

Greymouth Petroleum Limited  
Onaero Exploration Wellsite  
Monitoring Programme Report  
Technical Report 2011-92

ISSN: 0114-8184 (Print)  
ISSN: 1178-1467 (Online)  
Document: 1022831 (Word)  
Document: 1140732 (Pdf)

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July 2014



## Executive summary

Greymouth Petroleum Limited re-entered a hydrocarbon exploration site located on Mataro Road, Urenui, in the Onaero River catchment, including undertaking fracturing operations. The site is called Onaero. This operation took place from July 2011 - January 2012.

This report for the period July 2011 - January 2012 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance in relation to drilling and well enhancement operations at the Onaero well during the period under review, and the results and environmental effects of the Company's activities.

Greymouth Petroleum Limited holds a total of 6 resource consents, for the activities at the Onaero well, which include a total of 92 conditions setting out the requirements that the Company must satisfy. Greymouth Petroleum Limited holds consent 7554-1 to allow it to take groundwater, consents 7555-1 and 7556-1 to discharge treated stormwater, produced water and drilling water onto land and into the Onaero Stream, consents 7557-1 and 7558-1 to discharge emissions to air from flaring at this site, and consent 7932-1 to discharge contaminants in association with hydraulic fracturing.

The Council's monitoring programme for the period under review included 11 inspections of the site and surrounding environment. Samples were collected for physicochemical analysis. No bio-monitoring surveys of receiving waters or ambient air quality analyses were carried out. In each case, inspections found further specific investigations were unnecessary. Groundwater samples were collected and analysed, as a precautionary investigation responding to concerns voiced by some commentators. These samples showed no evidence of any contamination. No neighbours expressed concerns or identified issues.

Bunding of both wet and dry chemicals/hazardous substances was an important and integral consideration when setting up the site. Most chemicals were stored in low traffic areas. Goods stored within the banded areas were often covered to stop product getting wet.

Any spills on site were quickly cleaned up to avoid the potential for a contaminant to travel via surface water. Throughout the monitoring period the well site's stormwater system, consisting of an interceptor ring drain and two skimmer pits, worked effectively to capture and treat stormwater before it discharged offsite.

The receiving surface water body was visually inspected during most inspections and showed no evidence of any discharge entering it. Recreational users did not report any effects.

No water samples were taken because there was no discharge of stormwater from site at the times of inspection.

Staff on site were cooperative with requests made by officers of Taranaki Regional Council with any required works being completed quickly and to a satisfactory standard.

There were no Unauthorised Incidents recorded in respect of this consent holder during the period under review.

Drilling fluids and cuttings were disposed of off-site by contractor.

Flaring was carried out on site during the well clean up and testing phase.

During the monitoring period, Greymouth Petroleum Limited demonstrated a high level of environmental performance and compliance with the resource consents.

This report includes recommendations for future drilling operations at this and other sites.

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# **1. Introduction**

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

### **1.1.1 Introduction**

This report is for the period July 2011 - January 2012 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by Greymouth Petroleum Limited.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Greymouth Petroleum Limited that relate to exploration activities at the Onaero wellsite on Mataro Road, Urenui, within the Onaero River catchment.

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

### **1.1.2 Structure of this report**

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Greymouth Petroleum Limited in the Onaero catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at the Onaero wellsite during exploration activities.

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

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

Section 4 presents recommendations to be implemented during future drilling operations.

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 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 a discharger, and may include cultural and socio-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects;
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- (d) natural and physical resources having special significance (e.g. recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, (covering both activity and impact monitoring) also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further 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 performance

Besides discussing the various details of the performance and extent of compliance by Greymouth Petroleum Limited in the catchment during the period under review, this report also assigns an overall rating. The categories used by the Council, and their interpretation, are as follows:

- A **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline), non-compliance with conditions.
- A **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been

dealt with, and any inconsequential non compliances with conditions were resolved positively, co-operatively, and quickly.

- **Improvement required (environmental) or improvement required (administrative compliance)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.
- **Poor performance (environmental) or poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

## 1.2 Process description

Greymouth Petroleum Limited holds a 10 year exploration mining permit (38746) to mine oil, condensate, LPG, petroleum and gas within a 27.010 square kilometre area. The Onaero wellsite is one of many sites within this area that have been established in order to explore, evaluate and produce hydrocarbons from within the McKee Formation below.

The wellsite is located approximately 1.74km south of Urenui, approximately 230m from SH3 and 1.3km from the coastline. The site is accessed from Mataro Road.

The Onaero wellsite was established in 2011 and involved the removal of topsoil to create a firm level platform on which to erect a drilling rig and house associated equipment. Site establishment also involved the installation of:

- A wastewater control, treatment and disposal facilities;
- A system to collect and control stormwater and contaminants;
- A flare pit; and
- Other on-site facilities such as accommodation, parking and storage.

### Well creation

The Onaero well was a re-entry of an existing well that had been abandoned. The well was also deepened. A normal well is drilled in sections using different sized drill bits. The width of the well is wider at the surface as smaller drill bits are used as the well gets deeper. Once each section of the well is drilled, a steel casing is installed. Cement is then pumped down the well and encases the space between the steel casing and the surrounding rock. This process is repeated until the target depth is reached, with each section of steel casing interlocked with the next.

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

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

The Onaero well site currently has one well. Onaero was drilled to a target depth of 3122 metres.

### **Management of stormwater, wastewater and solid drilling waste**

The Onaero wellsite is situated approximately 160m from an unnamed tributary of the Onaero Stream. Management systems have been put in place to avoid any adverse effects on the surrounding environment from exploration and production activities on the wellsite. There are several potential sources of contamination from water and solid waste material which require appropriate management. These are:

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

These matters are addressed by conditions imposed through resource consents.

Important requirements of the site establishment are to ensure that the site is contoured so that all stormwater and any runoff from 'clean' areas of the site flow into perimeter drains. The drains direct stormwater into a skimmer pit system on site consisting of one or two settling ponds. Any hydrocarbons present in the stormwater float to the surface and can be removed. The ponds also provide an opportunity for suspended sediment to settle. Treated stormwater is then discharged from the wellsite overland, from where it may eventually enter the Onaero Stream.

Drilling mud, cuttings and water brought to the surface during drilling operations are separated out using a shale shaker. The drilling mud and some of the water was reused in the drilling process. Cuttings were collected in bins located at the base of the shaker and disposed of off site.

### **Hydraulic fracturing**

Hydraulic fracturing involves pumping fluids (consisting mainly of freshwater and some fracing chemicals) and a proppant (medium-grained sand or small ceramic pellets) at high pressure down the well through the perforated casing and into reservoir. The pressure exceeds the fracture strength of the reservoir rock and hydraulically causes an artificial fracture to form in the receiving formation, but not

in the overlaying geological seals that define the hydrocarbon reservoir. To do this the fracturing fluid is maintained under a pre-determined pressure for a period of time.

Once a fracture has been initiated, the fracturing fluid and proppant are carried into the fracture. The proppant keeps the fracture open when the pumping is stopped. The placement of proppant in the fractures is assisted by the use of cross-linked gels. These are solutions, which are liquid at the surface but, when mixed, form long-chain polymer bonds and thus become gels that transport the proppant into the formation.

Once in the formation these gels 'break' back with time and temperature to a liquid state and are flowed back to surface as back flow without disturbing the proppant wedge (i.e. the sand, small ceramic pellets or other particulates that prevent the fractures from closing when the injection is stopped), trapped in the fracture. With continued flow, formation hydrocarbon fluids should be drawn into the fracture, through the perforations into the wellbore and to the surface.

### Flaring from exploration activities

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

- well testing and clean-up;
- production testing;
- emergencies; and
- maintenance and enhancement activities [well workovers].



**Photo 1** Aerial view showing the location of Onaero well site

## 1.3 Resource consents

### 1.3.1 Background

Greymouth Petroleum Limited holds 6 resource consents related to exploration activities at the Onaero site. Consents 7885-1, 7557-1, 7556-1, 7555-1 and 7554-1 were granted on 10 December 2009. Consent 7932-1 was granted on 14 September 2011. The consent applications were processed on a non-notified basis as Greymouth Petroleum Limited had obtained the landowner's approval as an affected party, and the Council was satisfied that the environmental effects of the activity would be minor.

The consents are discussed below.

Copies of the consents and the Council reports describing the associated activities are contained in Appendix I to this report.

### 1.3.2 Water abstraction permit

Section 14 (Restrictions relating to water) of the Resource Management Act 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.

Greymouth Petroleum Limited was unable to estimate the rate or volume at which formation (produced) water might be taken during exploration, and might exceed the limits of the permitted activity Rule [Rule 48 of the RFWP]. The taking of groundwater therefore falls for consideration under Rule 49 of the RFWP as a controlled activity.

The standards of Rule 49 require that:

- The abstraction shall cause not more than a 10% lowering of static water-level by interference with any adjacent bore;
- The abstraction shall not cause the intrusion of saltwater into any fresh water aquifer.

Any produced water would be from reserves far below that which is used for domestic or farm purposes. In addition, there are no known bores within 500 m of the proposed wellsite. Shallow groundwater [which does not have any saltwater content] would be protected by casing within the bore hole. Given these factors, the abstraction would not cause the above potential adverse effects.

The Council was satisfied that the activity would meet all the standards for a controlled activity. It was therefore required to grant the consent but imposed conditions in respect of those matters over which it reserved control. Those matters over which the Council reserved its control are:

- Volume and rate of abstraction;
- Daily timing of abstraction;
- Effect on adjacent bores, the aquifer, river levels, wetlands and sea water intrusion;

- Fitting of equipment to regulate flows and to monitor water volumes, levels, flows and pressures;
- Payment of administrative charges;
- Monitoring and reporting requirements;
- Duration of consent;
- Review of the conditions of consent and the timing and purpose of the review.

Greymouth Petroleum Limited holds water discharge permit **7554-1** to *take groundwater, which is encountered as produced water drilling at the Onaero wellsite*.

This permit was issued by the Taranaki Regional Council on 10 December 2009 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

In granting the consent it was considered that the taking of groundwater was unlikely to have any adverse affect on the environment.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 3, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

### **1.3.3 Water discharge permit (treated stormwater)**

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

The discharge of contaminants from an industrial premise to land where the discharge is likely to enter water is a discretionary activity under Rule 44 of the RFWP, as the activity is not specifically provided for as a permitted activity.

Greymouth Petroleum Limited holds water discharge permit **7555-1** to *discharge treated stormwater, produced water and drilling water from hydrocarbon operations on the wellsite*.

This permit was issued by the Taranaki Regional Council on 10 December 2009 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

The discharge of stormwater may result in contaminants (e.g. sediment) entering surface water. These contaminants have the potential to adversely effect in-stream flora and fauna. On-site management of stormwater, as discussed in 1.2 above, is necessary to avoid/remedy any adverse effects on water quality.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 2, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

### 1.3.4 Water discharge permit (stormwater and sediment –earthworks)

Section 15(1)(a) of the Resource Management Act 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.

As there was the potential that earthworks might be undertaken in winter [between 1 May and 31 October], the discharge of stormwater and sediment into and onto land in association with the earthworks fell for consideration under Rule 27 of the RFWP as a controlled activity [which may be non-notified without written approval].

The standards of Rule 27 require that:

- A site erosion and sediment control management plan shall be submitted to the Taranaki Regional Council.

The Council was satisfied that the activity would meet all the standards for a controlled activity. It was therefore required to grant the consent but imposed conditions in respect of those matters over which it reserved control. Those matters over which the Council reserved its control are:

- Approval of a site erosion and sediment control management plan and the matters contained therein;
- Setting of conditions relating to adverse effects on water quality and the values of the waterbody;
- Timing of works;
- Any measures necessary to reinstate the land following the completion of the activity;
- Monitoring and information requirements;
- Duration of consent;
- Review of conditions of consent and the timing and purpose of the review;
- Payment of administrative charges and financial contributions.

Greymouth Petroleum Limited holds water discharge permit **7556-1 to discharge stormwater and sediment onto and into land in association with earthworks for the construction of the wellsite.**

This permit was issued by the Taranaki Regional Council on 10 December 2009 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 1, Section 3.3.

A copy of the permit is attached to this report in Appendix I.



### 1.3.5 Air discharge permit (exploration activities)

Section 15(1)(c) of the Resource Management Act 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.

Flaring in association with exploration activities falls for consideration under Rule 10 of the RAQP as a discretionary activity as there are no permitted rules for this activity.

Provided the activities were conducted in accordance with the applications and in compliance with the recommended special conditions, then no significant effects were anticipated. Special conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance.

Greymouth Petroleum Limited holds air discharge permit 7557-1 *to discharge emissions to air from flaring associated with well clean up and well testing.*

This permit was issued by the Taranaki Regional Council on 10 December 2010 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance and can be viewed in Table 4, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

### 1.3.6 Air discharge permit (production activities)

Section 15(1)(c) of the Resource Management Act 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.

Flaring in association with production activities falls for consideration under Rule 11 of the RAQP as a discretionary activity

The standard/term/condition of Rule 11 states that the:

- Discharger must at all times adopt the best practicable option to prevent or minimise any adverse effects on the environment.

Greymouth Petroleum Limited stated that they would undertake the best practicable option. As such, Council was satisfied that the above standard/term/condition would be met, and processed the application under this rule.

Greymouth Petroleum Limited holds air discharge permit 7558-1 *to discharge emissions to air during flaring from well workovers and in emergency situations.*

This permit was issued by the Taranaki Regional Council on 10 December 2009 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 5, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

### **1.3.7 Discharges to land (hydraulic fracturing)**

Sections 15(1)(b) and (d) of the Resource Management Act 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.

The discharge of contaminants associated with hydraulic fracturing, onto and into land where contaminants may reach water, is a discretionary activity under Rule 44 of the RFWP.

The rule is a “catch all” rule as there is currently no specific rule for the discharge of fracking contaminants. The rule is set out below:

*Discharge of contaminants onto or into land restricted by s15(1)(b) [where contaminants may reach water] and s15(1)(d) [where the discharge is from industrial or trade premises] of the Act which is not expressly provided for in Rules 21-42 or which is provided for but does not meet the standards, terms or conditions and any other discharge of contaminants to land which is provided for in Rules 21-42 but which does not meet the standards, terms or conditions of those rules [irrespective of whether the discharges are from industrial or trade premises or are likely to reach water].*

Provided the activities were conducted in accordance with the applications and in compliance with the recommended special conditions, then no significant effects were anticipated.

**Greymouth Petroleum Limited holds discharge permit 7932-1 to discharge contaminants in association with hydraulic fracturing activities into land at depths greater than 3000mTVD.**

This permit was issued by the Taranaki Regional Council on 14 September 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2012.

Consent conditions were imposed on Greymouth Petroleum Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 6, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

## **1.4 Monitoring programme**

### **1.4.1 Introduction**

Section 35 of the Resource Management Act sets out obligations upon the Taranaki Regional Council to: gather information, monitor, and conduct research on the exercise of resource consents and the effects arising, within the Taranaki region and report upon these.

The Taranaki Regional 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 exploration well sites allows for seven primary components. They are:

- Programme liaison and management
- Site inspections
- Chemical sampling
- Solid wastes
- Air quality monitoring
- Discharges to land (hydraulic fracturing)
- Ecological surveys.

The monitoring programme for the Onaero wellsite focused primarily on site inspections, chemical sampling, and discharges to land. However, the seven components are discussed below.

### **1.4.2 Programme liaison and management**

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters.

### **1.4.3 Site inspections**

Inspection and examination of wellsites is a fundamental and effective means of monitoring and are undertaken to ensure that good environmental practices are adhered to and resource consent special conditions complied with.

The inspections are based on internationally recognised and endorsed wellsite monitoring best-practice checklists developed by the Alberta Energy Resources Conservation Board and the USEPA.

The inspections also provide an opportunity for monitoring officers to liaise with staff about on site operations; monitoring and supervision; discuss matters of concern; and resolve any issues in a quick and informal manner.

Inspections pay special attention to the ring drains, mud sumps, treatment by skimmer pits and the final discharge point from the skimmer pit on to land and then into water and any potential receiving waters.

During each inspection the following are checked:

- weather;
- flow rate of surface waters in the general vicinity;
- flow rate of water take;
- whether pumping of water was occurring;
- general tidiness of site;
- site layout;
- ring drains;
- hazardous substance bunds;
- treatment by skimmer pits/sedimentation pits;
- drilling mud;
- drill cuttings;
- mud pit capacity and quantity contained in pit;
- sewage treatment and disposal;
- cementing waste disposal;
- surface works;
- whether flaring was in progress, and if there was a potential for flaring, whether the Council had been advised;
- discharges and surface waters in the vicinity for effects on colour and clarity, aquatic life and odour;
- site records;
- general observations; and
- odour (a marker for any hydrocarbon contamination).

By the time Council inspectors have on each visit checked the above matters a robust and comprehensive evaluation of compliance has been delivered.

#### **1.4.4 Chemical sampling**

The Taranaki Regional Council may undertake sampling of discharges from site and/or from sites upstream and downstream of the discharge point to ensure that resource consent special conditions are complied with.

#### **1.4.5 Solid wastes**

Taranaki Regional Council monitors any disposal of drill cuttings on site via mixed bury cover to ensure compliance with resource consent conditions.

In recent times consent holders have opted to remove drilling waste from their site by contractor for disposal at licensed disposal areas (land farming).

#### **1.4.6 Air quality monitoring**

Air quality monitoring is usually carried out in association with the well testing and clean-up phase, where flaring can cause smoke emissions.

#### **1.4.7 Discharges to land (hydraulic fracturing)**

Sampling and analysis of the fracking fluids, return flow, and nearby streams and bores may be carried out. Inspections of the site and surrounding land and water were carried out to ensure that no observable effects have occurred as a result of the deep discharge to land. Pre and post hydraulic fracturing reports were to be submitted by the consent holder detailing among other things, the effectiveness of the mitigation measures put in place to protect the environment.

#### **1.4.8 Ecological surveys**

Ecological surveys in any nearby streams may be carried out pre and post occupation of the well site to assess whether the activities carried out on site, and associated discharges have had any effect on ecosystems.

## **2. Results**

### **2.1 Water**

#### **2.1.1 Inspections**

The Onaero site, adjacent land and streams were inspected 11 times from the site construction phase through to the drilling and flaring phases.

Below is a copy of the comments that were noted on the day of each inspection.

##### **12 July 2011**

All consent conditions were being complied with at time of inspection. Only small amounts of chemicals were stored on site within a bunded area. The bunded area drained to a sump. The skimmer pits appeared visually to be high in suspended solids. No stormwater was discharging from site at time of inspection. It was possible that the muddy area at the northern end of the site is contributing to a high suspended solid level in the stormwater. It was recommended that hay bales/silt cloth be placed within the ringdrain to help reduce the silt levels.

##### **20 July 2011**

The site was clean and tidy. Good bunding was in place, especially around the mud pump where a spill to ground had occurred. The ring drains were dry and the skimmer pits nearly empty. It was observed that a silt trap had been placed in the ring drain, and another placed 2m downstream of the discharge from the skimmer pit. An unusual white substance was seen in the northern ring drain above the stormwater treatment system. This was conveyed to Andy (site supervisor) for follow up. The site was satisfactory with consent conditions being complied with at time of inspection.

##### **29 July 2011**

The site was tidy. The ring drains were dry. The second skimmer pit was dry. The first skimmer pit was half full and discoloured. No stormwater was discharging from the site. It was observed that some small spills had occurred around the rig such as drilling mud and various types of fluids. Sawdust was used to mop up the small spills that had been noticed. No flaring was occurring at time of inspection. Inspection indicated that resource consents' conditions were being complied with at time of inspection.

##### **16 August 2011**

No works were being carried out at time of inspection. The rig and all associated equipment had been removed from site. The ring drains were dry. The skimmer pits were nearly empty. Resource consent conditions were being complied with at time of inspection.

##### **23 August 2011**

All resource consent conditions were being complied with at time of inspection. Flaring was occurring during the site inspection. The flare was not objectionable or offensive. No liquid or solid hydrocarbons were observed to be combusted. Separation equipment was in use on site.

**29 August 2011**

Resource consent conditions were being complied with at time of inspection. The site was dry. There was no stormwater discharge from site and no flaring at time of inspection. The flare pit was dry with no liquid or solid hydrocarbons visible. Silt/sediment had been removed from the first skimmer pit.

**08 September 2011**

The well site was dry, including the ring drains and skimmer pits. There was good bunding on site. There were no persons on site at the time of inspection. No flaring was occurring. By inspection it was indicated all conditions are being complied with at time of inspection.

**28-29 September 2011**

Regional Council Officers were on site primarily to ensure the conditions of resource consent 7932-1 were complied with and to monitor the site and surrounding land for any effects that may have arisen during and after the fracturing operation.

It was observed that the site was dry, including the ring drains and skimmer pits. Water tanks, fuel tanks and storage tanks were all bunded. Two spill kits were located on site. A pilot flame was burning in the flare pit with no smoke visible upon inspection.

The fracturing fluid that was used was water based. A sample of the linear gel was collected as per condition 6 of consent 7933-1. It was understood that a Diagnostic Fluid Injection Test (DFIT) was carried out on 27 September 2011. During a DFIT fracturing fluid is pumped down the well at pressures that cause the formation to fracture. The DFIT allows operators to assess how the formation will react during the main fracturing operation and provides an opportunity to check that all equipment is in working order.

The surrounding land and waterways were inspected before and after the fracturing operation. No changes were observed post fracturing. All waterways looked clear and no unusual activity was observed. No ground vibrations were felt prior, during or after fracturing. Local white baiters situated on Onaero Road questioned by a Council officer did not feel, see or hear anything unusual.

A re-inspection of the site was carried out on Thursday 29 September 2011. The site, surrounding land and waterways appeared as they did the previous day. The pilot flame had been extinguished at time of inspection. A sample of the fluid within the well was collected.

**05 October 2011**

The site was sodden from torrential rain two days previous; however there were minimal puddles onsite. The ring drains were clear of stormwater. Stormwater was observed in both skimmer pits. It appeared that most stormwater is soaking into the ground through the base of the pit. Stormwater had recently discharged to land via the discharge pipe due to the volume of rain that fell onto the site. No stormwater was discharging at time of inspection. There were no effects observed. A pilot flame was being maintained at time of inspection. Separation equipment was in place. It was reported that flaring of gases had been occurring. There was good bunding on site. Inspection indicated that all consent conditions were being complied with.

**15 November 2011**

Testing continued onsite with sand catching, heating, separation and flaring of hydrocarbons taking place at time of inspection. Some smoke was observed being emitted from the flare pit. The smoke was not considered offensive or objectionable beyond the boundary of the site. The temperature of the heater was raised during the inspection to minimise the smoke. The site was dry and no stormwater was being discharged from site. One container of methanol was onsite and it was contained within two bunds. No other chemicals were onsite. Inspection indicated that all consent conditions were being complied with at time of inspection.

**10 January 2012**

Consents 7558-1, 7932-1 and 7556-1 were not being exercised at time of inspection.

Consent 7557-1 was being exercised at time of inspection. Flaring was occurring at time of inspection. The flare looked clean with minimal smoke being generated. Works had been undertaken to improve the quality of the flare.

Consent 7555-1 was being exercised at time of inspection. Heavy rain was falling at time of inspection. The ring drains and skimmer pits had been dry during the days prior. At the time of inspection stormwater was beginning to pool in the first skimmer pit. No stormwater was discharging off site. No chemicals were stored on site. It was advised to staff on site that a dry tray be placed under the diesel tank, instead of the current absorbent cloth.

Consent 7554-1 was being exercised at the time of inspection. Some produced water was being recovered from the formation and was being stored in a tank before being disposed of offsite.

**2.1.2 Results of abstraction and discharge monitoring**

During the period under review chemical sampling and analysis of the stormwater discharge at the Onaero well site was not undertaken as there was no discharge observed from the skimmer pits during any of the site inspections.

Any discharge off-site would have been onto land from the skimmer pits and flowed in an easterly direction towards an unnamed tributary of the Onaero Stream. Any discharge from site was unlikely to reach a surface water body due to the distance the wellsite was from any stream to the west (over 160m).

All sewage was directed for treatment through a septic tank system and removed by contractor to a licensed disposal facility.

Cementing wastes were contained and disposed of offsite.

During exploration activities on the site WBM drill cuttings were removed from the site by contractor and disposed of by land farming at the licensed disposal area at Uruti.



### **2.1.3 Results of receiving environment monitoring**

The receiving surface water body was visually inspected in conjunction with each site inspection. No effects were observed and the stream appeared clear with no visual change in colour or clarity. There was also no odour, oil, grease films, scum, foam or suspended solids observed in the stream during the monitoring period. Stream users were queried and indicated no effects.

No bio-monitoring surveys of receiving waters were carried out owing to the distance from the discharge point to any surface waterbodies.

## **2.2 Air**

### **2.2.1 Inspections**

Air quality monitoring inspections were carried out in conjunction with general compliance monitoring inspections. See section 2.1.1 above for comments concerning site inspections.

Assessments were made by officers of the Council during site inspections to ensure that the consent holder undertook all practicable steps to mitigate any effects from flaring gas.

Officers checked that that plant equipment was working effectively, that there was the provision of liquid and solid separation, and that staff on site had regard to wind direction and speed at the time of flaring.

The flare pit was also inspected to ensure that solid and liquid hydrocarbons were not combusted within the flare pit.

It is also a requirement that Taranaki Regional Council and immediate land owners are notified prior to any gas being flared. This requirement is checked to ensure compliance.

### **2.2.2 Results of discharge monitoring**

During monitoring inspections of the site the Inspecting Officer found there were no offensive or objectionable odours, smoke or dust associated with activities at the Onaero wellsite.

Flaring of gas occurred on 84 days at this wellsite during the period of monitoring.

Greymouth Petroleum Limited notified Taranaki Regional Council of its intention to test the well and flare gas on/about 22 August 2011. There are numerous residents living within a 1km radius of the well. The air discharge consent required that these residents be notified 24 hours prior to any gas being flared. Taranaki Regional Council contacted local residents to confirm that this condition was complied with.

Inspections indicated that Greymouth Petroleum Limited took all practicable steps to mitigate any effects from smoke, which included ensuring that plant equipment was working effectively and having regard to wind direction and speed. No smoke complaints were received by Taranaki Regional Council and no offensive or

objectionable smoke or odours were observed by monitoring officers. Some concerns were expressed about the duration of the flaring in terms of increased light and energy work. Both these matters are the responsibility of other regulators.

The flare pit was inspected during every inspection to ensure that solid and liquid hydrocarbons were not combusted within the flare pit. There was no evidence to suggest that solid and liquid hydrocarbons were being combusted through the gas flare system, or left as a residue in the flare pit.

From observations during site inspections it appeared that special conditions relating to the control of emissions to air from the flaring of hydrocarbons were complied with.

### **2.2.3 Results of receiving environment monitoring**

No chemical monitoring of air quality was undertaken during the testing phase of the Onaero well as the controls implemented by Greymouth Petroleum Limited did not give rise to any concerns with regard to air quality.

As mentioned in 2.2.2, visual inspections of the flare, the flare pit and surrounding area were carried out and no effects were observed.

During monitoring inspections of the site the Inspecting Officers found there were no offensive or objectionable odours, smoke or dust associated with activities at the Onaero wellsite.

### **2.2.4 Other ambient monitoring**

No other ambient air sampling was undertaken, as the controls implemented by Greymouth Petroleum Limited did not give rise to any concerns with regard to air quality.

## **2.3 Land**

### **2.3.1 Inspections (hydraulic fracturing)**

Land monitoring inspections were carried out in conjunction with general compliance monitoring inspections.

### **2.3.2 Results of receiving environment monitoring (hydraulic fracturing)**

Nearby receiving surface water bodies and the surrounding land were visually inspected in conjunction with site inspections. No effects were observed and the receiving surface water bodies appeared clear with no visual change in colour or clarity before, during and after the discharge. There was also no odour, oil, grease films, scum, foam or suspended solids observed in the receiving surface water bodies during the monitoring period.

On the day that hydraulic fracturing took place, local whitebaiters were spoken to. They were asked if they had felt any vibrations or seen vibrations on the surface of

the stream, and whether anything unusual had occurred. The whitebaiters had not experienced any effects from the deep discharge to land.

Samples of the fracturing fluid were obtained when it flowed back to surface and prior to it being discharged into land. These samples were held in storage and would be analysed if required to determine the characteristics of the fluid.

Resource Consent 7932-1 required a post fracture discharge report to be submitted that provided details of the activity and its effects (such as the depth, length and height of fractures; total volume of liquid pumped into the ground and the amount of fluid removed from the ground). Greymouth Petroleum Limited's post fracture discharge report provided the following information:

- a) The fracture interval was below 3000 m. Post job simulation indicates that the fracture was contained and did not extend beyond this depth.*
- b) The volume of fluid pumped into the formation (discharge) was 304m<sup>3</sup> (1,918 bbls) with total proppant (synthetic sand) of 48.1 ton (105,837 lbs).*
- c) Total fluid that remains in formation is 208m<sup>3</sup> (1,313 bbl), 96m<sup>3</sup> (605 bbls) were recovered (31%). The synthetic sand placed in the reservoir is 40.8 ton (89,738 lbs). 85% of sand and 69% of fluid remains in formation at depth.*
- d) Post job history match modelling indicates that the total injected sand and fluids created a propped fracture in the reservoir of 250 m in length (each side of the well), 36 m in height (max.), 3 mm in width (max.), with a sand concentration of 3.5 kg/m<sup>2</sup> (0.72 lb/ft<sup>2</sup>).*
- e) The average wellhead pressure during the job was 5870 psi. The maximum downhole pressure (discharge zone) was 7,830 psi. Due to the screenout (proppant saturation inside the formation) at the end of the operation the maximum pressure on surface was 9,700 psi. Total duration of treatment was 43 minutes.*
- f) The back flow (returning water based fluid) to surface was trucked to storage facilities for future disposal. A gas/liquid/solid separator was installed on the surface. Gas was combusted in a flare pit for the duration of the testing phase and condensate was trucked to the Omata Tank Farm.*
- g) The mitigation measurements in place worked as planned. There was zero discharge into the flare pit and all fluids were collected in storage tanks after being flowed through the sand catchers and separator. Condensate and water were separated in different tanks. The system in place consisted of 5000 psi lines connected to the wellhead, 2 sand catchers, one heater, one separator, water and condensate tank.*

In order to assess whether the discharge of fracturing fluids had contaminated or put at risk useable freshwater aquifers above the stated point of discharge three groundwater samples were taken and analysed.

The samples were taken on 22 November 2012. Two samples were taken on a property owned by a neighbour, on Main North Road Urenui. Both samples were

taken from wells. A third spring sample was taken upstream of the wellsite at 223 Mataro Road, Urenui. All sites were within 1km of the wellsite. A plan showing the location of the sample sites is attached at Appendix II of this report.

The sample results have been analysed by the Council's Hydrogeologist. Elevated levels of nitrates were observed in a spring approximately 900 m south west and upstream of the injection well. Nitrates are not associated with hydraulic fracturing and most likely result from agricultural activities at the surface. BTEX and total petroleum hydrocarbons, which are associated with hydraulic fracturing, were not observed at any of the groundwater sites. Very low levels of methane (0.006 g/m<sup>3</sup>) were found in the spring south west of the injection well. Concentrations less than 10 g/m<sup>3</sup> are generally considered safe and such low levels do not pose a risk and are normal for spring water in the Taranaki region. A copy of the sample results is attached at Appendix III of this report. The depth of the fracture operation and post fracture report shows there is minimal risk to freshwater resources from the discharge. The sampling undertaken provides for public assurance. No complaints have been received from local residents concerning the quality of their potable and stock water supplies.

### **2.3.3 Land status**

The well site was constructed in flat land in a rural dairy farming area. Significant earthworks were required to construct the site. The land had not been reinstated at the time of the last inspection (10 January 2012) and Taranaki Regional Council has not been notified of any intention to reinstate the site, as would be required by special condition 11 of Resource Consent 7555-1.

## **2.4 Contingency plan**

Greymouth Petroleum Limited has provided a general contingency plan with site specific maps which covers all onshore sites that they operate. The contingency plan has been reviewed and approved by officers of Taranaki Regional Council.

## **2.5 Investigations, interventions, and incidents**

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

The Taranaki Regional 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 Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by

investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the period under review, there were no abatement notices issued and no Unauthorised Incidents (UIs) recorded by the Council in relation to the operations occurring at the Onaero wellsite.

Any matter in relation to potential non-compliance with consent conditions were addressed during site inspections. Greymouth Petroleum Limited's staff would quickly take steps to ensure that requests made by Council officers were adhered to without delay.

### **3. Discussion**

#### **3.1 Discussion of plant performance**

Of the 6 resource consents relating to the Onaero wellsite, consents 7932-1 (hydraulic fracturing), 7557-1 (flaring associated with well clean-up), 7555-1 (stormwater discharge - exploration), 7556-1 (stormwater-earthworks) and 7554-1 (take groundwater) were exercised and actively monitored.

No flaring occurred in association with well workovers/emergencies during the monitored period, as permitted by consent 7558-1.

As far as could be determined from observations during site inspections and information submitted to Council, all conditions of the above resource consents were complied with during the monitoring period.

Greymouth Petroleum Limited provided the Council with the following plans and information in compliance with the consents:

- A spill contingency plan for accidental spillage or discharge of contaminants;
- Maximum stormwater catchment area;
- Advice of drilling muds' and fluids' components;
- Final site layout plan;
- Notification of the various stages of activity; and
- Post fracturing discharge report.

Careful management on site ensured that no effects to the environment occurred.

#### **3.2 Environmental effects of exercise of consents**

##### **Stormwater**

The discharge of stormwater from earthworks had the potential for sediment to enter surface water where it may have smothered in-stream flora and fauna. To mitigate these effects, perimeter drains were established during the construction of the wellsite, and care was taken to ensure runoff from disturbed areas was directed into the drains or directed through adequate silt control structures.

Once the well was constructed, attention was given to controlling stormwater that ran off the wellsite and the associated plant and equipment.

Adverse effects on surface water quality had the potential to occur if contaminated water escaped through the stormwater system. Interceptor pits were designed and installed to trap sediment and hydrocarbons through gravity separation. Any water that was unsuitable for release via the interceptor pits was directed to the drilling sumps, or removed for off-site disposal.

Greymouth Petroleum Limited also undertook the following mitigation measures in order to minimise off-site adverse effects:

- All stormwater was directed via perimeter drains to the skimmer pits for treatment prior to discharge;

- Additional bunding was constructed around the bulk fuel tank, chemical storage area and other areas where there was a possibility of runoff from areas containing contaminants;
- Regular inspections of the interceptor pits occurred; and
- Repairs and maintenance were carried out if required.

Interceptor pits did not discharge directly to surface water, and instead discharged onto and into land where the discharge usually soaked into the soil before reaching surface water. However, if rainfall was such that the discharge had reached surface water, significant dilution would have occurred. Inspections of receiving waters found no evidence of discharge.

There were numerous on-site procedures included in drilling and health and safety documentation that aimed at preventing spills on-site, and further procedures that addressed clean-up to remedy a spill situation before adverse environmental effects would have had the opportunity to occur (e.g. bunding of chemicals and bulk fuel).

### **Groundwater**

Saline and groundwater was encountered and abstracted from the target formation during the period under review. It was anticipated that the abstraction of groundwater would not impact on any freshwater resource and that shallow groundwater would not be affected as it will be protected by the well casing. No adverse effects were observed during the monitoring period and no complaints were received with regard to this activity.

### **Flaring**

The environmental effects from flaring have been evaluated and reported in previous studies prepared by the Council in relation to the flaring emissions from specific wells in the region.<sup>1</sup>

The measures to be undertaken by Greymouth Petroleum Limited to avoid or mitigate potential or actual adverse environmental impacts on air quality included:

- The use of a test separator to separate solids and fluids from gas during all well clean ups, and workover activities where necessary, thus reducing emissions to air. In particular, this would eliminate the heavy smoke incidents associated with elevated PAH and dioxin emissions;
- All residents with dwellings within 1km of the site were to be notified at least 24 hours prior to any flaring commencing wherever possible;
- Records of flaring events were kept by Greymouth Petroleum Limited and provided to the Council if required;

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<sup>1</sup> Taranaki Regional Council, *Fletcher Challenge Energy Taranaki Ltd, Mangaheva 2 Gas Well Air Quality Monitoring Programme Report 1997 – 98*, August 1998; Taranaki Regional Council: *Atmospheric Dispersion Modelling of Discharges to Air from the Flaring of Fracturing Fluid*, Backshall, March 2013; and *Investigation of air quality arising from flaring of fracturing fluids -emissions and ambient air quality*, Technical Report 2012–03, Taranaki Regional Council May 2012.

- Every endeavour would be made by Greymouth Petroleum Limited to minimise the total volume of gas flared while ensuring that adequate flow and pressure data is gathered to inform a prudent investment decision;
- Every endeavour would be made by Greymouth Petroleum Limited to minimise smoke emissions from the flare.

### **Odour and dust**

Wet suppression of dust was to be considered if it was apparent that dust may be travelling in such a direction to adversely affect off-site parties. Odour may stem from the product, flare, or some of the chemicals used on site. Care was taken to minimise the potential for odour emissions by keeping containers sealed, ensuring the flare burned cleanly, by having regard to wind speed and direction, and keeping an appropriate distance from nearby properties.

### **Hazardous substances**

The use and storage of hazardous substances on-site had the potential to contaminate surface water and soils in the event of a spill.

Greymouth Petroleum Limited undertook the following mitigation measures:

- All potentially hazardous material was to be used and stored in accordance with the relevant Hazardous Substances regulations;
- All areas containing hazardous chemicals were to be bunded;
- Ignition sources were not permitted on any site;
- Sufficient separation distances of chemicals from the flare pit were maintained for safety reasons;
- In the unlikely event of a spill escaping from bunded areas, the site perimeter drain and interceptor pit system would provide secondary containment on site;
- A spill contingency plan was prepared. This set out emergency response procedures to be followed in the event of a spill.

### **Hydraulic fracturing**

The process of fracturing results in some of the chemicals [e.g. clay stabilisers] being absorbed into the rock and some gel residually trapped near the fracture face. Some of the chemicals used in the hydraulic fracturing process are chemicals that are classified as hazardous substances when in concentrated bulk form. However, these additives as used in the process make up less than 2-3% of the total volume of fluid, the remaining being water sourced from municipal supplies. While in a concentrated form some of the chemicals used in the fluid are at toxic concentrations, but prior to the activity they are highly diluted as part of the process. The majority of the fluid returns to the surface for controlled disposal at a consented facility.

Hence there is a discharge of contaminants (energy, chemicals, water and sand/ small ceramic pellets) to land at considerable depth that has the potential to bring about minor changes to the physical and chemical condition of the land (target reservoir) in a way that does not affect other foreseeable users of the land resource.

The interval to be fractured was over 2.5 km below the fresh/saline water interface. It is isolated from the surface by a significant layer of impermeable rock. The reservoir sands are known to contain hydrocarbons at pressures that exceed hydrostatic



pressure, proving that the tight sand is relatively impermeable to the flow of water and hydrocarbons over very long time scales.

The geology above the target formation consists of overlapping formations containing limestone, sandstone, siltstone or claystone. The Turi Shale Formation lies immediately above the target formation and consists of ~400 metres of highly impermeable argillaceous shale rock and siltstone, in which fine grained clay-like components fill the spaces between grains of shale/siltstone. A number of other formations above the target formation are also argillaceous.

The hydro-geological risks of fracing affecting potable groundwater above arise from two potential sources. The integrity of the well being used for the fracing, including the well casing and cement programme, and the geologic integrity of the reservoir seal and seals above this. These matters are addressed by conditions imposed within the consent, and compliance reported within the post-fracturing discharge report.

Throughout the fracturing operation, the activity was carefully monitored to track exact composition, volume and pressure of all fluids being injected into the sub-surface environment. The surrounding countryside (especially waterways) was surveyed for any evidence of effects.

### Summary

There were no environmental effects observed to water, land or air as a result of the exploration drilling and fracing during the monitoring period. There was no unauthorised discharge observed from the Onaero wellsite.

## 3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Tables 1-6.

**Table 1** Summary of performance for Consent **7556-1** - to discharge stormwater and sediment onto and into land in association with earthworks for the construction of the Onaero wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. The discharge from site can only be associated with works to establish the site.	Visually inspecting site	Yes
2. The discharge shall not give rise to effects in the receiving water	Visual inspection of streams and water sampling	Yes
3. The concentration of suspended solids in the discharge shall not exceed 100 gm <sup>3</sup>	Water sampling if feasible and necessary	Yes – no discharge observed
4. Any stormwater from exposed areas of the site travel through settlement ponds of an appropriate size, taking into account the time of year and the area exposed.	Visually inspecting the site to see that stormwater travels to the settlement ponds of the correct size.	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. All earth worked areas shall be stabilised as soon as practicable.	Visual inspection	Yes
6. Consent shall lapse if not implemented by date specified	Notification of exercise received	N/A
7. Notice of Council to review consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

**Table 2** Summary of performance for Consent **7555-1** - to discharge treated stormwater, produced water and drilling water from hydrocarbon operations on the Onaero wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder to adopt best practicable option at all times	Visually inspecting site, procedures & processes	Yes
2. Stormwater catchment area < 11000m <sup>2</sup>	By comparing submitted & approved plans with the built site	Yes
3. 7 days written notice prior to site works and also drilling	By confirming if works commenced before/after 7 days from date notice was given	Yes
4. Maintain a contingency plan	Contingency plan received and approved	Yes
5. The stormwater system shall be designed, managed and maintained in accordance with information submitted	By comparing submitted & approved plans with the built site	Yes
6. Stormwater directed through system before being discharged	Visual Inspection of stormwater system	Yes
7. Hazardous substances to be banded/contained	Visual Inspection	Yes
8. Constituents in the discharge shall meet standards	Water sampling	N/A
9. Discharge shall not increase water temperature by more than 2 degrees	Test receiving waters	N/A
10. The discharge shall not give rise to effects in the receiving water	Water sampling and visual inspection	N/A
11. 48hrs notice of the reinstatement of the site	Inspection / notification from company	N/A
12. Consent shall lapse if not implemented by date specified	Inspection	N/A
13. Notice of Council to review consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

**Table 3** Summary of performance for Consent **7554-1** - to take groundwater that may be encountered during hydrocarbon exploration and production operations

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. The abstraction must not cause more than a 10% lowering of static water level by interference with any adjacent bore.	Inspection of Company records/complaints	Yes
2. The abstraction does not cause the intrusion of salt water into any freshwater aquifer	Inspection of Company records/complaints	Yes
3. A well log to 1000m must be submitted to TRC	Well log submitted	Yes
4. Maintain records of abstraction, including date and volume	Inspection of Company records	Yes
5. Consent shall lapse if not implemented by date specified	Inspection	N/A
6. Notice of Council to review consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

**Table 4** Summary of performance for Consent **7557-1** - to discharge emissions to air from flaring associated with hydrocarbon exploration activities at the Onaero wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Flaring shall not occur on more than 180 days per zone	Inspection of records	Yes
2. 24hrs notice of flaring to TRC for initial flare of each zone	Notification received/site inspection	Yes
3. 24hr notice of flaring to all residents within 1000 metres of the wellsite	By checking if/when residents received notification	Yes
4. No alteration to equipment or processes that may alter the nature or quality of the flare	Inspection of site and equipment used	Yes
5. Regard is to be had to wind speed and direction	Inspection of off site effects	Yes
6. Liquid and solid separation to occur before flaring to minimise smoke emissions	Inspection of flare	Yes
7. TRC to be advised if separation cannot be maintained	Inspection for proof of separation	Yes
8. No liquid or solid hydrocarbons are to be combusted in the flare pit	Inspection of flare pit	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
9. Gas is to be combusted to minimise smoke emissions	Inspection of flare	Yes
10. Best practicable option adopted	Visually inspecting site, procedures & processes	Yes
11. Only substances originating from well stream to be combusted in flare pit	Visual inspection of site	Yes
12. No offensive odour or smoke beyond boundary	Assessment via any complaints from public and by site inspection	Yes
13. The opacity of smoke shall not exceed level 1 on the Ringlemann Scale	Comparing opacity of smoke with the Ringlemann Scale	Yes
14. Control of carbon monoxide	Analysis of air quality	N/A
15. Control of nitrogen oxides	Analysis of air quality	N/A
16. Control of other emissions	Analysis of air quality	N/A
17. Analysis of typical gas and crude oil stream from field to be made available to TRC	Available upon request	Not requested
18. Report to TRC the time, duration and cause of each smoke incident	Inspection of Company records	Yes
19. Log all flaring including time, duration, zone and volumes flared	Inspection of Company records	Yes
20. Consent shall lapse if not implemented by date specified	Inspection	N/A
21. Notice of Council to review consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

**Table 5** Summary of performance for Consent **7558-1** - to discharge emissions to air from flaring associated with hydrocarbon production activities at the Onaero wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. 24hrs notice of flaring to TRC when flaring is longer than 5 minutes in duration	Notification received	N/A
2. 24hr notice of flaring to all residents within 1000 metres of the wellsite	Check residents have received notification	N/A
3. No alteration to equipment or processes that may alter the nature or quality of the flare	Inspection of site and equipment used	N/A
4. Regard is to be had to wind speed and direction	Inspection of off site effects	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Liquid and solid separation to occur before flaring to minimise smoke emissions	Inspection of flare	N/A
6. TRC to be advised if separation cannot be maintained	Notification received	N/A
7. No liquid or solid hydrocarbons are to be combusted in the flare pit	Inspection of flare pit	N/A
8. Best practicable option adopted	Visually inspecting site, procedures & processes	N/A
9. Only substances originating from well stream to be combusted in flare pit	Visual inspection of site	N/A
10. No offensive odour or smoke beyond boundary	Assessment via complaints from public	N/A
11. All storage tanks to have vapour recovery systems fitted.	Visual inspection of site	N/A
12. The opacity of smoke shall not exceed level 1 on the Ringlemann Scale	Comparing opacity of smoke with the Ringlemann Scale	N/A
13. Control of carbon monoxide	Analysis of air quality	N/A
14. Control of nitrogen oxides	Analysis of air quality	N/A
15. Control of other emissions	Analysis of air quality	N/A
16. Analysis of typical gas and condensate stream from field to be made available to TRC	Available upon request	N/A
17. Report to TRC the time, duration and cause of each smoke incident	Inspection of Company records	N/A
18. Log all flare events longer than 5 minutes (10 minutes aggregate or longer than 120 minutes) including time, duration, zone and reason for flare	Inspection of Company records	N/A
19. Provide a report to TRC every May	Check that report has been received by TRC	N/A
20. Consent shall lapse if not implemented by date specified	Inspection	N/A
21. Notice of Council to review consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		N/A

**Table 6** Summary of performance for Consent **7932-1** - to discharge contaminants in association with hydraulic fracturing activities into land

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Any discharge shall occur below 3000m TVD	Inspection of Company records	Yes
2. Exercise of consent shall not contaminate or put at risk freshwater aquifers	Inspection of Company records (well logs)	Yes
3. 24hrs notice to TRC prior to each discharge	Check that notification has been received by TRC	Yes
4. A post fracturing discharge report is to be provided to TRC within 30 days after the discharge has ceased	Report provided to TRC	Yes
5. The report must be emailed to consents@trc.govt.nz	Report emailed to consents@trc.govt.nz	Yes
6. The consent holder shall provide access to a location where samples of fracking fluids and return fluids can be obtained.	Access provided	Yes
7. Best practicable option adopted at all times	Visually inspecting site, procedures & processes	Yes
8. No hydrocarbon based fracking fluids are to be discharged	Inspection of company's MSD Sheets	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

N/A = not applicable

During the monitoring period, Greymouth Petroleum Limited demonstrated a high level of environmental performance and compliance with the resource consents. During the period under review there were no unauthorised spills or discharges to a surface water body. All Taranaki Regional Council requirements were adhered to swiftly and without question. The site was neat, tidy, and well maintained.

### 3.4 Exercise of optional review of consents

Condition 6 of consent 7554-1, condition 13 of consent 7555-1, condition 7 of consent 7556-1, and condition 21 of consents 7557-1 and 7558-1 allow the Council to review the consents in 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Noting that the consents may not be exercised again prior to 2015, based on the results of monitoring during the period under review it is considered at this time that there are no grounds that require a review to be pursued.

A recommendation to this effect is presented in Section 4 of this report.

### **3.5 Alterations to monitoring programmes for fracturing activities**

In designing and implementing the monitoring programmes for air/water discharges and water abstractions at wellsites in the region, the Taranaki Regional Council takes into account the extent of information made available by previous and other authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring emissions/discharges and effects, and of subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of wellsite processes within Taranaki.

The Council has routinely monitored wellsite activities for more than 20 years in the region. This work has included in the order of hundreds of water samples and biomonitoring surveys in the vicinity of wellsites, and has demonstrated robustly that a monitoring regime based on frequent and comprehensive inspections is rigorous and thorough, in terms of identifying any adverse effects from wellsite and associated activities. Accordingly the Council had for a time not routinely required the imposition of additional targeted physicochemical and biological monitoring unless a site-specific precautionary approach indicated this would be warranted for certainty and clarity around site effects.

In the case of the Onaero wellsite, the monitoring programme was based on this pre-existing regime. Given that the primary effects of concern (had they occurred) would have involved the movement of either sediment and/or hydrocarbons, both of which are easily detectable through inspection and visual scrutiny, this represented an appropriate and well-grounded approach. The wide-ranging scope of the routine inspections in this particular programme to include adjacent waterways and feedback from local residents should particularly be noted.

However, the Council has also noted a general community desire for a heightened level of information feedback and certainty around the results and outcomes of monitoring at wellsites where fracturing is to occur or has occurred. Notwithstanding the long track record of a demonstrable suitability of an inspection-based monitoring programme, the Council has therefore moved to extend the previous regime, to make the sampling and extensive analysis of shallow groundwater and surface waters in the general vicinity of a wellsite where hydraulic fracturing occurs, and the programmed bio-monitoring of surface water ecosystems, an integral part of the basic monitoring programme for such activities. Since the implementation of the programme for the Onaero site as reported herein, such enhanced programmes have since been put into effect elsewhere and will be reported in due course.

It is proposed that for any further work at the Onaero wellsite, the new standard programme will be implemented, notwithstanding the lack of any effects or concerns previously found. A recommendation to this effect is attached to this report.

## 4. Recommendations

1. THAT this report be forwarded to the Company, and to any interested parties upon request.
2. THAT the Company be asked to inform the Council of the intention to either drill, test or undertake reinstatement.
3. THAT the monitoring of any future consented activities at the Onaero wellsite be extended from that as implemented during the July 2011 - January 2012 monitoring period, by the addition of shallow groundwater and surface water analyses and by bio-monitoring surveys of surface water ecosystems in the vicinity.
4. THAT subject to the findings of monitoring of any further activities at the Onaero wellsite, consents 7554-1, 7555-1, 7556-1, 7557-1, 7558-1, and 7932-1 not be reviewed in 2015.



## Glossary of common terms and abbreviations

The following abbreviations and terms may have been used within this report:

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
<i>E.coli</i>	<i>Escherichia coli</i> , an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m <sup>3</sup>	Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
l/s	Litres per second.

MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N)
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM <sub>10</sub>	Relatively fine airborne particles (less than 10 micrometre diameter).
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 subsequent amendments.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
WBM	Water Based drilling Mud.
Zn*	Zinc.

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

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

## **Appendix I**

### **Resource consents held by Greymouth Petroleum Limited**





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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
[www.trc.govt.nz](http://www.trc.govt.nz)

Please quote our file number  
on all correspondence

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

Consent Granted  
Date: 10 December 2009

**Conditions of Consent**

Consent Granted: To take groundwater, which is encountered as produced  
water drilling at the Onaero wellsite at or about  
(NZTM) 1718879E-5681881N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Onaero wellsite, Mataro Road, Urenui  
[Property owner: R Godderidge & G Cleland]

Legal Description: Pt Sec 2 Urenui Dist Blk VII Waitara SD

Catchment: Onaero

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

## Consent 7554-1

### General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

### Special conditions


1. The consent holder shall ensure the abstraction does not cause more than a 10% lowering of static water-level by interference with any adjacent bore.
2. The consent holder shall ensure the abstraction does not cause the intrusion of salt water into any freshwater aquifer.
3. The consent holder shall submit, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a summary well log to a depth of 1000 metres. The report shall:
  - a) provide a log to show the true vertical depth to all geological formation tops intersected within the freshwater zone;
  - b) identify the true vertical depth to, and thickness of, any freshwater aquifers intersected by the well;
  - c) identify the true vertical depth to the freshwater- saline water interface in the well.
4. The consent holder shall maintain records of abstraction including date, volume of groundwater abstracted per day, and shall make these records available to the Chief Executive, Taranaki Regional Council, upon request.
5. This consent shall lapse on 31 December 2014 unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 7554-1

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

Signed at Stratford on 10 December 2009

For and on behalf of  
Taranaki Regional Council



---

Director-Resource Management







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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
www.trc.govt.nz

Please quote our file number  
on all correspondence

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

Consent Granted  
Date: 10 December 2009

**Conditions of Consent**

Consent Granted: To discharge treated stormwater, treated produced water and treated surplus drilling water from hydrocarbon exploration and production operations onto and into land in circumstances where the discharge may enter an unnamed tributary of the Onaero River at the Onaero wellsite at or about (NZTM) 1718879E-5681881N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Onaero wellsite, Mataro Road, Urenui  
[Property owner: R Godderidge & G Cleland]

Legal Description: Pt Sec 2 Urenui Dist Blk VII Waitara SD

Catchment: Onaero

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

www.trc.govt.nz

Doc# 699554-v1

## Consent 7555-1

### General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

### Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.
2. Stormwater discharged shall be collected from a catchment area of no more than 1.1 Ha.
3. The Chief Executive, Taranaki Regional Council, shall be notified in writing at least 7 days prior to any site works commencing, and again in writing at least 7 days prior to any well drilling operation commencing. Notification shall include the consent number and a brief description of the activity consented and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).
4. The consent holder shall maintain a contingency plan that, to the satisfaction of the Chief Executive, Taranaki Regional Council, details measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.
5. The design, management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the consent application [application 6361], in particular, section 8.1 of the Assessment of Environmental Effects.

Consent 7555-1

6. All stormwater and produced water shall be directed for treatment through the stormwater treatment system identified in condition 5 before being discharged.
7. Any significant volumes of hazardous substances [e.g. bulk fuel, oil, drilling fluid] on site shall be:
  - a) contained in a double skinned tank, or
  - b) stored in a dedicated bunded area with drainage to sumps, or to other appropriate recovery systems, and not directly to the site stormwater system.
8. Constituents in the discharge shall meet the standards shown in the following table.

<u>Constituent</u>	<u>Standard</u>
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm <sup>-3</sup>
total recoverable hydrocarbons	Concentration not greater than 15 gm <sup>-3</sup>
chloride	Concentration not greater than 50 gm <sup>-3</sup>

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

9. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to an increase in temperature of more than 2 degrees Celsius.
10. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to any of the following effects in the receiving water:
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.
11. The consent holder shall advise the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise adverse effects on stormwater quality. Notification shall include the consent number and a brief description of the activity consented and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).
12. This consent shall lapse on 31 December 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 7555-1

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

Signed at Stratford on 10 December 2009

For and on behalf of  
Taranaki Regional Council

  
\_\_\_\_\_  
Director-Resource Management



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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
[www.trc.govt.nz](http://www.trc.govt.nz)

Please quote our file number  
on all correspondence

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

Consent Granted  
Date: 10 December 2009

**Conditions of Consent**

Consent Granted: To discharge treated stormwater and sediment onto and into land in circumstances where the discharge may enter an unnamed tributary of the Onaero River in association with earthworks for the construction of the Onaero wellsite at or about (NZTM) 1718879E-5681881N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Onaero wellsite, Mataro Road, Urenui  
[Property owner: R Godderidge & G Cleland]

Legal Description: Pt Sec 2 Urenui Dist Blk VII Waitara SD

Catchment: Onaero

## Consent 7556-1

### General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

### Special conditions

1. The discharge of stormwater and sediment, authorised under this consent, shall only be from works associated with the establishment of the Onaero wellsite as shown in Drawing No 09314-04 Sheet 1 Rev 1 submitted with application 6362.
2. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to any of the following effects within streams in the unnamed tributary of the Onaero River:
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.
3. The concentration of suspended solids in the discharge shall not exceed 100 gm<sup>-3</sup>.

This condition shall apply before entry of the discharge into the receiving waters of the unnamed tributary of the Onaero River.
4. If any area of soil is exposed, all run off from that area shall pass through settlement ponds or sediment traps with a minimum total capacity of:
  - a) 100 cubic metres for every hectare of exposed soil between 1 November to 30 April; and
  - b) 200 cubic metres for every hectare of exposed soil between 1 May to 31 October;

unless other sediment control measures that achieve an equivalent standard of treatment are agreed to by the Chief Executive of the Taranaki Regional Council.

Consent 7556-1

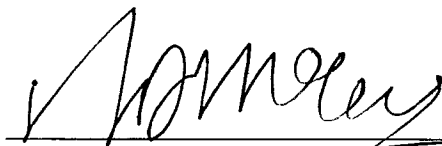
5. All earthwork areas shall be stabilised as soon as is practicable immediately following completion of soil disturbance activities.

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

6. This consent shall lapse on 31 December 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2021, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 10 December 2009

For and on behalf of  
Taranaki Regional Council

  
\_\_\_\_\_  
Director-Resource Management







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

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NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
www.trc.govt.nz

Please quote our file number  
on all correspondence

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

Decision Date: 18 October 2011  
[change]

Commencement  
Date: [change] 18 October 2011 [Granted: 10 December 2009]

**Conditions of Consent**

Consent Granted: To discharge emissions to air from flaring of hydrocarbons associated with well clean-up and well testing associated with exploration activities at the Onaero wellsite at or about (NZTM) 1718879E-5681881N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Onaero wellsite, Mataro Road, Urenui  
[Property owner: R Godderidge & G Cleland]

Legal Description: Pt Sec 2 Urenui Dist Blk VII Waitara SD [Discharge source & site]

### **General condition**

- a. On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b. Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c. The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i. the administration, monitoring and supervision of this consent; and
  - ii. charges authorised by regulations.



### **Special conditions**

#### **Exercise of consent**

1. Flaring shall not occur on more than 180 days, cumulatively for each well, for up to eight wells.

#### **Information and notification**

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, at least 24 hours before the initial flaring of each zone being commenced. Notification shall include the consent number and a brief description of the activity consented and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).
3. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to all residents within 1000 metres of the wellsite of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and complaints received in respect of any flaring activity.
4. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other wellsite emissions, including but not limited to the recovery of produced gas, other than as authorised by this consent, without prior consultation with the Chief Executive, Taranaki Regional Council.

## Flaring

5. Other than for the maintenance of a pilot flare flame, the consent holder shall have regard to the prevailing and predicted wind speed and direction at the time of initiation of, and throughout, any episode of flaring so as to minimise offsite effects.
6. All gas that is flared during well clean-up, drill stem testing, initial testing, well workovers, or production testing, or at any other time, must first be treated by effective liquid and solid separation and recovery, to ensure that smoke emission during flaring is minimised.
7. If separation required by condition 6 cannot be implemented or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall immediately advise the Taranaki Regional Council by phoning the Council and advising the Compliance Manager, or his delegate; and shall in any case re-establish liquid separation and recovery within three hours.

At the grant date of this consent, the Council's phone number is 0800 736 222 [24 hr service].

8. Subject to special condition 7, no liquid or solid hydrocarbons shall be combusted through the gas flare system.
9. The gas shall be combusted so that emissions of smoke are minimised.
10. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare or any other emissions to air from the Onaero wellsite [including use of a separator during well clean-up].
11. Only substances originating from the well stream and treated as required by conditions 6, 7, 8, 9, and 10 shall be combusted within the flare pit.
12. The discharge shall not cause any objectionable or offensive odour or smoke at or beyond the boundary of the property where the wellsite is located.
13. The opacity of any smoke emissions shall not exceed a level of 1, as measured on the Ringelmann Scale, for more than 4 minutes cumulative duration in any 60 minute period.
14. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare so that, whether alone or in conjunction with any other emissions from the wellsite, the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 milligrams per cubic metre [mg/m<sup>3</sup>] [eight-hour average exposure], or 30 mg/m<sup>3</sup> one-hour average exposure] at or beyond the boundary of the property where the wellsite is located.

15. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare, so that whether alone or in conjunction with any other emissions from the wellsite, the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 micrograms per cubic metre [ $\mu\text{g}/\text{m}^3$ ] [24-hour average exposure], or 200  $\mu\text{g}/\text{m}^3$  [1-hour average exposure] at or beyond the boundary of the property where the wellsite is located.
16. The consent holder shall control emissions to the atmosphere from the wellsite and flare of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides, so that whether alone or in conjunction with any emissions from the flare, the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the property where the wellsite is located, is not increased above background levels:
  - a) by more than 1/30<sup>th</sup> of the relevant Occupational Threshold Value-Time Weighted Average, or by more than the Short Term Exposure Limit at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or
  - b) if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

#### **Recording and reporting information**

17. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and condensate stream from the field, covering sulphur compound content and the content of carbon compounds of structure C<sub>6</sub> or higher number of compounds.
18. Each time there is visible smoke as a result of the exercise of this consent, the consent holder shall record the time, duration and cause. The consent holder shall make the record available to the Chief Executive, Taranaki Regional Council, upon request.
19. The consent holder shall record and make available to the Chief Executive, Taranaki Regional Council, logs of all flaring, including time, duration, zone, and volumes of substances flared.

#### **Lapse and Review**

20. This consent shall lapse on 31 December 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

21. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2021, for any of the following purposes:
- a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
  - b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
  - c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant.

Signed at Stratford on 18 October 2011

For and on behalf of  
Taranaki Regional Council



Chief Executive





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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
[www.trc.govt.nz](http://www.trc.govt.nz)

Please quote our file number  
on all correspondence

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

Consent Granted  
Date: 10 December 2009

**Conditions of Consent**

Consent Granted: To discharge emissions to air during flaring from well workovers and in emergency situations associated with production activities at the Onaero wellsite at or about (NZTM) 1718879E-5681881N

Expiry Date: 1 June 2027

Review Date(s): June 2015, June 2021

Site Location: Onaero wellsite, Mataro Road, Urenui  
[Property owner: R Godderidge & G Cleland]

Legal Description: Pt Sec 2 Urenui Dist Blk VII Waitara SD

## Consent 7558-1

### General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

### Special conditions

#### Information and notification

1. Other than in emergencies, the consent holder shall notify the Chief Executive, Taranaki Regional Council, whenever the continuous flaring of hydrocarbons [other than purge gas] is expected to occur for more than five minutes in duration. Notification shall be no less than 24 hours before the flaring commences. Notification shall include the consent number and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).
2. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to all residents within 1000 metres of the wellsite of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and complaints received in respect of any flaring activity.
3. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other site emissions, including but not limited to the recovery of produced gas, other than as authorised by this consent, without prior consultation with the Chief Executive, Taranaki Regional Council.

#### Emissions from the site

4. Other than for the maintenance of a pilot flare flame, the consent holder shall have regard to the prevailing and predicted wind speed and direction at the time of initiation of, and throughout, any episode of flaring so as to minimise offsite effects.
5. All gas that is flared must first be treated by effective liquid and solid separation and recovery to ensure that smoke emission during flaring is minimised.



## Consent 7558-1

6. If separation required by condition 5 cannot be implemented or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall immediately advise the Taranaki Regional Council by phoning the Council and advising the Compliance Manager, or his delegate; and shall in any case re-establish liquid separation and recovery within three hours.

At the grant date of this consent, the Council's phone number is 0800 736 222 [24 hr service].

7. Subject to special condition 6, no liquid or solid hydrocarbons shall be combusted through the gas flare system, other than in an emergency.
8. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare or any other emissions to air from the Onaero wellsite [including use of a separator during well clean-up].
9. Only substances originating from the well stream and treated as outlined by conditions 5, 6, 7, and 8 shall be combusted within the flare pit.
10. There shall not be any offensive or objectionable odour or smoke at or beyond the boundary of the property where the wellsite is located.
11. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.
12. The opacity of any smoke emissions shall not exceed a level of 1, as measured on the Ringelmann Scale, for more than 4 minutes cumulative duration in any 60 minute period.
13. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare so that, whether alone or in conjunction with any other emissions from the wellsite, the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 milligrams per cubic metre [ $\text{mg}/\text{m}^3$ ] [eight-hour average exposure], or 30  $\text{mg}/\text{m}^3$  one-hour average exposure] at or beyond the boundary of the property where the wellsite is located.
14. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare so that, whether alone or in conjunction with any other emissions from the wellsite, the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 micrograms per cubic metre [ $\mu\text{g}/\text{m}^3$ ] [24-hour average exposure], or 200  $\mu\text{g}/\text{m}^3$  [1-hour average exposure] at or beyond the boundary of the of the property where the wellsite is located.
15. The consent holder shall control emissions to the atmosphere from the wellsite and flare of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides so that, whether alone or in conjunction with any emissions from the flare, the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the property where the wellsite is located, is not increased above background levels:

## Consent 7558-1

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

### Recording and reporting information

16. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and condensate stream from the field, covering sulphur compound content and the content of carbon compounds of structure C<sub>6</sub> or higher number of compounds.
17. Each time there is visible smoke as a result of the exercise of this consent, the consent holder shall record the time, duration and cause. The consent holder shall make the record available to the Chief Executive, Taranaki Regional Council, upon request.
18. The consent holder shall record and maintain a log of all continuous flaring events longer than five minutes duration, and any intermittent flaring lasting for an aggregate of ten minutes or longer in any 120-minute period. The log shall contain the date, the start and finish times of the flaring event, the quantity and type of material flared, and the reason for flaring. The log shall be made available to the Chief Executive, Taranaki Regional Council, upon request, and summarised annually in the report required under condition 19.
19. The consent holder shall provide to the Taranaki Regional Council during May of each year, for the duration of this consent, a report:
  - i) detailing any energy efficiency measures implemented on the site;
  - ii) detailing smoke emissions as required under condition 18;
  - iii) detailing any measures undertaken or proposed to reduce smoke emissions;
  - iv) detailing any measures undertaken or proposed to reduce flaring;
  - v) addressing any other issue relevant to the minimisation or mitigation of emissions from the flare;
  - vi) detailing any complaints received and any measures undertaken to address complaints; and
  - vii) reviewing all options and technological advances relevant to the reduction or mitigation of any discharge to air from the site, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances.

### Lapse and Review

20. This consent shall lapse on 31 December 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 7558-1

21. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2021, for any of the following purposes:
- a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
  - b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
  - c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant.

Signed at Stratford on 10 December 2009

For and on behalf of  
Taranaki Regional Council



Director-Resource Management



**EXPIRED**  
1-06-2012



CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
[www.trc.govt.nz](http://www.trc.govt.nz)

Please quote our file number  
on all correspondence

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

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

Decision Date: 14 September 2011

Commencement  
Date: 14 September 2011

**Conditions of Consent**

Consent Granted: To discharge contaminants in association with hydraulic fracturing activities into land at depths greater than 3000 mTVD beneath the Onaero-1R wellsite at or about (NZTM) 1718880E-5681882N

Expiry Date: 1 June 2012

Site Location: Onaero-1R wellsite, Mataro Road, Urenui  
[Property Owner: R Godderidge & G Cleland]

Legal Description: Pt Section 2 Urenui Dist [discharge source & site]

Catchment: Onaero

EXPIRED

**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 to section 36 of the Resource Management Act.

**Special conditions**

1. Any discharge shall occur below 3000 mTVD.  
  
Note: mTVD = metres true vertical depth, i.e. the true vertical depth in metres below the surface.
2. The consent holder shall ensure that the exercise of this consent does not contaminate or put at risk actual or potential usable freshwater aquifers above the hydrocarbon reservoir.
3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing of the date that the discharges are expected to commence. Notification shall occur by email to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz), where practicable and reasonable one working day prior to the exercise of the consent, but in any event 24 hours notice shall be given.
4. At the conclusion of the discharge, the consent holder shall submit a comprehensive 'Post-fracturing discharge report' to the Chief Executive, Taranaki Regional Council. The report shall be provided within 30 working days after the discharge ceases and, as a minimum, shall contain:
  - (a) Confirmation of the interval where fracturing occurred;
  - (b) Confirmation of volumes and fluid compositions discharged;
  - (c) The volume of returned fluids and an estimate of the proportion of fluids and proppant remaining in the reservoir;
  - (d) The results of modeling the discharge, including a proppant concentration diagram or a similar diagram, showing the likely extent of the fractures generated by the discharge;
  - (e) Well and discharge zone pressure durations and the maximum pressure reached;
  - (f) Details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal; and
  - (g) An assessment of the effectiveness of the mitigation measures in place with specific reference to those described in application 6885.
5. The reports described in condition 4 shall be emailed to [consents@trc.govt.nz](mailto:consents@trc.govt.nz) with a reference to the number of this consent.
6. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the fracturing fluids and return fluids.

**EXPIRED**

7. 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 on the environment; in particular, ensuring that the discharge is contained within the discharge zone.
8. No hydrocarbon based fracking fluid shall be discharged.

Signed at Stratford on 14 September 2011

For and on behalf of  
Taranaki Regional Council



Director-Resource Management





## **Appendix II**

### **Location of Groundwater Sites**






# Groundwater Sampling Site Locations

Date Printed: 5 March 2013



## Legend

-  Regional Boundary
-  Well Sites
-  Road (35k-10k)

SCALE 1: 21,259

Projection: NZGD\_2000\_New\_Zealand\_Transverse\_Mercator

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1,079.9

0

1,079.9 Meters





## **Appendix III**

### **Groundwater Sample Results**





## ANALYSIS REPORT

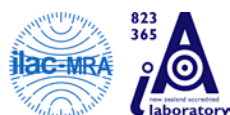
<b>Client:</b>	Taranaki Regional Council	<b>Lab No:</b>	1072983	SPV2
<b>Contact:</b>	Regan Phipps C/- Taranaki Regional Council Private Bag 713 STRATFORD 4352	<b>Date Registered:</b>	23-Nov-2012	
		<b>Date Reported:</b>	05-Mar-2013	
		<b>Quote No:</b>	47915	
		<b>Order No:</b>		
		<b>Client Reference:</b>	Groundwater	
		<b>Submitted By:</b>	Rachel Cranston	

### Amended Report

This report replaces an earlier report issued on the 30 Nov 2012 at 4:00 pm  
 The Sample Names have been amended at the request of the client.

#### Sample Type: Aqueous

Sample Name:	GND 2312 22-Nov-2012 9:20 am	GND 2313 22-Nov-2012 9:55 am	GND 2314 22-Nov-2012 10:35 am		
Lab Number:	1072983.1	1072983.2	1072983.3		
<b>Individual Tests</b>					
Sum of Anions	meq/L	1.50	2.4	1.35	-
Sum of Cations	meq/L	1.53	2.4	1.42	-
pH	pH Units	6.8	6.5	6.2	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	28	33	25	-
Bicarbonate	g/m <sup>3</sup> at 25°C	34	41	30	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	44	68	38	-
Electrical Conductivity (EC)	mS/m	16.4	27.4	15.0	-
Total Dissolved Solids (TDS)	g/m <sup>3</sup>	119	185	101	-
Dissolved Barium	g/m <sup>3</sup>	0.025	0.59	0.030	-
Dissolved Calcium	g/m <sup>3</sup>	9.2	15.1	7.5	-
Dissolved Copper	g/m <sup>3</sup>	0.0012	0.0005	0.0011	-
Dissolved Iron	g/m <sup>3</sup>	< 0.02	0.07	< 0.02	-
Dissolved Magnesium	g/m <sup>3</sup>	5.0	7.3	4.6	-
Dissolved Manganese	g/m <sup>3</sup>	0.0005	0.063	0.0007	-
Dissolved Mercury	g/m <sup>3</sup>	< 0.00008	< 0.00008	< 0.00008	-
Dissolved Nickel	g/m <sup>3</sup>	0.0012	< 0.0005	< 0.0005	-
Dissolved Potassium	g/m <sup>3</sup>	1.53	14.5	1.63	-
Dissolved Sodium	g/m <sup>3</sup>	14.3	16.3	14.3	-
Dissolved Zinc	g/m <sup>3</sup>	0.0095	0.0052	0.0157	-
Bromide	g/m <sup>3</sup>	0.14	0.17	0.14	-
Chloride	g/m <sup>3</sup>	26	36	27	-
Nitrite-N	g/m <sup>3</sup>	< 0.002	0.009	< 0.002	-
Nitrate-N	g/m <sup>3</sup>	1.65	9.7	< 0.002	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	1.65	9.7	< 0.002	-
Sulphate	g/m <sup>3</sup>	4.2	2.0	4.6	-
<b>Ethylene Glycol in Water</b>					
Ethylene glycol*	g/m <sup>3</sup>	< 4	< 4	< 4	-
<b>Propylene Glycol in Water</b>					
Propylene glycol*	g/m <sup>3</sup>	< 4	< 4	< 4	-
<b>Methanol in Water - Aqueous Solvents</b>					
Methanol*	g/m <sup>3</sup>	< 2	< 2	< 2	-
<b>BTEX in Water by Headspace GC-MS</b>					
Benzene	g/m <sup>3</sup>	< 0.0010	< 0.0010	< 0.0010	-
Toluene	g/m <sup>3</sup>	< 0.0010	< 0.0010	< 0.0010	-



Sample Type: Aqueous						
<b>Sample Name:</b>	GND 2312 22-Nov-2012 9:20 am	GND 2313 22-Nov-2012 9:55 am	GND 2314 22-Nov-2012 10:35 am			
<b>Lab Number:</b>	1072983.1	1072983.2	1072983.3			
BTEX in Water by Headspace GC-MS						
Ethylbenzene	g/m <sup>3</sup>	< 0.0010	< 0.0010	< 0.0010	-	-
m&p-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 in Water by DNPH & LCMSMS						
Formaldehyde	g/m <sup>3</sup>	< 0.02	< 0.02	< 0.02	-	-
Gases in groundwater						
Ethane	g/m <sup>3</sup>	< 0.003	< 0.003	< 0.003	-	-
Ethylene	g/m <sup>3</sup>	< 0.004	< 0.004	< 0.004	-	-
Methane	g/m <sup>3</sup>	< 0.002	0.006	< 0.002	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m <sup>3</sup>	< 0.10	< 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 (C7 - C36)	g/m <sup>3</sup>	< 0.7	< 0.7	< 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.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Samples
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	-	1-3
Propylene Glycol in Water*	Direct injection, dual column GC-FID	-	1-3
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	-	1-3
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1-3
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	-	1-3
Gases in groundwater	Manual headspace creation and sub-sampling, GC-FID analysis.	-	1-3
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L.	0.07 meq/L	1-3
Total cations for anion/cation balance check	Calculation: sum of cations as mEq/L.	0.05 meq/L	1-3
pH	pH meter. APHA 4500-H+ B 21 <sup>st</sup> ed. 2005.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21 <sup>st</sup> ed. 2005.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1-3
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 21 <sup>st</sup> ed. 2005.	1.0 g/m <sup>3</sup> at 25°C	1-3
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 21 <sup>st</sup> ed. 2005.	1.0 g/m <sup>3</sup> as CaCO <sub>3</sub>	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 21 <sup>st</sup> ed. 2005.	0.1 mS/m	1-3
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) 21 <sup>st</sup> ed. 2005.	10 g/m <sup>3</sup>	1-3
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.00010 g/m <sup>3</sup>	1-3
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.05 g/m <sup>3</sup>	1-3
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.0005 g/m <sup>3</sup>	1-3
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.02 g/m <sup>3</sup>	1-3
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.02 g/m <sup>3</sup>	1-3
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 21 <sup>st</sup> ed. 2005.	0.0005 g/m <sup>3</sup>	1-3



Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Samples
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>	1-3
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 2 <sup>nd</sup> ed. 2005.	0.0005 g/m <sup>3</sup>	1-3
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 2 <sup>nd</sup> ed. 2005.	0.05 g/m <sup>3</sup>	1-3
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 2 <sup>nd</sup> ed. 2005.	0.02 g/m <sup>3</sup>	1-3
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 2 <sup>nd</sup> ed. 2005.	0.0010 g/m <sup>3</sup>	1-3
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B 2 <sup>nd</sup> ed. 2005.	0.05 g/m <sup>3</sup>	1-3
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cf E (modified from continuous flow analysis) 21 <sup>st</sup> ed. 2005.	0.5 g/m <sup>3</sup>	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO <sub>2</sub> - I (Modified) 21 <sup>st</sup> ed. 2005.	0.002 g/m <sup>3</sup>	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO <sub>2</sub> N.	0.002 g/m <sup>3</sup>	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NQ <sub>2</sub> - I (Modified) 21 <sup>st</sup> ed. 2005.	0.002 g/m <sup>3</sup>	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 2 <sup>nd</sup> ed. 2005.	0.5 g/m <sup>3</sup>	1-3

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.

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