

Greymouth Petroleum Ltd
Turangi-C Wellsite
Monitoring Programme
Biennial Report
2016-2018

Technical Report 2018-28

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Executive summary

Greymouth Petroleum Ltd (the Company) established a hydrocarbon exploration site located on Turangi Road Upper at Motunui in the Parahaki catchment. This report for the period June 2016 to June 2018 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. During this period, one well was drilled, tested, hydraulically fractured and is now producing (Turangi 6). The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds four resource consents, which include a total of 40 conditions setting out the requirements that the Company must satisfy. The Company holds one consent to allow it to take and use water, two consents to discharge effluent/stormwater into an unnamed tributary of the Parahaki stream, and one consent to discharge emissions into the air at this site.

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

The Council's monitoring programme for the monitoring period under review included 12 inspections, one water sample collected for physicochemical analysis, and one biomonitoring survey of receiving waters.

The monitoring showed that all samples obtained were in compliance with consent conditions. The monitoring indicated there was no effect on the receiving environment from the activities at the Turangi-C wellsite. There were no Unauthorised Incidents recording non-compliance in respect of this consent holder during the period under review.

During the monitoring period, the Company demonstrated a high level of environmental and administrative performance with the resource consents. There were no significant issues observed by Council officers concerning silt or sediment controls, and stormwater discharges from the site. Site staff were cooperative with requests made by Council officers, with any required works being completed in a timely and satisfactory manner.

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.

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

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 in the monitoring period under review.

This report includes recommendations for the 2018-2019 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period June 2016 to June 2018 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by The Company Ltd (the Company). The Company operates a hydrocarbon wellsite situated on Upper Turangi Road in the Parahaki catchment.

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 Parahaki catchment, and the air discharge permit held by the Company to cover emissions to air from the site.

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

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 through annual programmes;
- the resource consents held by the Company in the Parahaki catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

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

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

Section 4 presents recommendations to be implemented in the 2018-2019 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 consent holders, this report also assigns a rating as to each Company's 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.

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

1.2 Process description

1.2.1 Site description

The Company holds a 30 year Petroleum Mining Permit No. 38161 to prospect, explore, and mine for condensate, gas, LPG, oil and petroleum within an area of 45.889 km². The Turangi-C wellsite is one of many sites within this area that have been established in order to explore, evaluate and produce hydrocarbons.

The Turangi-C wellsite is located approximately 1.5 km along Upper Turangi Road and approximately 4.5 km from Waitara, as per Figure 1. The Turangi-C wellsite was established for petrochemical exploration efforts. The establishment of the wellsite involved the removal of topsoil to create a firm level foundation on which to erect the drilling rig and house the associated equipment. Site establishment also involved the installation of:

- Wastewater control, treatment and disposal facilities;
- A system to collect and control stormwater and contaminants;
- A gas combustion system; and

- Other on-site facilities such as accommodation, parking and storage.

The nearest residence is approximately 910 m away from the wellsite. Bunding and earthworks helped minimise any potential for off-site effects for the neighbours.



Figure 1 Turangi-C wellsite location

1.2.2 Well development

The process of drilling a well can take a few weeks to several months, depending on the depth of the well, the geology of the area, and whether the well is vertical or horizontal.

Drilling fluids, more commonly known as 'drilling muds', are required in the drilling process for a number of reasons, including:

- As a safety measure to ensure that any pressurised liquids encountered in the rock formation are contained;
- To transport drill cuttings to the surface;
- To cool and lubricate the drilling bit;
- To provide information to the drillers about what is happening down hole and the actual geology being drilled; and
- To maintain well pressure and lubricate the borehole wall to control cave-ins and wash-outs.

The well is drilled progressively using different sized drill bits. The width of the well is widest at the surface as smaller drill bits are used as the well gets deeper. Once each section of the well is drilled, a steel casing is installed. Cement is then pumped down the well to fill the annulus (the space between the steel casing and the surrounding country rock). This process is repeated until the target depth is reached, with each section of steel casing interlocked with the next.

Production tubing is then fitted within the steel casing to the target depth. A packer is fitted between the production tubing and casing to stop oil/gas/produced water from entering the annulus. The packer is pressure tested to ensure it is sealed.

The construction aspects that are most important for a leak-free well include the correct composition and quality of the cement used, the installation method, and the setting time. The aim is to ensure that the cement binds tightly to the steel casing and the rock, and leaves no cavities through which liquids and gases could travel.

Once the well is sealed and tested the casing is perforated at the target depth, allowing fluids and gas to flow freely between the formation and the well.

1.2.3 Management of stormwater, wastewater and solid drilling waste

The Turangi-C wellsite is located approximately 70 m to the east of the nearest waterbody which is an unnamed tributary of the Parahaki Stream.

Management systems were put in place to avoid any adverse effects on the surrounding environment from exploration and production activities on the wellsite. There are several sources of potential contamination from water and solid waste material which require appropriate management. These include:

- Stormwater from 'clean' areas of the site (e.g. parking areas) which run off during rainfall. There is potential that this runoff will pick up small amounts of hydrocarbons and silt due to the nature of the activities on-site;
- Stormwater which collects in the area surrounding the drilling platform and ancillary drilling equipment. This stormwater has a higher likelihood of contact with potential contaminants, particularly drilling mud;
- Produced water which flows from the producing formation and is separated from the gas and water phase at the surface; and
- Drill cuttings, mud and residual fluid which are separated from the liquid waste generated during drilling.

An important requirement of the site establishment is to ensure that the site is contoured so that all stormwater and any runoff from 'clean' areas of the site flow into perimeter drains. The drains direct stormwater into a skimmer pit system on-site consisting of two settling ponds. Any hydrocarbons present in the stormwater float to the surface and can be removed. The ponds also provide an opportunity for suspended sediment to settle. Treated stormwater is then discharged from the wellsite onto and into land, and consequently into an unnamed tributary of the Parahaki Stream.

Drilling mud and cuttings brought to the surface during drilling operations are separated out using a shale shaker. The drilling mud and some of the water is then reused for the drilling process. Cuttings were collected in bins located at the base of the shaker and disposed of offsite at a consented facility.

1.2.4 Flaring from exploration activities

It is possible that flaring may occur during the following activities:

- Well testing and clean-up;
- Production testing;
- Emergencies; and

Maintenance and enhancement activities (well workovers).

1.3 Resource consents

The Company holds four resource consents, the details of which are summarised in the table below and outlined in sections 1.3.1 to 1.3.4

Table 1 Summary of consents held by The Company for Turangi-C

Consent number	Purpose	Granted	Review	Expires
9415-1	To discharge treated stormwater and produced water from hydrocarbon exploration and production operations to land.	5 February 2013	June 2021	1 June 2027
9416-1	To take groundwater, as 'produced water' during hydrocarbon exploration and production activities.	5 February 2013	June 2021	1 June 2027
9419-1	To discharge contaminants to air from hydrocarbon exploration.	5 February 2013	June 2021	1 June 2027
9422-1	To discharge stormwater and sediment, deriving from soil disturbance undertaken for the purpose of constructing the Turangi-C wellsite.	5 February 2013	N/A	1 June 2017

1.3.1 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.

The Company Ltd holds water permit **9416-1** to cover the taking of groundwater, as 'produced water' during hydrocarbon exploration and production activities at the Turangi-C wellsite at or about (NZTM) 1712960E-5680969. This permit was issued by the Council on 5 February 2013 under Section 87(d) of the RMA. It is due to expire on 1 June 2027.

Conditions 1 and 2 impose limits upon the abstraction rate and significant potential contaminants.

Condition 3 requires submission of a summary well log.

The last two conditions are lapse and review provisions.

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 consents which are appended to this report.

1.3.2 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.

The Company holds water discharge permit **9415-1** to cover the discharge of treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi-C wellsite onto land at or about (NZTM) 172890E-5681104N. This permit was issued by the Council on 5 February 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2027.

Conditions 1 requires the consent holder to adopt the best practicable option.

Conditions 2 and 3 detail limits on discharge area and rate.

Conditions 4 to 6 detail the design of the stormwater system and skimmer pits.

Condition 7 and 8 detail requirements for notification prior to works, and contingency plans.

Condition 9 details further stormwater design and management systems.

Condition 10 requires notification prior to reinstatement of the site.

The last two conditions are lapse and review provisions.

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 consents which are appended to this report.

1.3.3 Water discharge permit (stormwater and sediment - earthworks)

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

The Company holds water discharge permit **9422-1** to cover the discharge of stormwater and sediment, deriving from soil disturbance undertaken for the purpose of constructing the Turangi-C wellsite, onto land where it may enter an unnamed tributary of the Parahaki Stream or about (NZTM) 172890E-5681104N. This permit was issued by the Council on 5 February 2013 under Section 87(e) of the RMA. It expired on 1 June 2017.

Condition 1 authorises the discharge of stormwater associated with earthworks undertaken to establish the Turangi-C wellsite as shown in submitted documents.

Condition 2 requires the consent holder to adopt the best practicable option at all times to prevent or minimise adverse effects of the discharge on the environment.

Condition 3 requires 7 days written notice to the Council prior to the commencement of earthworks.

Condition 4 requires all run off to pass through a skimmer pit system.

Condition 5 allows for obligations laid out in Condition 4 to cease only when the area is stabilised.

Condition 6 requires stabilisation of vegetation as soon as practicable, no longer than six months after earthworks are completed.

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 consents which are appended to this report.

1.3.4 Air discharge permit (exploration activities)

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

The Company holds air discharge permit **9419-1** to cover the discharge of contaminants to air from hydrocarbon exploration at the Turangi-C wellsite, including combustion involving flaring or incineration of petroleum recovered from natural deposits, in association with well development or redevelopment and testing or enhancement of well production flows at or about (NZTM) 1712926E-5681060N. This permit was issued by the Council on 5 February 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2027.

Condition 1 defines terminology related to flaring.

Condition 2 specifies the requirements for the flare pit.

Conditions 3 and 4 specify the requirements for notification prior to flaring.

Conditions 5 to 8 specify the types of substances which may be flared to gases from the well stream, and the processes for undertaking flaring.

Condition 9 requires the consent holder to adopt the best practicable option.

Conditions 10 to 12 stipulate limits on contaminants and effects from flaring, and any other emissions from the wellsite.

Condition 13 requires the consent holder to provide an analysis of gas and condensate to the Council on request.

Condition 14 specifies the requirements for hydrocarbon storage.

Condition 15 requires the consent holder to provide a flaring log to the Council.

Condition 16 and 17 provide for review of 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 consents which are appended to this report.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the Turangi-C wellsite consisted of four primary components.

1.4.2 Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- 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.

1.4.3 Site inspections

The Turangi-C wellsite was visited 11 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.

1.4.4 Chemical sampling

The skimmer pit was sampled on one occasion, and the sample analysed for chloride, conductivity, pH, suspended solids, turbidity and temperature.

The unnamed tributary of the Parahaki Stream was not sampled on any occasion.

All discharges to air were assessed visually throughout the monitoring period.

1.4.5 Biomonitoring surveys

A biological survey was performed on one occasion in an unnamed tributary of the Parahaki Stream to determine whether or not the discharge of treated stormwater and uncontaminated site and process effluent from the site has had a detrimental effect upon the communities of the stream. The full report can be found in Appendix II at the back of this report.

2 Results

2.1 Water

2.1.1 Inspections

8 June 2016

An inspection of the Turangi-C wellsite was undertaken with the Company's staff during wellsite set up and prior to any drilling. Bunds were yet to be completed around mud mixing areas. Bulk diesel storage was stored in double skinned tanks. Ring drains and stormwater treatment via skimmer pits were set up correctly. The silt control measures were shut off and matting was in place. The flare pit was well situated to minimise off site effects. The auxillary pit was located off to a side, to be used when required. The site was well set up, apart from a few bunding modifications that were required, but were yet to be completed. It was noted that the ring drain on the eastern boundary needed to be checked to assess the integrity of the stormwater diversion and the drainage system.

14 June 2016

An inspection of the Turangi-C wellsite was undertaken to check for compliance with resource consent conditions. The site was found to be tidy. There was bunding in place for wet/dry chemicals with tarps being used to protect dry product from rainfall. The Council was advised that sucker trucks were used to remove stormwater that had accumulated in the bunds. Bunding was in place around the operation and around the brine/water/mud tanks. Waste drilling muds were mixed with sawdust in a tank and removed off site by truck. TRC discussed with staff the need to monitor this activity and clean any spills to ground to reduce the likelihood of chlorides accumulating/discharging offsite. The skimmer pits were not discharging at the time of inspection. No samples were taken. The ring drains were dry. Most ring drains contained natural vegetation but one side contained coconut matting. The edges of the site had large (65 mm) stones to help settle out sediment.

30 June 2016

An inspection of the Turangi-C wellsite was carried out to check for compliance with resource consent conditions. The discharge from the skimmer pits was checked for chloride concentrations and the ring drains were being monitored. This inspection was carried out following a period of heavy rainfall. The skimmer pits were discoloured but were not discharging at the time of inspection. It was noted that the ring drain in the southern corner of the site was low, allowing stormwater to pool. This had been noted by the Company and works were to be undertaken to ensure there was no ponding in the ring drain. It was noted that dry drilling muds were on the ground in the vicinity of the dry mud container. Works had been undertaken to remove the mud, however it still remained in low quantities in an area where tracking via vehicles or stormwater may occur. The Company was advised to install a small bund in front of the dry mud container and the area where the sawdust/wood chip is stored, to create a buffer zone between these areas and the rest of the site.

11 July 2016

An inspection at the Turangi-C wellsite was carried out to check for compliance with resource consent conditions. It was observed that the southern corner of the site had been raised to prevent ponding in the ring drain. The Company advised that further works would be required to contour the ring drain. It was to be assessed at the next decent rainfall event. It was reiterated that minor spills should be cleaned up at the time and drip trays used when possible. Some minor spills were observed at the time of inspection and staff were made aware of these. Bunding was in place where this requirement was applicable. All resource consent conditions were being complied with at the time of inspection.

21 July 2016

An inspection was carried out at the Turangi-C wellsite to check for compliance with resource consent conditions. This inspection found that resource consent conditions were being complied with at the time of inspection. The site was tidy and clean. The chemical storage bund was dry, with stormwater recently removed from the bund. The ring drain was dry. The skimmer pits were not discharging at the time of inspection.

1 August 2016

An inspection of the Turangi-C wellsite was carried out. It had been raining just prior to the inspection. There had been a lot of rain and wind during the preceding week. The site was very tidy. Some ponding was observed in the ring drain. This was in breach of resource consent conditions, however the volume was minimal. The skimmer pits were turbid and were not discharging at the time of inspection. The receiving environment showed no obvious effects from previous discharges. The dryer was not in use. The storage bund contained stormwater which was being monitored to avoid overflow to the ring drain. A bag of lime had been spilled onto the ground. This was to be cleaned up and the reasons for leaving it in situ had been followed up by the Company. A small spill had occurred around the area where chemicals were mixed. This had been cleaned up and sawdust placed on the ground in case of another. It was discussed that the wind has caused some issues with chemicals blowing away in the wind when undertaking mixing. This was identified as an area for improvement.

25 August 2016

An inspection was carried out at Turangi-C wellsite to check for compliance with resource consent conditions. Weather at the time was overcast with heavy showers and no wind. The site was busy with staff preparing for a hydraulic fracturing operation. The drill rig remained onsite however chemicals and mud had been removed from site. Sufficient bunding was in place. The site was tidy. Traffic movements had disturbed the site which resulted in sediment being released into the ring drains and skimmer pits. The pits had been pumped out the day before, so no discharges from the site were occurring at the time of inspection. The Company proposed that they would install further silt controls after the skimmer pits to help control sediment. The Council officer was concerned that discoloured stormwater may reach water if the rain was to continue. They also raised concern that the flowback tanks for the hydraulic fracturing operation should be bunded to prevent/contain a spill that may arise during loading/unloading operations.

30 August 2016

An inspection was carried out at the Turangi-C wellsite to check for compliance with resource consent conditions. At the time of inspection the well was shut in, and flaring had ceased and minimal activity was occurring at the site. It was observed that bunding had been constructed around the flowback tanks and the mud tanks. The skimmer pits contained discoloured stormwater following heavy rain during the previous week. The skimmer pits were not discharging. It was noted that further silt controls had been put in place to reduce sediment in the discharge. No issues were raised at the time of inspection. The site was clean and tidy.

18 October 2016

An inspection of Turangi-C wellsite was undertaken to check for compliance with resource consent conditions. No issues were raised during the inspection. It was noted that the site was dry and dusty. There was good bunding in place.

14 December 2016

An inspection was carried out at The Turangi-C wellsite. Well testing was taking place with product being stored in two tanks within a bunded area. One tank was for condensate and the other for produced water. The first impressions of the site was that it was untidy. It was raining lightly at the time of inspection. The

skimmer pits were clear and there was no discharge from the sire. The area below the point of discharge appeared fine with no effects were noted. There was unpleasant odour coming from the septic tanks. No discharge from the tanks was noted. A sample was taken from the second skimmer pit. Bunding onsite needed improving. It was noted that a tank accepting flowback waste was not bunded and was 3/4 full.

13 June 2017

An inspection was carried out at the Turangi-C wellsite to ensure that site specific resource consents and special conditions relating to stormwater, air discharges, and silt controls were being complied with.

The site had good existing systems and visual evidence of water quality did not give rise to any specific concerns. Some pre-existing flare pits had not been lined. Ring drains and silt control measures needed improvement to comply with the current accepted standards. These issues were to be resolved when a workover rig or further exploration drilling was undertaken. Flare pits were situated well, leading to the minimisation of any off site effects. Plantings of screening shrubs provided good cover, while mix-bury cover areas were generally revegetated and no evidence of any contamination was seen.

2.1.2 Results of abstraction and discharge monitoring



Figure 2 Location of receiving water sampling sites and skimmer pit discharge

During the period under review one stormwater sample was taken. This sample came from the second skimmer pit onsite.

Analysis of the sample obtained showed that the discharge would have complied with resource consent conditions should a discharge have occurred. With no ongoing effects to the surrounding environment.

Table 2 Stormwater sampling results for Turangi-C wellsite, 2016-2018

Date	Chloride <i>g/m3</i>	Conductivity <i>mS/m</i>	pH <i>pH</i>	Turbidity <i>NTU</i>	SS <i>g/m3</i>	Temp <i>Deg.C</i>	Sampling Location
15/12/16	17.2	8.8	7.3	1.7	<2	19.2	Second skimmer pit

2.1.3 Results of receiving environment monitoring

The Council's 'vegetation sweep' technique was used to collect macro-invertebrate samples from three sites in this unnamed tributary on two occasions. This has provided data to assess the impact of the stormwater discharge to land from the Turangi-C wellsite on the macroinvertebrate communities of the stream. Samples were processed to provide taxa richness, MCI and SQMCI₅ scores for each site.

Taxa richness is a valuable macroinvertebrate community metric when determining whether a community has been exposed to a toxic discharge, as macroinvertebrates will either drift downstream to avoid the discharge or may be killed. This would result in a reduced taxa richness at the downstream sites. In contrast, the MCI and SQMCI₅ scores are a measure of community tolerance to organic pollution, although they can also provide an indication of more subtle influences caused by a poor quality discharge. As the SQMCI₅ score takes into account relative abundances of the taxa found in the sample, it provides additional insight to that provided by the MCI score. However, it is also easily influenced by the 'patchiness' of invertebrates on the stream bed, and as such must be considered in the context of all three metrics.

Taxa richnesses were found to be low in all instances. There were no significant differences in taxa richnesses between any of the three sites or between surveys. All taxa richnesses were lower than the median taxa richness for Taranaki lowland coastal stream sites between 50 and 79 m above sea level (Table 5). The low taxa richnesses are most likely a result of poor quality habitat, with the streambed made up primarily of fine sediment which does not support high quality freshwater macroinvertebrate communities. Furthermore, the taxa found in the current surveys are generally associated with macrophytes, which were extensive at all sites.

MCI scores did not change significantly for any of the three sites between survey occasions, although site 3 (PRH000040) recorded a significantly lower MCI score than either site 1 (PRH000035) or site 2 (PRH000037) on both occasions. MCI scores at sites 1 and 2 were similar to the median scores for Taranaki lowland coastal streams at similar altitude, while the score for site 3 was significantly lower than this median on both occasions. This is likely a reflection of habitat differences, with site 3 having less shading (due to only minor overhanging vegetation at site 3), and less woody debris in the stream channel (which provides important invertebrate habitat in soft-bottomed streams).

SQMCI₅ scores were 2.2, 4.1 and 1.6 for sites 1-3 respectively in the pre-drill survey. Sites 1 and 3 recorded scores that are insignificantly different from each other, while site 2 had a significantly higher score than either site 1 or site 3 (Stark 1998). The scores recorded in the post-drill survey were 1.2, 1.4 and 1.7 for these sites respectively. There is no significant difference between in SQMCI₅ scores between sites in this survey (Stark 1998). Both site 1 and site 2 showed a significant decrease in SQMCI₅ score between the pre-drill and post-drill surveys (Stark 1998), while scores for site 3 were similar on both occasions. The decrease observed at site 1 was primarily due to the increase of oligochaete worms (MCI score 1) from 'very abundant' to 'extremely abundant', while at site 2 it was primarily due to the decrease of tanypod larvae from 'abundant' to 'common and Paracalliope amphipods from 'very abundant' to 'abundant'.

All scores except for site 2 during the pre-drill survey were significantly below the median SQMCI₅ score for Taranaki lowland coastal streams at similar altitude.

A previous survey has been carried out at these sites (TRC, unpublished data). The results of this survey found similar results at sites 1 and 2, with no decline in MCI score observed at site 3. It is possible that there has been a change in habitat at site 3, with increased sedimentation on the streambed since the previous survey. A culvert approximately 5m downstream of site 3 would contribute to a build up of deposited sediment on the streambed at this site. Furthermore, the construction of the wellsite pad occurred during this interval, which could have resulted in an increased fine sediment supply to the stream. However, there is insufficient evidence to attribute this change at site 3 to the Turangi-C wellsite.

Overall the invertebrate metrics recorded in these surveys provided no evidence that discharges from the Turangi-C wellsite have had any impact on the macroinvertebrate communities of this unnamed tributary of the Parahaki Stream. The low taxa richnesses observed are a result of poor quality habitat, and did not change significantly between surveys. The MCI scores did not change significantly at any site between the two surveys, indicating that any discharges from the Turangi-C wellsite have not had a significant impact on the macroinvertebrate communities. The significantly lower score recorded at site 3 compared to sites 1 and 2 is likely to be a reflection of habitat differences and is unlikely to be related to the wellsite discharges. This is evidenced by the score being similar in both the pre-drill and post-drill surveys. Further, any discharges would be expected to have the largest impact on macroinvertebrate communities at site 2, the 'primary impact' site and these were not observed. Differences in SQMCI_s scores are the result of changes in abundance of particular taxa, and are considered to reflect the patchy nature of stream macroinvertebrate communities rather than the effects of any discharges that may have occurred. The full biomonitoring report can be found in the appendix attached.



Figure 3 Biomonitoring sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi-C wellsite

2.2 Investigations, interventions, and incidents

The monitoring programme for the period under review was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with The Company. During the monitoring

period matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

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

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

In the 2016-2018 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 Discussion

3.1 Discussion of site performance

Monitoring of the Turangi-C wellsite during the period under review found that the site was well managed, with no issues with the silt and sediment controls in place. Any minor actual or potential non-compliance with consent conditions were addressed during site inspections. The Company would quickly take steps to ensure that requests made by the Council Inspecting Officers were adhered to without delay.

There were no significant incidents or complaints recorded, and it is considered that all resource consent conditions were complied with during the monitoring period, including the provision of various pieces of information (contingency plan, notifications etc.).

Monitoring has shown that the management onsite ensured that no effects to the environment occurred during the monitoring period.

3.2 Environmental effects of exercise of consents

Results of stormwater sampling were within the limits prescribed by the consent for the wellsite for all samples. No adverse effects were noted on the receiving environment due to a lack of discharge being observed or sampled.

Small amounts of groundwater may have been encountered as produced water during operations at the wellsite. It was anticipated that the abstraction of groundwater would not impact on any groundwater resource and that the groundwater would not be affected as it would be protected by the well casing from contamination by drilling activities.

There were no adverse effects on the environment resulting from the discharges to air at the Turangi-C wellsite.

The Company implemented various mitigation measures to ensure the storage and use of hazardous substances onsite did not contaminate surface waters and soils. As a result, there were no issues or adverse effects noted as a result of the use of these substances.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the monitoring period under review is set out in Tables 3-6

Table 3 Summary of performance for consent 9416

Purpose: To take groundwater, as 'produced water' during hydrocarbon activities at the Turangi-C wellsite		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Static water level not lowered by more than 10 % by abstraction	Inspection	Yes
2. Limits of abstraction upon saltwater intrusion effects	Inspection	Yes
3. Well log to 1000 m submitted to the Council	Report submitted	Yes
4. Lapse condition	Inspection	Yes

Purpose: To take groundwater, as 'produced water' during hydrocarbon activities at the Turangi-C wellsite		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Review Condition	No provision for review during the period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 4 Summary of performance for consent 9415-1

Purpose: To discharge treated stormwater and produced water from hydrocarbon exproation and production operations at the Turangi-C wellsite onto land		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practicable option	Inspection	Yes
2. Limits to size of discharge area	Inspection	Yes
3. Limits to discharge application rate	Inspection	Yes
4. Appropriate design of perimeter drain and skimmer pits	Inspection	Yes
5. Skimmer pits and stormwater reception areas shall be lined with appropriate material	Inspection	Yes
6. Skimmer pit capacity no less than 100 m ³ before discharge	Inspection	Yes
7. Notification of site works	Notification	Yes
8. Notification of contingency plan	Report submitted	Yes
9. Requirements of stormwater design	Inspection	Yes
10. Notification of site reinstatement	Notification	N/A
11. Lapse condition	Inspection	Yes
12. Review conditions	No provision for review during the period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 5 Summary of performance for consent 9422-1

Purpose: To discharge stormwater and sediment, deriving from soil disturbance undertaken for the purpose of constructing the Turangi-C wellsite, onto land where it may enter an unnamed tributary of the Parahaki Stream		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Limits on earthworks stormwater catchment size	Inspection	Yes
2. Consent holder to adopt best practicable option	Inspection	Yes
3. Notification of earthworks	Inspection	Yes
4. Requirements of stormwater system design	Inspection	Yes
5. Requirements of stormwater system construction	Inspection	Yes
6. Requirements upon completion of earthworks	Inspection	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 6 Summary of performance for consent 9419-1

Purpose: To discharge contaminants to air from hydrocarbon exploration at the Turangi-C wellsite, including combustion involving flaring or incineration of petroleum recovered from natural deposits, in association with well development or redevelopment and testing or enhancement of well production flows		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Defines limits on flaring	Inspection	Yes
2. Requirements of flare pit design	Inspection	Yes
3. Notification to TRC of flaring	Notification	Yes
4. Notification to affected parties of flaring	Notification	Yes
5. Limits upon flaring material	Inspection	Yes
6. Pre-treatment of flared material	Inspection	Yes
7. Conditions on flaring materials when separation not achievable	Notification, Inspection	Yes
8. Report on flaring associated with condition 7	Report	Yes
9. Consent holder to adopt best practicable option	Inspection	Yes

Purpose: To discharge contaminants to air from hydrocarbon exploration at the Turangi-C wellsite, including combustion involving flaring or incineration of petroleum recovered from natural deposits, in association with well development or redevelopment and testing or enhancement of well production flows		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
10. No offensive odour or smoke beyond the boundary	Inspection	Yes
11. Control of contaminants in emissions	Inspection	Yes
12. Control of contaminants other than in condition 11	Inspection	Yes
13. Gas and condensate analysis	Report received	Yes
14. Vapour recovery systems to be fitted	Inspection	Yes
15. Requirements of combustion recording and reporting	Report received	Yes
16. Lapse condition	Inspection	Yes
17. Review condition	No provision for review during the period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

3.4 Alterations to monitoring programmes for 2018-2019

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

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

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

It is proposed that for 2018-2019 monitoring of consented activities at the Turangi-C wellsite continue at the same level as in 2016-2018. A recommendation to this effect is attached to this report.

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 subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at Turangi-C wellsite in the 2018-2019 year continue at the same level as previously carried out.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

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.
Bund	A wall around a tank to contain its contents in the case of a leak.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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.
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.
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.

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	<i>Resource Management Act 1991</i> 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.
Zn*	Zinc.

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

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

Appendix I

Resource consents held by Greymouth Petroleum 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 Limited
P O Box 3394
NEW PLYMOUTH 4341

Decision Date: 5 February 2013

Commencement
Date: 5 February 2013

Conditions of Consent

Consent Granted: To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi-C wellsite onto land at or about (NZTM) 1712890E-5681104N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Turangi-C wellsite, 162-174 Turangi Road Upper, Motunui
(Property owner: Ducal Products Ltd)

Legal Description: Lot 1 DP 19476 (Discharge source & site)

Catchment: Parahaki

*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 14,000 m².
3. The discharge shall be applied at such a rate and over such an area of land that it infiltrates the soil and does not pond or run off to water.
4. All runoff from the site 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 the skimmer pit without ponding.
5. All skimmer pits and any other stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls.
6. Skimmer pits shall have a combined capacity of no less than 100 m³ before being discharged.
7. 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; and
 - b) commencement of any well drilling operation.

If either 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 a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

8. 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. The contingency plan shall be provided to the Council prior to discharging from the site.

Consent 9415-1

9. Subject 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 consent application 7260 and in particular, the:
 - a) AEE submitted with the application;
 - b) Stormwater management plan provided in Appendix 3 of the AEE; and
 - c) Stormwater pond design report for Turangi-C wellsite provided, dated 27 November 2012.
10. 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.
11. This consent shall lapse on 31 March 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
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 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 5 February 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: Greymouth Petroleum Limited
P O Box 3394
NEW PLYMOUTH 4341

Decision Date: 5 February 2013

Commencement
Date: 5 February 2013

Conditions of Consent

Consent Granted: To take groundwater, as 'produced water' during hydrocarbon exploration and production activities at the Turangi-C wellsite at or about (NZTM) 1712960E-5680969N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Turangi-C wellsite, 162-174 Turangi Road Upper, Motunui
(Property owner: Ducal Products Ltd)

Legal Description: Lot 1 DP 19476 (Site of take)

Catchment: Parahaki

*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 ensure the abstraction does not cause more than a 10% lowering of static water-level by interference with any adjacent bore.
2. The consent holder shall ensure the abstraction does not cause the intrusion of salt water into any freshwater aquifer.
3. The consent holder shall submit a summary well log to a depth of 1000 metres, within three months of the completion of drilling. The report shall:
 - a) include confirmation of the datum from which measurements are referenced;
 - b) provide a log to show the true vertical depth to all geological formation tops intersected within the freshwater zone;
 - c) identify the true vertical depth to, and thickness of, any freshwater aquifers intersected by the well; and
 - d) identify the true vertical depth to the freshwater-saline water interface in the well.
4. This consent shall lapse on 31 March 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
5. 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 5 February 2013

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 Limited
P O Box 3394
NEW PLYMOUTH 4341

Decision Date: 5 February 2013

Commencement
Date: 5 February 2013

Conditions of Consent

Consent Granted: To discharge contaminants to air from hydrocarbon exploration at the Turangi-C wellsite, including combustion involving flaring or incineration of petroleum recovered from natural deposits, in association with well development or redevelopment and testing or enhancement of well production flows at or about (NZTM) 1712926E-5681060N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021 and in accordance with special condition 17

Site Location: Turangi-C wellsite, 162-174 Turangi Road Upper, Motunui
(Property owner: Ducal Products Ltd)

Legal Description: Lot 1 DP 19476 (Discharge source & site)

*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. Flaring shall not occur on more than 15 days, cumulatively, per zone for each well (with a maximum of 4 zones per well), for up to 8 wells.
2. Flaring shall only occur in a flare pit that is located at NZTM 1712926E-5681060N and lined with impermeable material that prevents any liquid from leaking through its base or sidewalls.
3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, at least 24 hours before the initial flaring of each zone being commenced. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.
4. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to the occupants of all dwellings within 300 metres of the wellsite 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 in respect of any flaring activity.
5. No material shall be flared or incinerated, other than those derived from or entrained in the well stream.
6. To the greatest extent possible, all gas that is flared must first be treated by effective liquid and solid separation and recovery.
7. Only gaseous hydrocarbons originating from the well stream shall be combusted, except that if, for reasons beyond the control of the consent holder, effective separation can not be achieved and combustion of liquid hydrocarbon is unavoidable, the consent holder shall reinstate effective separation as soon as possible and if separation can not be achieved within 3 hours combustion must cease.
8. If liquid hydrocarbon is combusted in accordance with condition 7 the consent holder shall prepare a report that details:
 - a) the reasons that separation could not be achieved;
 - b) the date and time that separation was lost and reinstated; and
 - c) what was done to attempt to reinstate separation and, if the attempt was unsuccessful the reasons why.

The report shall be provided to the Chief Executive, Taranaki Regional Council within 5 working days from the date of combustion of liquid hydrocarbon.

Consent 9419-1

9. 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, including, but not limited to, having 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 (other than for the maintenance of a pilot flare flame).
10. The discharge shall not cause any objectionable or offensive odour or objectionable or offensive smoke at or beyond the boundary of the property where the wellsite is located.
11. The consent holder shall control all emissions of carbon monoxide, nitrogen dioxide, fine particles (PM₁₀) and sulphur dioxide to the atmosphere from the site, in order that the maximum ground level concentration of any of these contaminants arising from the exercise of this consent measured under ambient conditions does not exceed the relevant ambient air quality standard as set out in the Resource Management (National Environmental Standards for Air Quality Regulations, 2004) at or beyond the boundary of the property on which the wellsite is located.
12. The consent holder shall control all emissions to the atmosphere from the site of contaminants other than those expressly provided for under special condition 11, in order that they do not individually or in combination with other contaminants cause a hazardous, noxious, dangerous, offensive or objectionable effect at or beyond the boundary of the property on which the wellsite is located.
13. 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 C₆ or higher number of compounds.
14. All permanent tanks used as hydrocarbon storage vessels, shall be fitted with vapour recovery systems.
15. The consent holder shall record and make available to the Chief Executive, Taranaki Regional Council upon request, a 'flaring log' that includes:
 - a) the date, time and duration of all flaring episodes;
 - b) the zone from which flaring occurred;
 - c) the volume of substances flared;
 - d) whether there was smoke at any time during the flaring episode and if there was, the time, duration and cause of each 'smoke event'.
16. This consent shall lapse on 31 March 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 9419-1

17. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review:

- a) during the month of June 2015 and/or June 2021; and/or
- b) within 1 month of receiving a report provided in accordance with condition 8;

for any of the following purposes:

- i. dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
- ii. requiring the consent holder to adopt specific practices in order to achieve the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
- iii. to alter, add or delete limits on mass discharge quantities or ambient concentrations of any contaminant; and
- iv. reducing emissions or environmental effects that may arise from any loss of separation.

Signed at Stratford on 5 February 2013

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 Limited
P O Box 3394
NEW PLYMOUTH 4341

Decision Date: 5 February 2013

Commencement
Date: 5 February 2013

Conditions of Consent

Consent Granted: To discharge stormwater and sediment, deriving from soil disturbance undertaken for the purpose of constructing the Turangi-C wellsite, onto land where it may enter an unnamed tributary of the Parahaki Stream at or about (NZTM) 1712890E-5681104N

Expiry Date: 1 June 2017

Site Location: Turangi-C wellsite, 162-174 Turangi Road Upper, Motunui
(Property owner: Ducal Products Ltd)

Legal Description: Lot 1 DP 19476 (Discharge source & site)

Catchment: Parahaki

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

General condition

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

Special conditions

1. This consent authorises the discharge of stormwater from no more than 2.171 ha of land where earthworks is being undertaken for the purpose of establishing the Turangi-C wellsite.
2. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.
3. At least 7 working days before the commencement of earthworks for the purpose of wellsite construction and establishment, the consent holder shall notify the Taranaki Regional Council of the proposed start date for the earthworks. Notification shall include the consent number and a brief description of the activity consented and shall be emailed to worknotification@trc.govt.nz.
4. All run off from any area of exposed soil shall pass through settlement ponds or sediment traps with a minimum total capacity of:
 - a) 100 cubic metres for every hectare of exposed soil between 1 November to 30 April; and
 - b) 200 cubic metres for every hectare of exposed soil between 1 May to 31 October;unless other sediment control measures that achieve an equivalent standard are agreed to by the Chief Executive of the Taranaki Regional Council.
5. The obligation described in condition 4 above shall cease to apply, and accordingly the erosion and sediment control measures may be removed, in respect of any particular area, only when the area is stabilised

Note: For the purpose of conditions 4 and 5, "stabilised" in relation to any site or area means inherently resistant to erosion or rendered resistant, such as by using rock or by the application of basecourse, colluvium, grassing, mulch, or another method to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council and as specified in the Taranaki Regional Council's Guidelines for Earthworks in the Taranaki Region, 2006. Where seeding or grassing is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once, on reasonable visual inspection by an officer of the Taranaki Regional Council, an 80% vegetative cover has been established.

Consent 9422-1

6. All earthworked areas shall be stabilised vegetatively or otherwise as soon as is practicable and no longer than 6 months after the completion of soil disturbance activities.

Note: For the purposes of this condition "stabilised" has the same definition as that set out in condition 5.

Signed at Stratford on 5 February 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix II

Biomonitoring reports

To Job Manager, Callum MacKenzie
From Technical Officer, Katie Blakemore
Document 1738160
Report No. KB011
Date 31 August 2016

Biomonitoring of an unnamed tributary of the Parahaki Stream in relation to drilling at the Turangi-C wellsite, Winter 2016

Introduction

A pre-drill biological survey was carried out at the Turangi-C wellsite, to provide baseline data on the health of the macroinvertebrate community in this unnamed tributary of the Parahaki Stream prior to the commencement of drilling activities. A follow-up survey was undertaken upon completion of the drilling to determine whether stormwater discharges onto land near this unnamed tributary of the Parahaki Stream had impacted on the stream macroinvertebrate community.

Methods

The pre-drill survey was completed on 3 June 2016 at three previously established sites (Table 1, Figure 1). These sites were situated in an unnamed tributary of the Parahaki Stream, with a 'control' site approximately 20m upstream of the discharge point (Site 1), a 'primary impact' site 20m downstream of this discharge point (Site 2) and a 'secondary impact' site 85m downstream of this discharge point (Site 3). A post-drill survey at these same sites was carried out on 9 August 2016.

The Council's standard 'vegetation sweep' technique was used to collect streambed macroinvertebrates in the unnamed tributary of the Parahaki Stream. The 'vegetation sweep' technique is very similar to C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Table 1 Biomonitoring sites in the unnamed tributary of the Parahaki Stream in relation to discharges from the Turangi-C wellsite

Site number	Site code	Grid reference (NZTM)	Location	Altitude (masl)
1	PRH000035	E1712866 N5681040	20m upstream of Turangi-C wellsite discharge	60
2	PRH000037	E1712905 N5681107	20m downstream of Turangi-C wellsite discharge	60
3	PRH000040	E1712931 N5681171	85m downstream of Turangi-C wellsite discharge	60



Figure 1 Biomonitors sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi-C wellsite.

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 abundances found in each sample were recorded based on the 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. 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 and Boothroyd and Stark, 2000) (Table 3). More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

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 (SQMCI_s) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI_s is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower. Macroinvertebrate community health grades can also be assigned from the SQMCI_s, although these have not been modified for Taranaki. The grades based on the SQMCI_s are given in Table 4.

Table 4 Macroinvertebrate community health based on SQMCI_s ranges from Stark and Maxted's classification (Stark and Maxted 2007)

Grading	SQMCI _s
Excellent	> 5.99
Good	5.00-5.99
Fair	4.00-4.99
Poor	<4.00

Results

At the time of the pre-drill survey being carried out, there was a slow or very slow/still clear, uncoloured flow with a low water level at all three sites. The substrate at all sites was predominantly silt and sand. Sites 2 and 3 also had small amounts of fine and coarse gravel. Water temperatures ranged between 12.7- 13.6°C at the three sites. The survey was carried out 3 days since a fresh of 3x median flow and 6 days since a fresh of 7x median flow (based on the nearby Mangaoraka Stream).

All three sites had no periphyton, moss or wood present. Patchy leaves were present on the streambed at sites 1 and 2 but absent at site 3. Macrophytes were present throughout the streambed at all three sites.

The post-drill survey was carried out 1 day after a fresh of 3x median flow and 4 days after a fresh of 7x median flow. There was a moderate to high flow which was clear and uncoloured. The flow was steady at site 1 and slow at sites 2 and 3. Water temperatures ranged from 13.9 – 14.5 °C at the three sites. The substrate at all sites was predominantly silt and sand, with small amounts of fine and coarse gravel. Wood and root were also present at sites 1 and 2.

All three sites had no periphyton or moss present. Leaves were widespread on the streambed at site 1 and patchy at sites 2 and 3, while wood was patchy at sites 1 and 2 but absent at site 3. Macrophytes were present on the streambed at all three sites.

Macroinvertebrate communities

A summary of previously recorded median scores and ranges for macroinvertebrate indices in Taranaki lowland coastal streams between 50 and 79 metres above sea level, together with results recorded in the current surveys are provided in Table 5.

Table 5 Summary of medians and ranges based on previously recorded data from Taranaki lowland coastal streams between 50-79m above sea level (TRC 2015), together with results recorded in the current surveys

	Lowland Coastal		Pre-drill survey			Post-drill survey		
	Median	Range	PRH000035	PRH000037	PRH000040	PRH000035	PRH000037	PRH000040
Number of taxa	20	0-30	12	11	11	10	12	12
MCI	79	60-109	83	80	58	76	80	58
SQMCI _s	4.0	1.4-6.7	2.2	4.1	1.6	1.2	1.4	1.7

The results of the pre-drill survey are provided in Table 6, and the results of the post-drill survey are provided in Table 7.

Table 6 Macroinvertebrate fauna of the unnamed tributary of Parahaki Stream in relation to Turangi-C wellsite stormwater discharge sampled on 3 June 2016

Taxa List	Site Number	MCI score	1	2	3
	Site Code		PRH000035	PRH000037	PRH000040
	Sample Number		FWB16210	FWB16211	FWB16212
NEMERTEA	Nemertea	3	R	-	-
NEMATODA	Nematoda	3	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	VA	A	A
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	A
MOLLUSCA	<i>Potamopyrgus</i>	4	R	A	-
	Sphaeriidae	3	C	C	-
CRUSTACEA	Ostracoda	1	A	A	VA
	Isopoda	5	-	R	-
	<i>Paracalliope</i>	5	A	VA	C
	Paraleptamphopidae	5	A	C	-
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	-	R	C
TRICHOPTERA (CADDISFLIES)	<i>Polypsectropus</i>	6	R	-	-
	<i>Oxyethira</i>	2	-	-	R
	<i>Triplectides</i>	5	-	-	R
DIPTERA (TRUE FLIES)	<i>Paralimnophila</i>	6	R	-	-
	<i>Zelandotipula</i>	6	R	C	-
	<i>Chironomus</i>	1	-	-	A
	Orthoclaadiinae	2	-	-	R
	Tanypodinae	5	R	A	C
ACARINA (MITES)	Acarina	5	C	R	-
No of taxa			12	11	11
MCI			83	80	58
SQMCIs			2.2	4.1	1.6
EPT (taxa)			1	0	1
%EPT (taxa)			8	0	9
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa		
R = Rare	C = Common	A = Abundant	VA = Very Abundant	XA = Extremely Abundant	

Table 7 Macroinvertebrate fauna of the unnamed tributary of Parahaki Stream in relation to Turangi-C wellsite stormwater discharge sampled on 9 August 2016

Taxa List	Site Number	MCI score	1	2	3
	Site Code		PRH000035	PRH000037	PRH000040
	Sample Number		FWB16213	FWB16214	FWB16215
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	-	R
ANNELIDA (WORMS)	Oligochaeta	1	XA	XA	XA
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	C
MOLLUSCA	Lymnaeidae	3	-	R	R
	<i>Potamopyrgus</i>	4	C	A	-
	Sphaeriidae	3	A	A	-
CRUSTACEA	Copepoda	5	R	-	-
	Ostracoda	1	C	A	VA
	<i>Paracalliope</i>	5	C	A	VA
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	-	C	A
TRICHOPTERA (CADDISFLIES)	<i>Polypsectropus</i>	6	-	C	-
	<i>Oxyethira</i>	2	-	-	R
	<i>Triplectides</i>	5	-	R	C
DIPTERA (TRUE FLIES)	<i>Paralimnophila</i>	6	R	R	-
	<i>Chironomus</i>	1	-	-	C
	Orthoclaadiinae	2	-	-	R
	Tanypodinae	5	C	C	C
ACARINA (MITES)	Acarina	5	C	R	-
		No of taxa	10	12	12
		MCI	76	80	58
		SQMCI	1.2	1.4	1.7
		EPT (taxa)	0	2	1
		%EPT (taxa)	0	17	8
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa		
R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant					

Site 1 (Upstream of wellsite discharge)

Low taxa richness of 12 taxa was recorded at this upstream 'control' site at the time of the pre-drill survey, while 10 taxa were recorded in the post-drill survey. These values are below the median taxa richness of 20 taxa, but within the previously recorded range of taxa richnesses for lowland coastal streams at similar altitude in Taranaki (Table 5).

The pre-drill survey recorded a MCI score of 83 at this site, while the post-drill survey recorded a MCI score of 76. These scores categorised the site as having 'fair' and 'poor' macroinvertebrate community health respectively. The difference between these scores is not statistically significant (Stark 1998), and neither score is significantly different from the median MCI score of 79 for lowland coastal streams at similar altitude in Taranaki (Table 5). In contrast, the SQMCI_s score decreased from 2.2 to 1.2 between the pre-drill and post-drill surveys, a statistically significant difference (Stark 1998).

The invertebrate community was characterised by four taxa at the time of the pre-drill survey, two 'moderately sensitive' amphipods (*Paracalliope* and Paraleptamphopidae) and two 'tolerant' taxa (ostracod seed shrimps and oligochaete worms). Two 'tolerant' taxa (oligochaete worms and sphaerid pea clams) characterised the community at the time of the post-drill survey.

Site 2 (20m downstream of wellsite discharge)

Low taxa richness of 11 taxa was recorded at this 'primary impact' site at the time of the pre-drill survey, while 12 taxa were recorded in the post-drill survey. These values are below the median taxa richness of 20 taxa, but within the previously recorded range of taxa richnesses for lowland coastal streams at similar altitude in Taranaki (Table 5).

Both the pre-drill and post-drill surveys recorded a MCI score of 80, classifying the stream as having 'fair' ecological health. Both scores are similar to the median score of 79 for similar sites in this altitudinal range (Table 5). There is no statistically significant difference between these scores (Stark 1998). The SQMCI_s scores at this site were 4.1 and 1.4 in the pre-drill and post-drill surveys respectively. This indicates a statistically significant decrease in stream health (Stark 1998).

The macroinvertebrate community at this site was characterised by five taxa at the time of the pre-drill survey and by five taxa at the time of the post-drill survey. Characteristic taxa in both surveys included one 'moderately sensitive' amphipod (*Paracalliope*), and three 'tolerant' taxa [snail (*Potamopyrgus*), ostracod seed shrimps and oligochaete worms]. The pre-drill community was characterised further by a 'moderately sensitive' fly larvae (Tanypodinae); while the post-drill invertebrate community was characterised by an additional 'tolerant' taxon (sphaerid seed shrimps).

Site 3 (85m downstream of wellsite discharge)

Low taxa richness of 11 taxa was recorded at this 'primary impact' site at the time of the pre-drill survey, while 12 taxa were recorded in the post-drill survey. These values are below the median taxa richness of 20 taxa, but within the previously recorded range of taxa richnesses for lowland coastal streams at similar altitude in Taranaki (Table 5).

Both the pre-drill and post-drill surveys recorded a MCI score of 58, classifying the stream as having 'very poor' ecological health. These scores are significantly lower than the median MCI score of 79 for similar sites in this altitudinal range (Table 5) (Stark 1998). The SQMCI_s scores were recorded as 1.6 units for the pre-drill survey and a similar 1.7 units for the post-drill survey. These scores are not significantly different from each other, but are significantly lower than the median SQMCI_s score of 4.0 units for lowland coastal streams at similar altitude in Taranaki (Table 5).

The macroinvertebrate community at this site was characterised by four numerically dominant taxa at the time of the pre-drill survey and four taxa at the time of the post-drill survey. Characteristic taxa in both surveys

were the two 'tolerant' taxa [oligochaete worms and ostracod seed shrimps]. The pre-drill survey found two additional 'tolerant' characteristic taxa [leeches and midge larvae (*Chironomus*)], while the post-drill survey also found two additional characteristic taxa, the 'moderately sensitive' amphipod (*Paracalliope*) and the 'tolerant' damselfly (*Xanthocnemis*).

Discussion and conclusions

The Council's 'vegetation sweep' technique was used to collect samples from three sites in this unnamed tributary on two occasions. This has provided data to assess the impact of the stormwater discharge to land from the Turangi-C wellsite on the macroinvertebrate communities of the stream. Samples were processed to provide taxa richness, MCI and SQMCI_s scores for each site.

Taxa richness is a valuable macroinvertebrate community metric when determining whether a community has been exposed to a toxic discharge, as macroinvertebrates will either drift downstream to avoid the discharge or may be killed. This would result in a reduced taxa richness at the downstream sites. In contrast, the MCI and SQMCI_s scores are a measure of community tolerance to organic pollution, although they can also provide an indication of more subtle influences caused by a poor quality discharge. As the SQMCI_s score takes into account relative abundances of the taxa found in the sample, it provides additional insight to that provided by the MCI score. However, it is also easily influenced by the 'patchiness' of invertebrates on the stream bed, and as such must be considered in the context of all three metrics.

Taxa richnesses were found to be low in all instances. There were no significant differences in taxa richnesses between any of the three sites or between surveys. All taxa richnesses were lower than the median taxa richness for Taranaki lowland coastal stream sites between 50 and 79m above sea level (Table 5). The low taxa richnesses are most likely a result of poor quality habitat, with the streambed made up primarily of fine sediment which does not support high quality freshwater macroinvertebrate communities. Furthermore, the taxa found in the current surveys are generally associated with macrophytes, which were extensive at all sites.

MCI scores did not change significantly for any of the three sites between survey occasions, although site 3 recorded a significantly lower MCI score than either site 1 or site 2 on both occasions. MCI scores at sites 1 and 2 were similar to the median scores for Taranaki lowland coastal streams at similar altitude, while the score for site 3 was significantly lower than this median on both occasions. This is likely a reflection of habitat differences, with site 3 having less shading (due to only minor overhanging vegetation at site 3), and less woody debris in the stream channel (which provides important invertebrate habitat in soft-bottomed streams).

SQMCI_s scores were 2.2, 4.1 and 1.6 for sites 1-3 respectively in the pre-drill survey. Sites 1 and 3 recorded scores that are insignificantly different from each other, while site 2 had a significantly higher score than either site 1 or site 3 (Stark 1998). The scores recorded in the post-drill survey were 1.2, 1.4 and 1.7 for these sites respectively. There is no significant difference between SQMCI_s scores between sites in this survey (Stark 1998). Both site 1 and site 2 showed a significant decrease in SQMCI_s score between the pre-drill and post-drill surveys (Stark 1998), while scores for site 3 were similar on both occasions. The decrease observed at site 1 was primarily due to the increase of oligochaete worms (MCI score 1) from 'very abundant' to 'extremely abundant', while at site 2 it was primarily due to the decrease of tanypod larvae from 'abundant' to 'common' and *Paracalliope* amphipods from 'very abundant' to 'abundant'.

All scores except for site 2 during the pre-drill survey were significantly below the median SQMCI_s score for Taranaki lowland coastal streams at similar altitude.

A previous survey has been carried out at these sites (TRC, unpublished data). The results of this survey found similar results at sites 1 and 2, with no decline in MCI score observed at site 3. It is possible that there has been a change in habitat at site 3, with increased sedimentation on the streambed since the previous survey. A culvert approximately 5m downstream of site 3 would contribute to a buildup of deposited sediment on the streambed at this site. Furthermore, the construction of the wellsite pad occurred during this interval, which

could have resulted in an increased fine sediment supply to the stream. However, there is insufficient evidence to attribute this change at site 3 to the Turangi-C wellsite.

Overall the invertebrate metrics recorded in these surveys provided no evidence that discharges from the Turangi-C wellsite have had any impact on the macroinvertebrate communities of this unnamed tributary of the Parahaki Stream. The low taxa richnesses observed are a result of poor quality habitat, and did not change significantly between surveys. The MCI scores did not change significantly at any site between the two surveys, indicating that any discharges from the Turangi-C wellsite have not had a significant impact on the macroinvertebrate communities. The significantly lower score recorded at site 3 compared to sites 1 and 2 is likely to be a reflection of habitat differences and is unlikely to be related to the wellsite discharges. This is evidenced by the score being similar in both the pre-drill and post-drill surveys. Further, any discharges would be expected to have the largest impact on macroinvertebrate communities at site 2, the 'primary impact' site and these were not observed. Differences in SQMCI_s scores are the result of changes in abundance of particular taxa, and are considered to reflect the patchy nature of stream macroinvertebrate communities rather than the effects of any discharges that may have occurred.

Summary

Two macroinvertebrate surveys were carried out at three sites near the Turangi-C wellsite prior to and following drilling activities, to determine if discharges from the wellsite had had detrimental effects on the stream macroinvertebrate communities. These surveys, undertaken in June 2016 and August 2016, both recorded taxa richnesses that were low at all three sites. MCI scores ranged from 83 – 58 across the two surveys. No site recorded a significant change in MCI score between the two surveys, although site 3 recorded significantly lower scores than sites 1 and 2 in both surveys. This is likely to be a result of habitat differences between the sites. SQMCI_s scores ranged widely between sites and surveys, and reflected the changes in abundance of particular taxa. Overall, there is no evidence that discharges from the Turangi-C wellsite have impacted on the macroinvertebrate communities of this unnamed tributary of the Parahaki Stream.

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