the aquatic communities. Biomonitoring was not undertaken for nearly four years following the oil seepage period, until 1992. The results of surveys performed since the 1998-99 monitoring year are discussed in the references at the end of this report.

Methods

This survey was undertaken on 27 April 2017 at three sites in two unnamed tributaries of the Mangaoraka Stream. Figure 1 shows the location of these sampling sites. Site 1 is the 'control' site which is located in a major tributary of the Mangaoraka Stream, upstream of the confluence with a more minor tributary. Site 2 is situated in the minor tributary which receives the stormwater discharge from the production station and site 3 is approximately 50 metres downstream of the confluence of this tributary (Table 1).

Table 1 Biomonitoring sites in two tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station

Site number	Site code	Grid reference (NZTM)	Location	Altitude (masl)
1	MRK000198	E1700117 N5664652	Major tributary approx. 50m u/s of confluence with minor tributary	240
2	MRK000204	E1700054 N5664636	Minor tributary (receives discharge) 150m d/s of Upland Road	240
3	MRK000207	E1700171 N5665679	Major tributary approx. 50m d/s of confluence with minor tributary	240

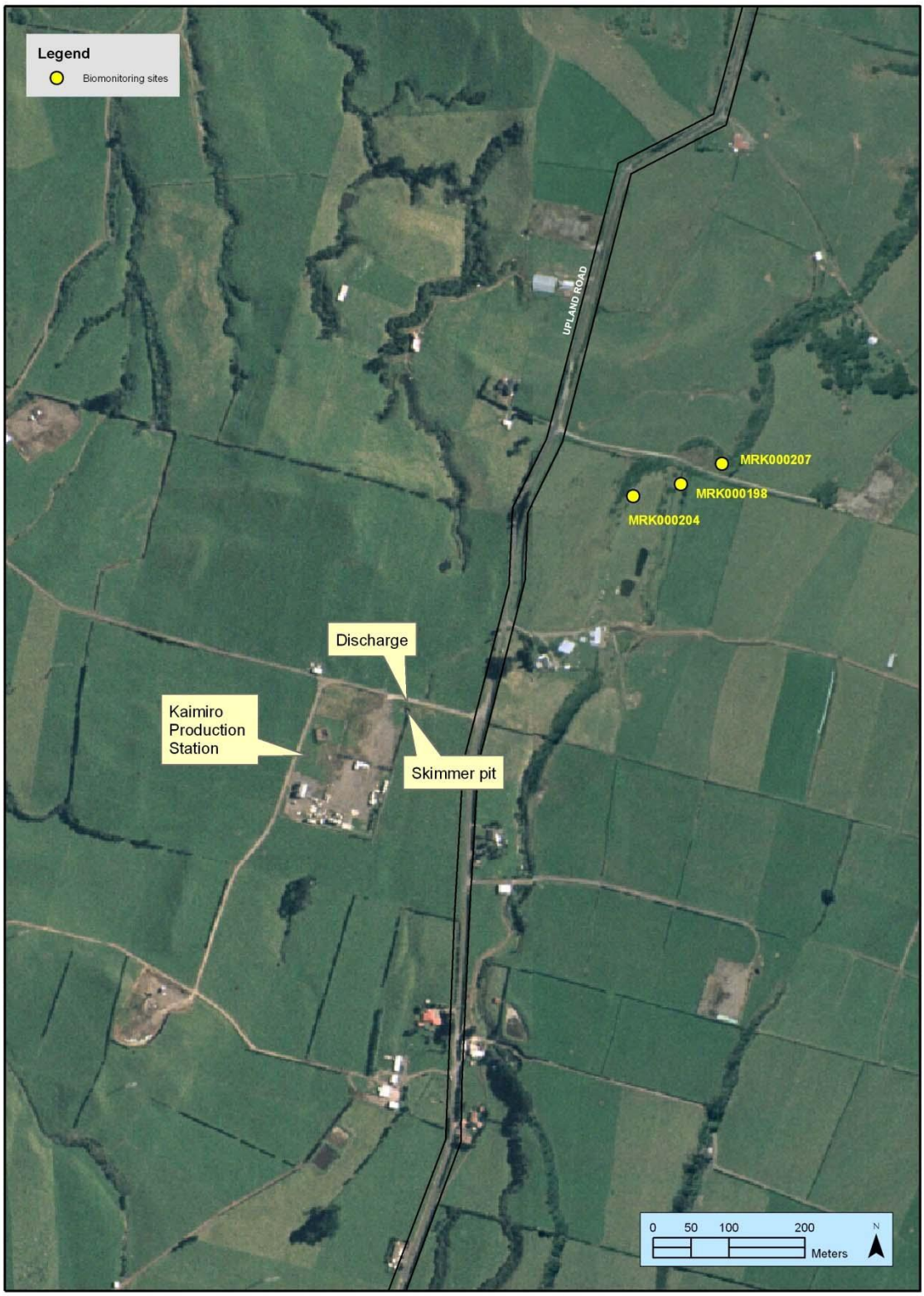

Figure 1 Biomonitoring sites in two unnamed tributaries of the Mangaoraka Stream related to the Kaimiro Production Station

The Council's standard '400ml kick-sampling' technique was used at sites 1, 2 and 3 (Table 1). The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded based on the abundance categories in Table 2.

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	>499

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. However, other physical variables such as sedimentation, temperatures, water velocity, and dissolved oxygen levels may also affect the MCI values because the taxa that are able to tolerate extremes in these variables generally have lower sensitivity scores. More 'sensitive' communities inhabit less polluted waterways. A gradation of biological water quality conditions based upon MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985; Boothroyd and Stark, 2000) (Table 3).

Table 3 Macroinvertebrate community health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985 and Boothroyd and Stark, 2000)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

A semi-quantitative MCI value (SQMCIs) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

Unlike the MCI, the SQMCIs is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

Results

Site habitat characteristics and hydrology

This April 2017 survey followed a period of nine days since a fresh of 3x median flow and 21 days since a fresh of 7x median flow. There had been two freshes in excess of 7x median flow and three freshes in excess of 3x median flow in the two month period since the preceding survvey. There was a steady moderate flow at sites 1 and 2, and a swift moderate flow at site 3 at the time of the survey. Water temperatures ranged from 13.4 -15.7°C at the time of the survey.

Substrate at sites 1 and 2 was predominantly cobble, boulder and fine and coarse gravel, with some silt and sand also present. Site 3 had predominantly bedrock substrate, with some coarse gravel, woody debris and root mat present. There was an iron oxide coating on the streambed at sites 2 but not at sites 1 or 3.

Site 1 had widespread long filamentous periphyton which was not present at any other site, while periphyton mats were slippery at site 2 and absent at sites 1 and 3. Moss and leaves were absent from the streambed at site 1 and patchy at sites 2 and 3. Woody debris was present at site 3 but absent at sites 1 and 2. Macrophytes were present on the stream edges only at sites 1 and 2 but absent at site 3. Overhanging vegetation was present at sites 1 and 3, while undercut banks were present at all three sites. Site 1 had no shading of the streambed, site 2 had partial shading of the streambed and site 3 had complete shading.

Macroinvertebrate communities

Most past surveys have shown that the larger tributary supports richer macroinvertebrate communities, including abundances of 'sensitive' mayflies. These results reflect the good habitat conditions normally provided by faster-flowing, stony-bedded streams on the upper to mid reaches of the ring plain. The smaller tributary has tended to support communities with lower numbers of taxa and smaller proportions of 'sensitive' taxa. This in part has been due to the slower flow and/or iron oxide deposition on the more sedimented streambed of this tributary.

Table 4 provides a summary of the results from previous surveys sampled in relation to the Kaimiro Production Station discharges along with current survey results.

Table 4 Number of taxa, MCI and SQMCIs values for two unnamed tributaries of the Mangaoraka Stream, sampled in relation to the Kaimiro Production Station on 27 April 2017 and a summary of historical data for these sites.

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Apr 2017	Median	Range	Apr 2017	Median	Range	Apr 2017
1	60	27	16-37	16	97	83-115	106	3.6	1.9-5.7	6.4
2	56	15	3-26	9	81	55-103	91	2.3	1.2-4.4	2.1
3	60	24	14-33	14	100	71-111	110	4.2	1.7-6.3	3.6

The full results of the current survey are presented in Table 5.

Table 5 Macroinvertebrate communities in two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station on 27 April 2017

Taxa List	Site Number	MCI score	1	2	3
	Site Code		MRK000198	MRK000204	MRK000207
	Sample Number		FWB17229	FWB17230	FWB17231
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	R
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	R	A	VA
	Lumbricidae	5	R	-	A
MOLLUSCA	*Potamopyrgus*	4	C	-	A
CRUSTACEA	Isopoda	5	-	-	R
	Paraleptamphopidae	5	R	-	A
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	-	A
	Coloburiscus	7	C	-	C
	Zephlebia group	7	VA	R	A
COLEOPTERA (BEETLES)	Elmidae	6	C	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	-	R
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	C	-	R
	Hydrobiosis	5	R	-	-
	Hydropsyche (Orthopsyche)	9	R	R	C
	Plectrocnemia	8	R	-	-
	Pycnocentria	7	C	-	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	R	-
	Zelandotipula	6	-	R	R
	Orthocladiinae	2	C	C	-
	Polypedilum	3	C	-	-
	Empididae	3	-	R	-
ACARINA (MITES)	Acarina	5	R	R	-
		No of taxa	16	9	14
		MCI	106	91	110
		SQMCIs	6.4	2.1	3.6
		EPT (taxa)	8	2	6
		%EPT (taxa)	50	22	43

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

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

Site 1

A relatively low taxa richness of 16 taxa was recorded at this 'control' site at the time of the survey. This is equal to the lowest taxa richness recorded at this site to date (Table 4) and to the richness recorded in the previous survey (Figure 2). The macroinvertebrate community at the time of sampling was characterised by two 'moderately sensitive' taxa, [mayflies (*Austroclima* and *Zephlebia*)] (Table 5).

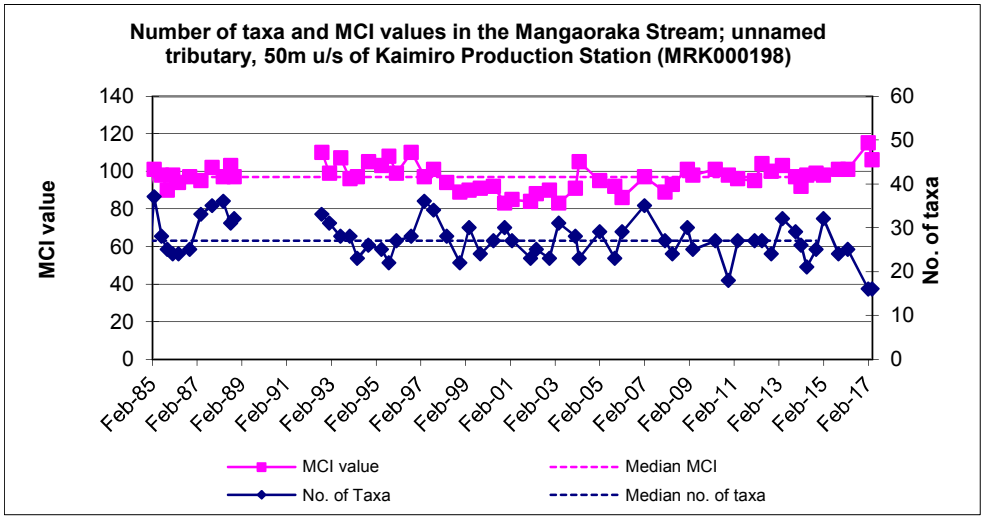

Figure 2 MCI scores and taxa richness at site 1, 50m upstream of Kaimiro Production Station tributary confluence (MRK000198)

The MCI score of 106 units indicated 'good' macroinvertebrate community health and was insignificantly (Stark 1998) higher than the median MCI score for this site of 100 units and insignificantly lower than the previously recorded score of 115 units (Table 4, Figure 2). The $SQMCI_s$ score of 6.4 units was significantly higher than both the median score of 3.6 units and the previously recorded score of 4.6 units (Table 4). This score is the highest $SQMCI_s$ score recorded to date at this site (Table 4).

Site 2

A low taxa richness of 9 taxa was recorded at the time of this survey. This is six taxa fewer than the median score of 15 for this site (Table 4, Figure 3), and is substantially lower than the previous result of 16 taxa (Figure 3). However, it is within the range of scores recorded at this site to date (Table 4). The macroinvertebrate community at the time of sampling was characterised by only one 'tolerant' taxon (oligochaete worms) (Table 5).

The recorded MCI score of 91 units indicated 'fair' macroinvertebrate community health. This score is an insignificant (Stark 1998) 10 units higher than the median score of 81 units for this site and 7 units lower than the previous score of 98 units (Table 4, Figure 3). The $SQMCI_s$ score of 2.1 units is not significantly different from the median $SQMCI_s$ score of 2.3 units for this site, but is significantly lower (Stark 1998) than the previous score of 4.4 units (which was the highest score recorded to date at this site).

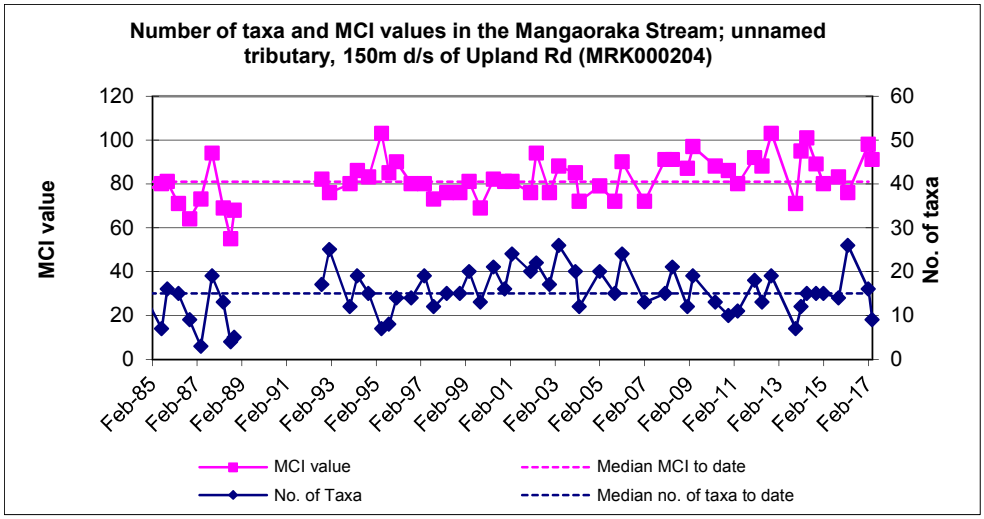

Figure 3 MCI scores and taxa richness at site 2, Kaimiro Production Station tributary 150m downstream of Upland Rd (MRK000204)

Site 3

A low taxa richness of 14 taxa was recorded in this survey. This is equal to the previously recorded score and ten taxa less than the median taxa richness for this site (Table 4, Figure 4). The macroinvertebrate community at the time of sampling was characterised by six taxa, four 'moderately sensitive' taxa [mayflies (*Austroclima* and *Zephlebia*), amphipod (Paraleptamphopidae) and worms (Lumbricidae)] and two tolerant taxa [oligochaete worms and mud snail (*Potamopyrgus*)].

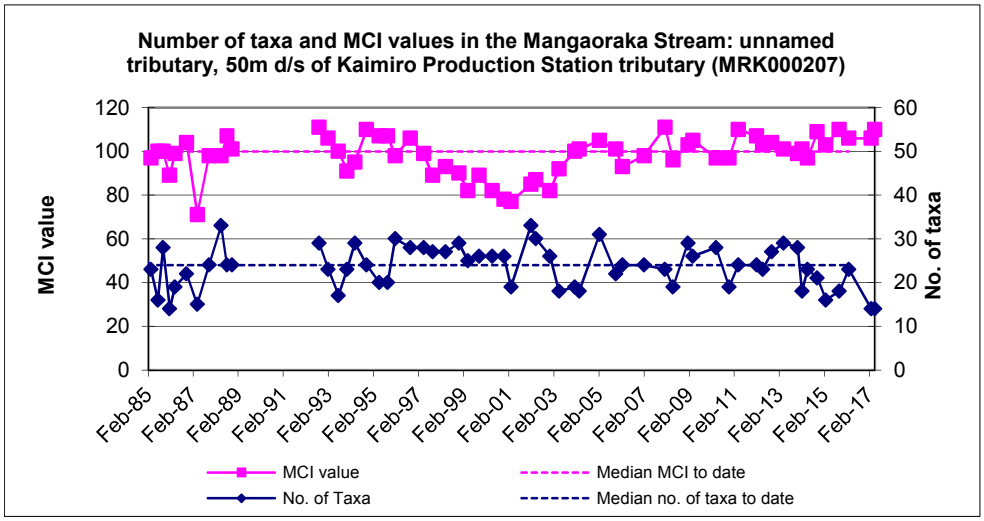

Figure 4 MCI scores and taxa richness at site 3, 50m downstream of Kaimiro Production Station tributary confluence (MRK000207)

The recorded MCI score of 110 units categorises the site as having 'good' macroinvertebrate community health. This is not significantly different from the median MCI score of 100 units for this site and four units higher than the previously recorded score of 106 units at this site (Table 4, Figure 4). The $SQMCI_s$ score of 3.6 units was insignificantly lower (Stark 1998) than the median score for this site of 4.2 units and was significantly lower than the previously recorded score of 5.8 units (Table 4).

Discussion and conclusions

The Council's 'kick-sampling' technique was used at three sites to collect benthic macroinvertebrates from two unnamed tributaries of the Mangaoraka Stream in relation to discharges from the Kaimiro Production Station. This has provided data to assess any potential impacts the consented discharges have had on the macroinvertebrate communities of the stream. Samples were processed to provide number of taxa (taxa richness), MCI and $SQMCI_s$ scores for each site.

Taxa richness is the most robust index when determining whether a macroinvertebrate community has been exposed to toxic discharges. Macroinvertebrates when exposed to toxic discharges may die and be swept downstream or may deliberately drift downstream as an avoidance mechanism (catastrophic drift). The MCI is a measure of the overall sensitivity of the macroinvertebrate community to organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_s$ takes into account relative abundances of taxa as well as sensitivity to pollution. Significant differences in taxa richness, MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Most of the previous surveys undertaken in relation to the Kaimiro Production Station stormwater discharge have shown that the larger tributary of the Mangaoraka Stream (sites 1 and 3) supports higher taxonomic richnesses and healthier macroinvertebrate communities than the smaller tributary receiving the Production Station discharges. Iron oxide deposition is often noted at this site, and was present on this sampling occasion. The results of this summer survey are in agreement with these previous results, with site 2 having the lowest taxonomic richness, MCI and $SQMCI_s$ scores of the sites. All three of these metrics were significantly lower (Stark 1998) at site 2 compared to sites 1 and 3. MCI scores were an insignificant nine – ten units higher than historic medians at all three sites. In contrast, the $SQMCI_s$ showed significant differences between all sites, with site 3 recording a value significantly higher than site 2, and site significantly lower than site 1. Further, the $SQMCI_s$ score at site 1 was the highest score recorded to date at this site, reflecting the numerical dominance of the 'moderately sensitive' mayfly taxa in the community recorded at this site.

Taxonomic richnesses of 16, 9 and 14 taxa were recorded at sites 1-3 respectively, and these values were lower than respective median scores for each site. The recorded taxa richness was equal to the lowest value recorded to date at site 3. However, when taken together with the higher than usual MCI scores and $SQMCI_s$ scores, this indicates that although fewer taxa have been recorded in the most recent survey, the taxa which are present include some which are more 'sensitive' to organic pollution. Overall, these results do not provide any evidence of detrimental impacts caused by discharges from Kaimiro Production Station, as site 2, which is located in the tributary receiving the discharge, had a similar to median taxonomic richness.

In general, this survey found low taxonomic richness and higher than usual MCI and $SQMCI_s$ scores. These results provide no evidence that discharges from the Kaimiro Production Station have had any recent detrimental effects on the macroinvertebrate communities of these two unnamed tributaries of the Mangaoraka Stream.

Summary

A macroinvertebrate survey was performed at three sites in two unnamed tributaries of the Mangaoraka Stream in relation to stormwater discharges from the Kaimiro Production Station. All three sites had similar taxonomic richness, while site 2 had significantly lower MCI scores than sites 1 and 3. $SQMCI_s$ scores were significantly different between all sites, with the lowest score recorded at site 2. This most likely reflects

poorer habitat quality due to sediment and iron oxide deposition in the minor tributary where site 2 was located.

Taxonomic richness was lower than medians and MCI scores ware insignificantly higher than medians for all three sites respectively. $SQMCI_s$ scores were similar to medians at sites 2 and 3, while at site 1 this was significantly higher than the median score and was the highest score recorded to date at this site. Overall there is no evidence that discharges from the Kaimiro Production Station have had any recent detrimental effects on the macroinvertebrate communities of these two unnamed tributaries of the Mangaoraka Stream.

References

Blakemore, KS 2017: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2017. TRC report KB015.

Blakemore, KS 2016: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2016. TRC report KB004.

Colgan, B, 2003: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2003. TRC Report BC005.

Dunning KJ, 2001a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2000. TRC report KD28.

Dunning KJ, 2001b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2001.TRC report KD55.

Dunning KJ, 2002a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2002. KD96.

Dunning KJ, 2002b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2002. TRC report KD120.

Hope KJ, 2006: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2005. TRC report KH057.

Hope KJ, 2006: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2006. TRC report KH075.

Fowles, CR and Hope, KJ, 2005: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2005. TRC report CF378.

Fowles, CR and Jansma, B, 2008a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2008. TRC report CF459.

Fowles, CR and Jansma, B, 2008b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2008, CF464.

Fowles, CR and Jansma, B, 2014: Post-well drilling biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2014. CF617.

Fowles, CR and Moore, SC, 2004: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, March 2004. CF320.

Fowles, CR and Smith, K, 2013: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2012. CF583

Fowles, CR and Thomas, BR, 2014: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2013. CF614.

Fowles, CR and Thomas, BR, 2014: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2014. CF615.

Jansma B, 2007: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2007. TRC report BJ019.

Jansma B, 2009a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2009. TRC report BJ077.

Jansma B, 2009b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2009. TRC report BJ078.

Jansma B, 2010: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2010. TRC report BJ099.

Jansma B, 2011a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 2010 TRC report BJ150.

Jansma B, 2011b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2011 TRC report BJ151.

Jansma B, 2013: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 2013 TRC report BJ221.

McWilliam H, 1999a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, November 1998. HM153.

McWilliam H, 1999b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, April 1999. HM165.

McWilliam H, 2000: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 1999. HM200.

Moore, SC, 2004: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2004. SM589.

Smith K, 2012: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, January 2012. TRC report KS013.

Smith K, 2012: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, May 2012. TRC report KS014.

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Sutherland DL, 2015a: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2014. TRC report DS018.

Sutherland DL, 2015b: Biomonitoring of two unnamed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, February 2015. TRC report DS019.

Sutherland DL, 2015c: Biomonitoring of tow unnmaed tributaries of the Mangaoraka Stream in relation to the Kaimiro Production Station, October 2015.

TRC, 2015: Some statistics from the Taranaki Regional Council database (Esam) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 30 September 2016. Technical Report 2015-105.

Appendix III

Air monitoring reports

To	Job Manager, Callum MacKenzie
From	Scientific Officer - Air Quality, Brian Cheyne
File	1895081
Date	July 7, 2017

Ambient Gas (PM10, NOx, CO and LEL) Monitoring at Kaimiro Production Stations during 2016-2017 monitoring year

Introduction

In August 2016 and January 2017 as part of the compliance monitoring programme for the Kaimiro production station, a survey of ambient air quality sampling was carried out by the Taranaki Regional Council (the Council) in the vicinity of the plant. The main objectives were to measure:

- The concentrations of PM10 using a portable data logging TSI 'DustTrak';
- To measure the concentrations of the nitrogen oxides (NOx) using a passive sampling method, that gives a result for average exposure;
- And to measure carbon monoxide (CO) using a portable multi gas meter that provides instantaneous data throughout the monitoring period.

The findings of this study are presented in this memorandum, together with the locations of the monitoring sites which are provided in Figure 1.

Carbon monoxide (CO) and Lower explosive limit (LEL)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately 65 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases).

Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.

Figure 1 Air monitoring sites at Kaimiro production station (2016-2017)

The details of the sample run are summarised in Table 1 and the data from the sample run are presented graphically in Figure 2**.**

The consents covering air discharges from the Kaimiro production station have specific limits related to particular gases. Special condition 13 of consent 4048-3 set a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m^3 for an eight hour average or 30 mg/m^3 for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 6.4 mg/m^3 with average concentration for the entire dataset was only 0.23 mg/m^3 which comply with consent conditions. This is in line with the pattern found in previous years.

Table 1 Results of carbon monoxide and LEL monitoring at Kaimiro production station

Period (from-to)		30/08/2017 15:05 to 01/09/2016 08:38
Max	CO(ppm)	5.60
	LEL(%)	0.10
Mean	CO(ppm)	0.20
	LEL(%)	0.00
Min	CO(ppm)	0.00
	LEL(%)	0.00

Note: (1) the instrument records in units of ppm. At 25°C, 1 atm.

1ppm CO = 1.145 mg/m^3

(2) See text for explanation of LEL. Because the LEL of methane is equivalent to a mixture of approximately 5% methane in air, then the actual concentration of methane in air can be obtained by dividing the percentage LEL by 20.

LEL gives the percentage of the lower explosive limit, expressed as methane that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Kaimiro production station reach any more than a trivial level.

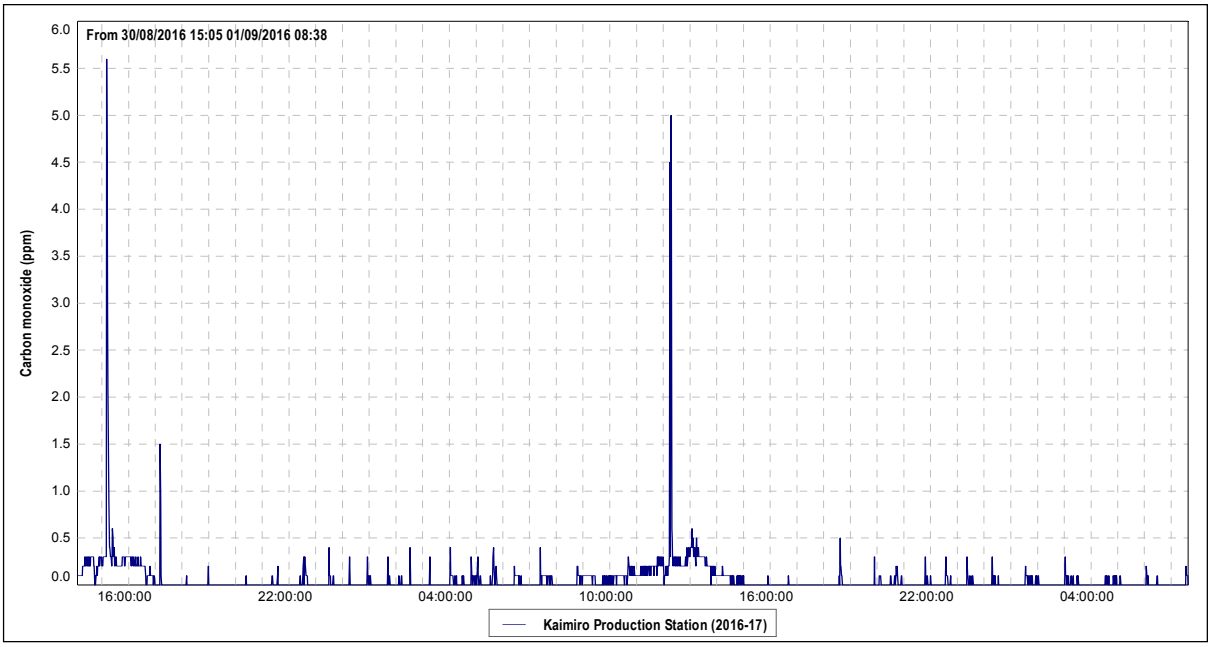

Figure 2 Graph of ambient CO levels in the vicinity of the Kaimiro Production Station (2016-17)

PM10

In September 2004 the Ministry for the Environment made public National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 is 50 µg/m^3 (24-hour average).

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a "DustTrak" PM10 monitor was deployed on one occasion in the vicinity of the Kaimiro production station. The deployment lasted approximately 65 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations. The location of the "DustTrak" monitor during the sampling run is shown in Figure 1.

The details of the sample run are presented in Figure 3 and Table 2.

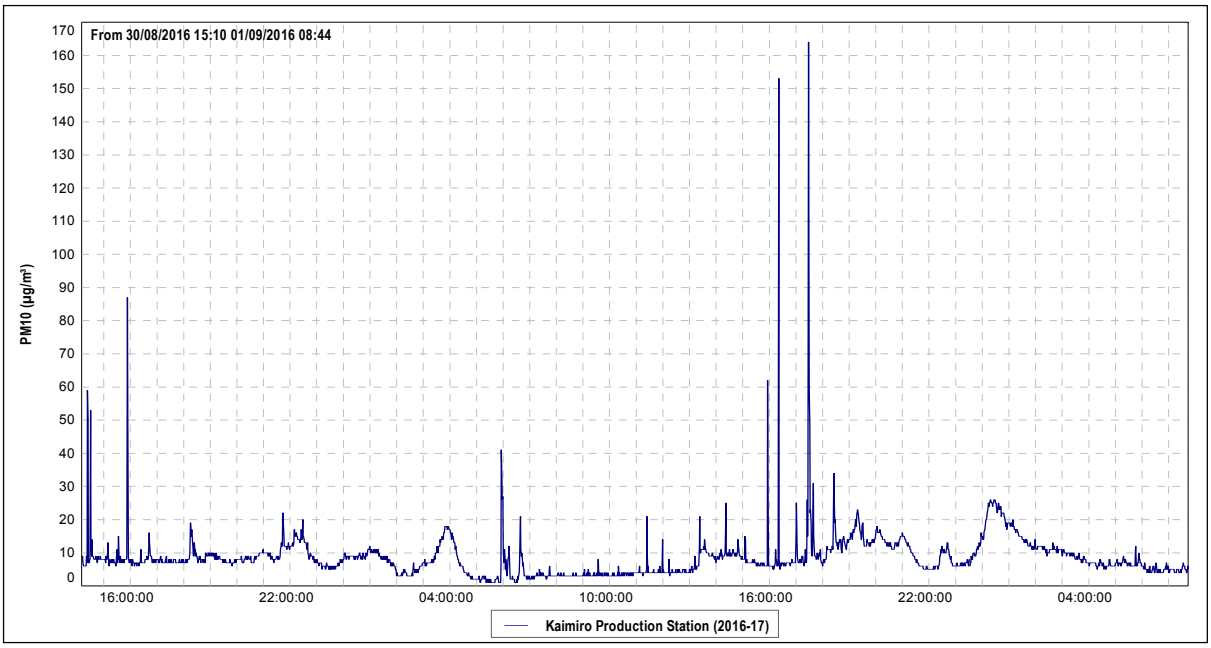

Figure 2 PM10 concentrations (µg/m^3) at the Kaimiro production station (2016-17)

Table 1 Daily mean of PM10 results during two days' monitoring at Kaimiro production station

	(65 hours) (31/08-01/09/2016)	
24 hr. set	Day 1	Day 2
Daily average	7.06 µg/m^3	9.06 µg/m^3
NES	50µg/m^3	

During the 65-hour run, from 30th of August to 1st of September 2016, the average recorded PM_{10} concentration for the first 24 hour period was 7.06µg/m^3 and 9.06µg/m^3 for the second 24 hour period. These daily means equate to 14.1% and 18.1%, respectively, of the 50 µg/m^3 value that is set by the National Environmental Standard.

Background levels of PM_{10} in the region have been found to be typically around 11µg/m^3.

Nitrogen oxides (NOx)

From 2014 onwards, the Council has implemented a coordinated region-wide compliance monitoring programme to measure NOx. The programme involves deploying all measuring devices at 24 NOx monitoring sites (including two sites in the vicinity of the Kaimiro production station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The complete report covering region-wide NOx monitoring is attached in the Appendix to this memorandum (TRC #1841084).

The consents covering air discharges from the Kaimiro production station have specific limits related to particular gases. Special condition 14 of consent 4048-3 set a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 100 µg/m^3 for a 24 hour average or 200 µg/m^3 for a one hour average exposure.

NOx passive adsorption discs were place at two locations in the vicinity of the Kaimiro production station on one occasion during the year under review. The discs were left in place for a period of 21 days.

The calculated 1-hour and 24-hour theoretical maximum NOx concentrations found at the Kaimiro production station during the year under review equates to 5.21µg/m^3 and 2.71 µg/m^3 respectively. The results show that the ambient ground level concentration of NO_x is well below the limits set out by consent 4048-3.