

**Greymouth Petroleum Turangi Ltd**

**Turangi-A Hydraulic Fracturing**

Monitoring Programme

2018-2021

Technical Report 22-101



Working with people | caring for Taranaki



Taranaki Regional Council  
Private Bag 713  
Stratford

ISSN: 1178-1467 (Online)  
Document: 2688029 (Word)  
Document: 3131919 (Pdf)  
March 2023

**Greymouth Petroleum Turangi Ltd**

**Turangi-A Hydraulic Fracturing**

Monitoring Programme

2018-2021

Technical Report 22-101



# Greymouth Petroleum Turangi Ltd

## Turangi-A Hydraulic Fracturing

Monitoring Programme  
2018-2021

Technical Report 22-101

Taranaki Regional Council  
Private Bag 713  
Stratford

ISSN: 1178-1467 (Online)  
Document: 268029 (Word)  
Document: 3131919 (Pdf)  
March 2023



## Executive summary

Greymouth Petroleum Turangi Ltd (the Company) operates the Turangi-A hydrocarbon exploration site located on Turangi Road, Motunui. This site is located in the Parahaki catchment. This report outlines and discusses the results of the monitoring programme implemented by the Council in relation to hydraulic fracturing activities conducted by the Company at the wellsite over the period 15 October 2019 to 8 January 2020. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The programme of hydraulic fracturing undertaken by the Company at the Turangi-A wellsite included the hydraulic fracturing of one well. The well targeted for stimulation was the Turangi-7 well.

**During the monitoring period, the Company demonstrated an overall high level of environmental and a high level of administrative performance.**

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities spanned the 2018-2019, 2019-2020 and 2020-2021 monitoring years. Monitoring included pre and post-discharge groundwater sampling. Two biomonitoring surveys were also carried out on a tributary of the Parahaki Stream in relation to the hydraulic fracturing programme. Samples of hydraulic fracturing fluids, and fluids returning to the wellhead post-fracturing, were also obtained for physicochemical analysis in order to characterise the discharges and to determine compliance with consent conditions.

This is the second monitoring report produced by the Council in relation to the hydraulic fracturing activities at the Turangi-A wellsite.

The monitoring carried out by the Council indicates that the hydraulic fracturing activities undertaken by the Company had no significant adverse effects on local groundwater or surface water resources. There were no unauthorised incidents recording non-compliance in respect of the resource consent held by the Company in relation to these activities or provisions in regional plans, during the period under review.

For reference, in the 2021-2022 year, consent holders were found to achieve a high level of environmental performance and compliance for 88% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 10% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the future monitoring of any hydraulic fracturing activities at the Turangi-A wellsite.





## Table of contents

	Page	
1	Introduction	1
1.1	Compliance monitoring programme reports and the Resource Management Act 1991	1
1.1.1	Introduction	1
1.1.2	Structure of this report	1
1.1.3	The Resource Management Act 1991 and monitoring	1
1.1.4	Evaluation of environmental and administrative performance	2
1.2	Process description	2
1.2.1	Hydraulic fracturing	2
1.2.1.1	Gel fracturing	3
1.2.1.2	Slick water fracturing	3
1.2.1.3	Nitrogen gas fracturing	3
1.2.2	The Turangi-A wellsite and hydraulic fracturing activities	3
1.3	Resource consents	4
1.4	Monitoring programme	6
1.4.1	Introduction	6
1.4.2	Programme liaison and management	6
1.4.3	Assessment of data submitted by the consent holder	6
1.4.4	Physicochemical sampling	6
1.4.4.1	Groundwater	6
1.4.4.2	Hydraulic fracturing and return fluids	7
1.4.5	Surface water quality monitoring	7
1.4.5.1	Biomonitoring surveys	7
2	Results	9
2.1	Consent holder submitted data	9
2.1.1	Turangi-7 post-fracturing discharge report	9
2.2	Physicochemical sampling	9
2.2.1	Groundwater	9
2.2.2	Hydraulic fracturing and return fluids	11
2.3	Biomonitoring surveys	15
2.4	Investigations, interventions, and incidents	16
3	Discussion	17
3.1	Environmental effects of exercise of consents	17

3.2	Evaluation of performance	17
3.3	Alterations to monitoring programmes of future hydraulic fracturing events	19
3.4	Exercise of optional review of consent	19
4	Recommendations	20
	Glossary of common terms and abbreviations	21
	Bibliography and references	23
Appendix I	Resource consent held by Greymouth Petroleum Turangi Ltd	1
Appendix II	Categories used to evaluate environmental and administrative performance	1
Appendix III	Certificates of analysis (groundwater)	i
Appendix IV	Certificates of analysis (hydraulic fracturing fluids)	i

## List of tables

Table 1	Summary of hydraulic fracturing details	4
Table 2	Resource consent held by the Company during the period under review	4
Table 3	Details of groundwater sites included in the monitoring programme	6
Table 4	Surface water monitoring site details	7
Table 5	Results of groundwater sampling carried out in relation to the Turangi-7 fracturing event	10
Table 6	Results of hydraulic fracturing fluid sampling	12
Table 7	Results of hydraulic fracturing return fluid sampling	13
Table 8	Summary of performance for consent 10000-1	17

## List of figures

Figure 1	Location map	5
Figure 2	Location of biomonitoring sites in relation to the Turangi-A wellsite	15

# 1 Introduction

## 1.1 Compliance monitoring programme reports and the Resource Management Act 1991

### 1.1.1 Introduction

This report outlines and discusses the results of the monitoring programme implemented by the Taranaki Regional Council (the Council) in relation to the programme of hydraulic fracturing undertaken by Greymouth Petroleum Turangi Limited (the Company) at the Turangi-A wellsite, over the period 15 October 2019 to

8 January 2020. The report also assesses the Company's level of environmental performance and compliance with the resource consent held in relation to the activity.

The programme of hydraulic fracturing undertaken by the Company at the Turangi-A wellsite included the hydraulic fracturing of one well. The well targeted for stimulation was the Turangi-7 well.

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities spanned the 2018-2019, 2019-2020 and 2020-2021 monitoring years. Monitoring included a mixture of groundwater, surface water and discharge monitoring components. This is the second monitoring report produced by the Council in relation to hydraulic fracturing activities at the Turangi-A wellsite. The first covered hydraulic fracturing activities related to the Turangi-3 well during the 2016-2017 and 2017-2018 monitoring years.

### 1.1.2 Structure of this report

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

- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at the Turangi-A wellsite.

**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 for the future monitoring of any hydraulic fracturing activities at the Turangi-A wellsite.

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 Resource Management Act 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

- a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
- b. physical effects on the locality, including landscape, amenity and visual effects;
- c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

- d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and
- e. risks to the neighbourhood or environment.

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

### 1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns a rating as to each Company's environmental and administrative performance during the period under review. The rating categories are high, good, improvement required and poor for both environmental and administrative performance. The interpretations for these ratings are found in Appendix II.

For reference, in the 2021-2022 year, consent holders were found to achieve a high level of environmental performance and compliance for 88% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 10% of the consents, a good level of environmental performance and compliance was achieved.<sup>1</sup>

## 1.2 Process description

### 1.2.1 Hydraulic fracturing

Hydraulic fracturing is a reservoir stimulation technique used to increase the flow of hydrocarbons to the surface. The primary objective of hydraulic fracturing is to increase the permeability of the target reservoir by creating numerous small, interconnected fractures, thus increasing the flow of hydrocarbons from the formation to a given well. The process of hydraulic fracturing has enabled companies to produce hydrocarbons at economically viable rates from extremely low permeability reservoirs and those that have become depleted using conventional production techniques.

The process of hydraulic fracturing involves the pumping of fluids and a proppant (medium-grained sand or small ceramic pellets) down a well, through a perforated section of the well casing, and into the target reservoir. The fluid mixture is pumped at a pressure that exceeds the fracture strength of the reservoir rock in order to create fractures. Once fractures have been initiated, pumping continues in order to force the fluid and proppant into the fractures created. The proppant is designed to keep the fractures open when the pumping is stopped. The placement of proppant into the fractures can be assisted by the use of cross-linked gels (gel fracturing), turbulent flow (slick-water fracturing) or the use of nitrogen gas.

---

<sup>1</sup> The Council has used these compliance grading criteria for more than 18 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

### 1.2.1.1 Gel fracturing

Gel fracturing utilises cross-linked gel solutions, which are liquid at the surface but, when mixed, form long-chain polymer bonds and thus become viscous gels. These gels are used to transport the proppant into the formation. Once in the formation they 'break' back with time, temperature and the aid of gel breaking chemicals into a liquid state and are flowed back to surface, without disturbing the proppant which remains in place and enhances the flow of hydrocarbons back to the surface.

### 1.2.1.2 Slick water fracturing

Slick water fracturing utilises water based fracturing fluids with friction-reducing additives. The addition of the friction reducers allows the fracturing fluids and proppant to be pumped to the target zone at higher rates and reduced pressures, than when using water alone. The higher rate creates turbulence within the fluid column holding the proppant and enabling its placement into the open fractures and enhancing the flow of hydrocarbons back to the surface.<sup>2</sup>

### 1.2.1.3 Nitrogen gas fracturing

Nitrogen gas assisted fracturing involves replacing some of the fluid used in the fracturing process with nitrogen gas, which can fracture rock at high pressures much like water. While nitrogen (N<sub>2</sub>) is a gas at room temperature, it can be maintained in a liquid state through cooling and pressurisation. Nitrogen assisted fracturing is extremely beneficial from a production standpoint as inevitably during the fracturing process some of the water pumped down the well remains underground in the rock formation, which can block some of the small pores, inhibiting hydrocarbon recovery. Nitrogen gas achieves the same purpose as water but returns more easily to the surface.<sup>3</sup> Additionally, a reduction in the volume of water used also reduces the total concentration of chemical additives required and the volume of water returning to the surface that requires subsequent disposal.<sup>2</sup>

## 1.2.2 The Turangi-A wellsite and hydraulic fracturing activities

The Turangi-A wellsite is located on Turangi Road, Motonui and lies within the Parahaki catchment. An unnamed tributary of the Parahaki Stream is located approximately 80 m to the east of the wellsite and the main channel of the Parahaki Stream is located approximately 50 m to the west of the wellsite. The location of the wellsite is illustrated in Figure 1. A summary of the hydraulic fracturing activities carried out by the Company in the Turangi-7 well at the Turangi-A wellsite during the period being reported is provided below in Table 1.

---

<sup>2</sup> <http://geology.com/energy/hydraulic-fracturing-fluids>

<sup>3</sup> <http://frackwire.com/nitrogen-gas-fracking>

Table 1 Summary of hydraulic fracturing details

Well	Bore id.	Date	Interval	Injection zone (m TVDss)	Formation
Turangi-7	GND3049	15/10/2019	1	4,394.9-4,400.9	Mangahewa
		24/10/2019	2	4,027.9-4,049.9	
		09/11/2019	3	4,013.9-4,016.9	
		17/11/2019	4	3,971.9-3,984.9	
		03/12/2019	5	3,948.9-3,961.9	
		11/12/2019	6	3,654.9-3,660.9	
		17/12/2019	7	3,583.9-3,592.9	
		23/12/2019	8	3,503.9-3,509.9	
		30/12/2019	9	3,432.9-3,438.9	
		08/01/2020	10	3,406.9-3,412.9	

### 1.3 Resource consents

The Company holds one resource consent the details of which are summarised in Table 2 below. Summaries of the conditions attached to the permit are set out in Section 3 of this report.

A summary of the various consent types issued by the Council is included Appendix I, as are a copy of the permits held by the Company during the period under review.

Table 2 Resource consent held by the Company during the period under review

Consent number	Purpose of consent	Granted	Next review	Expires
10000-1	To discharge water based hydraulic fracturing fluids into land at depths greater than 3,350 m TVDss beneath the Turangi-A wellsite	30 Oct 2014	N/A	replaced
10000-2	To discharge water based hydraulic fracturing fluids into land at depths greater than 3,200 m TVDss beneath the Turangi-A wellsite	22 Oct 2020	June 2021	1 Jun 2039

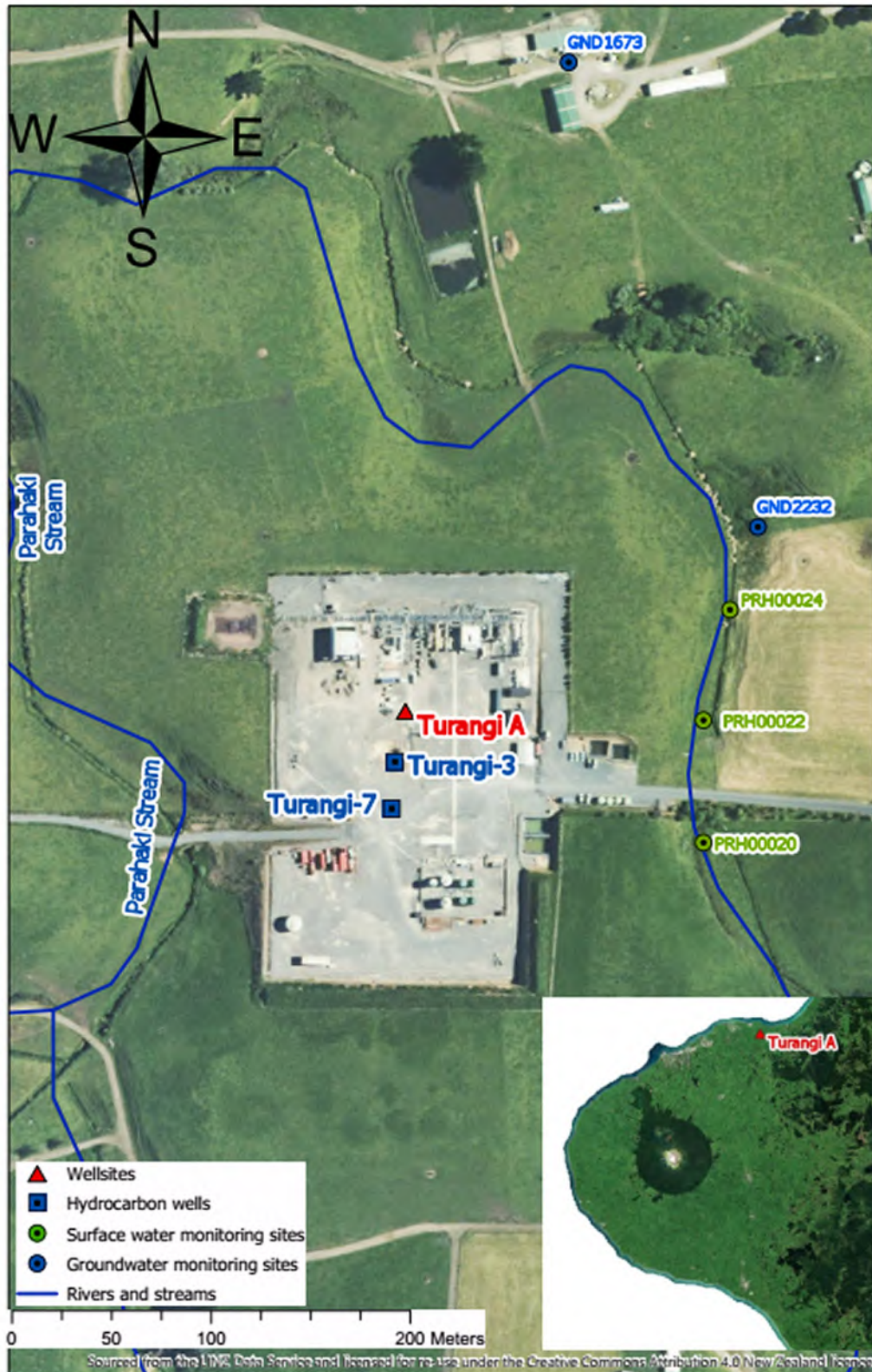


Figure 1 Location map

## 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-A 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 Assessment of data submitted by the consent holder

As required by the conditions of the Consent the Company submitted pre and post-fracturing discharge reports to the Council for the well fractured during the period under review. Pre-fracturing discharge reports provide an outline of the proposed fracturing operations in relation to each well, while post-fracturing reports confirm details of what actually occurred. The specific range of information required in each report is stipulated in the conditions of the consent.

### 1.4.4 Physicochemical sampling

#### 1.4.4.1 Groundwater

As a generally accepted rule, all existing bores or wells within a 1 km radius of the proposed hydraulic fracturing activity are assessed for their suitability for sampling (or otherwise) in the monitoring programme. Two groundwater monitoring sites (GND2232 and GND1673) were found within 1 km of the wellsite. One of the sites identified (GND1673) was deemed suitable for inclusion in the groundwater monitoring programme. The other (GND2232) was excluded from the programme as the well is very shallow (~2.5 m deep) and up-gradient of the surface water drainage from the site. Groundwater quality at this site is also already regularly monitored by the Council as part of the Company's deep well injection monitoring programme. The location of these groundwater monitoring sites are displayed in Figure 1.

Bore details for GND1673, the only groundwater monitoring site included in the Turangi-A Hydraulic Fracturing monitoring programme, are summarised in Table 3.

Table 3 Details of groundwater sites included in the monitoring programme

Monitoring site	Easting	Northing	Distance from wellsite (m)	Total depth (m)	Screened/open interval (m)	Aquifer
GND1673	5681723	1713925	285	42	26-42	Marine terraces



Samples of groundwater were obtained pre-fracturing to provide a baseline reference of groundwater composition, with further rounds of sampling carried out at various scheduled intervals during and after the commencement of activities.

#### 1.4.4.2 Hydraulic fracturing and return fluids

In addition to the sampling of local groundwater, representative samples of the hydraulic fracturing fluid and reservoir fluids produced back to the wellhead immediately following each fracturing event (return fluids) were obtained for analysis.

Samples of return fluids were collected at regular intervals during the flow-back period. Return fluids are comprised of a mixture of hydraulic fracturing fluids and formation fluids produced from the target reservoir, following the completion of the hydraulic fracturing process. The relative concentrations of each contributing fluid type change as the volume of fluid produced from the well increases. Immediately following the opening of the well post-fracturing, a high proportion of the fluid returning to the wellhead is fluid injected during the hydraulic fracturing process. As the volume of fluid produced from the well increases, the proportion of hydraulic fracturing fluid reduces in relation to formation fluids. The individual samples of return fluid are generally combined in a composite sample for laboratory analysis. Composites are designed to provide a representative sample of fluids returning to the wellhead over the entire flow-back period.

All samples were transported to Hill laboratories (Hills) for analysis following standard chain of custody procedures.

#### 1.4.5 Surface water quality monitoring

An unnamed tributary of the Parahaki Stream is located 80 m east of the site and the main channel of the Parahaki Stream is located 50 m to the west of the site (Figure 1).

Monitoring sites have been selected to monitor upstream and downstream of the estimated location of groundwater/subsurface drainage from the wellsite. Details of the three sites monitored on the unnamed tributary are included in Table 4. The locations are illustrated on Figure 1.

Table 4 Surface water monitoring site details

Monitoring site	Description	Location	Eastings	Northings
PRH000020	Unnamed tributary of the Parahaki Stream	188 m downstream of GND2106	1714011	5681322
PRH000022	Unnamed tributary of the Parahaki Stream	30 m downstream of PRH000020	1714002	5681392
PRH000024	Unnamed tributary of the Parahaki Stream	37 m downstream of PRH000022	1714012	5681446

##### 1.4.5.1 Biomonitoring surveys

Biomonitoring surveys are undertaken to determine whether stormwater discharges from the wellsite have had any detrimental impacts on the macroinvertebrate communities of the unnamed tributary of the Parahaki Stream. Samples are processed to provide number of taxa (richness), MCI and SQMCI<sub>5</sub> scores, and EPT taxa for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>5</sub> takes into account taxa abundance as well as sensitivity to pollution,

and may reveal more subtle changes in communities. It may be the more appropriate index if non-organic impacts are occurring.

Significant differences in either the MCI or the SQMCI<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

One macroinvertebrate survey was carried out prior to commencement of fracturing the Turangi-7 well on 19 June 2019. One macroinvertebrate survey was also carried out after completion of the hydraulic fracturing programme on 2 March 2020. Additional surveys were carried out on 7 November 2019 and 24 November 2020 as part of the Company's Production Station monitoring programme.

## 2 Results

### 2.1 Consent holder submitted data

#### 2.1.1 Turangi-7 post-fracturing discharge report

The conclusions from the Turangi-7 well post-fracturing discharge report are summarised as follows:

- A total of 10 zones were fractured over the period 15 October 2019 to 8 January 2020 at depths between 3,412 to 4,401 m TVDs.
- A total of 14,709 bbls (2,339 m<sup>3</sup>) of liquid was discharged across the 10 fractured zones. The total proppant weight was 437 tonnes (963,076 lbs).
- The Turangi-7 well was opened for flow-back following the completion of fracturing operations. In total 14,460 bbls (2,299 m<sup>3</sup>) of fluid was returned from the well over the initial flow-back period.
- Zones 1, 3, 5, 8, 9 and 10 returned less fluid than injected with any fluid remaining underground flowed to surface once all zones are comingled and the well begins producing.
- Four screen outs occurred (treatments 1, 3, 8 and 10) resulting in under placement of some proppant. All proppant was recovered during flow back and there were no implications for compliance with special conditions 1 and 2 of the consent.
- All return fluid from the Turangi-7 well fracturing operations was disposed of by deep well injection at the Kaimiro-G wellsite under consent 9470-1.
- Pressure testing was undertaken of all surface equipment, including flow lines and the wellhead, prior to injection.
- There was no escape of fluids during hydraulic fracturing operations.
- It is considered that the mitigation measures implemented by the Company were effective in reducing the potential for adverse environmental effects associated with fracturing operations.

### 2.2 Physicochemical sampling

#### 2.2.1 Groundwater

Hydraulic fracturing activities commenced at the Turangi-A wellsite on 15 October 2019 and continued until 8 January 2020. A pre-fracturing baseline sample was collected on 23 May 2019. Post-fracturing groundwater samples were collected three months, and 12 months following commencement of the activities on 23 January 2020 and 16 October 2020 respectively.

Methane concentrations > 1 g m<sup>3</sup> were reported in all samples both pre and post-hydraulic fracturing activities and can occur as a result of biogenic processes in sulphate depleted groundwater systems. To determine whether the source of the methane was biogenic or thermogenic, samples were sent to Geological and Nuclear Sciences (GNS) for carbon 13 isotope analysis. The presence of carbon 13 isotopes at concentrations less than -50‰ indicate a thermogenic deep gas source and concentrations greater than -50‰ a shallow biogenic gas source. Carbon 13 concentrations ranged between -61.7 to -68.3‰ indicating the source of methane was predominantly biogenic and within the expected range for shallow groundwater across Taranaki.

Overall, samples demonstrate relatively narrow ranges between analyte concentrations over time. The subtle variation in analyte concentrations at each site are a result of natural seasonal fluctuation and sampling variability. The results of the laboratory analysis indicate there have been no significant changes in groundwater composition over the period monitored.

A summary of the results for groundwater samples taken in relation to the hydraulic fracturing activities compared to baseline is included in Table 5. The certificates of analysis for the review period are included in Appendix III.

Table 5 Results of groundwater sampling carried out in relation to the Turangi-7 fracturing event

Parameter	Bore id	GND1673		
		pre-fracturing	3 mth post frac	1 Year Post frac
Sample date	-	23/05/2019	23/01/2020	16/10/2020
Lab number (Hill)	-	TRC192144	TRC200317	TRC203503
pH	pH	7.4	7.2	6.9
Total alkalinity	g/m <sup>3</sup> CaCO <sub>3</sub>	162	144	150
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	197	175	183
Total hardness	g/m <sup>3</sup> CaCO <sub>3</sub>	98	88	87
Electrical conductivity	mS/m	34.1	31.6	32
Total dissolved solids	g/m <sup>3</sup>	240	220	220
Dissolved calcium	g/m <sup>3</sup>	21	18.7	18.4
Chloride	g/m <sup>3</sup>	13.2	15.1	14.8
Dissolved magnesium	g/m <sup>3</sup>	11.3	10.1	9.9
Dissolved potassium	g/m <sup>3</sup>	5.7	5.1	5.5
Dissolved sodium	g/m <sup>3</sup>	31	30	32
Nitrite nitrogen	g/m <sup>3</sup> N	<0.002	<0.002	<0.002
Nitrate nitrogen	g/m <sup>3</sup> N	<0.002	0.004	0.004
Nitrate & nitrite nitrogen	g/m <sup>3</sup> N	<0.002	0.005	0.004
Sulphate	g/m <sup>3</sup>	<0.5	<0.5	<0.5
Dissolved barium	mg/kg	0.025	0.02	0.021
Bromide	g/m <sup>3</sup>	0.06	0.05	0.09
Dissolved copper	g/m <sup>3</sup>	<0.0005	<0.0005	<0.0005
Dissolved iron	g/m <sup>3</sup>	6.7	7.6	7
Dissolved manganese	g/m <sup>3</sup>	0.192	0.193	0.181
Dissolved mercury	g/m <sup>3</sup>	<0.00008	<0.00008	<0.00008
Dissolved nickel	mg/kg	0.0034	0.0005	0.0006
Dissolved zinc	g/m <sup>3</sup>	1.54	0.072	0.04
Ethylene glycol	g/m <sup>3</sup>	<4	<4	<4
Propylene glycol	g/m <sup>3</sup>	<4	<4	<4
Methanol	g/m <sup>3</sup>	<2	<2	<2
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010
m-Xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002
o-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010
Formaldehyde	g/m <sup>3</sup>	0.03	<0.02	<0.02
Ethane	g/m <sup>3</sup>	<0.003	<0.003	<0.003

Parameter	Bore id	GND1673		
	Unit	pre-fracturing	3 mth post frac	1 Year Post frac
Sample date	-	23/05/2019	23/01/2020	16/10/2020
Lab number (Hill)	-	TRC192144	TRC200317	TRC203503
Ethylene	g/m <sup>3</sup>	<0.004	<0.004	<0.004
Methane	g/m <sup>3</sup>	1.02	7.9	7.6
C7-C9	g/m <sup>3</sup>	<0.06	<0.10	<0.10
C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2
C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4
Total hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7	<0.7
δ13C value*	‰ (-)	66.5	68.3	61.7

## 2.2.2 Hydraulic fracturing and return fluids

The results of the analyses carried out on samples of the hydraulic fracturing fluid used in the treatment of the Turangi-7 well are shown below in Table 6. The certificates of analysis are included in Appendix IV.

The results of the analyses carried out on the return fluid samples obtained following the hydraulic fracturing of the Turangi-7 well are summarised below in Table 7 and certificates of analysis are included in Appendix IV. There was no return fluid sampled following stimulation of Interval 3 as there was insufficient fluid to enable sampling returned to the surface during flow back.

The results demonstrate the variability of groundwater composition and hydrocarbon concentrations with depth. The relatively high levels of chloride, sodium and hydrocarbons in each sample indicate that the composite samples prepared contained a greater proportion of reservoir fluids than hydraulic fracturing fluids introduced during the fracturing activities, which are comprised predominantly of freshwater.

Table 6 Results of hydraulic fracturing fluid sampling

Parameter	Well id	GND3049 (Turangi-7 well)									
Interval/treatment	-	1	2	3	4	5	6	7	8	9	10
Sample date	Unit	15-10-19	24-10-19	09-11-19	17-11-19	3-12-19	11-12-19	17-12-19	23-12-19	30-12-19	8-01-20
Lab number	Hill	2260151	2260152	2275774	2282075	2287484	2293544	2300781	2302029	2302023	2302724
Ethylene glycol*	g/m <sup>3</sup>	<10	<4	<4	<8	<20	<4	<4	<4	<4	<4
Propylene glycol*	g/m <sup>3</sup>	<10	<4	<4	<8	<20	<4	<4	<4	<4	<4
Methanol*	g/m <sup>3</sup>	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2
Benzene	g/m <sup>3</sup>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Toluene	g/m <sup>3</sup>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.017	<0.010	<0.010	0.015
Ethylbenzene	g/m <sup>3</sup>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
m-Xylene	g/m <sup>3</sup>	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
o-Xylene	g/m <sup>3</sup>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
C7-C9	g/m <sup>3</sup>	<0.6	1.2	0.6	1.1	1.3	0.6	0.8	0.6	<0.4	1
C10-C14	g/m <sup>3</sup>	1,190	2,600	1,570	2,100	1,950	2,600	2,400	2,300	610	3,600
C15-C36	g/m <sup>3</sup>	90	194	152	169	182	193	220	240	110	430
Total hydrocarbons	g/m <sup>3</sup>	1,280	2,800	1,720	2,300	2,100	2,800	2,600	2,500	720	4,000

Table 7 Results of hydraulic fracturing return fluid sampling

Parameter	GND3049 (Turangi-7 well)									
	Sample date**	-	16-10-19	31-10-19	27-11-19	19-12-19	19-12-2019	14-01-20	14-01-20	14-01-20
Interval/treatment	Unit	1	2	4	5	6	7	8	9	10
Lab number	Hill	2266823	2266824	2282066	2296091	2296160	2303984	2304041	2303996	2314172
pH	pH	9.9	7.3	6.9	6.6	7.2	6.7	6.9	7.3	6.9
Total alkalinity	g/m <sup>3</sup> CaCO <sub>3</sub>	520	1,090	760	670	3,000	1,190	2,400	1,690	1,080
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	-	1,257	693	-	2,800	-	2,480	-	915
Total hardness	g/m <sup>3</sup> CaCO <sub>3</sub>	139	131	320	320	126	184	98	87	103
Electrical conductivity	mS/m	179.7	1,299	1,590	1,439	1,230	1,460	1,113	700	494
Total dissolved solids	g/m <sup>3</sup>	-	9,200	10,800	11,700	9,900	9,700	7,100	6,000	4,800
Total barium	g/m <sup>3</sup>	0.053	30	26	18.1	39	26	6.4	2.5	1.88
Total bromine	g/m <sup>3</sup>	<0.5	12.8	14.3	13.3	9	12.1	9.6	5.7	3.8
Dissolved calcium	g/m <sup>3</sup>	45	40	100	95	37	53	28	26	30
Total copper	g/m <sup>3</sup>	0.026	0.008	0.062	0.048	0.029	0.024	0.152	0.019	0.057
Total iron	g/m <sup>3</sup>	0.76	2.1	4.6	7	2.6	2.3	0.8	11.5	17.1
Dissolved magnesium	g/m <sup>3</sup>	7	7	18	19	9	13	7	6	7
Total manganese	g/m <sup>3</sup>	0.01	2.5	3	3.6	2.4	1.62	1.79	8.8	3.6
Total nickel	g/m <sup>3</sup>	0.065	0.041	0.114	0.154	0.112	0.038	0.196	0.6	0.45
Total potassium	g/m <sup>3</sup>	350	180	230	220	187	199	106	177	110
Total sodium	g/m <sup>3</sup>	61	2,700	3,100	3,000	2,800	3,300	2,500	1,510	940
Total sulphur	g/m <sup>3</sup>	45	17	23	37	30	16	13	32	43
Total zinc	g/m <sup>3</sup>	0.109	0.132	0.06	0.131	0.157	1.16	0.5	0.078	0.129
Chloride	g/m <sup>3</sup>	340	3,800	5,400	4,700	2,800	37	23	11.6	1,030
Nitrite nitrogen*	g/m <sup>3</sup> N	<0.10	<0.10	<0.10	<1.0	0.15	<0.10	<0.10	<0.10	<0.10
Nitrate nitrogen*	g/m <sup>3</sup> N	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nitrate & nitrite nitrogen*	g/m <sup>3</sup> N	<0.10	<0.10	0.18	<1.0	0.17	<0.5	<0.10	<0.10	<0.10
Sulphate	g/m <sup>3</sup>	135	51	68	112	90	49	38	96	129
Ethylene glycol*	g/m <sup>3</sup>	<4	<4	<4	<20	<20	20	<4	<4	<4
Propylene glycol*	g/m <sup>3</sup>	<4	<4	<4	<20	<20	<4	<4	<4	<4

Parameter	GND3049 (Turangi-7 well)									
Sample date**	-	16-10-19	31-10-19	27-11-19	19-12-19	19-12-2019	14-01-20	14-01-20	14-01-20	31-01-20
Interval/treatment	Unit	1	2	4	5	6	7	8	9	10
Lab number	Hill	2266823	2266824	2282066	2296091	2296160	2303984	2304041	2303996	2314172
Methanol*	g/m <sup>3</sup>	<2	<2	<2	<20	<20	<2	<2	<2	139
Benzene	g/m <sup>3</sup>	8.5	15.6	13.1	109	17.3	11.2	8.1	44	10.4
Toluene	g/m <sup>3</sup>	20	16.4	12.2	310	9.9	44	5.7	130	18
Ethylbenzene	g/m <sup>3</sup>	3.4	1.53	1.15	34	0.66	6.9	0.27	15	2.9
m-Xylene	g/m <sup>3</sup>	14.1	6.6	5.9	230	3.9	48	1.52	94	17.3
o-Xylene	g/m <sup>3</sup>	5.2	2.6	1.86	52	1.29	13.5	0.64	25	6
Formaldehyde	g/m <sup>3</sup>	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.21	<0.15	<0.15
C7-C9	g/m <sup>3</sup>	120	92	33	2,400	37	400	11.7	1,620	172
C10-C14	g/m <sup>3</sup>	1,200	200	199	3,400	98	750	23	2,100	680
C15-C36	g/m <sup>3</sup>	360	105	103	2,900	63	500	49	910	480
Total hydrocarbons	g/m <sup>3</sup>	1,690	400	340	8,600	199	1,650	83	4,600	1,330

Note \* Depending on the viscosity of the sample received at the laboratory, samples may require dilution prior to analysis which results in higher detection limits. \*\* Date sample received in lab.



## 2.3 Biomonitoring surveys

A macroinvertebrate survey was carried out at three sites in an unnamed tributary of the Parahaki Stream located approximately 80 m east of the Turangi-A wellsite prior to the commencement of hydraulic fracturing activities. Following completion of hydraulic fracturing at the Turangi-A wellsite another survey was undertaken to determine if discharges from the Turangi-A wellsite had had any detrimental effects on the stream macroinvertebrate communities.

A pre-fracturing survey undertaken 19 June 2019 recorded relatively poor macroinvertebrate communities that were typical for the three sites. Taxa richnesses were lower than usual, but were similar to the preceding survey. MCI and SQMCI scores were highest at site 2, the 'primary impact' site, which would be expected to be affected the most by any discharges from the Turangi-A wellsite. Further, both the MCI and SQMCI were higher at site 3 than at site 1, which is upstream of the discharges.

A post-hydraulic fracturing survey undertaken 2 March 2020 recorded SQMCI scores of 'very poor' macroinvertebrate health at site 1 and 'poor' macroinvertebrate health at sites 2 and 3. There were no significant differences recorded between sites 2 and 3, while the SQMCI score recorded at site 1 was significantly lower than those recorded downstream. SQMCI scores in the survey were also significantly higher than site medians at all three sites.

The results of these surveys indicate that the discharges from the Turangi-A wellsite had not caused any recent significant detrimental impacts on the macroinvertebrate communities of the unnamed tributary of the Parahaki Stream.

Copies of the biomonitoring reports for the site are available from the Council upon request.

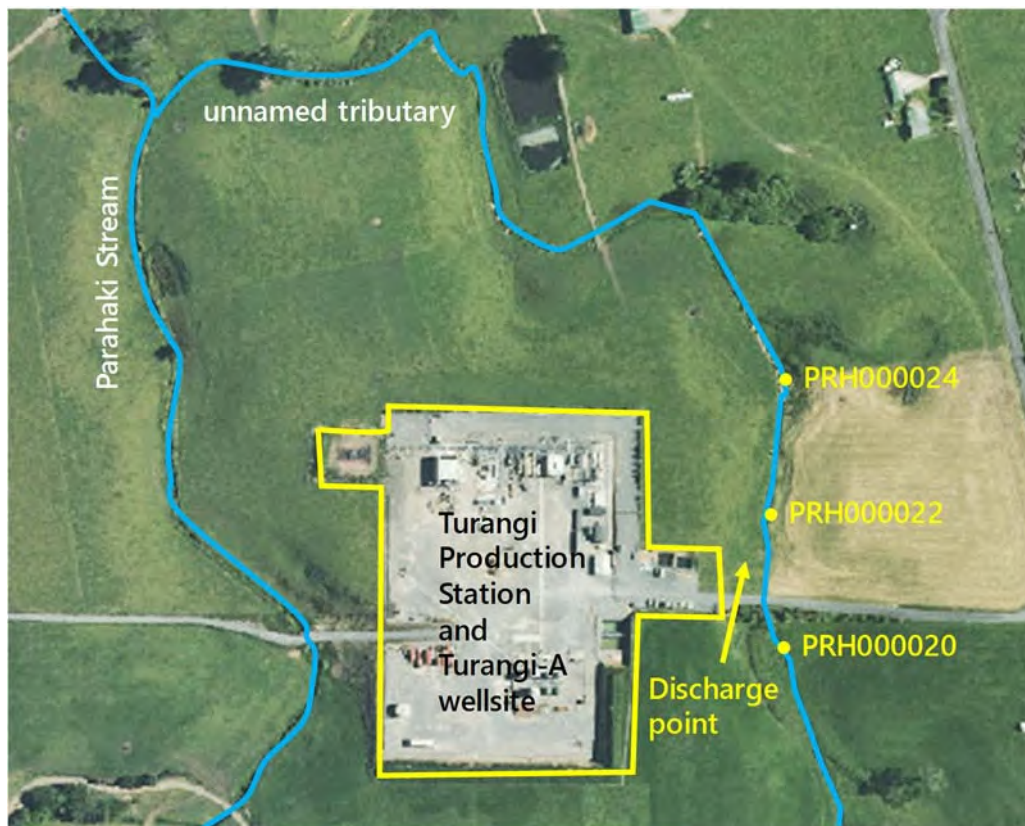


Figure 2 Location of biomonitoring sites in relation to the Turangi-A wellsite

## 2.4 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the consent holder 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).

During the period under review, 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 Environmental effects of exercise of consents

One well (Turangi-7) was stimulated by hydraulic fracturing at the Turangi-A wellsite during the period 15 October 2019 to 8 January 2020.

The monitoring programme carried out by the Council in relation to the fracturing events undertaken included both groundwater and surface water monitoring components.

The groundwater monitoring component incorporated pre and post-fracturing sampling at one groundwater monitoring site located to the north of the Turangi-A wellsite. The results of post-fracturing groundwater sampling carried out showed only very minor variations in water composition in comparison to baseline results. The minor variations in analytes are a result of natural variations in water composition.

The surface water monitoring component of the programme comprised of two biomonitoring surveys of an unnamed tributary of the Parahaki catchment pre and post-fracturing of the Turangi-7 well. The results of the biomonitoring surveys undertaken in relation to the fracturing event indicate that the site activities had no adverse effects on the invertebrate communities within the stream.

In summary, the monitoring carried out by the Council during the period being reported indicated that the hydraulic fracturing activities undertaken by the Company at the Turangi-A wellsite has had no significant adverse effects on local groundwater or surface water resources.

### 3.2 Evaluation of performance

A tabular summary of the consent holder's compliance record for the period under review is set out in Table 8.

Table 8 Summary of performance for consent 10000-1

<b>Purpose: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,350 m TVDss beneath the Turangi-A wellsite</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Any discharge shall occur below 3,350 m TVDss	Assessment of consent holder submitted data	Yes
2. No discharge shall occur after 1 June 2022	Assessment of consent holder submitted data	Renewed in 2020
3. Exercise of consent shall not result in any contaminants reaching any useable freshwater	Results of groundwater monitoring	Yes
4. Consent holder shall undertake sampling programme	Development and certification of a monitoring programme	Yes
5. Monitoring programme to include a minimum of one suitable bore	Consultation and installation of monitoring bore	Yes
6. Sampling programme shall follow recognised field procedures and be analysed for a specified range of chemical parameters	Development and certification of a monitoring programme and assessment of results	Yes

**Purpose: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,350 m TVDss beneath the Turangi-A wellsite**

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. All sampling to be carried out in accordance with a certified Sampling and Analysis Plan	Development and certification of a Sampling and Analysis Plan	Yes
8. Well and equipment pressure testing to be carried out prior to any hydraulic fracturing programme commencing	Assessment of consent holder submitted data	Yes
9. A pre-fracturing discharge report is to be provided to the Council 14 days prior to discharge	Pre-fracturing discharge report received	Yes
10. Consent holder shall notify the Council of hydraulic fracturing discharge	Notification received	Yes
11. A post-fracturing discharge report is to be provided to the Council within 90 days of any commencement	Post-fracturing discharge report received	Yes
12. An interim post-fracturing discharge report is to be provided in order to meet the 90 day requirement if the consent holder cannot provide all the information required by condition 13	Interim post-fracturing report received	Yes
13. The reports outlined in conditions 11 and 13 must be emailed to consents@trc.govt.nz	Reports received via email	Yes
14. The consent holder shall provide access to a location where samples of hydraulic fracturing fluids and return fluids can be obtained by the Council officers	Access provided	Yes
15. Consent holder to adopt best practicable option at all times	Site inspections, sampling and assessment of consent holder submitted data	Yes
16. Fracture fluid composition no less than 95 % water and proppant by volume	Assessment of consent holder submitted data and sampling of fracturing fluid	Yes
17. Lapse clause	Receive notice of exercise of consent	Yes
18. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of environmental performance and compliance in respect of this consent		<b>High</b>
Overall assessment of administrative performance and compliance in respect of this consent		<b>High</b>

N/A = not applicable

During the year, the Company demonstrated a high level of environmental and high level of administrative performance with the resource consent as defined in Appendix II.

### 3.3 Alterations to monitoring programmes of future hydraulic fracturing events

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 the range of monitoring carried out in relation to the hydraulic fracturing activities undertaken by the Company be replicated for any future fracturing events at the Turangi-A wellsite.

Recommendations to this effect are included in Section 4 of this report.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site 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 future monitoring periods.

### 3.4 Exercise of optional review of consent

Resource consent 10000-2 provides for an optional review of the consent in June annually. Condition 20 allows the Council to review the consent, for the purpose of:

- a. ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
- b. further specifying the best practicable option as required by condition 17; and/or
- c. ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Based on the results of monitoring in the year under review, it is considered that there are no grounds that require a review to be pursued or grounds to exercise the review option.

## 4 Recommendations

1. THAT in the first instance, the range of monitoring carried out during the reporting period in relation to the Company's hydraulic fracturing activities be replicated for any future fracturing events at the Turangi-A wellsite.
2. THAT should there be issues with environmental or administrative performance in future periods, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
3. THAT the option for a review of resource consent in June 2022 as set out in condition 20 of the consent not be exercised.

## 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.
bbls	Barrel. Unit of measure used in the oil and gas industry (equivalent to approximately 159 litres).
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 25°C and expressed in $\mu\text{S}/\text{cm}$ .
DO	Dissolved oxygen.
<i>E.coli</i>	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
EPT	Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) which are macroinvertebrates sensitive to pollution.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
$\text{g}/\text{m}^3$	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 the circumstances/events surrounding an incident including any allegations of an incident.
L/s	Litres per second.
Macroinvertebrate	An invertebrate that is large enough to be seen without the use of a microscope.
masl	Metres above sea level.
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.
$\text{m}^3$	Cubic metre (1,000 litres).
NZTM	New Zealand Transverse Mercator coordinates.
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.
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	Resource Management Act 1991 and including all subsequent amendments.

Screen Out	A condition that occurs when the solids carried in a treatment fluid, such as proppant in a fracture fluid, create a bridge across the perforations or similar restricted flow area. This creates a sudden and significant restriction to fluid flow that causes a rapid rise in pump pressure.
SQMCI	Semi quantitative macroinvertebrate community index.
TVDss	True vertical depth sub-sea.
$\mu\text{S/cm}$	Microsiemens per centimetre.
Workover	The repair or stimulation of an existing production well for the purpose of restoring, prolonging or enhancing the production of hydrocarbons.

For further information on analytical methods, contact an Environmental Quality Manager.



## Bibliography and references

- Baker Hughes at <http://blogs.bakerhughes.com/reservoir/2012/02/20/hydraulic-fracturing-an-environmentally-responsible-technology-for-ensuring-our-energy-future-part-iii-of-iii>
- Geology.Com at <http://geology.com/energy/hydraulic-fracturing-fluids/>
- Greymouth Petroleum Turangi Ltd (2020) Hydraulic fracturing –Turangi-A wellsite water quality monitoring programme January 2021 Frodo Number #2256072.
- Greymouth Petroleum Ltd (2020) Turangi-7 Final post-stimulation discharge report April 2020 Frodo Number #2472536.
- Greymouth Petroleum Ltd (2018) Turangi 7 pre-fracturing report May 2019 Frodo Number #2256449.
- Ministry for the Environment. 2018 Guidelines for compliance monitoring and enforcement under the Resource Management Act 1991. Wellington: Ministry for the Environment.
- Stark JD, (1998). SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.
- TRC (2019), Greymouth Petroleum Ltd Turangi-A Hydraulic Fracturing Programme 2017-2018. Technical Report 19-03, June 2018 #2224560.
- TRC (2019) Biomonitoring of an unnamed tributary of the Parahaki Stream in relation to drilling at the Turangi-A wellsite, June 2019 #2294647.
- TRC (2019) Biomonitoring of an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station, Greymouth Petroleum Ltd, March 2020 #2562032.



# Appendix I

## Resource consent held by Greymouth Petroleum Turangi Ltd

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

### Water abstraction permits

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. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

### Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

### Air discharge permits

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. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

### Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

### Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

### Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

**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  
PO Box 3394  
New Plymouth 4341

Decision Date: 30 October 2014

Commencement Date: 30 October 2014

**Conditions of Consent**

Consent Granted: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,350 mTVDss beneath the Turangi-A wellsite

Expiry Date: 01 June 2028

Review Date(s): June annually

Site Location: Turangi-A wellsite, 126 Turangi Road, Motunui  
(Property owners: BA & JM McKenzie)

Legal Description: Sec 21 Blk VI Waitara SD (Discharge source & site)

Grid Reference (NZTM) 1713843E-5681398N

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 discharge point shall be deeper than 3,350 mTVDss.  
Note: mTVDss = metres true vertical depth subsea, i.e., the true vertical depth in metres below mean sea level.
2. There shall be no discharge of hydraulic fracturing fluids after 1 June 2022.
3. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Usable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.
4. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources to assess compliance with condition 3 (the 'Monitoring Programme'). The Monitoring Programme shall be certified by the Chief Executive, Taranaki Regional Council ('the Chief Executive'), before this consent is exercised, and shall include:
  - (a) the location of the discharge point(s);
  - (b) the location of sampling sites; and
  - (c) sampling frequency with reference to a hydraulic fracturing programme.
5. Depending on the suitability of existing bores within 500 metres of the wellsite for obtaining a representative groundwater sample, it may be necessary for the Monitoring Programme to include installation of, and sampling from, at least one monitoring bore. The bore(s) would be of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.
6. All water samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:
  - (a) pH;
  - (b) conductivity;
  - (c) total dissolved solids;
  - (d) major ions (Ca, Mg, K, Na, total alkalinity, bromide, chloride, nitrate-nitrogen, and sulphate);
  - (e) trace metals (barium, copper, iron, manganese, nickel, and zinc);
  - (f) total petroleum hydrocarbons;
  - (g) formaldehyde;
  - (h) dissolved methane and ethane gas;
  - (i) methanol;
  - (j) glycols;
  - (k) benzene, toluene, ethylbenzene, and xylenes (BTEX); and
  - (l) carbon-13 composition of any dissolved methane gas discovered (<sup>13</sup>C-CH<sub>4</sub>).

*Note: The samples required, under conditions 4 and 6 could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.*

7. All sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive for review and certification before the first sampling is undertaken. The plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand (IANZ) accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive within 30 days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 3.

*Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 4.*

8. The consent holder shall undertake well and equipment pressure testing prior to any hydraulic fracture programme on a given well to ensure any discharge will not affect the integrity of the well and hydraulic fracturing equipment.
9. Any hydraulic fracture discharge shall only occur after the consent holder has provided a comprehensive 'Pre-fracturing Discharge Report' to the Chief Executive. The report shall be provided at least 14 days before the discharge is proposed to commence and shall detail the hydraulic fracturing programme proposed, including as a minimum:
- (a) the specific well in which each discharge is to occur, the intended fracture interval(s) ('fracture interval' is the discrete subsurface zone to receive a hydraulic fracture treatment), and the duration of the hydraulic fracturing programme;
  - (b) the number of discharges proposed and the geographical position (i.e. depth and lateral position) of each intended discharge point;
  - (c) the total volume of fracture fluid planned to be pumped down the well, including mini-fracture treatments, and their intended composition, including a list of all contaminants and Material Safety Data Sheets for all the chemicals to be used;
  - (d) the monitoring techniques to be used to determine the fate of discharged material;
  - (e) the results of the reviews required by condition 15;
  - (f) results of modelling showing an assessment of the likely extent and dimensions of the fractures that will be generated by the discharge;
  - (g) the preventative and mitigation measures to be in place to ensure the discharge does not cause adverse environmental effects and complies with condition 3;
  - (h) the extent and permeability characteristics of the geology above the discharge point to the surface;
  - (i) any identified faults within the modelled fracture length plus a margin of 50%, and the potential for adverse environmental effects due to the presence of the identified faults;
  - (j) the burst pressure of the well casing and the anticipated maximum well and discharge pressures and the duration of the pressures; and
  - (k) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal; and
  - (l) details why the contaminants in the discharge and the monitoring techniques used comply with condition 15.

*Note: For the avoidance of doubt, the information provided with a resource consent application would usually be sufficient to constitute a 'Pre-fracturing Discharge Report' for any imminent hydraulic fracturing discharge. The Pre-fracturing Discharge Report provided for any later discharge may refer to the resource consent application or earlier Pre-fracturing Discharge Reports noting any differences.*

10. The consent holder shall notify the Taranaki Regional Council of the date that each discharge is intended to commence by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz). Notification also shall identify the 'Pre-fracturing Discharge Report', required by condition 9, which details the discharge and be given no less than 3 days before the intended discharge date. If any discharge occurs more than 30 days after the notification date, additional notification as specified in this condition is required.
11. Subject to condition 12, within 90 days of any commencement date as advised under condition 10, the consent holder shall submit a comprehensive 'Post-fracturing Discharge Report' to the Chief Executive. The report shall, as a minimum, contain:
  - (a) date and time of discharge;
  - (b) confirmation of the interval(s) where fracturing occurred for that programme, and the geographical position (i.e., depth and lateral position) of the discharge point for each fracture interval;
  - (c) the contaminant volumes and composition of fluid discharged into each fracture interval;
  - (d) the volume of return fluids from each fracture interval;
  - (e) an analysis for the constituents set out in conditions 6(a) to 6(k), in a return fluid sample taken within the first two hours of flow back, for each fracture interval if flowed back individually, or for the well if flowed back with all intervals comingled;
  - (f) an estimate of the volume of fluids (and proppant) remaining underground;
  - (g) the volume of water produced with the hydrocarbons (produced water) over the period beginning at the start of the hydraulic fracturing programme and ending 30 days after the programme is completed or after that period of production;
  - (h) an assessment of the extent and dimensions of the fractures that were generated by the discharge, based on modelling undertaken after the discharge has occurred and other diagnostic techniques, including production analysis, available to determine fracture length, height and containment;
  - (i) the results of pressure testing required by condition 8 and the top-hole pressure (psi), slurry rate (bpm), surface proppant concentration (lb/gal), bottom hole proppant concentration (lb/gal), and calculated bottom hole pressure (psi), as well as predicted values for each of these parameters; prior to, during and after each hydraulic fracture treatment;
  - (j) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal;
  - (k) details of any incidents where hydraulic fracture fluid is unable to pass through the well perforations (screen outs) that occurred, their likely cause and implications for compliance with conditions 1 and 3; and
  - (l) results of the monitoring referred to in condition 9(d);
  - (m) an assessment of the effectiveness of the mitigation measures in place with specific reference to those described in the application for this consent.



## Consent 10000-1.0

12. For programs including multiple hydraulic fracturing discharges, more than one 'Post-fracturing discharge report' may be required in order to meet the specified 90 day deadline from each commencement date. In these situations the consent holder shall submit a subsequent 'Post-fracturing Discharge Report' to the Chief Executive within 90 days of the previous report submitted.
13. The reports described in conditions 9 and 11 shall be emailed to [consents@trc.govt.nz](mailto:consents@trc.govt.nz) with a reference to the number of this consent.
14. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the hydraulic fracturing fluids and the return fluids.
15. 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 minimize any actual or likely adverse effect of the activity on the environment by, as a minimum, ensuring that:
  - (a) the discharge is contained within the fracture interval;
  - (b) regular reviews of monitoring techniques used to ensure the discharge does not cause adverse environmental effects are undertaken;
  - (c) regular reviews are undertaken of the preventative and mitigation measures adopted to ensure the discharge does not cause adverse environmental effects; and
  - (d) regular reviews of the chemicals used are undertaken with a view to reducing the toxicity of the chemicals used.
16. The fracture fluid shall be comprised of no less than 95% water and proppant by volume.
17. This consent shall lapse on 1 June 2022, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
18. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June each year, for the purposes of:
  - (a) ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
  - (b) further specifying the best practicable option as required by condition 15; and/or
  - (c) ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Signed at Stratford on 30 October 2014

For and on behalf of  
Taranaki Regional Council

---

A D McLay  
**Director - Resource Management**



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

Name of  
Consent Holder: Greymouth Petroleum Turangi Limited  
PO Box 3394  
Fitzroy  
New Plymouth 4341

Decision Date 22 October 2020

Commencement Date 22 October 2020

**Conditions of Consent**

Consent Granted: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,200 mTVDss beneath the Turangi-A Production Station

Expiry Date: 1 June 2039

Review Date(s): June annually

Site Location: Turangi-A Production Station, 126 Turangi Road, Motunui

Grid Reference (NZTM) 1713843E-5681398N

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 discharge point shall be deeper than 3,200 mTVDss.  
*Note: mTVDss = metres true vertical depth subsea i.e., the true vertical depth in metres below sea level.*
2. There shall be no discharge of hydraulic fracturing fluids after 1 June 2034.
3. If the Geonet seismic monitoring network records a seismic event higher than a Modified Mercalli intensity of Magnitude 3 within 5 km of the geographical position (in 3 dimensions) of any hydraulic fracturing discharge then;
  - (a) If hydraulic fracturing discharge is currently being undertaken it shall cease immediately and not recommence; or
  - (b) If a hydraulic fracturing discharge has occurred within the previous 72 hours no further hydraulic fracturing discharges shall occur.
4. Following the occurrence of any seismic event described in special condition 3 the consent holder shall immediately notify the Chief Executive, Taranaki Regional Council and investigate and report on the likelihood of the seismic event being induced by the exercise of this consent. Hydraulic fracturing discharges may only then continue once the Chief Executive, Taranaki Regional Council has considered the report and concluded that the environmental risk of recommencing hydraulic fracturing is acceptable and has advised the consent holder accordingly.
5. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Usable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.
6. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources to assess compliance with condition 5 (the 'Monitoring Programme'). The Monitoring Programme shall be certified by the Chief Executive, Taranaki Regional Council ('the Chief Executive'), before this consent is exercised, and shall include:
  - (a) the location of the discharge point(s);
  - (b) the location of sampling sites; and
  - (c) sampling frequency with reference to a hydraulic fracturing programme.

## Consent 10000-2.0

7. Representative groundwater sampling is required to be undertaken at a minimum of one suitable site within 500 metres of the wellsite. If no suitable groundwater monitoring sites can be identified it will be necessary to install at least one monitoring bore of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.
8. All water samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:
  - (a) pH;
  - (b) conductivity;
  - (c) total dissolved solids;
  - (d) major ions (Ca, Mg, K, Na, total alkalinity, bromide, chloride, nitrate-nitrogen, and sulphate);
  - (e) trace metals (barium, copper, iron, manganese, nickel, and zinc);
  - (f) total petroleum hydrocarbons;
  - (g) formaldehyde;
  - (h) dissolved methane and ethane gas;
  - (i) methanol;
  - (j) glycols;
  - (k) benzene, toluene, ethylbenzene, and xylenes (BTEX); and
  - (l) carbon-13 composition of any dissolved methane gas discovered ( $^{13}\text{C-CH}_4$ ).

*Note: The samples required, under conditions of this consent could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.*

9. All sampling and analysis shall be undertaken in accordance with a Sampling and Analysis Plan, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken. The plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand (IANZ) accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive within 30 days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 5.

*Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 6.*

10. The consent holder shall undertake well and equipment pressure testing prior to any hydraulic fracture programme on a given well to ensure any discharge will not affect the integrity of the well and hydraulic fracturing equipment.

11. Any hydraulic fracture discharge shall only occur after the consent holder has provided a comprehensive 'Pre-fracturing Discharge Report' to the Chief Executive, Taranaki Regional Council. The report shall be provided at least 14 days before the discharge is proposed to commence and shall detail the hydraulic fracturing programme proposed, including as a minimum:
- (a) the specific well in which each discharge is to occur, the intended fracture interval(s) ('fracture interval' is the discrete subsurface zone to receive a hydraulic fracture treatment), and the duration of the hydraulic fracturing programme;
  - (b) the number of discharges proposed and the geographical position (i.e. depth and lateral position) of each intended discharge point;
  - (c) the total volume of fracture fluid planned to be pumped down the well, including mini-fracture treatments, and their intended composition, including a list of all contaminants and Material Safety Data Sheets for all the chemicals to be used;
  - (d) the monitoring techniques to be used to determine the fate of discharged material;
  - (e) the results of the reviews required by condition 17;
  - (f) results of modelling showing an assessment of the likely extent and dimensions of the fractures that will be generated by the discharge;
  - (g) the preventative and mitigation measures to be in place to ensure the discharge does not cause adverse environmental effects and complies with condition 5;
  - (h) the extent and permeability characteristics of the geology above the discharge point to the surface;
  - (i) an annotated seismic profile showing the locations of any interpreted faults (active or inactive) within 2 km if available of the surface discharge location, and a discussion regarding the potential for adverse effects due to the presence of any identified faults.
  - (j) an assessment of the integrity of the well.
  - (k) the burst pressure of the well casing and the anticipated maximum well and discharge pressures and the duration of the pressures; and
  - (l) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal; and
  - (m) details of the contaminants in the discharge and the monitoring techniques used to comply with condition 17.

*Note: If seismic data is not available within 2 km of the subsurface discharge location the pre-fracturing report shall include a seismic profile to the distance that the data is available and a map showing any identified faults within the modelled fracture length plus a margin of 50%.*

*For further information regarding the level of detail required to adequately comply with the requirements of the pre- fracturing report contact Taranaki Regional Council.*

12. The consent holder shall notify the Taranaki Regional Council of the date that each discharge is intended to commence. Notification also shall identify the 'Pre-fracturing Discharge Report', required by condition 11, which details the discharge and be given no less than 3 days before the intended discharge date. If any discharge occurs more than 30 days after the notification date, additional notification as specified in this condition is required. Unless the Chief Executive advises that an alternative method is required this notice shall be served by completing and submitting the 'Notification of work' form on the Council's website (<http://bit.ly/TRCWorkNotificationForm>).

*Note: For clarification the notification date is the date that the Chief Executive, Taranaki Regional Council received notification in accordance with this condition, not the intended discharge date.*

## Consent 10000-2.0

13. Subject to condition 14, within 90 days of any commencement date as advised under condition 12, the consent holder shall submit a comprehensive 'Post-fracturing Discharge Report' to the Chief Executive. The report shall, as a minimum, contain:
- (a) date and time of discharge;
  - (b) confirmation of the interval(s) where fracturing occurred for that programme, and the geographical position (i.e., depth and lateral position) of the discharge point for each fracture interval;
  - (c) the contaminant volumes and composition of fluid discharged into each fracture interval;
  - (d) the volume of return fluids from each fracture interval;
  - (e) an analysis for the constituents set out in conditions 1(a) to 1(k), in a return fluid sample taken within the first two hours of flow back, for each fracture interval if flowed back individually, or for the well if flowed back with all intervals comingled;
  - (f) an estimate of the volume of fluids (and proppant) remaining underground;
  - (g) the volume of water produced with the hydrocarbons (produced water) over the period beginning at the start of the hydraulic fracturing programme and ending 30 days after the programme is completed or after that period of production;
  - (h) an assessment of the extent and dimensions of the fractures that were generated by the discharge, based on modelling undertaken after the discharge has occurred and other diagnostic techniques, including production analysis, available to determine fracture length, height and containment;
  - (i) the results of seismic monitoring required by conditions 3.
  - (j) the results of pressure testing required by condition 10 and the top-hole pressure (psi), slurry rate (bpm), surface proppant concentration (lb/ gal), bottom hole proppant concentration (lb/ gal), and calculated bottom hole pressure (psi), as well as predicted values for each of these parameters; prior to, during and after each hydraulic fracture treatment;
  - (k) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal;
  - (l) details of any incidents where hydraulic fracture fluid is unable to pass through the well perforations (screen outs) that occurred, their likely cause and implications for compliance with conditions 1 and 5; and
  - (m) results of the monitoring referred to in condition 11(d);
  - (n) an assessment of the effectiveness of the mitigation measures in place with specific reference to those described in the application for this consent.

*Note: Further information regarding the level of detail required to adequately comply with the requirements of the post- fracturing report can be found on the Taranaki Regional Council website.*

14. For programs including multiple hydraulic fracturing discharges, more than one 'Post-fracturing discharge report' may be required in order to meet the specified 90 day deadline from each commencement date. In these situations the consent holder shall submit a subsequent 'Post-fracturing Discharge Report' to the Chief Executive within 90 days of the previous report submitted.
15. Unless the Chief Executive advises that an alternative method is required, the reports required by conditions 11 and 13 shall be provided by completing and submitting the 'Notification of work' form on the Council's website (<http://bit.ly/TRCWorkNotificationForm>).

## Consent 10000-2.0

16. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the hydraulic fracturing fluids and the return fluids.
17. 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 of the activity on the environment by, as a minimum, ensuring that:
  - (a) the discharge is contained within the fracture interval;
  - (b) regular reviews of monitoring techniques used to ensure the discharge does not cause adverse environmental effects are undertaken;
  - (c) regular reviews are undertaken of the preventative and mitigation measures adopted to ensure the discharge does not cause adverse environmental effects; and
  - (d) regular reviews of the chemicals used are undertaken with a view to reducing the toxicity of the chemicals used.
18. The fracture fluid shall be comprised of no less than 95% water and proppant by volume.
19. This consent lapses 5 years after its date of commencement, 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.
20. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review;
  - (a) during the month of June each year, and/or,
  - (b) within 30 days of receiving any investigation and report in accordance with special condition 4 above;

For the purpose of:

- (a) ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
- (b) further specifying the best practicable option as required by condition 17; and/or
- (c) ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Signed at Stratford on 22 October 2020

For and on behalf of  
Taranaki Regional Council

---

A D McLay  
**Director - Resource Management**



## Appendix II

Categories used to evaluate environmental and administrative performance

## Categories used to evaluate environmental and administrative performance

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 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 during investigations of incidents reported to the Council by a third party 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 during investigations of incidents reported to the Council by a third party. 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 during investigations of incidents reported to the Council by a third party. 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.



## Appendix III

### Certificates of analysis (groundwater)





## Certificate of Analysis

<b>Client:</b>	Taranaki Regional Council	<b>Lab No:</b>	2182109	SPV1
<b>Contact:</b>	Jane Harvey C/- Taranaki Regional Council Private Bag 713 Stratford 4352	<b>Date Received:</b>	25-May-2019	
		<b>Date Reported:</b>	06-Jun-2019	
		<b>Quote No:</b>	47915	
		<b>Order No:</b>	72831	
		<b>Client Reference:</b>	#5075 - Turangi A Pre Frac HF GW	
		<b>Submitted By:</b>	Sarah Larkin	

### Sample Type: Aqueous

<b>Sample Name:</b>	TRC192144 (GND1673) 23-May-2019 3:10 pm				
<b>Lab Number:</b>	2182109.1				

#### Individual Tests

Sum of Anions	meq/L	3.6	-	-	-	-
Sum of Cations	meq/L	3.8	-	-	-	-
pH	pH Units	7.4	-	-	-	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	162	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at 25°C	197	-	-	-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	98	-	-	-	-
Electrical Conductivity (EC)	mS/m	34.1	-	-	-	-
Total Dissolved Solids (TDS)	g/m <sup>3</sup>	240	-	-	-	-
Sample Temperature*	°C	15.8	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	0.025	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	21	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	< 0.0005	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	6.7	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	11.3	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	0.192	-	-	-	-
Dissolved Mercury	g/m <sup>3</sup>	< 0.00008	-	-	-	-
Dissolved Nickel	g/m <sup>3</sup>	0.0034	-	-	-	-
Dissolved Potassium	g/m <sup>3</sup>	5.7	-	-	-	-
Dissolved Sodium	g/m <sup>3</sup>	31	-	-	-	-
Dissolved Zinc	g/m <sup>3</sup>	1.54	-	-	-	-
Bromide	g/m <sup>3</sup>	0.06	-	-	-	-
Chloride	g/m <sup>3</sup>	13.2	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.002	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.002	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.002	-	-	-	-
Sulphate	g/m <sup>3</sup>	< 0.5	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-



Sample Type: Aqueous						
<b>Sample Name:</b>	TRC192144 (GND1673) 23-May-2019 3:10 pm					
<b>Lab Number:</b>	2182109.1					
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.002	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m <sup>3</sup>	0.03	-	-	-	-
Gases in groundwater						
Ethane	g/m <sup>3</sup>	< 0.003	-	-	-	-
Ethylene	g/m <sup>3</sup>	< 0.004	-	-	-	-
Methane	g/m <sup>3</sup>	1.02	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	< 0.06	-	-	-	-
C10 - C14	g/m <sup>3</sup>	< 0.2	-	-	-	-
C15 - C36	g/m <sup>3</sup>	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	< 0.7	-	-	-	-

## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	1
Gases in groundwater	Manual headspace creation and sub-sampling, GC-FID analysis.	0.002 - 0.003 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m <sup>3</sup>	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H <sup>+</sup> ) also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO <sub>2</sub> D 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> at 25°C	1



Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	10 g/m <sup>3</sup>	1
Sample Temperature*	Supplied by customer, otherwise 20°C.	0.1 °C	1
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.005 g/m <sup>3</sup>	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m <sup>3</sup>	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
C7 - C9	Head Space, GCMS analysis.	0.06 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental





## Certificate of Analysis

<b>Client:</b> Taranaki Regional Council	<b>Lab No:</b> 2457198	SPV1
<b>Contact:</b> Jane Harvey	<b>Date Received:</b> 17-Oct-2020	
C/- Taranaki Regional Council	<b>Date Reported:</b> 27-Oct-2020	
Private Bag 713	<b>Quote No:</b> 47915	
Stratford 4352	<b>Order No:</b> 72831	
	<b>Client Reference:</b> #6285 - Greymouth Turangi A 1 year PF GW	
	<b>Submitted By:</b> Sarah Larkin	

### Sample Type: Aqueous

<b>Sample Name:</b>	TRC203503 (GND1673) 16-Oct-2020 9:40 am				
<b>Lab Number:</b>	2457198.1				

#### Individual Tests

Sum of Anions	meq/L	3.4	-	-	-	-
Sum of Cations	meq/L	3.5	-	-	-	-
pH	pH Units	6.9	-	-	-	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	150	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at 25°C	183	-	-	-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	87	-	-	-	-
Electrical Conductivity (EC)	mS/m	32.0	-	-	-	-
Total Dissolved Solids (TDS)	g/m <sup>3</sup>	220	-	-	-	-
Sample Temperature*†	°C	15.3	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	0.021	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	18.4	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	< 0.0005	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	7.0	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	9.9	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	0.181	-	-	-	-
Dissolved Mercury	g/m <sup>3</sup>	< 0.00008	-	-	-	-
Dissolved Nickel	g/m <sup>3</sup>	0.0006	-	-	-	-
Dissolved Potassium	g/m <sup>3</sup>	5.5	-	-	-	-
Dissolved Sodium	g/m <sup>3</sup>	32	-	-	-	-
Dissolved Zinc	g/m <sup>3</sup>	0.040	-	-	-	-
Bromide	g/m <sup>3</sup>	0.09	-	-	-	-
Chloride	g/m <sup>3</sup>	14.8	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.002	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	0.004	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	0.004	-	-	-	-
Sulphate	g/m <sup>3</sup>	< 0.5	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked \* or any comments and interpretations, which are not accredited.

**Sample Type: Aqueous**

<b>Sample Name:</b>	TRC203503 (GND1673) 16-Oct-2020 9:40 am				
<b>Lab Number:</b>	2457198.1				
BTEX in Water by Headspace GC-MS					
Benzene	g/m <sup>3</sup>	< 0.0010	-	-	-
Toluene	g/m <sup>3</sup>	< 0.0010	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.0010	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.002	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.0010	-	-	-
Formaldehyde in Water by DNPH & LCMSMS					
Formaldehyde	g/m <sup>3</sup>	< 0.02	-	-	-
Gases in groundwater					
Ethane	g/m <sup>3</sup>	< 0.003	-	-	-
Ethylene	g/m <sup>3</sup>	< 0.004	-	-	-
Methane	g/m <sup>3</sup>	7.6	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	< 0.10	-	-	-
C10 - C14	g/m <sup>3</sup>	< 0.2	-	-	-
C15 - C36	g/m <sup>3</sup>	< 0.4	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	< 0.7	-	-	-

**Analyst's Comments**

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H <sup>+</sup> ) also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO <sub>2</sub> D 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	10 g/m <sup>3</sup>	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.005 g/m <sup>3</sup>	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m <sup>3</sup>	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m <sup>3</sup>	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m <sup>3</sup>	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m <sup>3</sup>	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m <sup>3</sup>	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m <sup>3</sup>	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 19-Oct-2020 and 27-Oct-2020. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental





## Certificate of Analysis

<b>Client:</b>	Taranaki Regional Council	<b>Lab No:</b>	2310318	SPV1
<b>Contact:</b>	Jane Harvey C/- Taranaki Regional Council Private Bag 713 Stratford 4352	<b>Date Received:</b>	24-Jan-2020	
		<b>Date Reported:</b>	11-Feb-2020	
		<b>Quote No:</b>	47915	
		<b>Order No:</b>	72831	
		<b>Client Reference:</b>	#5632 - Greymouth Turangi A 3 month PF GW Jan 2020	
		<b>Submitted By:</b>	Sarah Larkin	

### Sample Type: Aqueous

<b>Sample Name:</b>	TRC200317 (GND1673) 23-Jan-2020 9:40 am				
<b>Lab Number:</b>	2310318.1				

#### Individual Tests

Sum of Anions	meq/L	3.3	-	-	-	-
Sum of Cations	meq/L	3.5	-	-	-	-
pH	pH Units	7.2	-	-	-	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	144	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at 25°C	175	-	-	-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	88	-	-	-	-
Electrical Conductivity (EC)	mS/m	31.6	-	-	-	-
Total Dissolved Solids (TDS)	g/m <sup>3</sup>	220	-	-	-	-
Sample Temperature*	°C	15.6	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	0.020	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	18.7	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	< 0.0005	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	7.6	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	10.1	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	0.193	-	-	-	-
Dissolved Mercury	g/m <sup>3</sup>	< 0.00008	-	-	-	-
Dissolved Nickel	g/m <sup>3</sup>	0.0005	-	-	-	-
Dissolved Potassium	g/m <sup>3</sup>	5.1	-	-	-	-
Dissolved Sodium	g/m <sup>3</sup>	30	-	-	-	-
Dissolved Zinc	g/m <sup>3</sup>	0.072	-	-	-	-
Bromide	g/m <sup>3</sup>	0.05	-	-	-	-
Chloride	g/m <sup>3</sup>	15.1	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.002	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	0.004	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	0.005	-	-	-	-
Sulphate	g/m <sup>3</sup>	< 0.5	-	-	-	-
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.002	-	-	-	-



Sample Type: Aqueous						
<b>Sample Name:</b>	TRC200317 (GND1673) 23-Jan-2020 9:40 am					
<b>Lab Number:</b>	2310318.1					
BTEX in Water by Headspace GC-MS						
o-Xylene	g/m <sup>3</sup>	< 0.0010	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m <sup>3</sup>	< 0.02	-	-	-	-
Gases in groundwater						
Ethane	g/m <sup>3</sup>	< 0.003	-	-	-	-
Ethylene	g/m <sup>3</sup>	< 0.004	-	-	-	-
Methane	g/m <sup>3</sup>	7.9	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	< 0.10	-	-	-	-
C10 - C14	g/m <sup>3</sup>	< 0.2	-	-	-	-
C15 - C36	g/m <sup>3</sup>	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	< 0.7	-	-	-	-

## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	1
Gases in groundwater	Manual headspace creation and sub-sampling, GC-FID analysis.	0.002 - 0.003 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H <sup>+</sup> ) also included in calculation if available. APHA 1030 E 23 <sup>rd</sup> ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO <sub>2</sub> D 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	10 g/m <sup>3</sup>	1
Sample Temperature*	Supplied by customer, otherwise 20°C.	0.1 °C	1



Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.005 g/m <sup>3</sup>	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m <sup>3</sup>	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0005 g/m <sup>3</sup>	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.02 g/m <sup>3</sup>	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.05 g/m <sup>3</sup>	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.002 g/m <sup>3</sup>	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Propylene glycol*	Direct injection, dual column GC-FID.	4 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Graham Corban MSc Tech (Hons)  
Client Services Manager - Environmental





## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2282066	SPv2
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	27-Nov-2019	
		<b>Date Reported:</b>	13-Dec-2019	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248418	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Turangi-7 Stim 4 Composite Return Fluid				
<b>Lab Number:</b>	2282066.4				

#### Individual Tests

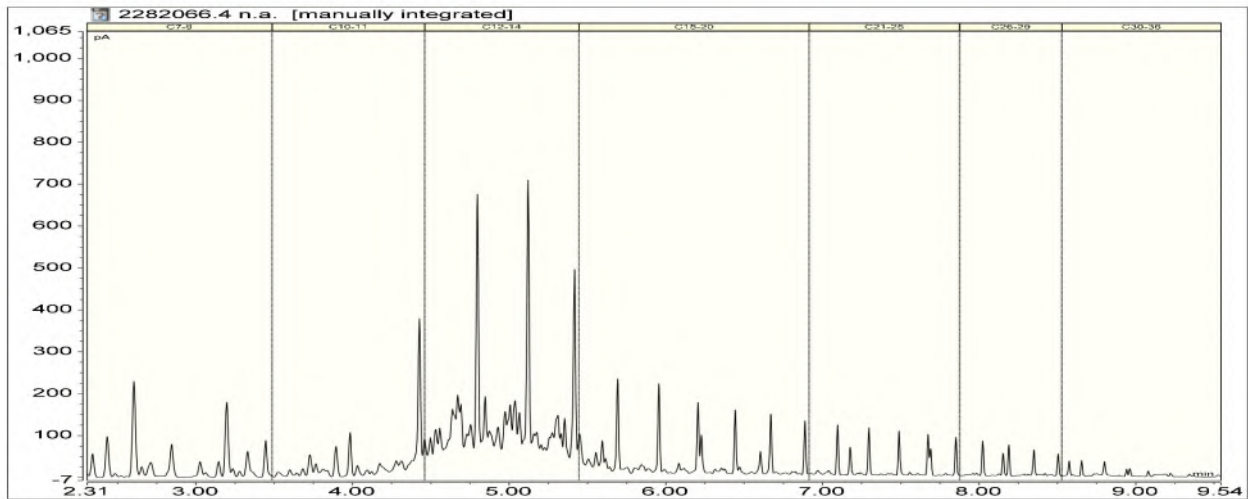
pH*	pH Units	6.9	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	760	-	-	-	-
Analysis Temperature for Bicarbonate	°C	22	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at Analysis Temperature	693	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	320	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,590	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	10,800	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	26	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	14.3	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	100	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.062	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	4.6	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	18	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	3.0	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.114	-	-	-	-
Total Potassium	g/m <sup>3</sup>	230	-	-	-	-
Total Sodium	g/m <sup>3</sup>	3,100	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	23	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.060	-	-	-	-
Chloride*	g/m <sup>3</sup>	5,400	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	0.18	-	-	-	-
Sulphate*	g/m <sup>3</sup>	68	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene*	g/m <sup>3</sup>	13.1	-	-	-	-
Toluene*	g/m <sup>3</sup>	12.2	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	1.15	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	5.9	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	1.86	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	Turangi-7 Stim 4 Composite Return Fluid					
<b>Lab Number:</b>	2282066.4					
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9*	g/m <sup>3</sup>	33	-	-	-	-
C10 - C14*	g/m <sup>3</sup>	199	-	-	-	-
C15 - C36*	g/m <sup>3</sup>	103	-	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	340	-	-	-	-

2282066.4  
 Turangi-7 Stim 4 Composite Return Fluid  
 Client Chromatogram for TPH by FID



**Analyst's Comments**

Appendix No.1 - GNS report

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

<b>Sample Type: Saline</b>			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	4
Bicarbonate	Bicarbonate (HCO <sub>3</sub> ) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m <sup>3</sup> at Analysis Temperature	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> -I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> -I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental



**ANALYTICAL LABORATORY**  
 Private Bag 2000, Taupo  
 Phone: (07) 374 8211  
 Fax: (07) 374 8199  
 Email: w.labmanager@gns.cri.nz

**CERTIFICATE OF ANALYSIS**  
**ENVSUBGNS\_WAIRAKEI 98**

Report No: 2019112905

Customer Ref:152923

Ara Heron  
 RJ Hill Laboratories (Hamilton)  
 Environmental Reports Officers  
 Private Bag 3205  
 Hamilton

**GNS Lot No: 2019112905**

**GNS Sample No.** 2019007156  
**Collection Date**  
**Site ID** 2282066.4  
**Field ID**

pH		7.66	-	-	-
Bicarbonate (Total)	mg/l	693	-	-	-
HCO <sub>3</sub> Analysis Temperature	°C	22	-	-	-
HCO <sub>3</sub> Analysis Date		9/12/2019	-	-	-

**SUMMARY OF METHODS AND DETECTION LIMITS**

The following table gives a brief description of the methods used to conduct the analyses on this report.  
 The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit	
Bicarbonate (total)	HCO <sub>3</sub> Titration Method ASTM Standards D513-82 Vol.11.01 1988	20	mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-	-

\*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Notes: These samples were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.

*M. K. Appleby*  
 Moya Appleby  
 Senior Technician



**IANZ**  
 ACCREDITED LABORATORY

Tests marked with a † are not accredited and are outside the scope of the laboratory's accreditation

## Appendix IV

Certificates of analysis  
(hydraulic fracturing fluids)







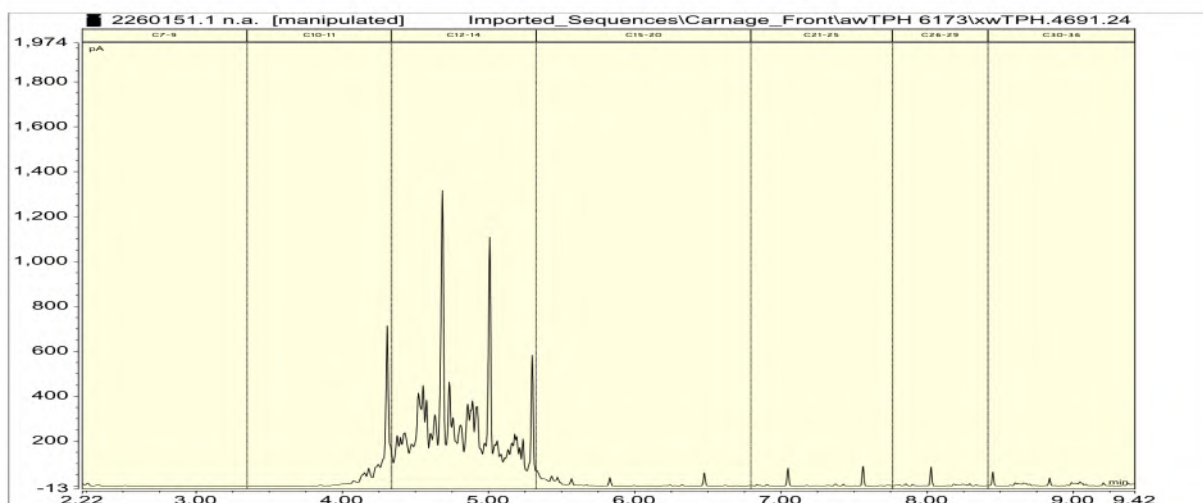
## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2260151	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	17-Oct-2019	
		<b>Date Reported:</b>	29-Oct-2019	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248022	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	TUR-7 Stim 1 Prepumped HF Fluid 15-Oct-2019				
<b>Lab Number:</b>	2260151.1				
Ethylene Glycol in Water					
Ethylene glycol*	g/m <sup>3</sup>	< 10	-	-	-
Propylene Glycol in Water					
Propylene glycol*	g/m <sup>3</sup>	< 10	-	-	-
Methanol in Water - Aqueous Solvents					
Methanol*	g/m <sup>3</sup>	< 2	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	< 0.6	-	-	-
C10 - C14	g/m <sup>3</sup>	1,190	-	-	-
C15 - C36	g/m <sup>3</sup>	90	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	1,280	-	-	-

2260151.1  
TUR-7 Stim 1 Prepumped HF Fluid 15-Oct-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Solvent extraction, GC-FID analysis. Headspace GC-MS analysis for C7-C9 carbon band. In-house based UEPA 8015, 8260 & 5021 / MfE Petroleum Industry Guidelines.	0.06 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Graham Corban MSc Tech (Hons)  
Client Services Manager - Environmental



## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2302724	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	10-Jan-2020	
		<b>Date Reported:</b>	28-Jan-2020	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248860	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

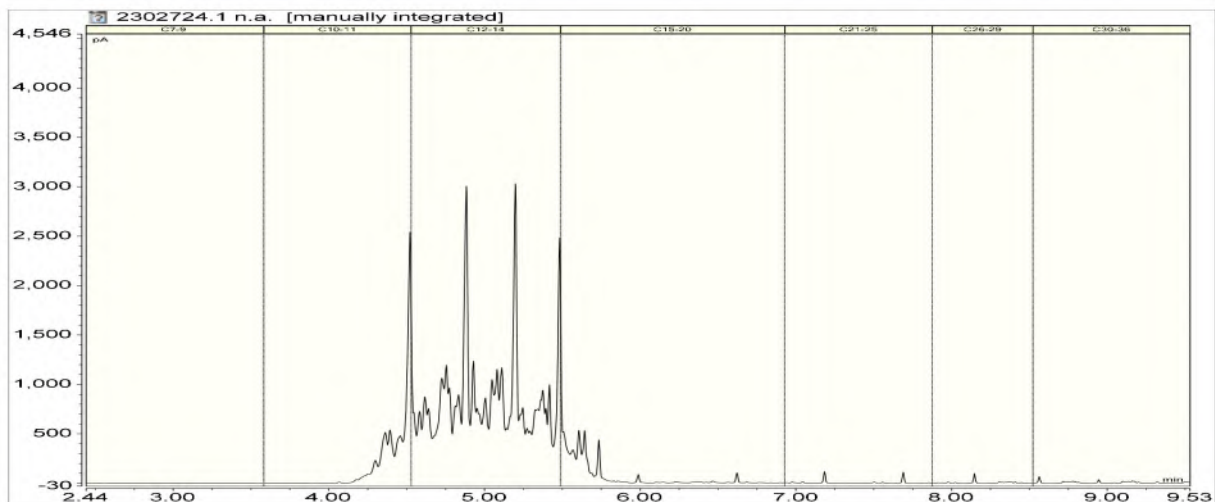
### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 - Stim 10 Pre-pumped 08-Jan-2020				
<b>Lab Number:</b>	2302724.1				
Ethylene Glycol in Water*					
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-
Propylene Glycol in Water*					
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m <sup>3</sup>	< 2	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-
Toluene	g/m <sup>3</sup>	0.015	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	1.0	-	-	-
C10 - C14	g/m <sup>3</sup>	3,600	-	-	-
C15 - C36	g/m <sup>3</sup>	430	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	4,000	-	-	-

2302724.1

Turangi 7 - Stim 10 Pre-pumped 08-Jan-2020

Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental



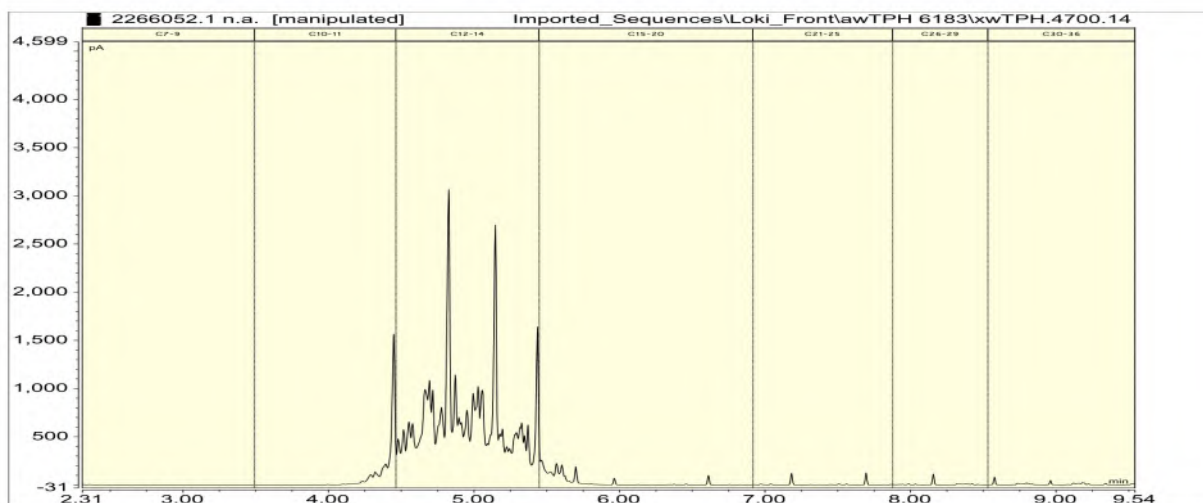
## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2266052	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	30-Oct-2019	
		<b>Date Reported:</b>	05-Nov-2019	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248116	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	TUR7 Stim 2 Prepumped HF Fluid 24-Oct-2019 12:30 pm				
<b>Lab Number:</b>	2266052.1				
Ethylene Glycol in Water					
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-
Propylene Glycol in Water					
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-
Methanol in Water - Aqueous Solvents					
Methanol*	g/m <sup>3</sup>	< 2	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	1.2	-	-	-
C10 - C14	g/m <sup>3</sup>	2,600	-	-	-
C15 - C36	g/m <sup>3</sup>	194	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,800	-	-	-

2266052.1  
TUR7 Stim 2 Prepumped HF Fluid 24-Oct-2019 12:30 pm  
Client Chromatogram for TPH by FID



## Analyst's Comments

The matrix in sample 2266052.1 has affected all of the Internal standard Compound in the BTEX analysis, whereby the recoveries was -55.8% The sample was extracted on less volume, hence the higher detection limits reported.

## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

### Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental



## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2275774	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	15-Nov-2019	
		<b>Date Reported:</b>	22-Nov-2019	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248327	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

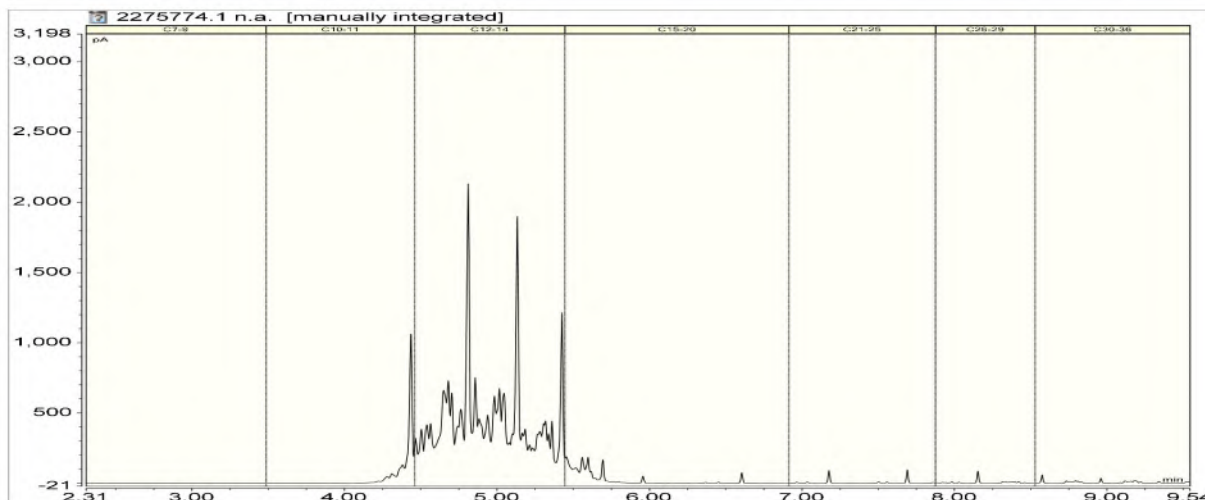
### Sample Type: Aqueous

<b>Sample Name:</b>	Tur-7 Stim 3 Prepumped 09-Nov-2019					
<b>Lab Number:</b>	2275774.1					
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	0.6	-	-	-	-
C10 - C14	g/m <sup>3</sup>	1,570	-	-	-	-
C15 - C36	g/m <sup>3</sup>	152	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	1,720	-	-	-	-

2275774.1

Tur-7 Stim 3 Prepumped 09-Nov-2019

Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental





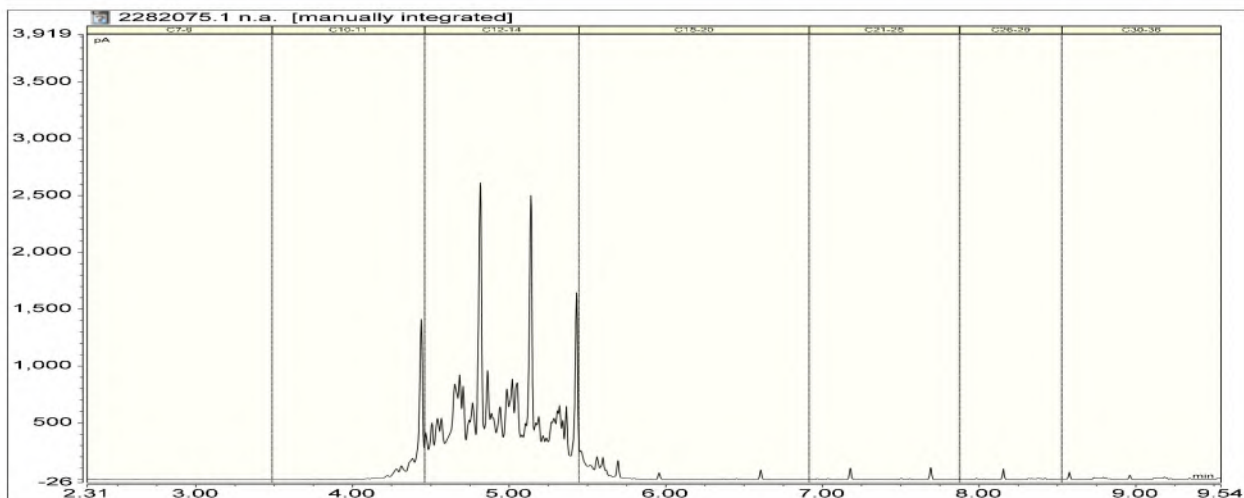
## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2282075	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	27-Nov-2019	
		<b>Date Reported:</b>	03-Dec-2019	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248418	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 Stim 4 Prepumped 17-Nov-2019					
<b>Lab Number:</b>	2282075.1					
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 8	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 8	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	1.1	-	-	-	-
C10 - C14	g/m <sup>3</sup>	2,100	-	-	-	-
C15 - C36	g/m <sup>3</sup>	169	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,300	-	-	-	-

2282075.1  
Turangi 7 Stim 4 Prepumped 17-Nov-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental



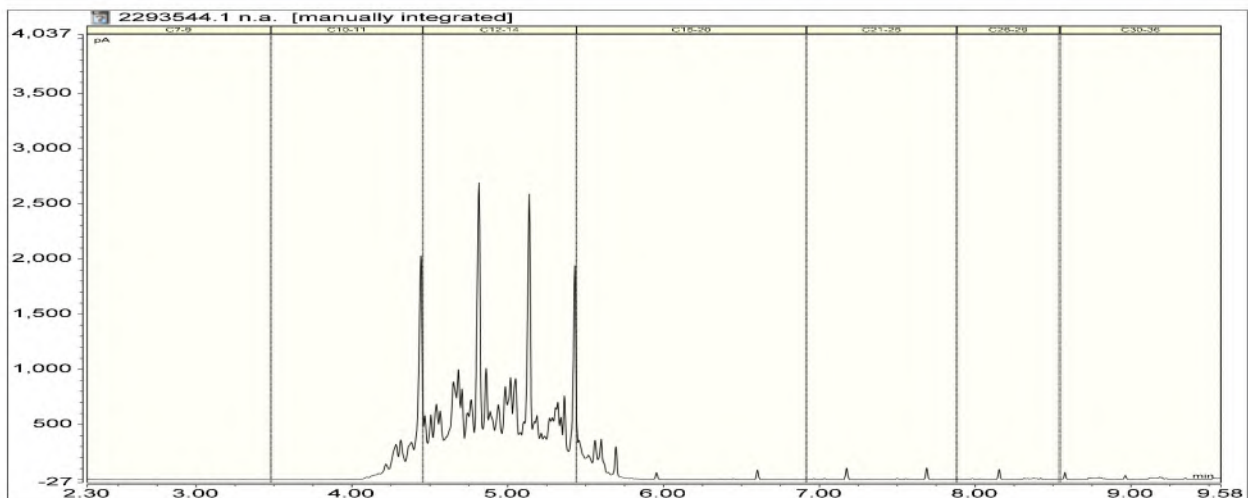
## Certificate of Analysis

<b>Client:</b> Greymouth Petroleum Limited	<b>Lab No:</b> 2293544	SPV1
<b>Contact:</b> Nakeysha Lammers	<b>Date Received:</b> 14-Dec-2019	
C/- Greymouth Petroleum Limited	<b>Date Reported:</b> 06-Jan-2020	
14 Connett Road West	<b>Quote No:</b> 85159	
Bell Block	<b>Order No:</b> 248640	
New Plymouth 4312	<b>Client Reference:</b> Hydraulic fracturing fluid testing	
	<b>Submitted By:</b> Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 Stim 6 Pre-Pumped 11-Dec-2019					
<b>Lab Number:</b>	2293544.1					
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	0.6	-	-	-	-
C10 - C14	g/m <sup>3</sup>	2,600	-	-	-	-
C15 - C36	g/m <sup>3</sup>	193	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,800	-	-	-	-

2293544.1  
Turangi 7 Stim 6 Pre-Pumped 11-Dec-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

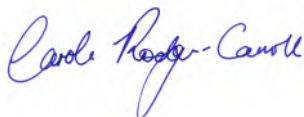
Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Carole Rodgers-Carroll BA, NZCS  
Client Services Manager - Environmental



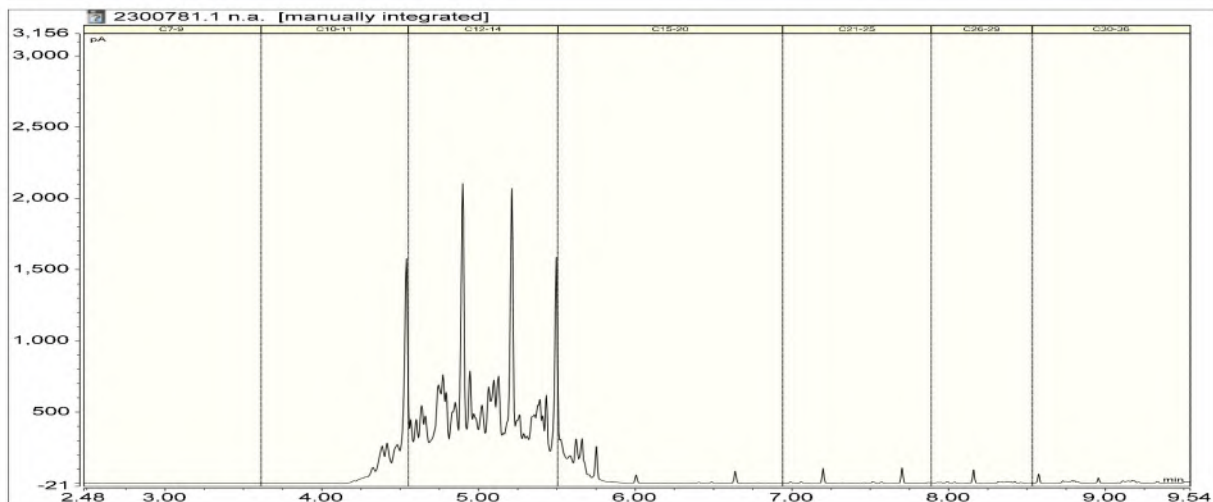
## Certificate of Analysis

<b>Client:</b> Greymouth Petroleum Limited	<b>Lab No:</b> 2300781	SPV1
<b>Contact:</b> Nakeysha Lammers	<b>Date Received:</b> 07-Jan-2020	
C/- Greymouth Petroleum Limited	<b>Date Reported:</b> 13-Jan-2020	
14 Connett Road West	<b>Quote No:</b> 85159	
Bell Block	<b>Order No:</b> 248740	
New Plymouth 4312	<b>Client Reference:</b> Hydraulic fracturing fluid testing	
	<b>Submitted By:</b> Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 - Stim 7 Prepumped 17-Dec-2019					
<b>Lab Number:</b>	2300781.1					
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	0.017	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	< 0.8	-	-	-	-
C10 - C14	g/m <sup>3</sup>	2,400	-	-	-	-
C15 - C36	g/m <sup>3</sup>	220	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,600	-	-	-	-

2300781.1  
Turangi 7 - Stim 7 Prepumped 17-Dec-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Martin Cowell - BSc  
Client Services Manager - Environmental

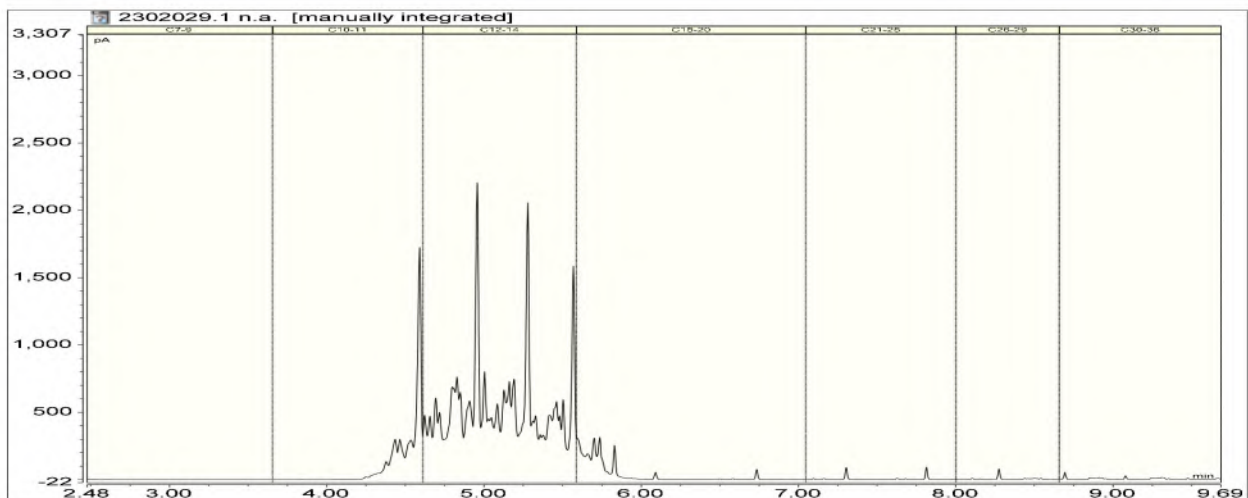


## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2302029	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	09-Jan-2020	
		<b>Date Reported:</b>	28-Jan-2020	
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248823	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

Sample Type: Aqueous						
Sample Name:		Turangi 7 Stim 8 Prepumped 23-Dec-2019				
Lab Number:		2302029.1				
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	0.6	-	-	-	-
C10 - C14	g/m <sup>3</sup>	2,300	-	-	-	-
C15 - C36	g/m <sup>3</sup>	240	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,500	-	-	-	-

2302029.1  
Turangi 7 Stim 8 Prepumped 23-Dec-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental





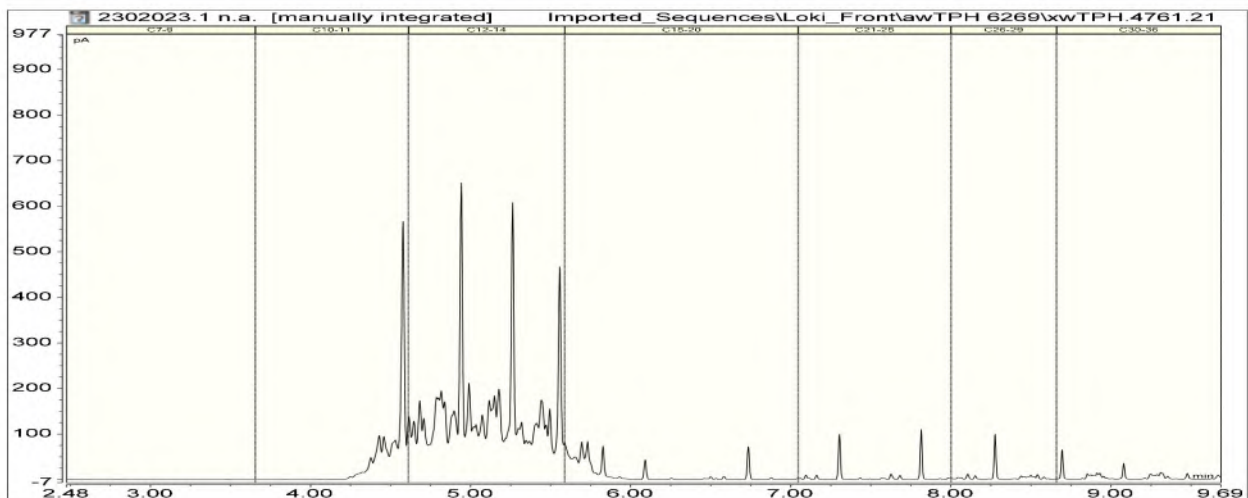
## Certificate of Analysis

<b>Client:</b> Greymouth Petroleum Limited	<b>Lab No:</b> 2302023	SPV1
<b>Contact:</b> Nakeysha Lammers	<b>Date Received:</b> 09-Jan-2020	
C/- Greymouth Petroleum Limited	<b>Date Reported:</b> 28-Jan-2020	
14 Connett Road West	<b>Quote No:</b> 85159	
Bell Block	<b>Order No:</b> 248846	
New Plymouth 4312	<b>Client Reference:</b> Hydraulic fracturing fluid testing	
	<b>Submitted By:</b> Nakeysha Lammers	

### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 Stim 9 Pre-pumped 30-Dec-2019					
<b>Lab Number:</b>	2302023.1					
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	< 0.4	-	-	-	-
C10 - C14	g/m <sup>3</sup>	610	-	-	-	-
C15 - C36	g/m <sup>3</sup>	110	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	720	-	-	-	-

2302023.1  
Turangi 7 Stim 9 Pre-pumped 30-Dec-2019  
Client Chromatogram for TPH by FID



## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental



## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2266823	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	31-Oct-2019	
		<b>Date Reported:</b>	11-Nov-2019	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248037	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	TUR-7 Stim 1 Composite Return Sample 15-Oct-2019				
<b>Lab Number:</b>	2266823.1				

### Individual Tests

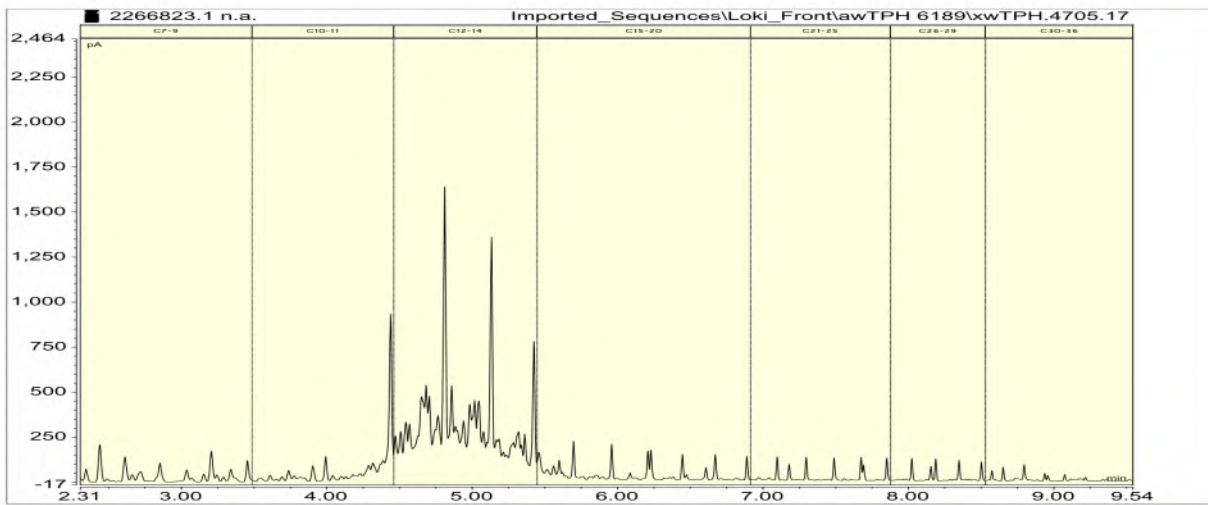
pH*	pH Units	9.9	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	520	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	139	-	-	-	-
Electrical Conductivity (EC)*	mS/m	179.7	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	0.053	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	< 0.5	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	45	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.026	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	0.76	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	7	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	0.010	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.065	-	-	-	-
Total Potassium	g/m <sup>3</sup>	350	-	-	-	-
Total Sodium	g/m <sup>3</sup>	61	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	45	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.109	-	-	-	-
Chloride*	g/m <sup>3</sup>	340	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	135	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene*	g/m <sup>3</sup>	8.5	-	-	-	-
Toluene*	g/m <sup>3</sup>	20	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	3.4	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	14.1	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	5.2	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	TUR-7 Stim 1 Composite Return Sample 15-Oct-2019				
<b>Lab Number:</b>	2266823.1				
Formaldehyde in Water by DNPH & LCMSMS					
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9*	g/m <sup>3</sup>	120	-	-	-
C10 - C14*	g/m <sup>3</sup>	1,200	-	-	-
C15 - C36*	g/m <sup>3</sup>	360	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	1,690	-	-	-

2266823.1  
TUR-7 Stim 1 Composite Return Sample 15-Oct-2019  
Client Chromatogram for TPH by FID



**Analyst's Comments**

#1 Due to the nature of this sample a dilution was performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO<sub>2</sub>N, NO<sub>3</sub>N and NO<sub>x</sub>N analysis.

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	1
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	1
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	1
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	1
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	1
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	1
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	1
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	1
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	1
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	1
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	1
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	1
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	1
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	1
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	1
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	1
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	1
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental





## Certificate of Analysis

Page 1 of 4

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2314172	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	31-Jan-2020	
		<b>Date Reported:</b>	18-Feb-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248860	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Turangi 7 Stim 10 Composite Return Fluid				
<b>Lab Number:</b>	2314172.3				

#### Individual Tests

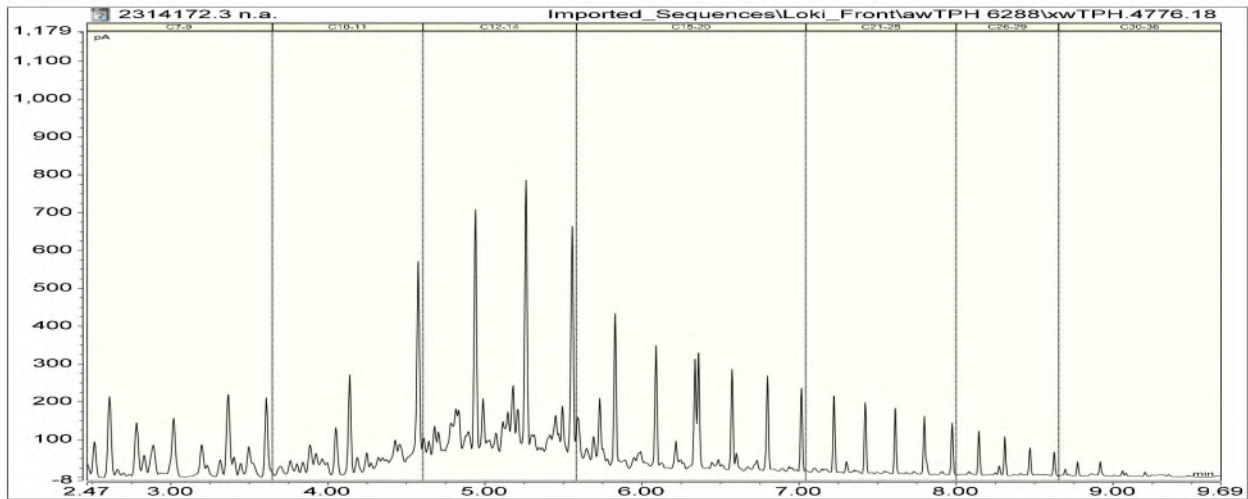
pH*	pH Units	6.9	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	1,080	-	-	-	-
Analysis Temperature for Bicarbonate <sup>‡</sup>	°C	22	-	-	-	-
Bicarbonate <sup>‡</sup>	g/m <sup>3</sup> at Analysis Temperature	915	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	103	-	-	-	-
Electrical Conductivity (EC)*	mS/m	494	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	4,800	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	1.88	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	3.8	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	30	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.057	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	17.1	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	7	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	3.6	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.45	-	-	-	-
Total Potassium	g/m <sup>3</sup>	110	-	-	-	-
Total Sodium	g/m <sup>3</sup>	940	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	43	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.129	-	-	-	-
Chloride*	g/m <sup>3</sup>	1,030	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	129	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	139	-	-	-	-
BTEX in Water by Headspace GC-MS*						
Benzene*	g/m <sup>3</sup>	10.4	-	-	-	-
Toluene*	g/m <sup>3</sup>	18.0	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	2.9	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	17.3	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	6.0	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	Turangi 7 Stim 10 Composite Return Fluid				
<b>Lab Number:</b>	2314172.3				
Formaldehyde in Water by DNPH & LCMSMS*					
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-
Total Petroleum Hydrocarbons in Water*					
C7 - C9*	g/m <sup>3</sup>	172	-	-	-
C10 - C14*	g/m <sup>3</sup>	680	-	-	-
C15 - C36*	g/m <sup>3</sup>	480	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	1,330	-	-	-

2314172.3  
 Turangi 7 Stim 10 Composite Return Fluid  
 Client Chromatogram for TPH by FID



**Analyst's Comments**

‡ Analysis subcontracted to an external provider. Refer to the Summary of Methods section for more details.  
 #1 Due to the nature of this sample a dilution was performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO<sub>2</sub>N, NO<sub>3</sub>N and NO<sub>x</sub>N analysis.  
 Appendix No.1 - GNS report

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

<b>Sample Type: Saline</b>			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	3
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	3
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	3
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	3
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	3
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	3
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	3
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	3
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	3



Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
pH*	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	3
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	3
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	3
Bicarbonate	Bicarbonate (HCO <sub>3</sub> ) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m <sup>3</sup> at Analysis Temperature	3
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	3
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	3
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	3
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	3
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	3
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	3
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	3
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	3
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	3
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	3
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	3
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	3
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	3
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	3
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	3
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	3
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	3
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	3
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	3
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	3
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, appearing to be 'Ara Heron', written over a faint grid background.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental



**ANALYTICAL LABORATORY**  
 Private Bag 2000, Taupo  
 Phone: (07) 374 8211  
 Fax: (07) 374 8199  
 Email: w.labmanager@gns.cri.nz

**CERTIFICATE OF ANALYSIS**  
**ENVSUBGNS\_WAIRAKEI 113**

Report No: 2020020406

Customer Ref:153310

Ara Heron  
 RJ Hill Laboratories (Hamilton)  
 Environmental Reports Officers  
 Private Bag 3205  
 Hamilton

GNS Lot No: 2020020406

GNS Sample No. 2020000668  
 Collection Date  
 Site ID 2314172.3  
 Field ID

pH		7.14	-	-	-
Bicarbonate (Total)	mg/l	915	-	-	-
HCO <sub>3</sub> Analysis Temperature	°C	22	-	-	-
HCO <sub>3</sub> Analysis Date		05/02/2020	-	-	-

## SUMMARY OF METHODS AND DETECTION LIMITS

The following table gives a brief description of the methods used to conduct the analyses on this report.  
 The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit	
Bicarbonate (total)	HCO <sub>3</sub> Titration Method ASTM Standards D513-82 Vol.11.01 1988	20	mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-	-

\*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Notes: These samples were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.

Ann Noddings  
 Senior Technician



**IANZ**  
 ACCREDITED LABORATORY

Tests marked with a †  
 are not accredited and are  
 outside the scope of the  
 laboratory's accreditation





## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2266824	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	31-Oct-2019	
		<b>Date Reported:</b>	15-Nov-2019	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248116	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	TUR-7 Stim 2 Composite Return Fluid				
<b>Lab Number:</b>	2266824.4				

#### Individual Tests

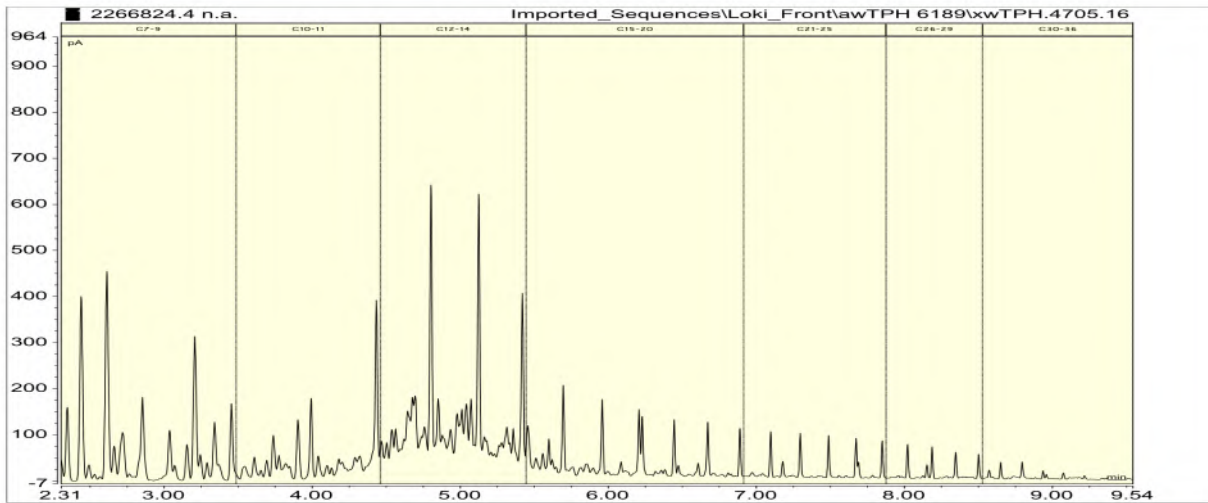
pH*	pH Units	7.3	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	1,090	-	-	-	-
Analysis Temperature for Bicarbonate	°C	22	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at Analysis Temperature	1,257	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	131	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,299	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	9,200	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	30	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	12.8	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	40	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.008	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	2.1	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	7	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	2.5	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.041	-	-	-	-
Total Potassium	g/m <sup>3</sup>	180	-	-	-	-
Total Sodium	g/m <sup>3</sup>	2,700	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	17	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.132	-	-	-	-
Chloride*	g/m <sup>3</sup>	3,800	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.10 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	51	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene*	g/m <sup>3</sup>	15.6	-	-	-	-
Toluene*	g/m <sup>3</sup>	16.4	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	1.53	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	6.6	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	2.6	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	TUR-7 Stim 2 Composite Return Fluid				
<b>Lab Number:</b>	2266824.4				
Formaldehyde in Water by DNPH & LCMSMS					
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9*	g/m <sup>3</sup>	92	-	-	-
C10 - C14*	g/m <sup>3</sup>	200	-	-	-
C15 - C36*	g/m <sup>3</sup>	105	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	400	-	-	-

2266824.4  
TUR-7 Stim 2 Composite Return Fluid  
Client Chromatogram for TPH by FID



**Analyst's Comments**

#1 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NOxN /NO2N analysis.

Appendix No.1 - GNS report

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
pH*	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	4
Bicarbonate	Bicarbonate (HCO <sub>3</sub> ) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m <sup>3</sup> at Analysis Temperature	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, consisting of several overlapping, stylized lines that form a unique, somewhat abstract shape.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental





**ANALYTICAL LABORATORY**  
 Private Bag 2000, Taupo  
 Phone: (07) 374 8211  
 Fax: (07) 374 8199  
 Email: w.labmanager@gns.cri.nz

**CERTIFICATE OF ANALYSIS**  
**ENVSUBGNS\_WAIRAKEI 96**

Report No: 2019110107

Customer Ref:152739

Ara Heron  
 RJ Hill Laboratories (Hamilton)  
 Environmental Reports Officers  
 Private Bag 3205  
 Hamilton

**GNS Lot No: 2019110107**

**GNS Sample No.** 2019006463  
**Collection Date**  
**Site ID** 2266824.4  
**Field ID**

pH		7.92	-	-	-
Bicarbonate (Total)	mg/l	1257	-	-	-
HCO <sub>3</sub> Analysis Temperature	°C	22	-	-	-
HCO <sub>3</sub> Analysis Date		06/11/2019	-	-	-

**SUMMARY OF METHODS AND DETECTION LIMITS**

The following table gives a brief description of the methods used to conduct the analyses on this report.  
 The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit	
Bicarbonate (total)	HCO <sub>3</sub> Titration Method ASTM Standards D513-82 Vol.11.01 1988	20	mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-	-

\*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Notes: These samples were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.

Ann Noddings  
 Senior Technician



**IANZ**  
 ACCREDITED LABORATORY

Tests marked with a † are not accredited and are outside the scope of the laboratory's accreditation





## Certificate of Analysis

Page 1 of 3

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2296091	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	19-Dec-2019	
		<b>Date Reported:</b>	09-Jan-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248541	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

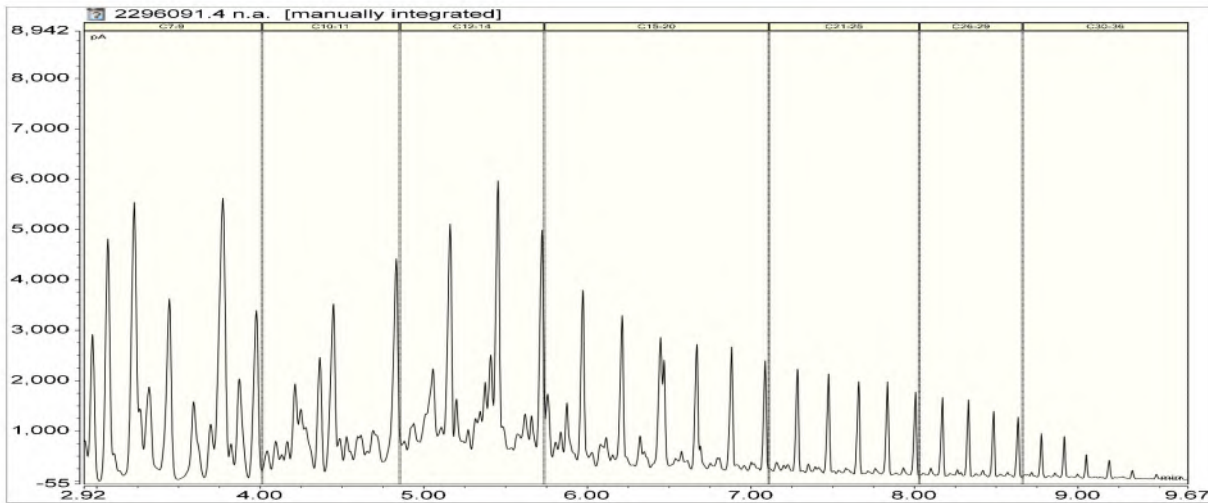
<b>Sample Name:</b>	Turangi 7 Stim5 Composite Return Fluid					
<b>Lab Number:</b>	2296091.4					
Individual Tests						
pH*	pH Units	6.6	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	670	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	320	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,439	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	11,700	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	18.1	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	13.3	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	95	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.048	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	7.0	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	19	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	3.6	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.154	-	-	-	-
Total Potassium	g/m <sup>3</sup>	220	-	-	-	-
Total Sodium	g/m <sup>3</sup>	3,000	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	37	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.131	-	-	-	-
Chloride*	g/m <sup>3</sup>	4,700	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 1.0 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 1.0	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 1.0 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	112	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 20	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene*	g/m <sup>3</sup>	109	-	-	-	-
Toluene*	g/m <sup>3</sup>	310	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	34	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	230	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	52	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	Turangi 7 Stim5 Composite Return Fluid					
<b>Lab Number:</b>	2296091.4					
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9*	g/m <sup>3</sup>	2,400	-	-	-	-
C10 - C14*	g/m <sup>3</sup>	3,400	-	-	-	-
C15 - C36*	g/m <sup>3</sup>	2,900	-	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	8,600	-	-	-	-

2296091.4  
 Turangi 7 Stim5 Composite Return Fluid  
 Client Chromatogram for TPH by FID



**Analyst's Comments**

The sub-contracted bicarbonate is unable to be analysed in 2296091.4 due to sample matrix.

#1 Severe matrix interferences required that a dilution be performed prior to analysis of this sample, resulting in a detection limit higher than that normally achieved for the NO<sub>2</sub>N, NO<sub>3</sub>N and NO<sub>x</sub>N analysis.

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

<b>Sample Type: Saline</b>			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Carole Rodgers-Carroll BA, NZCS  
Client Services Manager - Environmental





## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2296160	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	19-Dec-2019	
		<b>Date Reported:</b>	16-Jan-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248640	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Composite of Turangi 7 Strm 6 - Start Flowback, Turangi 7 Strm 6 - Middle Flowback & Turangi 7 Strm 6 - End Flowback				
<b>Lab Number:</b>	2296160.4				

### Individual Tests

pH*	pH Units	7.2	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	3,000	-	-	-	-
Analysis Temperature for Bicarbonate	°C	21	-	-	-	-
Bicarbonate	g/m <sup>3</sup> at Analysis Temperature	2,800	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	126	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,230	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	9,900	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	39	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	9.0	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	37	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.029	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	2.6	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	9	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	2.4	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.112	-	-	-	-
Total Potassium	g/m <sup>3</sup>	187	-	-	-	-
Total Sodium	g/m <sup>3</sup>	2,800	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	30	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.157	-	-	-	-
Chloride*	g/m <sup>3</sup>	2,800	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	0.15 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	0.17 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	90	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Propylene Glycol in Water						
Propylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 20	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	Composite of Turangi 7 Strm 6 - Start Flowback, Turangi 7 Strm 6 - Middle Flowback & Turangi 7 Strm 6 - End Flowback				
<b>Lab Number:</b>	2296160.4				

**BTEX in Water by Headspace GC-MS**

Benzene*	g/m <sup>3</sup>	17.3	-	-	-	-
Toluene*	g/m <sup>3</sup>	9.9	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	0.66	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	3.9	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	1.29	-	-	-	-

**Formaldehyde in Water by DNPH & LCMSMS**

Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-	-
---------------	------------------	--------	---	---	---	---

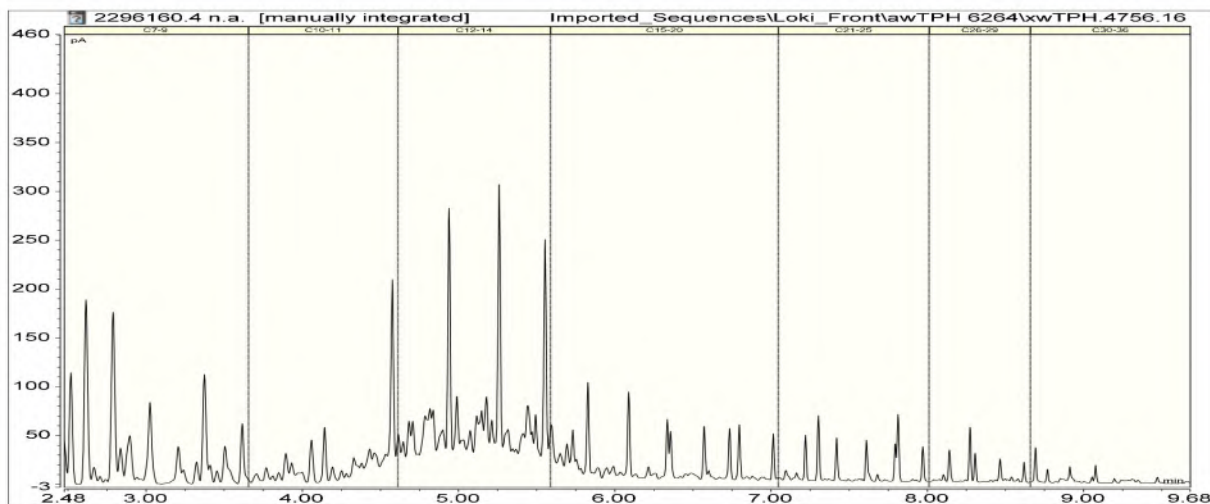
**Total Petroleum Hydrocarbons in Water**

C7 - C9*	g/m <sup>3</sup>	37	-	-	-	-
C10 - C14*	g/m <sup>3</sup>	98	-	-	-	-
C15 - C36*	g/m <sup>3</sup>	63	-	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	199	-	-	-	-

2296160.4

Composite of Turangi 7 Strm 6 - Start Flowback, Turangi 7 Strm 6 - Middle Flowback & Turangi 7 Strm 6 - End Flowback

Client Chromatogram for TPH by FID



**Analyst's Comments**

#1 Severe matrix interferences required that a dilution be performed prior to analysis of this sample, resulting in a detection limit higher than that normally achieved for the NO<sub>2</sub>N, NO<sub>3</sub>N and NO<sub>x</sub>N analysis.

Appendix No.1 - GNS report

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4



Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
pH*	pH meter. APHA 4500-H <sup>+</sup> B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	4
Bicarbonate	Bicarbonate (HCO <sub>3</sub> ) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m <sup>3</sup> at Analysis Temperature	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental



**ANALYTICAL LABORATORY**  
 Private Bag 2000, Taupo  
 Phone: (07) 374 8211  
 Fax: (07) 374 8199  
 Email: w.labmanager@gns.cri.nz

**CERTIFICATE OF ANALYSIS**  
**ENVSUBGNS\_WAIRAKEI 102**

Report No: 2020010707

Customer Ref:153079

Ara Heron  
 RJ Hill Laboratories (Hamilton)  
 Environmental Reports Officers  
 Private Bag 3205  
 Hamilton

**GNS Lot No: 2020010707**

**GNS Sample No.** 2020000070  
**Collection Date**  
**Site ID** 2296160-4  
**Field ID**

pH		7.31	-	-	-
Bicarbonate (Total)	mg/l	2803	-	-	-
HCO <sub>3</sub> Analysis Temperature	°C	21	-	-	-
HCO <sub>3</sub> Analysis Date		07/01/2020	-	-	-

## SUMMARY OF METHODS AND DETECTION LIMITS

The following table gives a brief description of the methods used to conduct the analyses on this report. The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit	
Bicarbonate (total)	HCO <sub>3</sub> Titration Method ASTM Standards D513-82 Vol.11.01 1988	20	mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-	-

\*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Notes: These samples were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.

Moya Appleby  
 Principal Technician



**IANZ**  
 ACCREDITED LABORATORY

Tests marked with a † are not accredited and are outside the scope of the laboratory's accreditation





## Certificate of Analysis

Page 1 of 3

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2303984	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	14-Jan-2020	
		<b>Date Reported:</b>	28-Jan-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248740	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Turangi-7 - Stim 7 Composite Return Fluid				
<b>Lab Number:</b>	2303984.4				

#### Individual Tests

pH*	pH Units	6.7	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	1,190	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	184	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,460	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	9,700	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	26	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	12.1	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	53	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.024	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	2.3	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	13	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	1.62	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.038	-	-	-	-
Total Potassium	g/m <sup>3</sup>	199	-	-	-	-
Total Sodium	g/m <sup>3</sup>	3,300	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	16	-	-	-	-
Total Zinc	g/m <sup>3</sup>	1.16	-	-	-	-
Chloride*	g/m <sup>3</sup>	37	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.5 #1	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 3	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.5 #1	-	-	-	-
Sulphate*	g/m <sup>3</sup>	49	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	20	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS*						
Benzene*	g/m <sup>3</sup>	11.2	-	-	-	-
Toluene*	g/m <sup>3</sup>	44	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	6.9	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	48	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	13.5	-	-	-	-



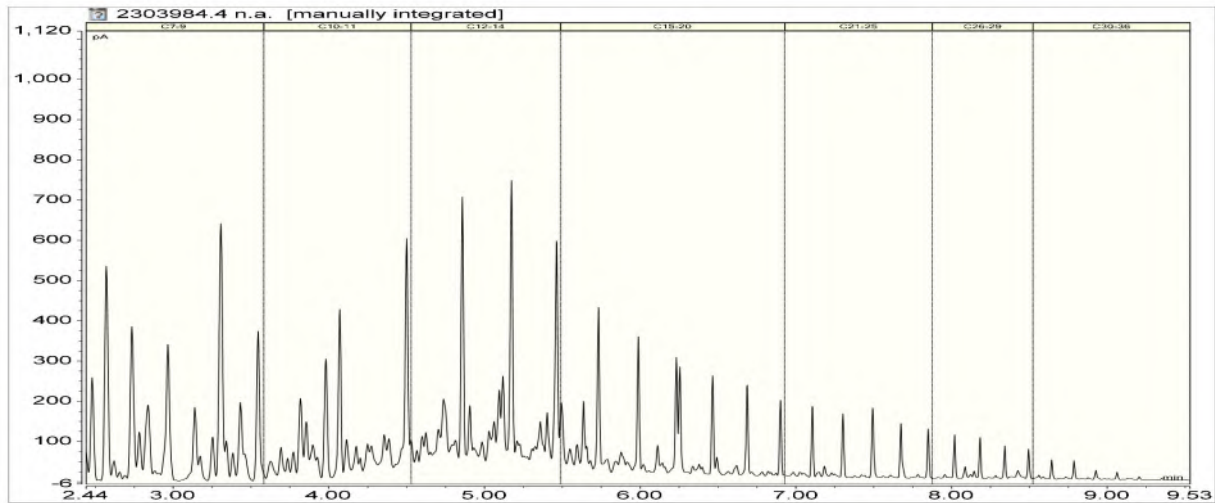
**Sample Type: Saline**

<b>Sample Name:</b>	Turangi-7 - Stim 7 Composite Return Fluid				
<b>Lab Number:</b>	2303984.4				
Formaldehyde in Water by DNPH & LCMSMS*					
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-
Total Petroleum Hydrocarbons in Water*					
C7 - C9*	g/m <sup>3</sup>	400	-	-	-
C10 - C14*	g/m <sup>3</sup>	750	-	-	-
C15 - C36*	g/m <sup>3</sup>	500	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	1,650	-	-	-

2303984.4

Turangi-7 - Stim 7 Composite Return Fluid

Client Chromatogram for TPH by FID

**Analyst's Comments**

The bicarbonate analysis could not be performed on this sample.

#1 Severe matrix interferences required that a dilution be performed prior to analysis of this sample, resulting in a detection limit higher than that normally achieved for the NO<sub>2</sub>N, NO<sub>3</sub>N and NO<sub>x</sub>N analysis.

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

<b>Sample Type: Saline</b>			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental







## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2304041	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	14-Jan-2020	
		<b>Date Reported:</b>	28-Jan-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248823	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Turangi 7 - Stim 8 Composite Return Fluid				
<b>Lab Number:</b>	2304041.4				

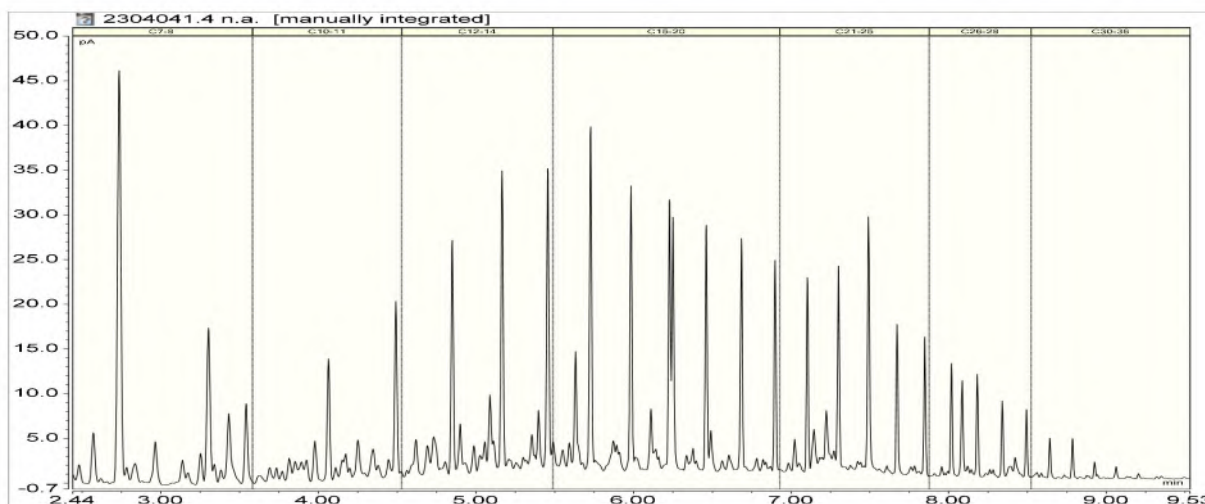
#### Individual Tests

pH*	pH Units	6.9	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	2,400	-	-	-	-
Analysis Temperature for Bicarbonate <sup>‡</sup>	°C	21	-	-	-	-
Bicarbonate <sup>‡</sup>	g/m <sup>3</sup> at Analysis Temperature	2,480	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	98	-	-	-	-
Electrical Conductivity (EC)*	mS/m	1,113	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	7,100	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	6.4	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	9.6	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	28	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.152	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	0.80	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	7	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	1.79	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.196	-	-	-	-
Total Potassium	g/m <sup>3</sup>	106	-	-	-	-
Total Sodium	g/m <sup>3</sup>	2,500	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	13	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.50	-	-	-	-
Chloride*	g/m <sup>3</sup>	23	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Sulphate*	g/m <sup>3</sup>	38	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS*						
Benzene*	g/m <sup>3</sup>	8.1	-	-	-	-
Toluene*	g/m <sup>3</sup>	5.7	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	0.27	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	1.52	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	0.64	-	-	-	-



Sample Type: Saline						
<b>Sample Name:</b>		Turangi 7 - Stim 8 Composite Return Fluid				
<b>Lab Number:</b>		2304041.4				
Formaldehyde in Water by DNPH & LCMSMS*						
Formaldehyde*	g/m <sup>3</sup>	0.21	-	-	-	-
Total Petroleum Hydrocarbons in Water*						
C7 - C9*	g/m <sup>3</sup>	11.7	-	-	-	-
C10 - C14*	g/m <sup>3</sup>	23	-	-	-	-
C15 - C36*	g/m <sup>3</sup>	49	-	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	83	-	-	-	-

2304041.4  
 Turangi 7 - Stim 8 Composite Return Fluid  
 Client Chromatogram for TPH by FID



### Analyst's Comments

‡ Analysis subcontracted to an external provider. Refer to the Summary of Methods section for more details.

Appendix No.1 - GNS Report

## Summary of Methods

The following table(s) give a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	4
Bicarbonate	Bicarbonate (HCO <sub>3</sub> ) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m <sup>3</sup> at Analysis Temperature	4
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)  
Client Services Manager - Environmental



**ANALYTICAL LABORATORY**  
 Private Bag 2000, Taupo  
 Phone: (07) 374 8211  
 Fax: (07) 374 8199  
 Email: w.labmanager@gns.cri.nz

**CERTIFICATE OF ANALYSIS**  
**ENVSUBGNS\_WAIRAKEI 108**

Report No: 2020011505

Customer Ref:153170

Ara Heron  
 RJ Hill Laboratories (Hamilton)  
 Environmental Reports Officers  
 Private Bag 3205  
 Hamilton

**GNS Lot No: 2020011505**

**GNS Sample No.** 2020000274  
**Collection Date**  
**Site ID** 2304041.4  
**Field ID**

pH	7.46	-	-	-
Bicarbonate (Total) mg/l	2477	-	-	-
HCO <sub>3</sub> Analysis Temperature °C	21	-	-	-
HCO <sub>3</sub> Analysis Date	16/01/2020	-	-	-

**SUMMARY OF METHODS AND DETECTION LIMITS**

The following table gives a brief description of the methods used to conduct the analyses on this report. The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit	
Bicarbonate (total)	HCO <sub>3</sub> Titration Method ASTM Standards D513-82 Vol.11.01 1988	20	mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-	-

\*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Notes: These samples were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.

Ann Noddings  
 Senior Technician



**IANZ**  
 ACCREDITED LABORATORY

Tests marked with a † are not accredited and are outside the scope of the laboratory's accreditation



## Certificate of Analysis

Page 1 of 3

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2303996	SPV1
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	14-Jan-2020	
		<b>Date Reported:</b>	28-Jan-2020	
		<b>Quote No:</b>	81870	
		<b>Order No:</b>	248846	
		<b>Client Reference:</b>	Return Fluid Composite	
		<b>Submitted By:</b>	Nakeysha Lammers	

### Sample Type: Saline

<b>Sample Name:</b>	Turangi 7 - Stim 9 Composite Return Fluid				
<b>Lab Number:</b>	2303996.4				

#### Individual Tests

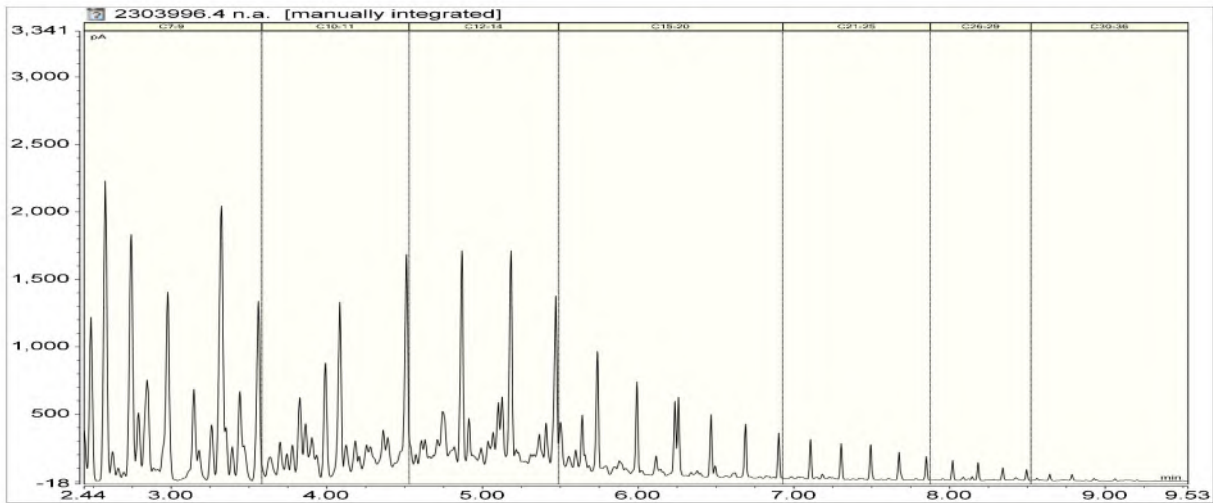
pH*	pH Units	7.3	-	-	-	-
Total Alkalinity*	g/m <sup>3</sup> as CaCO <sub>3</sub>	1,690	-	-	-	-
Total Hardness*	g/m <sup>3</sup> as CaCO <sub>3</sub>	87	-	-	-	-
Electrical Conductivity (EC)*	mS/m	700	-	-	-	-
Total Dissolved Solids (TDS)*	g/m <sup>3</sup>	6,000	-	-	-	-
Dissolved Barium	g/m <sup>3</sup>	2.5	-	-	-	-
Dissolved Bromine	g/m <sup>3</sup>	5.7	-	-	-	-
Dissolved Calcium	g/m <sup>3</sup>	26	-	-	-	-
Dissolved Copper	g/m <sup>3</sup>	0.019	-	-	-	-
Dissolved Iron	g/m <sup>3</sup>	11.5	-	-	-	-
Dissolved Magnesium	g/m <sup>3</sup>	6	-	-	-	-
Dissolved Manganese	g/m <sup>3</sup>	8.8	-	-	-	-
Total Nickel	g/m <sup>3</sup>	0.60	-	-	-	-
Total Potassium	g/m <sup>3</sup>	177	-	-	-	-
Total Sodium	g/m <sup>3</sup>	1,510	-	-	-	-
Total Sulphur*	g/m <sup>3</sup>	32	-	-	-	-
Total Zinc	g/m <sup>3</sup>	0.078	-	-	-	-
Chloride*	g/m <sup>3</sup>	11.6	-	-	-	-
Nitrite-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Nitrate*	g/m <sup>3</sup>	< 0.5	-	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	< 0.10	-	-	-	-
Sulphate*	g/m <sup>3</sup>	96	-	-	-	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 2	-	-	-	-
BTEX in Water by Headspace GC-MS*						
Benzene*	g/m <sup>3</sup>	44	-	-	-	-
Toluene*	g/m <sup>3</sup>	130	-	-	-	-
Ethylbenzene*	g/m <sup>3</sup>	15.0	-	-	-	-
m&p-Xylene*	g/m <sup>3</sup>	94	-	-	-	-
o-Xylene*	g/m <sup>3</sup>	25	-	-	-	-



**Sample Type: Saline**

<b>Sample Name:</b>	Turangi 7 - Stim 9 Composite Return Fluid					
<b>Lab Number:</b>	2303996.4					
Formaldehyde in Water by DNPH & LCMSMS*						
Formaldehyde*	g/m <sup>3</sup>	< 0.15	-	-	-	-
Total Petroleum Hydrocarbons in Water*						
C7 - C9*	g/m <sup>3</sup>	1,620	-	-	-	-
C10 - C14*	g/m <sup>3</sup>	2,100	-	-	-	-
C15 - C36*	g/m <sup>3</sup>	910	-	-	-	-
Total hydrocarbons (C7 - C36)*	g/m <sup>3</sup>	4,600	-	-	-	-

2303996.4  
 Turangi 7 - Stim 9 Composite Return Fluid  
 Client Chromatogram for TPH by FID



**Analyst's Comments**

The bicarbonate analysis could not be performed on this sample.

**Summary of Methods**

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

<b>Sample Type: Saline</b>			
Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	4
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	4
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	4
Formaldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.02 g/m <sup>3</sup>	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	4
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	4
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 <sup>rd</sup> ed. 2017.	-	4
pH*	pH meter. APHA 4500-H+ B 23 <sup>rd</sup> ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	4
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	4
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 <sup>rd</sup> ed. 2017.	0.1 mS/m	4
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 <sup>rd</sup> ed. 2017.	50 g/m <sup>3</sup>	4
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23 <sup>rd</sup> ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0006 g/m <sup>3</sup>	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.10 g/m <sup>3</sup>	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.0 g/m <sup>3</sup>	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.004 g/m <sup>3</sup>	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.4 g/m <sup>3</sup>	4
Dissolved Manganese	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0070 g/m <sup>3</sup>	4
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	1.1 g/m <sup>3</sup>	4
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.42 g/m <sup>3</sup>	4
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H <sub>2</sub> S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 <sup>rd</sup> ed. 2017.	0.0042 g/m <sup>3</sup>	4
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 <sup>rd</sup> ed. 2017.	0.5 g/m <sup>3</sup>	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N. In-House.	0.0010 g/m <sup>3</sup>	4
Nitrate*	Calculation from Nitrate-N.	0.005 g/m <sup>3</sup>	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) 23 <sup>rd</sup> ed. 2017.	0.0010 g/m <sup>3</sup>	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m <sup>3</sup>	4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental







## Certificate of Analysis

<b>Client:</b>	Greymouth Petroleum Limited	<b>Lab No:</b>	2287484	SPv3
<b>Contact:</b>	Nakeysha Lammers C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	<b>Date Received:</b>	05-Dec-2019	
		<b>Date Reported:</b>	30-Jan-2020	(Amended)
		<b>Quote No:</b>	85159	
		<b>Order No:</b>	248541	
		<b>Client Reference:</b>	Hydraulic fracturing fluid testing	
		<b>Submitted By:</b>	Nakeysha Lammers	

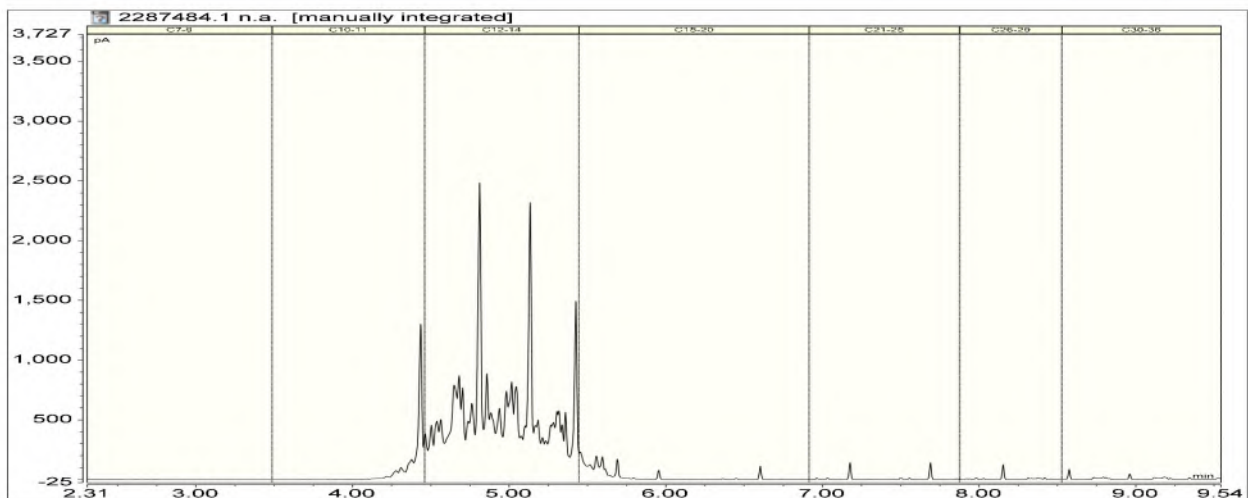
### Sample Type: Aqueous

<b>Sample Name:</b>	Turangi 7 Stim 5 Pre-pumped 03-Dec-2019					
<b>Lab Number:</b>	2287484.1					
Ethylene Glycol in Water*						
Ethylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Propylene Glycol in Water*						
Propylene glycol*	g/m <sup>3</sup>	< 20	-	-	-	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m <sup>3</sup>	< 4 #1	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Toluene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Ethylbenzene	g/m <sup>3</sup>	< 0.010	-	-	-	-
m&p-Xylene	g/m <sup>3</sup>	< 0.02	-	-	-	-
o-Xylene	g/m <sup>3</sup>	< 0.010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	1.3	-	-	-	-
C10 - C14	g/m <sup>3</sup>	1,950	-	-	-	-
C15 - C36	g/m <sup>3</sup>	182	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	2,100	-	-	-	-

2287484.1

Turangi 7 Stim 5 Pre-pumped 03-Dec-2019

Client Chromatogram for TPH by FID



## Analyst's Comments

#1 Due to some interference found in the chromatography, the detection limit was raised. Hence the higher detection limit reported.

**Amended Report:** This certificate of analysis replaces an earlier report issued on 07 Jan 2020 at 11:56 am  
Reason for amendment: The sample name has been amended, at the request of the client.

## Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

### Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines	0.10 - 0.7 g/m <sup>3</sup>	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Carole Rodgers-Carroll BA, NZCS  
Client Services Manager - Environmental