

TAG Oil (NZ) Limited  
Cheal-B Wellsite  
Monitoring Programme Report  
2014

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## Executive summary

TAG Oil (NZ) Limited entered an already established a hydrocarbon exploration site located along Taylor Road, Stratford, within the Patea catchment. The site is called Cheal-B wellsite. This wellsite was initially established for earlier exploration efforts, and has since had minor upgrades and boundaries extended to accommodate new exploration wells. This report covers the period from January 2014 to July 2014. During this period, two wells (B9 and B10) were drilled, tested and are now producing. In addition, other pre-existing wells at the Cheal-B wellsite were also re-worked during the period under review.

**During the monitoring period, Tag Oil demonstrated a high level of environmental performance at the Cheal-B wellsite.**

This report for TAG Oil (NZ) Limited describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess TAG Oil (NZ) Limited's environmental performance in relation to drilling operations at the Cheal-B wellsite during the period under review, and the results and environmental effects of TAG Oil (NZ) Limited's activities.

TAG Oil (NZ) Limited holds five resource consents for the activities at the Cheal-B wellsite, which include a total of 92 consent conditions setting out the requirements that TAG Oil (NZ) Limited must satisfy. TAG Oil (NZ) Limited holds consent 6813-1 to discharge emissions to air from the flaring hydrocarbons associated with hydrocarbon exploration; consent 6814-1 to discharge emissions to air associated with production activities at the Cheal-B wellsite; consent 6815-1 to discharge treated stormwater and treated produced water onto and into land in the vicinity of the Ngaere Stream; consent 6817-1 to discharge drilling muds, drilling cutting and drilling wastes onto and into land via mix-bury-cover (not exercised during the period under review); and consent 7907-1 to discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream (not exercised during the period under review).

The Council's monitoring programme for the period under review included six inspections of the site and surrounding environment, at approximately fortnightly intervals, and five stormwater samples and four surface water samples were obtained for analysis. Analysis showed that all of the samples obtained were compliant. Furthermore, biomonitoring surveys were conducted during drilling activities, and another following the completion of drilling activities at the Cheal-B wellsite, which concluded that drilling activities at the Cheal-B wellsite did not cause any impacts on the macroinvertebrate communities within an unnamed tributary of the Ngaere Stream.

TAG Oil (NZ) Limited did not notify the Council of their intention to combust gas. Although a flare stack was deployed at the Cheal-B wellsite in anticipation of gas combustion during drilling, well workover campaigns and production testing, no actual gas combustion occurred at the Cheal-B wellsite during the period under review. No other offensive or objectionable odours, smoke or dust associated with activities at the wellsite were observed. The drilling fluids and cuttings were disposed of at a consented off site facility.

The site was generally neat, tidy and well maintained and site staff were cooperative with requests made by officers of the Council, with any required works completed to a satisfactory standard.

During the monitoring period, TAG Oil (NZ) Limited demonstrated a high level of environmental and administrative performance with the resource consents.

This report includes recommendations for future drilling operations at this site.

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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 January 2014 to July 2014 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consent held by TAG Oil (NZ) Limited. During this period, two wells (B9 and B10) were drilled, tested and are now producing. In addition, other pre-existing wells at the Cheal-B wellsite were also re-worked during the period under review.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by TAG Oil (NZ) Limited that relate to exploration activities at Cheal-B wellsite located off Taylor Road in the Stratford District.

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

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

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by TAG Oil (NZ) Limited in the Patea 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 Cheal-B 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 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

- (a) the neighbourhood or the wider community around 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 (eg, 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' in as much as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with section 35 of the 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, including 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, to move closer to achieving sustainable development of the region's resources.

### 1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

**Environmental performance** is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year.

**Administrative performance** is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

## Environmental Performance

- **High** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.
- **Good** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.
- **Improvement required** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.
- **Poor** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

## Administrative compliance

- **High** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.
- **Good** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

- **Improvement required** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.
- **Poor** Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents. In the 2013-2014 year, 60% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated good level of environmental performance and compliance.

## 1.2 Process description

### Site description

TAG Oil (NZ) Limited holds the ten year Petroleum Mining Permit No. 38156 to prospect, explore, and mine for condensate, gas, LPG, oil and petroleum within an area of 30.30 Km<sup>2</sup>. The Cheal-B wellsite is one of many sites within this area that have been established in order to explore, evaluate and produce hydrocarbons.

The Cheal-B wellsite is located approximately 20 km along Taylor Road and approximately 3 km from Stratford, as per Figure 1. The Cheal-B wellsite was initially established for previous exploration efforts and has since had minor upgrades boundaries extended to accommodate new exploration wells. The establishment of the wellsite involved the removal of topsoil to create a firm level foundation on which to erect the drilling rig and house associated equipment. Site establishment also involved the installation of:

- Wastewater control, treatment and disposal facilities;
- A system to collect and control stormwater and contaminants;
- A gas combustion system; and
- Other on-site facilities such as accommodation, parking and storage.

The nearest residence is approximately 260 m away from the wellsite. Bunding, earthworks and good site location helped minimise any potential for off-site effects for the neighbours.



**Figure 1** Aerial view depicting the locality of the Cheal-B wellsite, with approximate regional location (inset)

### Well development

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

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

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

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

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

The construction aspects that are most important for a leak-free well include the correct composition and quality of the cement used, the installation method, and the

setting time. The aim is to ensure that the cement binds tightly to the steel casing and the rock, and leaves no cavities through which liquids and gases could travel.

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

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

The Cheal-B wellsite is located approximately 90 m to the west of the nearest waterbody which is an unnamed tributary of the Ngaere Stream.

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

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

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

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

### **Flaring from exploration activities**

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

- Well testing and clean-up;
- Production testing;
- Emergencies; and
- Maintenance and enhancement activities [well workovers].

## 1.3 Resource consents

### 1.3.1 Background

TAG Oil (NZ) Limited holds five resource consents related to exploration activities at the Cheal-B wellsite site, as follows:

- Discharge Permit 6813-1; granted 23 March 2006,
- Discharge Permit 6814-1; granted 23 March 2006,
- Discharge Permit 6815-1; granted 23 March 2006,
- Discharge Permit 6817-1; granted 23 March 2006 and
- Discharge Permit 7907-1; granted 25 August 2011

Each of the consent applications were processed on a non-notified basis as TAG Oil (NZ) Limited obtained the landowner approvals as an affected party, and the Council were satisfied that the environmental effects of the activity would be minor. The consents are discussed in further detail below.

Copies of the consents can be found within Appendix I of this report.

### 1.3.2 Air discharge permit (exploration activities)

Section 15(1)(c) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The Council determined that the application to discharge emissions to air associated with the exploration activities at the Cheal-B wellsite fell within Rule 9 of the Regional Air Quality Plan (RAQP).

The standard/term/conditions associated with Rule 9 are as follows:

- *Flare or incinerator point is at least 300 metres from any dwelling house;*
- *The discharge to air from the flare must not last longer than 15 days cumulatively, including of testing, clean-up, and completion stages of well development or work-over, per zone to be appraised; and*
- *No material to be flared or incinerated, other than those derived from or entrained in the well steam.*

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

TAG Oil (NZ) Limited holds air discharge permit 6813-1 to discharge emissions to air from flaring of hydrocarbons and miscellaneous emissions associated with drill stem testing, well clean up, initial well testing and production testing associated with up to 14 wells at the Cheal-B wellsite.

This permit was issued by the Council on 23 March 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Consent conditions were imposed on TAG Oil (NZ) Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 3, Section 3.3.

### **1.3.3 Air discharge permit (production activities)**

Section 15(1)(c) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The Council determined that the application to discharge emissions to air associated with the production activities at the Cheal-B wellsite fell within Rule 11 of the RAQP.

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

- *Flare or incinerator point is a distance equal to or greater than 300 metres from any dwelling house.*

TAG Oil (NZ) Limited holds air discharge permit 6814-1 to discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Cheal-B wellsite.

This permit was issued by the Council on 23 March 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Consent conditions were imposed on TAG Oil (NZ) Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 4, Section 3.3.

### **1.3.4 Water discharge permit (treated stormwater and treated produced water)**

Section 15(1)(a) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

The Council determined that the application to discharge treated stormwater, treated produced water and surplus drill water fell within Rule 44 of the RFWP, which provides for a discharge as a discretionary activity.

The discharge of stormwater may result in contaminants (e.g. sediment, oil) entering surface water. These contaminants have the potential to smother or detrimentally affect 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.

TAG Oil (NZ) Limited holds water discharge permit 6815-1 to discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment.

This permit was issued by the Council on 23 March 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Consent conditions were imposed on TAG Oil (NZ) Limited to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed in Table 5, Section 3.3.

### 1.3.5 Land discharge permit (mix-bury-cover)

Sections 15(1)(b) and (d) of the *Resource Management Act 1991* (RMA) stipulates 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 mix-bury cover, onto and into land where contaminants may reach water, is a discretionary activity under Rule 44 of the RFWP.

TAG Oil (NZ) Limited holds discharge permit 6817-1 to discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Cheal-B wellsite onto and into land via mix-bury-cover.

This permit was issued by the Council on 23 March 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2022.

Consent conditions were imposed on TAG Oil (NZ) Limited to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed in Table 6, Section 3.3.

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

Section 15(1)(a) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

Council considered that the application fell under Rule 27 of the RFWP as a controlled activity (which may be non-notified without written approval), subject to one standard/term/condition to be met:

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

TAG Oil (NZ) Limited supplied a site erosion and sediment control management plan in support of the application.

The Council was satisfied that the activity would meet all the standards for a controlled activity. It was therefore obliged 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 were:

- 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; and
- Payment of administrative charges and financial contributions.

TAG Oil (NZ) Limited holds water discharge permit 7907-1 to discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment.

This permit was issued by the Council on 25 August 2011 under Section 87(e) of the RMA. It is due to expire on 1 June 2016.

Consent conditions were imposed on TAG Oil (NZ) Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 7, Section 3.3.

## **1.4 Monitoring programme**

### **1.4.1 Introduction**

Section 35 of the *Resource Management Act 1991* (RMA) sets out obligation/s upon the Council to: gather information, monitor, and conduct research on the exercise of resource consent and the effects arising, within the Taranaki region and report upon these.

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

The monitoring programme for exploration well sites consists of seven primary components. They are:

- Programme liaison and management;
- Site inspections;
- Chemical sampling;
- Solid wastes monitoring;
- Air quality monitoring;
- Discharges to land (hydraulic fracturing and deep well injection); and
- Biomonitoring surveys.

The monitoring programme for the Cheal-B wellsite focused primarily on programme liaison and management, site inspections, and discharges to land. However, all seven components are discussed below.

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

There is generally a significant investment of time and resources by the Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any 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, adapted for local application.

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 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;
- Gas combustion systems, whether flaring was in progress, and if there was a likelihood of flaring, whether the Council had been advised;
- Discharges;
- 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 and hazardous chemical contamination).

#### **1.4.4 Chemical sampling**

The Council may undertake sampling of discharges from site and from sites upstream and downstream of the discharge point to ensure that resource consent special conditions are complied with and to determine whether site activities were causing any adverse effects within the receiving environment.

#### **1.4.5 Solid wastes**

The Council monitors any disposal of drill cuttings on site via mix-bury cover to ensure compliance with resource consent conditions and to determine whether site activities were causing any adverse effects within the receiving environment.

In recent times consent holders have opted to remove drilling waste from the site by contractor and dispose of it at licensed disposal areas (land farming), which are monitored separately.

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

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

Assessments are made by Inspecting Officers of the Council during site inspections to ensure that operators undertake all practicable steps to mitigate any effects from flaring gas.

Inspecting Officers check that that plant equipment is working effectively, that there is the provision for liquid and solid separation, and that on site staff have regard to wind direction and speed at the time of flaring.

It is also a requirement that the Council and immediate land owners are notified prior to any gas being flared when practicable. This requirement was checked to ensure compliance with consent conditions and to determine whether site activities were causing any adverse effects within the receiving environment.

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

If hydraulic fracturing activities are undertaken at site, sampling and analysis of the return flow of hydraulic fracturing fluids and nearby bores are carried. These inspections of the site and surrounding land and water are carried out to ensure that no observable effects have occurred as a result of the discharge to land. Pre and post hydraulic fracturing reports are 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 Biomonitoring surveys**

Biomonitoring surveys in any nearby streams may be carried out pre and post occupation of the wellsite 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 Cheal-B wellsite, adjacent land and streams were inspected 6 times during this monitoring period. Below is a copy of the comments that were noted on the day of each inspection.

##### **27 January 2014**

Little activity was occurring on-site at the time of inspection, however a workover rig was on-site. The site appeared to be in a neat and tidy condition. Skimmer pits appeared to be in good operational condition. No flaring was occurring on-site.

##### **6 June 2014**

Contractors were on-site conducting wire-lining operations at the time of inspection. Drilling had reached target depth of well B9 and drilling of well B10 was anticipated to commence next. The chemical store area was correctly bunded and placed on a plastic liner. The storage tanks were also bunded off to prevent spills entering the ring-drain. Skimmer pits were inspected and found to be clear and not discharging. A sample was obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges. The drain along the rear of the site where steel plates were retaining the bank required attention as ponding was occurring along this boundary and was not being directed to the skimmer pits. Site staff were advised to address perimeter drain ponding immediately.

##### **4 July 2014**

Inspection found that drilling of well B10 had reached target depth. Casing was being run in the hole at the time of inspection. The site was found to be in a good general order. Chemicals were stored within steel bunded lockable containers with other non-hazardous chemicals stored on an impermeable liner within a gravel bunded area. The area about the cuttings tank was mostly clean, yet some mud was present about this area as a result of traffic movements and the extended period of wet weather. The flare stack was present on-site, however no flaring had yet been undertaken during the drilling operation of well B10. Ring-drains were found to be working effectively directing all stormwater to the skimmer pits without any pooling or ponding within the drain system. Spring on the western boundary of the site was discharging into the ring-drain and then flowing into the skimmer pits. Skimmer pits were inspected and found to be discharging. The discharge appeared clean and clear. A sample was obtained of the discharge. In general the site appeared well managed.

##### **17 July 2014**

Inspection found that the Nova-1 rig had left site with only a couple of accommodation units remaining on-site. Testing of well B10 was occurring on-site at the time of inspection. No flaring was occurring on-site with all gas and product being piped through to the Cheal-A production station. The site was in a clean and tidy order, however some empty drums remained on site. Although the drums were stored upright some of the caps were not secured tightly, meaning that spills may occur should the drums fall over. Site staff were advised to arrange for the removal of these drums from the site. The cellar about well B10 was full with what appeared visually to be contaminated water. This was not overflowing onto the site, however only a small amount of free board remained. Site staff were also advised to ensure that the contents from the cellar did not overflow onto the surface and subsequently

track into the storm water system. Skimmer pits were inspected and found to be discharging. A sample was obtained of the discharge. Additional samples were obtained from the receiving environment upstream and downstream of the discharge point. No visual effects were noted in or on the receiving environment at the time of the inspection.

### 23 July 2014

At the time of inspection the site was unmanned with all producing wells flowing to the Cheal-A production station. Drums that were stored on-site were scheduled to be removed the following week as confirmed by TAG Oil (NZ) Limited. Skimmer pits were inspected and found to be discharging. A sample was obtained of the discharge. Additional samples were obtained from the receiving environment upstream and downstream of the discharge point. Deposits of waxy hydrocarbons were found in and around the cellar of well B7, deposits were also found near the eastern perimeter drain. TAG Oil (NZ) Limited were advised to remove the cellar contents around the B7 well and hydrocarbon deposits on-site to be undertaken immediately.

### 31 July 2014

Contractors were on-site conducting remedial works. All producing wells were flowing to the Cheal-A production station. Waxy hydrocarbon deposits sited during previous inspection had since been removed and cleaned from site. Cellars had been pumped out, however the heavy machinery implemented to clean up the site had churned the pad up. Site staff were recommended to keep an eye on the potential suspended solids entering the skimmer pits. Skimmer pits were inspected and found not to be discharging at the time of inspection as the shut-off valve was closed. A sample was obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges. Consents were compliant at the time of inspection.

## 2.1.2 Results of discharge monitoring

During the period under review a total of five stormwater samples were obtained. The wellsite skimmer pits were observed discharging on three occasions, and three samples were obtained in conjunction with this. The remaining two samples were obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges.

Analysis of the samples obtained showed that all of the samples were compliant or would have been compliant with resource consent conditions should a discharge have occurred. Results are detailed in Table 1 and sampling locations can be seen in Figure 2.

**Table 1** Results of stormwater samples obtained from the Cheal-B wellsite during the monitoring period

Date	Chloride <i>g/m<sup>3</sup></i>	Hydrocarbons <i>g/m<sup>3</sup></i>	pH <i>pH</i>	Suspended Solids <i>g/m<sup>3</sup></i>	Sampling location
06 Jun 2014	19.6	<0.5	7.0	4	Second skimmer pit
04 Jul 2014	18.2	<0.5	7.0	17	Discharge
17 Jul 2014	22.6	<0.5	6.8	9	Discharge
23 Jul 2014	21.4	<0.5	7.0	10	Discharge
31 Jul 2014	17.6	8.2	6.9	15	Second skimmer pit

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

### 2.1.3 Results of receiving environment monitoring

During the period under review, four samples were obtained in conjunction with the stormwater discharges on 17 July 2014 and 23 July 2014 from an unnamed tributary of the Ngaere Stream to ensure that stormwater discharges were not having an adverse effect on the receiving stream environment. Of the stream samples obtained, no exceedences were recorded in relation to consent 6815-1. Results are detailed in Table 2 and sampling locations can be seen in Figure 2.

**Table 2** Samples obtained from an unnamed tributary of the Ngaere Stream during the monitoring period

Date	Chloride <i>g/m<sup>3</sup></i>	Hydrocarbons <i>g/m<sup>3</sup></i>	pH <i>pH</i>	Suspended Solids <i>g/m<sup>3</sup></i>	Sampling location
17 Jul 2014	17.4	<0.5	7.2	<2	Upstream of discharge
	17.7	<0.5	7.2	2	Downstream of discharge
23 Jul 2014	18.6	<0.5	7.4	3	Upstream of discharge
	19.0	<0.5	7.4	3	Downstream of discharge



**Figure 2** Stormwater and surface water sampling locations at the Cheal-B wellsite

The receiving surface water body was inspected regularly in conjunction with site inspections. No effects were observed and the stream appeared clear with no visual change in colour or clarity. In addition, no odour, oil, grease films, scum, foam or suspended solids were observed in the stream as a result of activities at the Cheal-B wellsite during the monitoring period.

## **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 for comments concerning site inspections.

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

TAG Oil (NZ) Limited did not notify the Council of their intention to combust gas at the Cheal-B wellsite, as although a flare stack was deployed at the Cheal-B wellsite in anticipation of gas combustion during drilling, well workover campaigns and production testing, no actual gas combustion occurred at the Cheal-B wellsite during the period under review.

During routine inspections, no offensive or objectionable odours, smoke or dust associated with activities at the Cheal-B wellsite were observed. From observations during site inspections, including the inspection of the flare log maintained by TAG Oil (NZ) Limited, it appeared that special conditions relating to the control of emissions to air from the combustion of hydrocarbons were largely complied with.

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

No chemical monitoring of air quality was undertaken during the monitoring period under review at the Cheal-B wellsite as gas combustion activities did not occur. In addition, controls implemented by TAG Oil (NZ) Limited did not give rise to any concerns with regard to air quality.

### **2.2.4 Other ambient monitoring**

No other ambient air sampling was undertaken, as the controls implemented by TAG Oil (NZ) Limited did not give rise to any concerns with regard to air quality.

## **2.3 Land**

### **2.3.1 Inspections**

Land monitoring inspections were carried out in conjunction with general compliance monitoring inspections. See Section 2.1.1 for comments concerning site inspections.

### **2.3.2 Results of discharge and receiving environment monitoring**

Consent 7907-1 to discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream was not exercised during the period under review, as the wellsite had already been established for previous exploration efforts regarding wells B1, B2, B3, B4, B5, B6, B7 and B8. Furthermore, minor site upgrades to accommodate the new exploration wells were completed during the previous monitoring period.

### **2.3.3 Results of discharge and receiving environment monitoring (mix-bury-cover)**

Consent 6817-1 to discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Cheal-B wellsite onto and into land via mix-bury-cover was not exercised during the monitoring period under review. Drilling muds, drilling cuttings and drilling wastes were disposed of at consented off-site facilities.

### **2.3.4 Land status**

The wellsite was constructed on relatively flat rural dairy farming area. Relatively minor earthworks were required to construct the site. The land had not been reinstated at the time of the last inspection as the site was still in use.

## **2.4 Biomonitoring surveys**

Biomonitoring surveys were performed during drilling activities on 16 November 2012, and another following the completion of drilling activities on 15 April 2014 at the Cheal-B wellsite to determine whether or not consented discharges of treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream have had a detrimental effect upon the macroinvertebrate communities of this stream.

Both biomonitoring surveys were undertaken at three established sites; 5 m upstream of the Cheal-B wellsite (site 1), 10 m downstream of the Cheal-B wellsite discharge point (site 2) and 180 m downstream of the Cheal-B wellsite discharge point (site 3), as seen in Figure 3.

The Councils 'vegetation sweep' sampling technique was used at the three sites to collect streambed macroinvertebrates from the unnamed tributary of the Ngaere Stream. This has provided baseline data for any future assessment of consented discharge effects from the Cheal-B wellsite on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), MCI, and SQMCI<sub>5</sub> scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>5</sub> takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>5</sub> between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Summaries of each biomonitoring survey are as follows. A complete copy of the biomonitoring surveys can be found within Appendix II of this report.



**Figure 3** Biomonitoring sites in the Ngaere Stream in relation to the Cheal-B wellsite

### 16 November 2012

This November 2012 survey of three sites, upstream and downstream of the skimmer pit discharge point to land near the Ngaere stream, was undertaken during drilling activities at the Cheal-B wellsite. Taxa richness were moderate and similar to numbers found in 'control' streams at comparative altitudes elsewhere in the region. At site 1, the SQMCI<sub>s</sub> score showed a significant increase from the previous two surveys and from the median SQMCI<sub>s</sub> score for 'control' sites at similar altitudes; a reflection of an increased numerical abundance of 'sensitive' taxa. No significant changes to MCI and SQMCI<sub>s</sub> scores were recorded at site 2 between the three surveys. At site 3, the SQMCI<sub>s</sub> score decreased significantly (1 unit) from the previous post-drill report and from the median SQMCI<sub>s</sub> score for 'control' sites at similar altitudes (1.1 units). However, there was no significant difference between the current survey results and the previously obtained pre-drill results, suggesting that this decrease, and other variations in MCI and SQMCI<sub>s</sub> scores between sites and surveys is considered a reflection of habitat variability, and differences in sampling effort, rather than a change in water quality.

The MCI scores recorded in this survey indicated that the stream communities were of reasonable 'health' (TRC, 2013), and are considered to be typical of what might be expected from a stream originating from a swampy area (i.e. Ngaere Swamp). There was no indication from the results of two previous surveys conducted that the discharge from the Cheal-B wellsite has impacted on the biological communities of the Ngaere Stream.

### 15 April 2014

The April 2014 survey of three sites, upstream and downstream of the skimmer pit discharge point to land near the stream, was undertaken after three previous surveys and following ongoing drilling at the Cheal-B wellsite. Taxa richness was moderate for all three sites and was similar to previous results with only site 3 showing a non-significant decrease from previous surveys. However, other indices of macroinvertebrate health were generally of a lower standard. Site 1, which is the

control site and unaffected by any wellsite discharges was the site in the worst condition in terms of its macroinvertebrate community. The SQMCI<sub>s</sub> in particular was very low and significantly lower than median values of previous surveys. Site 1 also had the lowest median SQMCI<sub>s</sub> values indicating that habitat at the site played an important role in the historic low macroinvertebrate indices as opposed to physicochemical water quality, which would also be expected to affect the macroinvertebrate values at sites 2 and 3. In contrast, site 2, just 15 m downstream from site 1 and potentially affected by wellsite discharges, had on average higher macroinvertebrate values than site 1 in both the previous and the current surveys indicating that the habitat was better than site 1 which makes comparisons between sites more difficult.

The SQMCI<sub>s</sub> value for site 2 was 0.8 units lower than the median value from previous surveys, close to the boundary of being significantly lower. Site 3 had a significantly lower SQMCI<sub>s</sub> value compared with previous surveys. The decrease in SQMCI<sub>s</sub> scores at all the sites highlighted by the high abundances of very 'tolerant' oligochaete worms suggested that an overall decline in the biological health of the Ngaere Stream had occurred and was unrelated to any wellsite activities.

## 2.5 Contingency plan

TAG Oil (NZ) Limited has provided a general contingency plan, as required by Condition 4 of resource consent 6815-1 with site specific maps. The contingency plan has been reviewed and approved by officers of the Council.

## 2.6 Investigations, interventions and incidents

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

Incidents may be alleged to be associated with a particular site. If there is 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 monitoring period under review, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with TAG Oil (NZ) Limited's conditions in resource consents or provisions in Regional Plans.

Any minor actual or potential non-compliance with consent conditions were addressed during site inspections. TAG Oil (NZ) Limited staff would quickly take steps to ensure that requests made by Council Inspecting Officers were adhered to.

### **3. Discussion**

#### **3.1 Discussion of consent exercise**

Of the five resource consents relating to the Cheal-B wellsite, consents 6813-1 (to discharge emissions to air associated with hydrocarbon exploration), 6814-1 (to discharge emissions to air associated with production activities), 6815-1 (to discharge treated stormwater and treated produced water onto and into land in the vicinity of the Ngaere Stream), and 7907-1 (to discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite) were exercised and actively monitored.

The discharge of stormwater and sediment from earthworks during expansion of the Cheal-B wellsite as permitted by resource consent 7907-1, and the discharge of drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Cheal-B wellsite onto and into land via mix-bury-cover as permitted by resource consent 6817-1 were not exercised during the period under review. The drilling muds, cuttings and wastes were disposed of at consented off-site facilities.

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

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

##### **Stormwater**

The discharge of stormwater from earthworks has the potential for sediment and other contaminants to enter surface water where it may detrimentally affect in-stream flora and fauna. To mitigate these effects, TAG Oil (NZ) Limited established perimeter drains 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 can occur if contaminated water escapes through the stormwater system. Interceptor pits are designed to trap sediment and hydrocarbons through gravity separation. Any water that is unsuitable for release via the interceptor pits was directed to the drilling sumps, or removed for off-site disposal.

TAG Oil (NZ) Limited also undertook the following mitigation measures in order to minimize 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 runoff from areas containing contaminants could occur;
- Regular inspections of the interceptor pits occurred; and
- Maintenance and repairs were carried out if required.

Interceptor pits do not discharge directly to surface water, instead they discharge onto and into land where the discharge usually soaks into the soil before reaching any surface water. However, if high rainfall had resulted in the discharge reaching the surface water, significant dilution would have occurred.

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

### **Groundwater**

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

### **Flaring**

The environmental effects from flaring have been evaluated in monitoring reports prepared by the Council in relation to the flaring emissions from specific wells in the region.

The Council has previously undertaken field studies at two wells (one gas, and the other producing oil and heavier condensates); together with dispersion modelling at a third site<sup>1</sup>. More recently two studies have focused on field investigations and modelling of emissions from flares involving fracturing fluids.<sup>2</sup>

In brief, the previous studies found that measurements of carbon monoxide, carbon dioxide, and methane concentrations to be safe at all points downwind, including within 50 m of the flare pit. Measurements of suspended particulate matter found concentrations typical of background levels, and measurements of PM<sub>10</sub> found compliance with national standards even in close proximity to the flare. Beyond 120 m from the flare pit, concentrations of polycyclic aromatic hydrocarbons (PAH) approached background levels, as did levels of dioxins beyond 250 m from the flare.

In summary, the studies established that under combustion conditions of high volume flaring of gases with some light entrained liquids etc., atmospheric concentrations of all contaminants had reduced by a distance of 250 m downwind to become essentially typical of or less than elsewhere in the Taranaki environment (e.g. urban areas). These levels are well below any concentrations at which there is any basis for concern over potential health effects.

The measures to be undertaken by TAG Oil (NZ) Limited to avoid or mitigate actual or potential adverse environmental impacts on air quality would have included:

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<sup>1</sup> Taranaki Regional Council, *Fletcher Challenge Energy Taranaki Ltd, Mangahewa 2 Gas Well Air Quality Monitoring Programme Report 1997 - 98*, August 1998.

<sup>2</sup> 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.

- The use of a test separator to separate solids and fluids from the gas during all well clean-ups, and workover activities where necessary, thus reducing emissions to air. In particular, this would reduce the potential for heavy smoke incidents associated with elevated PAH and dioxin emissions;
- Records of flaring events are kept by TAG Oil (NZ) Limited and provided to the Council;
- Every endeavor was made by TAG Oil (NZ) Limited to minimise the total volume of gas flared while ensuring that adequate flow and pressure data was gathered to inform their investment decision; and
- Every endeavor was made by TAG Oil (NZ) Limited to minimise smoke emissions from the flare.

### **Odour and dust**

Suppression of dust with water was to be implemented 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 minimize the potential for odour emissions (e.g. by keeping containers sealed, and ensuring the flare burnt cleanly).

### **Hazardous substances**

The use and storage of hazardous substances on-site has the potential to contaminate surface water and soils in the event of a spill. In the unlikely event of a serious spill or fire, the storage of flammable materials could have resulted in air, soil and water contamination.

TAG Oil (NZ) Limited was required to implement the following mitigation measures:

- All potentially hazardous material were used and stored in accordance with the relevant Hazardous Substances and New Organisms regulations;
- All areas containing hazardous chemicals were bunded;
- Sufficient separation of chemicals from the flare stack were maintained for safety reasons;
- In the unlikely event of a spill escaping from bunded areas, the site perimeter drain and interceptor pit system was implemented to provide secondary containment on-site; and
- A spill contingency plan was prepared that sets out emergency response procedures to be followed in the event of a spill.

### **Summary**

There were no significant adverse environmental effects observed to water, land or air as a result of the wellsite activities during the monitoring period.

### 3.3 Evaluation of performance

A tabular summary of TAG Oil (NZ) Limited's compliance record for the period under review is set out in Tables 3 to 7.

**Table 3** Summary of performance for consent 6813-1 to discharge emissions to air from flaring of hydrocarbons and miscellaneous emissions associated with drill stem testing, well clean up, initial well testing and production testing associated with up to 14 wells

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent shall not be exercised for more than an accumulated duration of 15 days, allowing 3 zones to be tested per well, for up to 14 wells	Inspection of records	Yes
2. Prior to the commencement of testing the consent holder shall submit to the Council a final site layout plan	Plan received	Yes
3. Council must be notified 24hrs prior to initial flaring of each zone	Notification received	Yes
4. Occupants of dwellings within 1000 m of the wellsite shall be provided with notification at least 24 hrs prior to flaring, when practicable	Notification	Yes
5. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions	Comparative inspections in accordance with information submitted	Yes
6. Consent holder shall have regard to prevailing winds, predicted wind speed and direction during any episode of gas combustion	Inspection	Yes
7. All gas flared must first be treated by effective liquid and solid separation and recovery	Inspection of flare stack	Yes
8. If effective separation could not be achieved, the consent holder shall notify the Council; and shall re-establish liquid separation and recovery within 3 hours	Inspection of Company records and no notification received	Yes
9. No liquid or solid hydrocarbons shall be combusted through the gas flare system	Inspection of flare stack	Yes
10. As soon as practicable after flow commences, the separated gas shall be combusted so that emissions of smoke are minimised	Inspection of flare stack and company records	Yes
11. Best practicable option to be adopted	Inspections, procedures and processes	Yes
12. Only substances originating from the well stream shall be combusted	Inspection of flare stack and Company records	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
13. Consent holder shall not discharge any contaminant to air at a rate or quantity that is liable to the hazardous, toxic or noxious at or beyond the boundary of the wellsite	Inspection of flare stack and company records	Yes
14. No offensive or objectionable odour or smoke at or beyond the boundary	Inspection	Yes
15. Opacity of any smoke emissions shall not exceed level 1 as per the Ringelmann scale	Inspection	Yes
16. Control of carbon monoxide	Inspection of Company records	Yes
17. Control of nitrogen oxides	Inspection of Company records	Yes
18. Control of other emissions	Inspection of Company records	Yes
19. Analysis of typical gas and condensate stream from field to be made available to the Council	Available upon request	Yes
20. Consent holder shall make available to the Council upon request, a record of all smoke-emitting incidents noting time, duration and cause	Not requested	N/A
21. Consent holder shall make available to the Council a log detailing all flaring events including time, duration and volumes flared	Inspection of Company records	Yes
22. Consent shall lapse if not implemented	Consent exercised	Yes
23. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

**Table 4** Summary of performance for consent 6814-1 to discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Cheal-B wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder shall notify the Council at least one month prior to the establishment of production operations at the Cheal-B wellsite	Notification received	Yes
2. Occupants of dwellings within 1000 m of the wellsite shall be provided with notification at least 24 hrs prior to flaring, when practicable	Notification received	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
3. Consent holder shall notify the Council whenever the continuous flaring of hydrocarbons is expected to occur for more than 5 minutes	Notification received	Yes
4. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions	Comparative inspections in accordance with information submitted	Yes
5. Consent holder shall have regard to prevailing winds, predicted wind speed and direction during any episode of gas combustion	Inspection	Yes
6. All gas flared must first be treated by effective liquid and solid separation and recovery	Inspection of flare stack	Yes
7. If effective separation could not be achieved, the consent holder shall notify the Council; and shall re-establish liquid separation and recovery within 3 hours	Inspection of company records and no notification received	Yes
8. No liquid or solid hydrocarbons shall be combusted through the gas flare system	Inspection of gas combustion system	Yes
9. Only substances originating from the well stream shall be combusted	Inspection of flare stack and company records	Yes
10. Best practicable option to be adopted	Inspections, procedures and processes	Yes
11. Consent holder shall not discharge any contaminant to air at a rate or quantity that is liable to the hazardous, toxic or noxious at or beyond the boundary of the wellsite	Inspection of flare stack and company records	Yes
12. No offensive or objectionable odour or smoke at or beyond the boundary	Inspection	Yes
13. All hydrocarbon storage vessels shall be fitted with vapour recovery systems	Inspection	Yes
14. Opacity of any smoke emissions shall not exceed level 1 as per the Ringelmann scale	Inspection	Yes
15. Control of carbon monoxide	Inspection of company records	Yes
16. Control of nitrogen oxides	Inspection of company records	Yes
17. Control of other emissions	Inspection of company records	Yes
18. Flare pit shall be located 300m from all dwelling houses	Inspection	Yes

19. Consent holder shall make available to the Council upon request, a record of all smoke-emitting incidents noting time, duration and cause	Not requested	N/A
20. Consent holder shall make available to the Council a log detailing all flaring events including time, duration and volumes flared	Inspection of Company records	Yes
21. Consent holder shall provide to the Council a report annually	Report received	Yes
22. Analysis of typical gas and condensate stream from field to be made available to the Council	Available upon request	Yes
23. Consent shall lapse if not implemented	Consent exercised	Yes
24. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

**Table 5** Summary of performance for consent 6815-1 to discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder to adopt best practicable option at all times	Inspection of site, procedures & processes	Yes
2. Maximum stormwater catchment area shall be no more than 15,000 m <sup>2</sup>	Plans, procedures and processes	Yes
3. 7 days written notice provided to the Council prior to site works and drilling	Notification received	Yes
4. Council to approve prepared contingency plan in relation to the wellsite prior to exercise of consent	Contingency plan approved	Yes
5. All stormwater and produced water discharged under this permit shall be directed for treatment through the stormwater treatment system for prior to discharging	Inspection	Yes
6. Any above ground hazardous substances areas shall be bunded with drainage to appropriated recovery systems	Inspection	Yes

7. Constituents in discharges shall meet the following standards: a) pH 6.5 – 8.5 b) Suspended solids <100 g/m <sup>3</sup> c) Hydrocarbon <15 g/m <sup>3</sup> d) Chloride 50 g/m <sup>3</sup>	Physicochemical sampling	Yes
8. Following a mixing zone of 20 m , discharges shall not give rise to an increase in temperature of more than 2°C	Physicochemical sampling	Yes
9. Following the mixing zone, the discharge shall not give rise to adverse effects in the receiving waters	Inspection	Yes
10. Discharge onto and into land shall occur a minimum of 30 metres from any surface. There shall be no direct discharge to surface water	Inspection	Yes
11. The Council shall be advised in writing 48 hrs prior to reinstatement of the site	Notification	Yes
12. Consent shall lapse if not implemented	Exercise of consent confirmed by inspection	Yes
13. Notice of Council to review consent	No provision for review during period	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

**Table 6** Summary of performance for consent 6817-1 to discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Cheal-B wellsite onto and into land via mix-bury-cover

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent allows for the discharge of up to 3000m <sup>3</sup> of solid drilling wastes	Inspection of company records	N/A
2. Prior to the exercise of consent for each separate mix-bury-cover discharge the consent holder shall provide to the Council a report describing the proposed mix-bury-cover activities. In addition, no discharges shall occur within 12 months of any previous mix-bury-cover discharge at the site	Inspection of company records	N/A
3. Discharges are to take place in accordance with information submitted in support of application	Confirming discharges were undertaken in accordance with information submitted	N/A

4. The Council to be notified 48hrs prior to and completion of each mix-bury-cover discharge	Notification received	N/A
5. Records of composition, volumes and quantities of material to be discharged shall be kept and supplied to the Council	Inspection of Company records	N/A
6. Mix-bury-cover discharge sites must be 30m from any water body, spring or bore	Inspection	N/A
7. All ponded water shall be removed from the drilling waste holding receptacle prior to recovery/mixing operation	Inspection	N/A
8. All sumps are to be permeable	Inspection	N/A
9. Drilling waste to be mixed with uncontaminated soil	Sampling soil prior to mixing	N/A
10. Mix-bury-cover discharge sites are to be as far above the groundwater table as practicable	Inspection	N/A
11. The total loading of trace elements in waste is not to exceed Alberta Energy and Utilities Board, 1996, G-50 guidelines	Inspection of company records	N/A
12. Chloride levels in each mix-bury-cover shall not exceed 1,600kg	Physicochemical sampling	N/A
13. Nitrogen levels in each mix-bury-cover shall not exceed 400kg	Physicochemical sampling	N/A
14. The hydrocarbon content of solid drilling waste shall not exceed 15mg/kg	Physicochemical sampling	N/A
15. Level of salts in surface & ground water not to exceed 2,500g/m <sup>3</sup>	Physicochemical sampling	N/A
16. Various metals in the soil covering the mix-bury-cover to be below agreed limits	Physicochemical sampling	N/A
17. The mixture of solid drilling wastes soil shall be covered by at least one metre of uncontaminated soil and shall be revegetated and maintained with pasture cover	Inspection, procedures and processes	N/A
18. The cover material is to be compacted and contoured so that stormwater is directed away from the mix-bury-cover site	Inspection	N/A
19. Consent holder to adopt best practicable option at all times	Inspection, procedures and processes	N/A

20. Exercise of consent shall not lead to a direct discharge of contaminants to a surface water body	Inspection	N/A
21. Exercise of consent shall not result in any adverse impacts on groundwater or surface water including aquatic ecosystems	Physicochemical sampling and biomonitoring	N/A
22. Hydrocarbon concentrations in the soil covering the mix-bury-cover shall comply with agreed guideline values	Physicochemical sampling	N/A
23. Various parameters in the soil covering the mix-bury-cover to be below agreed limits	Physicochemical sampling	N/A
24. Consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent	Application for review	N/A
25. Council may review any or all of the conditions of this consent	No provision for review	N/A
26. Consent shall lapse if not implemented by date specified	Exercise of consent confirmed by inspection	N/A
27. Notice of Council to review consent	No provision for review during period	N/A
28. Volume of solid drilling wastes discharged shall not exceed 1500 m <sup>3</sup> per well from up to 8 wells	Inspection, procedures and processes	N/A
29. Discharge areas for waste from individual wells are to be kept separate and distinct	Inspection of company records	N/A
30. As far as practicable, all fluids shall be removed from the drilling wastes	Inspection, procedures and processes	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

**Table 7** Summary of performance for consent 7907-1 to discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder to adopt best practicable option at all times	Inspections, procedures and processes	N/A
2. All run off from any exposed soil shall pass through settlement ponds or sediment traps or other sediment control measures of equal standard	Inspections	N/A

3. Condition 2 shall cease to apply, and sediment control measures removed when the area is stabilised	Inspections	N/A
4. All earth worked areas shall be stabilised as soon as practicable	Inspection	N/A
5. 7 days written notice prior to site earthworks commencing	Notification received	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

During the monitoring period, TAG Oil (NZ) Limited demonstrated a high level of environmental and administrative performance with the resource consents. The site was generally neat, tidy, and well maintained.

### 3.4 Exercise of optional review of consents

Each resource consent includes a condition which allows the Council to review the consent, 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 not foreseen at the time the application was considered or which it was not appropriate to deal with at the time. The next provisions for review are in 2016.

Based on the results of monitoring during the period under review, it is considered that there are no grounds that require a review to be pursued. A recommendation to this effect is presented in section 4.

### 3.5 Alterations to monitoring programmes

In designing and implementing the monitoring programmes for air and water discharges and water abstractions at wellsites in the region, the Council takes into account the extent of information made available by previous and other authorities, its relevance under the 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. Furthermore, with regard to hydraulic fracturing activities, baseline groundwater monitoring samples have demonstrated that hydraulic fracturing discharges have not given rise to any significant adverse effects on groundwater aquifers within the region. However, 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 addition, the Council has also noted a desire by some community areas or individuals for a heightened level of information feedback and certainty around the results and outcomes of monitoring at wellsites. The Council has therefore moved to extend the previous regime, to make the sampling and extensive analysis of groundwater and surface waters in the general vicinity of a wellsite where hydraulic fracturing occurs, and biomonitoring of surface water ecosystems, an integral part of the basic monitoring programme for such activities.

Therefore, it is proposed that for any further work at the Cheal-B wellsite, the new standard programme will continue to be repeated, 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 monitoring of future consented activities at Cheal-B wellsite continue to include biomonitoring surveys;
3. THAT the monitoring of future consented activities include sampling and extensive analysis of both groundwater and surface waters in the general vicinity of the wellsite if hydraulic fracturing is to commence at the Cheal-B wellsite;
4. THAT, subject to the findings of monitoring of any further activities at the Cheal-B wellsite consents 6813-1, 6814-1, 6815-1, 6817-1 and 7907-1 shall not be reviewed in 2016.

## 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.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
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 g/m <sup>3</sup>	Elevated flow in a stream, such as after heavy rainfall. Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.

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 consent 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.
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**



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

Name of  
Consent Holder:           Cheal Petroleum Limited  
                                  1407-1050 Burrard Street  
                                  Vancouver BC  
                                  CANADA V6Z 253

Consent Granted           23 March 2006  
Date:

**Conditions of Consent**

Consent Granted:           To discharge drilling muds, drilling cuttings and drilling  
                                  wastes from hydrocarbon exploration activities at the  
                                  Cheal-B wellsite onto and into land via mix bury cover at or  
                                  about (NZTM) 1712585E-5640816N

Expiry Date:               1 June 2022

Review Date(s):           June 2010, June 2016

Site Location:             Cheal-B wellsite, 2 Taylor Road, Stratford  
                                  [Property owner: RC & CA Taylor]

Legal Description:        Lot 1 DP 18576 Lots 1& 2 DP 20526 Blk VI Ngaere SD

Catchment:                Patea

Tributary:                 Ngaere

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

## Consent 6817-1

### 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. This consent allows for the discharge of up to 3000 m<sup>3</sup> of solid drilling wastes [including drill cuttings and residual fluids] by way of mix-bury-cover into land on the Cheal-B wellsite and surrounding land.
2. Prior to the exercise of this consent for each separate mix-bury-cover discharge the consent holder shall provide to the written satisfaction of the Chief Executive, Taranaki Regional Council, a report describing proposed mix-bury-cover, including area, location, nature of material, means of compliance with conditions, etc, and the results of any relevant monitoring of existing mix-bury-cover discharge sites under this consent. In any case additional mix-bury-cover discharges shall not take place under this consent within 12 months of any previous mix-bury-cover discharge, unless this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.
3. The consent holder shall ensure that the discharge, licensed by this consent, takes place in general accordance with the information submitted in support of application 4121. In particular but without limitation, any amendment to the location of the mix-bury-cover site, pre-treatment of solids, changes to fluids/additives, method of mix-bury-cover, or post burial site management, shall be advised to the Chief Executive, Taranaki Regional Council, prior to any discharge to the mix-bury-cover site, and shall not provide or result in any less environmental protection than that set out or provided for in the information submitted in support of application 4121.
4. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to commencement, and upon completion of the discharge to the mix-bury-cover site[s].

## Consent 6817-1

5. The consent holder shall keep records of the composition and volumes of the material to be discharged, including records of quantities and types of drilling fluids and additives used [materials and their composition], and shall forward the records to the Taranaki Regional Council prior to the discharge.
6. The edge of the mix-bury-cover zone shall be at least 30 metres from any surface water body, spring, or any pre-existing groundwater supply bore.
7. All ponded water shall be removed from the drilling waste holding receptacle prior to the recovery/mixing operation.
8. If sumps are used as drilling waste holding receptacles on the site, and the sump is to be used for a disposal area, the impermeable liner shall be perforated, and where possible removed, so that it no longer encloses the solid drilling wastes.
9. The solid drilling wastes [drill cuttings and residual fluids] shall be incorporated with uncontaminated soils with a mixing ratio of 1 part solid drilling wastes [drill cuttings, additives and residual fluids] to a minimum of 3 parts uncontaminated soil.
10. The placement of the solid drilling wastes [drill cuttings and residual fluids] shall, as far as practicable, be above the watertable.
11. The total loading of trace elements in the solid drilling wastes to be disposed of in the mix-bury-cover operation shall not exceed those listed in Table 3-1 of the Alberta Energy and Utilities Board, 1996, G-50 guidelines.
12. The loading of chloride must not exceed 1,600 kg for each distinct mix-bury-cover disposal area for wastes from an individual well.
13. The loading of nitrogen must not exceed 400 kg for each distinct mix-bury-cover disposal area for wastes from an individual well.
14. The hydrocarbon content of the soil waste mix shall not exceed 0.0015% [15 mg/kg] on a dry weight basis.
15. The exercise of this consent shall not result in a level of total dissolved salts within any surface water or ground water of more than 2500 gm<sup>-3</sup>.
16. The disposal of solid drilling wastes shall comply with the heavy metal receiving environment concentration limits specified in Table C, Section 9, Public Guidelines for the Safe Use of Sewage Effluent and Sewage Sludge on Land, Ministry of Health, 1992.

## Consent 6817-1

17. The solid drilling wastes [drill cuttings and residual fluids] shall be covered by at least one metre of uncontaminated soil, and shall be revegetated and thereafter maintained with pasture cover within 6 months of the completion of any mix-bury-cover operation.
18. The consent holder shall compact and contour the cover material such that all surface stormwater is directed away from the mix-bury-cover site and shall maintain the cover layer of soil so as to ensure its integrity at all times to the satisfaction of the Chief Executive, Taranaki Regional Council.
19. 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 adverse effects on the environment arising from the discharge, including but not limited to any water body or soil.
20. The exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.
21. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.
22. At any time the levels of hydrocarbons in the soil shall comply with the guideline values for the designated soil type in the surface layer [less than 0.5 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
23. At any time the upper [less than 0.5 metre depth] soil levels shall not exceed the following limits: conductivity 290 mSm<sup>-1</sup>; total dissolved salts 2500 gm<sup>-3</sup>; sodium 460 gm<sup>-3</sup>; and chloride 700 gm<sup>-3</sup>.
24. The consent holder may apply to the Taranaki Regional Council for a change or cancellation of any of the conditions of this consent in accordance with section 127(1)(a) of the Resource Management Act 1991 to take account of operational requirements or the results of monitoring.
25. The Taranaki Regional Council may review any or all of the conditions of this consent within two months of receiving data on the volume and composition of the material under condition 5 for the purpose of assessing the adequacy of monitoring and mitigation measures.

## Consent 6817-1

26. This consent shall lapse on the expiry of five years after the date of issue of this consent, 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.
  
27. 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 2010 and/or June 2016, 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.

Transferred at Stratford on 28 October 2009

For and on behalf of  
Taranaki Regional Council

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**Director-Resource Management**



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

Name of  
Consent Holder:           Cheal Petroleum Limited  
                                  P O Box 402  
                                  NEW PLYMOUTH 4340

Decision Date:             25 August 2011

Commencement  
Date:                         25 August 2011

**Conditions of Consent**

Consent Granted:         To discharge stormwater and sediment from earthworks during expansion of the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment at or about (NZTM) 1712638E-5640842N

Expiry Date:              1 June 2016

Site Location:             Cheal-B wellsite, Taylor Road, Stratford

Legal Description:        Lot 1 DP 18576 Blk VI Ngaere SD  
                                  [Discharge source & site]

Catchment:                Patea

Tributary:                 Ngaere

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

### General condition

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

### 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. 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 are agreed to by the Chief Executive of the Taranaki Regional Council.
3. The obligation described in condition 2 above shall cease to apply, and accordingly the erosion and sediment control measures can be removed, in respect of any particular site or area of any site, only when the site is stabilised.

*Note: For the purpose of conditions 3 and 4 "stabilised" in relation to any site or area means inherently resistant to erosion or rendered resistant, such as by using rock or by the application of basecourse, colluvium, grassing, mulch, or another method to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council and as specified in the Taranaki Regional Council's Guidelines for Earthworks in the Taranaki Region, 2006. Where seeding or grassing is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once, on reasonable visual inspection by an officer of the Taranaki Regional Council, an 80% vegetative cover has been established.*

4. All earthworked areas shall be stabilised vegetatively or otherwise as soon as is practicable immediately following completion of soil disturbance activities.

Consent 7907-1

5. At least 7 working days prior to the commencement of earthworks the consent holder shall notify the Taranaki Regional Council of the proposed start date for the earthworks. Notification shall include the consent number and a brief description of the activity consented and shall be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).

Signed at Stratford on 25 August 2011

For and on behalf of  
Taranaki Regional Council

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**Director-Resource Management**



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

Name of  
Consent Holder:           Cheal Petroleum Limited  
                                  P O Box 402  
                                  NEW PLYMOUTH 4340

Decision Date               24 August 2011  
[Change]:

Commencement              24 August 2011     [Granted: 23 March 2006]  
Date [Change]:

**Conditions of Consent**

Consent Granted:           To discharge emissions to air from flaring of hydrocarbons  
                                  and miscellaneous emissions associated with drill stem  
                                  testing, well clean up, initial well testing and production  
                                  testing associated with up to 14 wells at the Cheal-B  
                                  wellsite at or about (NZTM) 1712640E-5640861N

Expiry Date:                1 June 2022

Review Date(s):            June 2016

Site Location:              Cheal-B wellsite, 2 Taylor Road, Stratford  
                                  [Property owner: RC & CA Taylor]

Legal Description:         Lot 1 DP 18576 Lots 1 & 2 DP 20526 Blk VI Ngaere SD  
                                  [Discharge source & site]

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

### **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**

#### **Duration**

1. This consent shall not be exercised for more than an accumulated duration of 15 days per zone, allowing 3 zones to be tested per well, for up to 14 wells. The time interval specified in this condition refers to that period during which this consent is exercised and is not regarded as continuous elapsed time from the first exercise of this consent.

#### **Information and notification**

2. Prior to the commencement of testing, the consent holder shall supply to the Chief Executive, Taranaki Regional Council, a final site layout plan, demonstrating configuration of the facilities and equipment so as to avoid or mitigate the potential effects of air emissions.
3. The Taranaki Regional Council shall be notified within 24 hours prior to the initial flaring of each zone being commenced.
4. At least 24 hours prior to any flaring, the consent holder shall undertake all practicable measures to notify 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/or complaints received.
5. 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 notified in this consent application, without prior consultation with the Chief Executive, Taranaki Regional Council.

## Flaring

6. 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 any episode of flaring or other combustion of hydrocarbons.
7. All gas being flared, at any time during well clean-up, drill stem testing, initial testing, or production testing, or at any other time, must first be treated by effective liquid and solid separation and recovery, as far as is practicable to ensure that smoke emission during flaring is minimised.
8. If separation cannot be implemented and/or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall notify the Chief Executive, Taranaki Regional Council, and shall in any case re-establish liquid separation and recovery within three hours.
9. No liquid or solid hydrocarbons shall be combusted through the gas flare system.
10. As soon as is practicable after flow commences, the separated gas shall be combusted so that emissions of smoke are minimised.
11. 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 the flare emission, emissions from the flare pit, or any other emissions from the wellsite [including use of a separator during well clean-up]. This requirement applies in addition to any of the specific requirements set out in conditions 1, 6, 7, 8, 9 and 10.
12. Only substances originating from the well stream and treated as outlined by conditions 7, 8, 9, 10 and 11 are to be combusted within the flare pit.
13. The consent holder shall not discharge any contaminant to air authorised by this consent at a rate or a quantity such that the contaminant, whether alone or in combination with other contaminants, is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the wellsite, or beyond 100 metres of the flare, whichever distance is greater.
14. There shall not be any offensive odour or smoke, as determined by an enforcement officer of the Taranaki Regional Council, beyond the boundary of the wellsite or beyond 100 metres of the flare, whichever distance is greater, arising from the exercise of this consent
15. The opacity of any smoke emissions shall not exceed a level of 1 as measured on the Ringelmann Scale for more than four minutes cumulative duration in any 60-minute period.
16. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 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 wellsite or beyond 100 metres from the flare, whichever distance is greater.

## Consent 6813-1

17. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 mg/m<sup>3</sup> [24-hour average exposure], or 200 mg/m<sup>3</sup> [1-hour average exposure] at or beyond the boundary of the wellsite, or beyond 100 metres from the flare, whichever distance is greater.
18. 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, whether alone or in conjunction with any emissions from the flare, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater, is not increased above background levels:
  - a) by more than 1/30th of the relevant Occupational Threshold Value-Time Weighted Average, or by more than the Short Term Exposure Limit at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or
  - b) if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

### Recording and reporting information

19. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and crude oil 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.
20. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, a record of all smoke-emitting incidents noting time, duration and cause.
21. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, logs of all flaring, including time, duration and [as far as is practicable] volumes of substances flared.

### Lapse and Review

22. This consent shall lapse on the expiry of five years after the date of issue of this consent, 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 6813-1

23. 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 2010 and/or June 2016, 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 24 August 2011

For and on behalf of  
Taranaki Regional Council

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**Director-Resource Management**



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

Name of  
Consent Holder:           Cheal Petroleum Limited  
                                  1407-1050 Burrard Street  
                                  Vancouver BC  
                                  CANADA V6Z 253

Consent Granted           23 March 2006  
Date:

**Conditions of Consent**

Consent Granted:        To discharge emissions to air during flaring from well  
                                  workovers and in emergency situations and miscellaneous  
                                  emissions associated with production activities at the  
                                  Cheal-B wellsite at or about (NZTM) 1712688E-5640749N

Expiry Date:            1 June 2022

Review Date(s):        June 2010, June 2016

Site Location:           Cheal-B wellsite, 2 Taylor Road, Stratford  
                                  [Property owner: RC & CA Taylor]

Legal Description:       Lot 1 DP 18576 Lot 1 2 DP 20526 Blk VI Ngaere SD

### **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. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least one month prior to the establishment of production operations at the Cheal-B wellsite.
2. At least 24 hours prior to any flaring, other than in emergencies, the consent holder shall undertake all practicable measures to notify residents within 1000 metres of the site of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and/or complaints received.
3. The consent holder shall, whenever practicable, 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, as far as practicable, be no less than 24 hours prior to such flaring being commenced.
4. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other site emissions, including but not limited to the recovery of produced gas, other than as notified in this consent application, without prior consultation with the Chief Executive, Taranaki Regional Council, and the consent holder shall obtain any necessary approvals under the Resource Management Act 1991.

#### **Emissions from the site**

5. Other than for the maintenance of a pilot flare flame, the consent holder shall have regard to the prevailing and predicted wind speed and direction at the time of initiation of any episode of flaring or other combustion of hydrocarbons.

## Consent 6814-1

6. All gas being flared, at any time must first be treated by effective liquid and solid separation and recovery, as far as is practicable, to ensure that smoke emission during flaring is minimised.
7. If separation cannot be implemented and/or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall notify the Chief Executive, Taranaki Regional Council, and shall in any case re-establish liquid and solid separation and recovery within three hours.
8. Subject to special conditions 6 and 7, no liquid or solid hydrocarbons shall be combusted through the gas flare system other than in an emergency.
9. Only substances originating from the well stream and treated as outlined by conditions 6, 7, 8, and 10 shall be combusted within the flare pit.
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 Cheal-B wellsite. Any adoption of the best practicable option as outlined in this special condition shall be to the satisfaction of the Chief Executive, Taranaki Regional Council.
11. The consent holder shall not discharge any contaminant to air authorised by this consent at a rate or a quantity such that the contaminant, whether alone or in combination with other contaminants, is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the wellsite, or beyond 100 metres of the flare, whichever distance is greater.
12. There shall not be any offensive odour or smoke, as determined by an enforcement officer of the Taranaki Regional Council, beyond the boundary of the wellsite or beyond 100 metres of the flare, whichever distance is greater, arising from the exercise of this consent.
13. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.
14. The opacity of any smoke emissions shall not exceed a level of 1 as measured on the Ringelmann Scale for more than four minutes cumulative duration in any 60-minute period.
15. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 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 wellsite or beyond 100 metres from the flare, whichever distance is greater.

## Consent 6814-1

16. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 mg/m<sup>3</sup> [24-hour average exposure], or 200 mg/m<sup>3</sup> [1-hour average exposure] at or beyond the boundary of the wellsite, or beyond 100 metres from the flare, whichever distance is greater.
17. 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, whether alone or in conjunction with any emissions from the flare, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater, 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].
18. The flare pit shall be located 300 metres from all dwellinghouses. In this case the flare pit should be 300 metres from the Vosseler/Turner dwelling-house [Legal Description 1 DP 19529 Blk VI Ngaere SD] and the Frost dwelling-house [Legal Description Lot 1 DP 19125 Blk VI Ngaere SD].

### **Recording and reporting information**

19. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, a record of all smoke-emitting incidents noting time, duration and cause.
20. The consent holder shall keep and maintain a log of all continuous flaring incidents longer than five minutes, and any intermittent flaring lasting for an aggregate of ten minutes or longer in any 120-minute period. Such a log shall contain the date, the start and finish times, the quantity and type of material flared, and the reason for flaring. This log shall be made available to the Chief Executive, Taranaki Regional Council, upon request, and summarised annually in the report required under condition 21.

## Consent 6814-1

21. 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 19;
  - iii) detailing any measures to reduce smoke emissions;
  - iv) detailing any measures 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.
22. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and crude oil 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.

### Lapse and Review

23. This consent shall lapse on the expiry of 16 years after the date of issue of this consent, 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.
24. 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 2010 and/or June 2016, 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.

Transferred at Stratford on 28 October 2009

For and on behalf of  
Taranaki Regional Council

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**Director-Resource Management**



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

Name of  
Consent Holder:                      Cheal Petroleum Limited  
   P O Box 402  
   NEW PLYMOUTH 4340

Decision Date                              18 September 2013  
(Change):

Commencement Date                      18 September 2013      (Granted: 23 March 2006)  
(Change):

**Conditions of Consent**

Consent Granted:                      To discharge treated stormwater and treated produced  
   water from hydrocarbon exploration and production  
   operations at the Cheal-B wellsite onto and into land in the  
   vicinity of the Ngaere Stream in the Patea catchment

Expiry Date:                              1 June 2022

Review Date(s):                          June 2016

Site Location:                              Cheal-B wellsite, 2 Taylor Road, Stratford  
   (Property owner: RC & CA Taylor)

Legal Description:                          Lot 1 DP 18576 Lots 1& 2 DP 20526 Blk VI Ngaere SD  
   (Discharge source & site)

Grid Reference (NZTM)                      1712675E-5640813N

Catchment:                                  Patea

Tributary:                                      Ngaere

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

### General conditions

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

### Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge.
2. The maximum stormwater catchment area shall be no more than 15,000 m<sup>2</sup>.
3. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 7 days prior to any site works commencing, and again in writing at least 7 days prior to any well drilling operation commencing.
4. Prior to the exercise of this consent, the consent holder shall provide for the written approval of the Chief Executive, Taranaki Regional Council, site specific details relating to contingency planning for the wellsite.
5. All stormwater and produced water to be discharged under this permit shall be directed for treatment through the stormwater treatment system for discharge in accordance with the special conditions of this consent.
6. Any above ground hazardous substances storage areas shall be bunded with drainage to sumps, or other appropriate recovery systems, and not to the stormwater catchment.
7. The following concentrations shall not be exceeded in the discharge:

<b>Component</b>	<b>Concentration</b>
pH (range)	6.5 - 8.5
suspended solids	100 gm <sup>-3</sup>
total recoverable hydrocarbons (infrared spectroscopic technique)	15 gm <sup>-3</sup>
chloride	50 gm <sup>-3</sup>

## Consent 6815-1

This condition shall apply prior to the entry of the treated stormwater and produced water either onto and into land, or into surface water, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

8. After allowing for reasonable mixing, within a mixing zone extending seven times the width of the water body downstream of a designated discharge point, the discharge shall not give rise to an increase in temperature of more than 2 degrees Celsius.
9. After allowing for reasonable mixing, within a mixing zone extending seven times the width of the water body downstream of a designated discharge point, the discharge shall not give rise to any of the following effects in the receiving waters:
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.
10. The discharge onto and into land shall occur a minimum of 30 metres from any surface water body. Discharge shall be onto and into land and there shall be no direct discharge to surface water.
11. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality.
12. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2010 and/or June 2016, 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 18 September 2013

For and on behalf of  
Taranaki Regional Council



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## **Appendix II**

### **Biomonitoring surveys**



To Job Manager; Callum MacKenzie  
From Freshwater Biologist; Brooke Thomas  
Document 1214698  
Date 28 June 2013

## **Biomonitoring of the Ngaere Stream following drilling by Cheal Petroleum Limited at the Cheal-B well site, November 2012**

### **Introduction**

This biological survey was performed during on-going drilling operations at the Cheal-B wellsite, to determine whether or not treated stormwater and uncontaminated site and production water discharges from the drilling site onto land, in the vicinity of the Ngaere Stream had any effects upon the communities of the stream. This follow-up survey followed two previous surveys; one conducted prior to drilling (Smith, 2012), but following site preparation earthworks (to provide baseline data on the macroinvertebrate community of the stream), and the other following drilling activities at the Cheal-B wellsite (Smith, 2012).

### **Methods**

To collect streambed macroinvertebrates in the Ngaere Stream (downstream of the stormwater discharges from the Cheal-B well site), two sampling methods were employed. The 'vegetation sweep' sampling technique was used at sites 1 and 3, while a combination of the 'vegetation sweep' and 'kick-sampling' technique was used at site 2 (Table 1, Figure 1). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

The Cheal-B wellsite stormwater and site production water was discharged from a skimmer pit on to land within the vicinity of the Ngaere Stream (Figure 1). This survey was undertaken on 16 November 2012 at three established sites; 5 m upstream of Cheal-B well site (site 1), 10 m downstream Cheal-B well site discharge (site 2), and 180 m downstream of Cheal-B well site discharge (site 3).

Table 1: Biomonitoring sites in the Ngaere Stream related to the Cheal-B well site

Site No.	Site code	Grid reference (NZTM)	Location	Sampling method	Time of Sampling (NZST)
1	NGR000010	1712709E-5640717N	5m u/s of Cheal-B well site	Sweep	1045
2	NGR000012	1712740E-5640761N	10m d/s Cheal-B well site discharge	Kick-sweep	1030
3	NGR000014	1712891E-5640691N	180m d/s of Cheal-B well site discharge	Sweep	1000



Figure 1 Biomonitoring sites in the Ngaere Stream sampled in relation to the Cheal-B well site

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using Protocol P1 of NZMWG protocols of sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities inhabit less polluted waterways.

A semi-quantitative MCI value (SQMCI<sub>s</sub>) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI<sub>s</sub> score is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

## Results and discussion

At the time of this late morning survey, stream temperatures were recorded as 12.7°C (sites 1 and 2) and 12.3°C (site 3). A moderate flow of clear, uncoloured water was noted at all three sites. Substrate at site 1 was comprised predominantly of silt, with a small amount of sand. Substrate at site 2 was comprised predominantly of willow roots with equal amounts of silt, sand and fine and coarse gravels. At site 3, substrate was comprised predominantly of silt with equal amounts of sand and fine and coarse gravels. Slippery mats of periphyton were noted at sites 2 and 3 only. Macrophytes were noted at all three sites, both at the edges and on the bed of the stream.

### Macroinvertebrate communities

Table 2 summarises the results of the current macroinvertebrate survey performed during on-going drilling operations of the Cheal-B wellsite, along with results from the pre-drill and post-drill surveys. Comparative data for sites in similar streams in the region are presented in Table 3. The macroinvertebrate fauna recorded by the current survey are presented in Table 4.

Table 2: Number of taxa, MCI and SQMCI<sub>s</sub> values for the Ngaere Stream prior to and following drilling of Cheal-B well.

Site no	Site code	No of taxa			MCI value			SQMCI <sub>s</sub> value		
		Pre-drill (Dec 11)	Post-drill (Feb 12)	Follow-up (Nov 12)	Pre-drill (Dec 11)	Post-drill (Feb 12)	Follow-up (Nov 12)	Pre-drill (Dec 11)	Post-drill (Feb 12)	Follow-up (Nov 12)
1	NGR000010	33	20	24	81	82	93	2.2	2.2	5.7
2	NGR000012	31	16	19	90	93	86	4.3	4.7	4.5
3	NGR000014	21	26	21	74	85	79	3.8	4.0	3.0

Table 3: Range and median number of taxa, MCI values and SQMCI<sub>s</sub> scores for smaller lowland stream control sites at a similar altitude ((TRC, 1999 (updated 2012)).

	No. of taxa	MCI value	SQMCI <sub>s</sub> value
No. samples	167	167	81
Range	5-33	52-108	1.5-6.3
Median	18	78	4.1

Table 4: Macroinvertebrate fauna of the Ngaere Stream in relation to the Cheal-B follow-up survey sampled 16 November 2012.

Taxa List	Site Number	MCI score	1	2	3
	Site Code		NGR000010	NGR000012	NGR000014
	Sample Number		FWB12418	FWB12419	FWB12420
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	R	-
NEMERTEA	Nemertea	3	-	R	R
NEMATODA	Nematoda	3	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	-	A	VA
	Lumbricidae	5	-	R	R
MOLLUSCA	<i>Gyraulus</i>	3	-	R	-
	<i>Physa</i>	3	R	-	R
	<i>Potamopyrgus</i>	4	C	XA	C
CRUSTACEA	Ostracoda	1	-	-	A
	<i>Paracalliope</i>	5	C	A	VA
	Paraleptamphopidae	5	A	VA	-
	<i>Paranephrops</i>	5	R	-	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	-	A	R
	<i>Neozephlebia</i>	7	C	C	-
	<i>Zephlebia group</i>	7	VA	VA	C
ODONATA (DRAGONFLIES)	<i>Antipodochlora</i>	5	R	-	-
	<i>Xanthocnemis</i>	4	C	-	R
HEMIPTERA (BUGS)	<i>Microvelia</i>	3	C	-	-
COLEOPTERA (BEETLES)	Dytiscidae	5	C	-	-
	Hydrophilidae	5	R	-	-
	Scirtidae	8	R	-	-
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	R	R	R
	<i>Orthopsyche</i>	9	-	C	-
	<i>Polylectropus</i>	6	C	-	R
	<i>Psilochorema</i>	6	R	-	R
	Oeconesidae	5	-	C	C
	<i>Oxyethira</i>	2	-	R	R
	<i>Triplectides</i>	5	C	-	R
DIPTERA (TRUE FLIES)	<i>Chironomus</i>	1	-	-	R
	<i>Corynoneura</i>	3	R	-	-
	Orthoclaadiinae	2	C	A	A
	Tanypodinae	5	R	-	-
	<i>Paradixa</i>	4	C	-	-
	Empididae	3	R	-	-
	Psychodidae	1	-	R	-
	<i>Austrosimulium</i>	3	A	A	C
ACARINA (MITES)	Acarina	5	-	R	-
No of taxa			24	19	21
MCI			93	86	79
SQMCIs			5.7	4.5	3.0
EPT (taxa)			6	6	7
%EPT (taxa)			25	32	33
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa	

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

### Site 1- 5 metres upstream of discharge

A moderate community richness of twenty four taxa was found at site 1 (Table 2 and Table 4). This was four taxa more than what was recorded in the post-drill survey but nine fewer than what was recorded in the pre-drill survey and six taxa more than the median richness found at similar sites elsewhere in the region (Table 3). The macroinvertebrate community contained a significant proportion of 'moderately sensitive' taxa (54%), which was reflected in the MCI score of 93 units. This result represented a significant increase from 81 MCI units recorded in the pre-drill survey and 82 MCI units recorded in the post-drill survey and was also significantly higher (Stark, 1998) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 3).

The community at this site was characterised by one 'tolerant' taxon (sandfly larvae (*Austrosimulium*)) and two 'moderately sensitive' taxa (amphipod (*Paraleptamphopidae*) and mayfly (*Zephlebia group*)). Two 'tolerant' taxa which characterised site one in the previous two surveys were absent during the current survey. This included oligochaete worms and seed shrimp (Ostracoda).

The numerical dominance of two 'moderately sensitive' taxa, and a decrease in abundance of 'tolerant' taxa, resulted in a SQMCI<sub>s</sub> score of 5.7 units, which was significantly higher (by 3.5 units) than what was recorded in the previous two surveys, and significantly higher (1.6 units) than the median score for 'control' sites in similar streams at this altitude (Stark, 1998).

### Site 2- 10 metres downstream of discharge

A moderate community richness of nineteen taxa was found at site 2 (Table 2 and Table 4), representing a decrease of twelve taxa from the pre-drill survey. However, this richness was similar to what was recorded in the post-drill survey and similar to the median richness found at sites of a comparative altitude (Table 3). The macroinvertebrate community was comprised of equal proportions of 'moderately sensitive' (47%) and 'tolerant' (47%) taxa, which was reflected in the MCI score of 86 units; an insignificant 4 units fewer than what was recorded during the pre-drill survey, and an insignificant 7 units fewer than what was recorded in the post-drill survey. This MCI score was slightly higher (Stark, 1998) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 3).

This community was characterised by four 'tolerant' taxa (extremely abundant snail (*Potamopyrgus*), sandfly larvae (*Austrosimulium*), oligochaete worms and orthoclad midges); and four 'moderately sensitive' taxa (amphipods (*Paracalliope* and *Paraleptamphopidae*), and mayflies (*Austroclima* and *Zephlebia group*)). Of these eight taxa, five were also characteristic taxa of the macroinvertebrate communities recorded in the pre-drill and post-drill survey.

An equal dominance of 'tolerant' and 'moderately sensitive' taxa resulted in a SQMCI<sub>s</sub> score of 4.5 units, which was slightly higher (by 0.2 unit) than what was recorded in the pre-drill survey, but lower (0.2 unit) than what was recorded in the post-drill survey and an insignificant 0.4 unit greater than the median score for 'control' sites in similar streams at this altitude (Table 3).

### Site 3- 180 metres downstream of discharge

A moderate community richness of twenty one taxa was found at site 3 (Table 2 and Table 4), three taxa fewer than the upstream control site, but the same as what was recorded during the pre-drill survey. This was two taxa more than the median richness found at similar sites elsewhere in the region (Table 3). In comparison to the two upstream sites, the macroinvertebrate community was comprised of a larger proportion of 'tolerant' taxa (52%), which was reflected in the MCI score of 79 units; an insignificant 5 units higher than the pre-drill survey. This score was only one unit higher (Stark, 1998) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 3).

This community was characterised by three 'tolerant' taxa (Oligochaete worms, seed shrimp (Ostracoda), true fly larvae (Orthoclaadiinae)); and one 'moderately sensitive' taxa (amphipod (*Paracalliope*)). A similar community composition (excluding true fly larvae (Orthoclaadiinae)) was recorded in the pre-drill and post-drill surveys.

The SQMCI<sub>s</sub> score of 3.0 units recorded at site 3 represented a 0.8 unit decrease from the SQMCI<sub>s</sub> score in the pre-drill survey and a 1 unit decrease from the SQMCI<sub>s</sub> score in the post-drill survey. It was a significant 1.1 units fewer than the median score for 'control' sites in similar streams at this altitude elsewhere the region (TRC, 1999 (updated 2012)); which can be attributed to the numerical dominance of 'tolerant' taxa.

## Summary and Conclusions

A combination of the Council's standard 'vegetation sweep' and 'kick-sampling' techniques was used at three sites to collect streambed macroinvertebrates from the Ngaere Stream. This has provided data to compare with previous data, for the assessment of skimmer pit discharge effects from the Cheal-B wellsite on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), MCI, and SQMCI<sub>s</sub> scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>s</sub> takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>s</sub> between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

This November 2012 survey of three sites, upstream and downstream of the skimmer pit discharge point to land near the Ngaere stream, was undertaken during drilling activities at the Cheal-B wellsite. Taxa richness's were moderate and similar to numbers found in 'control' streams at comparative altitudes elsewhere in the region. At site 1, the SQMCI<sub>s</sub> score showed a significant increase from the previous two surveys and from the median SQMCI<sub>s</sub> score for 'control' sites at similar altitudes; a reflection of an increased numerical abundance of 'sensitive' taxa. No significant changes to MCI and SQMCI<sub>s</sub> scores were recorded at site 2 between the three surveys. At site 3, the SQMCI<sub>s</sub> score decreased significantly (1 unit) from the post-drill report and from the median SQMCI<sub>s</sub> score for 'control' sites at similar altitudes (1.1 units). However, there was no significant difference between the current survey results and the pre-drill results, suggesting that this decrease, and other variations in MCI and SQMCI<sub>s</sub>

scores between sites and surveys is considered a reflection of habitat variability, and differences in sampling effort, rather than a change in water quality.

The MCI scores recorded in this survey indicated that the stream communities were of reasonable 'health' (TRC, 2013), and are considered to be typical of what might be expected from a stream originating from a swampy area (i.e. Ngaere Swamp). There was no indication from the results of the two surveys that the discharge from the Cheal-B wellsite has impacted on the biological communities of the Ngaere Stream.

## References

- Smith KL, 2012: Biomonitoring of the Ngaere Stream prior to drilling by Cheal Petroleum Limited at the Cheal-B well site, December 2011, TRC report KS002.
- Smith KL, 2012: Biomonitoring of the Ngaere Stream following drilling by Cheal Petroleum Limited at the Cheal-B well site, February 2012, TRC report KS005.
- Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.
- Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research* 32(1): 55-66.
- Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.
- Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998 (statistics updated 2012). Technical Report 99-17.
- TRC, 2013: Fresh Water Macroinvertebrate Fauna Biological Monitoring Programme Annual State of the Environment Monitoring Report 2011-2012. TRC Technical Report 2012-18. 243p.



To Job Manager; Callum MacKenzie  
 From Freshwater Biologists; Darin Sutherland and Brooke Thomas  
 Report No DS001  
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 Date 4 November 2014

## **Biomonitoring of the Ngaere Stream during ongoing activities by Cheal Petroleum Limited at the Cheal-B well site, April 2014**

### **Introduction**

A macroinvertebrate survey was performed at the Cheal -B well site to determine whether on-going drilling discharges of treated stormwater, uncontaminated site water and production water onto land had been having a detrimental effect upon macroinvertebrate communities of the nearby Ngaere Stream. This follow-up survey followed three previous surveys; one conducted prior to drilling (Smith, 2012a), but following site preparation earthworks (to provide baseline data on the macroinvertebrate community of the stream), the next following drilling activities at the Cheal-B wellsite (Smith, 2012b) and a survey monitoring ongoing discharges (Thomas, 2013).

### **Methods**

The Cheal -B wellsite stormwater and site production water was discharged from a skimmer pit on to land within the vicinity of the Ngaere Stream (Figure 1). The survey was undertaken on 15 April 2014 at three previously established sites; 8 m upstream of the well site (site 1), 10 m downstream of the well site discharge (site 2) and 180 m downstream of the discharge (site 3). The altitude of the three sites is approximately 240 m asl.

Two different sampling techniques were used to collect macroinvertebrates in the Ngaere Stream: the Council's standard 'kick-sampling' technique, the 'vegetation sweep' technique and a combination of both (Table 1). The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). The two different techniques are used depending on the situation and a combination of techniques may be used when different conditions are encountered in the same reach of river. Furthermore, vegetation sweeps may be used when the stream is not wadeable but vegetation on the bank edges can still be sampled.

Table 1 Biomonitoring sites and sampling methods used in the Ngaere Stream in relation to the Cheal-B wellsite.

Site No.	Site code	Grid reference (NZTM)	Location	Sampling method
1	NGR000010	1712709E-5640717N	5m u/s of Cheal-B well site	Sweep
2	NGR000012	1712740E-5640761N	10m d/s Cheal-B well site discharge	Sweep
3	NGR000014	1712891E-5640691N	180m d/s of Cheal-B well site discharge	Kick-sweep



Figure 1 Biomonitoring sites in the Ngaere Stream in relation to the Cheal-B wellsite

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology which uses Protocol P1 of NZMWG protocols of sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

A semi-quantitative MCI value (SQMCI<sub>s</sub>) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCI<sub>s</sub> is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower. A difference of 0.9 units or more in SQMCI<sub>s</sub> is considered significantly different (Stark, 1998).

## Results

### Site habitat characteristics

The water temperatures were moderate, with slow flows and cloudy water (Table 2). Substrate at all three sites was comprised predominantly of silt, with varying small amounts of sand, fine gravel, coarse gravel and bedrock.

No periphyton growth was noted which would be expected with a silt substrate. Leaves and wood were patchy and macrophytes were present on the edges of site 1 and on the edges and in the bed in sites 2 and 3. Sites 1 and 2 were partially shaded by overhanging vegetation while no shading was recorded at site 3.

**Table 2** Summary of time of sampling and some water phys- chem variables for the April 2014 macroinvertebrate survey.

	Time (NZST)	Temperature (C°)	Water Colour	Water Clarity	Flow Conditions	Water Speed
NGR000010	1215	15.2	Uncoloured	Cloudy	Low	Slow
NGR000012	1205	15.0	Brown	Cloudy	Low	Slow
NGR000014	1150	14.5	Uncoloured	Cloudy	Low	Slow

### Macroinvertebrate communities

**Table 3** Summary of number of taxa, MCI values and SQMCI<sub>s</sub> from macroinvertebrates surveys in relation to the Cheal B wellsite.

	Number of previous surveys	Numbers of taxa			MCI values			SQMCI <sub>s</sub>		
		Median	Range	Current Survey	Median	Range	Current Survey	Median	Range	Current Survey
NGR000010	3	24	20-33	21	82	81-93	71	2.2	2.2-5.7	1.2
NGR000012	3	19	16-31	19	90	86-93	86	4.5	4.3-4.7	3.5
NGR000014	3	21	21-26	15	79	74-85	75	3.8	3.0-4.0	2.5

**Table 4** Range and median number of taxa, MCI values and SQMCI<sub>s</sub> scores for control sites (smaller lowland hill country) at altitudes between 200 and 249 m asl ((TRC, 1999 (updated 2013)).

	No. of taxa	MCI value	SQMCI <sub>s</sub> value
No. Samples	169	169	90
Range	5-33	52-108	1.5-6.3
Median	18	79	4.0

Table 5 Macroinvertebrate fauna of the Ngaere Stream in relation to the Cheal-B survey sampled 15 April 2014

Taxa List	Site Number	MCI score	Site 1	Site 2	Site 3
	Site Code		NGR000010	NGR000012	NGR000014
	Sample Number		FWB14196	FWB14197	FWB14198
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	-	-	C
NEMERTEA	Nemertea	3	R	-	-
NEMATODA	Nematoda	3	R	-	-
ANNELIDA (WORMS)	Oligochaeta	1	XA	A	VA
	Lumbricidae	5	-	R	-
MOLLUSCA	Lymnaeidae	3	R	-	-
	<i>Physa</i>	3	R	-	-
	<i>Potamopyrgus</i>	4	C	C	A
	Sphaeriidae	3	R	-	-
CRUSTACEA	Ostracoda	1	R	-	C
	<i>Paracalliope</i>	5	C	C	A
	Paraleptamphopidae	5	C	A	-
	<i>Paranephrops</i>	5	R	R	R
EPHEMEROPTERA (MAYFLIES)	<i>Zephlebia group</i>	7	-	R	-
ODONATA (DRAGONFLIES)	<i>Ischnura</i>	4	R	-	-
	<i>Xanthocnemis</i>	4	R	R	R
	<i>Antipodochlora</i>	5	R	-	-
COLEOPTERA (BEETLES)	Scirtidae	8	-	R	-
TRICHOPTERA (CADDISFLIES)	<i>Polypectropus</i>	6	-	R	C
	<i>Psilochorema</i>	6	-	R	-
	Oeconesidae	5	R	-	R
	<i>Triplectides</i>	5	-	C	A
DIPTERA (TRUE FLIES)	<i>Chironomus</i>	1	A	R	C
	Orthoclaadiinae	2	-	R	-
	<i>Polypedilum</i>	3	-	R	-
	Tanypodinae	5	R	-	-
	Tanytarsini	3	-	R	-
	<i>Paradixa</i>	4	R	R	R
	Empididae	3	R	-	-
	<i>Austrosimulium</i>	3	C	A	R
	Tanyderidae	4	-	-	R
ACARINA (MITES)	Acarina	5	C	R	R
No of taxa			21	19	15
MCI			71	86	75
SQMCIs			1.2	3.5	2.5
EPT (taxa)			1	4	3
%EPT (taxa)			5	21	20
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa	

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

### Site 1. 5 m upstream of Cheal-B wellsite

A moderate community richness of 21 taxa was found at site 1 the 'control' site (Table 3 and

Table 5). Comparison with median numbers found previously at the site, show taxa richness was slightly lower than the median but within the range previously found. Comparison with median numbers found at other sites in similar streams in the Taranaki region within the same altitudinal band showed that site 1 had slightly higher taxa richness (Table 4).

The macroinvertebrate community was comprised of a low proportion of 'moderately sensitive or highly sensitive' taxa (33%), which was reflected in the MCI score of 71 units. This MCI score was 10 or more units lower than all values previously found at the site (Table 3).

The community at this site was characterised by two 'tolerant' taxa, oligochaete worms which were extremely abundant and a non-biting midge larvae (*Chironomus*) which was abundant. The numerical dominance of these two 'tolerant' taxa resulted in a SQMCI<sub>S</sub> score of only 1.2 units, which was very low (SQMCI<sub>S</sub> of 4.0 at similar sites; Table 4), and usually indicates a site of 'poor' biological health (TRC, 2013). Comparison with previous surveys at the site showed a low median SQMCI<sub>S</sub> score for the site but significantly higher than the score found by the current sample indicating some deterioration at the site.

### **Site 2. 10 m downstream of discharge from Cheal-B wellsite**

A moderate community richness of 19 taxa was found at site 2 (Table 3 and Table 5), two taxa fewer than found at site 1, and one taxon more than the median richness found at similar sites (Table 4) but equal with the number previously found at the site (Table 3). The macroinvertebrate community was comprised of a low proportion of 'moderately sensitive' taxa (47%), which was reflected in the MCI score of 86 units. This MCI score was similar to the median MCI score for 'control' sites in similar streams and within the range of scores previously found at the site (Table 4).

This community was characterised by two 'tolerant' taxa [oligochaete worms and sandfly larvae (*Austrosimulium*)]; and one moderately sensitive taxa (Paraleptamphopidae amphipods). A significant reduction in the numbers of 'tolerant' snails and non-biting midges between sites 1 and 2 was principally responsible for the large increase of 2.3 units in SQMCI<sub>S</sub>. This value was close to scores at other similar sites but lower than the median value for the site (Table 3 and Table 4).

### **Site 3. 180m downstream of discharge from Cheal-B wellsite**

A moderately low community richness of 15 taxa was found at site 3 (Table 3 and 5), three taxa less than the median richness found at similar sites elsewhere in the region, and six taxa less than at the 'control' site (Table 4).

The macroinvertebrate community was comprised of a high proportion of 'tolerant' taxa (60%), which was reflected in the low MCI score of 75 units. This MCI score was not significantly (Stark, 1998) lower than the median MCI score for 'control' sites in similar Taranaki streams at comparative altitudes but was within the range of scores previously found for the site (Table 3 and Table 4).

This community was characterised by two 'tolerant' taxa [oligochaete worms and snails (*Potamopyrgus*)] and two moderately sensitive taxa [*Paracalliope* amphipods and the caddisfly (*Triplectides*)]. An increase in the number of 'tolerant' oligochaete worms between sites 2 and 3 was principally responsible for the decrease of 1.0 units in SQMCI<sub>S</sub>. The SQMCI<sub>S</sub> was also

significantly lower than the score for other similar sites and significantly lower than the median value found for the site (Table 3 and Table 4).

## Discussion and Conclusions

The Councils 'vegetation sweep' and a combination of 'vegetation sweep' and 'kick-sampling' techniques were used at three sites to collect streambed macroinvertebrates from the Ngaere Stream. This has provided data to assess any ongoing impacts of skimmer pit discharge effects from the Cheal-B wellsite on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), MCI, and SQMCI<sub>5</sub> scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>5</sub> takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI<sub>5</sub> between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

The April 2014 survey of three sites, upstream and downstream of the skimmer pit discharge point to land near the stream, was undertaken after three previous surveys and following ongoing drilling at the Cheal-B wellsite. Taxa richness was moderate for all three sites and was similar to previous results with only site 3 showing a non-significant decrease from previous surveys. However, other indices of macroinvertebrate health were generally of a lower standard. Site 1, which is the control site and unaffected by any wellsite discharges was the site in the worst condition in terms of its macroinvertebrate community. The SQMCI<sub>5</sub> in particular was very low and significantly lower than median values of previous surveys. Site 1 also had the lowest median SQMCI<sub>5</sub> values indicating that habitat at the site played an important role in the historic low macroinvertebrate indices as opposed to physiochemical water quality, which would also be expected affect the macroinvertebrate values at sites 2 and 3. In contrast, site 2, just 15 m downstream from site 1 and potentially affected by wellsite discharges, had on average higher macroinvertebrate values than site 1 in both the previous and the current surveys indicating that the habitat was better than site 1 which makes comparisons between sites more difficult. The SQMCI<sub>5</sub> value for site 2 was 0.8 units lower than the median value from previous surveys, close to the boundary of being significantly lower. Site 3 had a significantly lower SQMCI<sub>5</sub> value compared with previous surveys. The decrease in SQMCI<sub>5</sub> scores at all the sites highlighted by the high abundances of very 'tolerant' oligochaete worms suggested that an overall decline in the biological health of the Ngaere Stream had occurred that was unrelated to any wellsite activities.

## Summary

- Taxa richness was moderate for all three sites and was similar to those found by previous sampling surveys.
- Percentage EPT, MCI and SQMCI<sub>5</sub> indices were either moderate or low for all three sites compared with other similar sites and in general were lower than in previous sampling surveys suggesting some decline in biological health in the Ngaere Stream.
- The site in the poorest condition was site 1, the control site, while site 2, the site that would be expected to be most impacted by any wellsite discharges was in the best condition, indicating that there was no evidence of wellsite discharges having any detrimental effect on the macroinvertebrate communities in the Ngaere Stream.

## References

- Smith KL, 2012a: Biomonitoring of the Ngaere Stream prior to drilling by Cheal Petroleum Limited at the Cheal-B well site, December 2011, TRC report KS002.
- Smith KL, 2012b: Biomonitoring of the Ngaere Stream following drilling by Cheal Petroleum Limited at the Cheal-B well site, February 2012, TRC report KS005.
- Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil Miscellaneous Publication No. 87*.
- Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research* 32(1): 55-66.
- Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.
- Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Thomas BR 2013: Biomonitoring of the Ngaere Stream following drilling by Cheal Petroleum Limited at the Cheal-B well site, November 2012, TRC report BT003.
- TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998 (statistics updated July 2005). Technical Report 99-17.
- TRC, 2013: Fresh Water Macroinvertebrate Fauna Biological Monitoring Programme Annual State of the Environment Monitoring Report 2011-2012. TRC Technical Report 2012-18. 243p.