Taranaki Ventures Limited
Copper Moki 1 Wellsite
Monitoring Programme Report

Technical Report 2011–102

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Executive summary

Taranaki Ventures Limited operates a hydrocarbon exploration site located on Cheal Road, Ngaere, in the Patea catchment. The site is called Copper Moki. A drilling and evaluation operation took place at the site from February 2011-May 2012.

The site was established by Green Gate Limited. In April 2011 all consents related to operations at the Copper Moki site were transferred to Taranaki Ventures Limited.

This report for the period February 2011-May 2012 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance in relation to drilling operations at the Copper Moki site during the period under review, and the results and environmental effects of the Company's activities.

Investigation of an incident at the wellsite on 17 April 2012 led to a decision by the Taranaki Regional Council to pursue a prosecution. As a consequence, release of this report had to be delayed in order not to prejudice the judicial process. The matter has now been resolved.

Taranaki Ventures Limited hold a total of seven resource consents, for activities at the Copper Moki site, which include a total of 76 conditions setting out the requirements that the Company must satisfy. Taranaki Ventures Limited holds the following consents:

- consent 7760-1 to discharge stormwater and sediment into and onto land from earthworks associated with site construction;
- consent 7761-1 to discharge treated stormwater, produced water and surplus drilling water into and onto land;
- consent 7762-1 to take groundwater that may be encountered during drilling;
- consent 7763-1 to take and use water from an unnamed tributary of the Ngaere Stream;
- consent 7764-1 to discharge emissions to air associated with exploration activities;
- consent 7765-1 to discharge emissions to air associated with production activities; and
- consent 7766-1 to discharge drilling wastes from hydrocarbon exploration activities into land via mix-bury-cover.

The Council's monitoring programme for the period under review included 34 inspections of the site and surrounding environment and water samples were collected for physicochemical analysis on one occasion. Ambient air quality analyses were carried out by a consultant on 17 October 2011.

The monitoring showed that staff played as active role in ensuring the site was kept clean and tidy. Some processes/procedures were reviewed as incidents occurred, and changes were made to avoid a repeat event.

During the period under review, there were three Unauthorised Incidents.

The first reported incident occurred when Green Gate Limited operated the site and before the current operator, Taranaki Ventures Limited, became the operator. The incident was a procedural failure to give 7 days' notification of the commencement of drilling operations, although notification of the commencement of concurrent earthworks was made. The

breach was due to the inexperience of a new staff member at Green Gate Limited's contractor, BTW, and BTW received an infringement notice as a result.

The second reported incident was a complaint received concerning smoke emanating from the site. Upon inspection, Taranaki Ventures Limited was found to be in compliance with its resource consent and national environmental standards.

The third incident was a self notification regarding a discharge of oil into a tributary of the Ngaere Stream.

An investigation into the incident found that the acts of Taranaki Ventures Limited's contractor caused liquid hydrocarbon (oil) to discharge into the flare pit in circumstances where the pit was not fully contained. Most of the oil caught alight, leading to a discharge of contaminants to air. The remaining oil (estimated at less than 50 litres) soaked into the base of the flare pit and eventually discharged into a tributary of the Ngaere Stream. As soon as it became aware of the incident, the Company took immediate action to recover the oil such that there was no lasting environmental effects. Local iwi visited the site and approved the remedial measures. The Council brought an enforcement action against the Company, which pleaded guilty at the earliest opportunity to the charge. The Company was fined $20,000. The Court noted that the Company was prompt and responsible in its clean-up attempt and that it co-operated fully with the Council in its investigation and clean-up.

Drilling fluids and cuttings were disposed of to a licensed disposal area at Waikaikai landfarm.

Flaring was carried out on site during exploration activities. From August 2012, where possible, gas has been piped from the wellsite to Waihapa Production Station via a purpose built pipeline.

The oil spill incident that was the subject of the prosecution automatically puts the Company into the category of 'poor environmental performance' for one of its consents, for the period under review. For its other consents, the Company achieved various classifications of 'Improvement Desirable', 'Good', and 'High' environmental performance.

The Company has been consistently receptive to suggestions to enhance its environmental performance and this report includes further recommendations for the monitoring of future drilling and exploration operations at this site.

The report notes that the first optional review date for the Company's is 2016. It recommends that, subject to the findings of any further monitoring, the consents not be reviewed at that date. The next review date is in 2022.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

This report is for the period February 2011-May 2012 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by Taranaki Ventures Limited in relation to exploration activities at the Copper Moki site. Taranaki Ventures Limited operates a wellsite situated on Cheal Road at Ngaere, in the Patea River catchment. Resource consents were transferred from Green Gate Limited to Taranaki Ventures Limited on 1 April 2011.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Taranaki Ventures Limited that relate to exploration activities within the Patea catchment at the Copper Moki wellsite.

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

1.1.1 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Taranaki Ventures 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 Copper Moki 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.

1.1.2 The Resource Management Act (1991) and monitoring

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

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

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

1.1.3 Evaluation of environmental performance

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

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.

- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and

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

- **improvement desirable** indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, or, there were measurable environmental effects arising from activities and intervention by Council staff was required, and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at end of the period under review, and/or abatement notices may have been issued.

- **poor performance** indicates that the Council may have been obliged to record a verified unauthorised incident involving significant environmental impacts, or, there were adverse environmental effects arising from activities and there were grounds for prosecution or an infringement notice.

1.2 Process description

1.2.1 Site management

Taranaki Ventures Limited holds a 5 year exploration mining permit No.51150 to mine oil, condensate, LPG, petroleum, and gas within a 377.03 square kilometre area. The Copper Moki wellsite is one of many sites within this area that have been established in order to explore, evaluate and produce hydrocarbons from within the Mount Messenger formation.

The wellsite is located on a property which borders both Cheal and Skinner Roads approximately 3.3km from State Highway 3, south-east of Stratford and north-east of Eltham. The site is accessed from Cheal Road.

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

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

There are no dwellings located within 300m of the flare pit. Bunding, earthworks and good site location helped mitigate any off site effects for the neighbours.

Well creation
The well was drilled progressively using different sized drill bits. The width of the well is widest at the surface and 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 rock). This process is repeated until the target depth is reached, with each section of steel casing interlocked with the next.

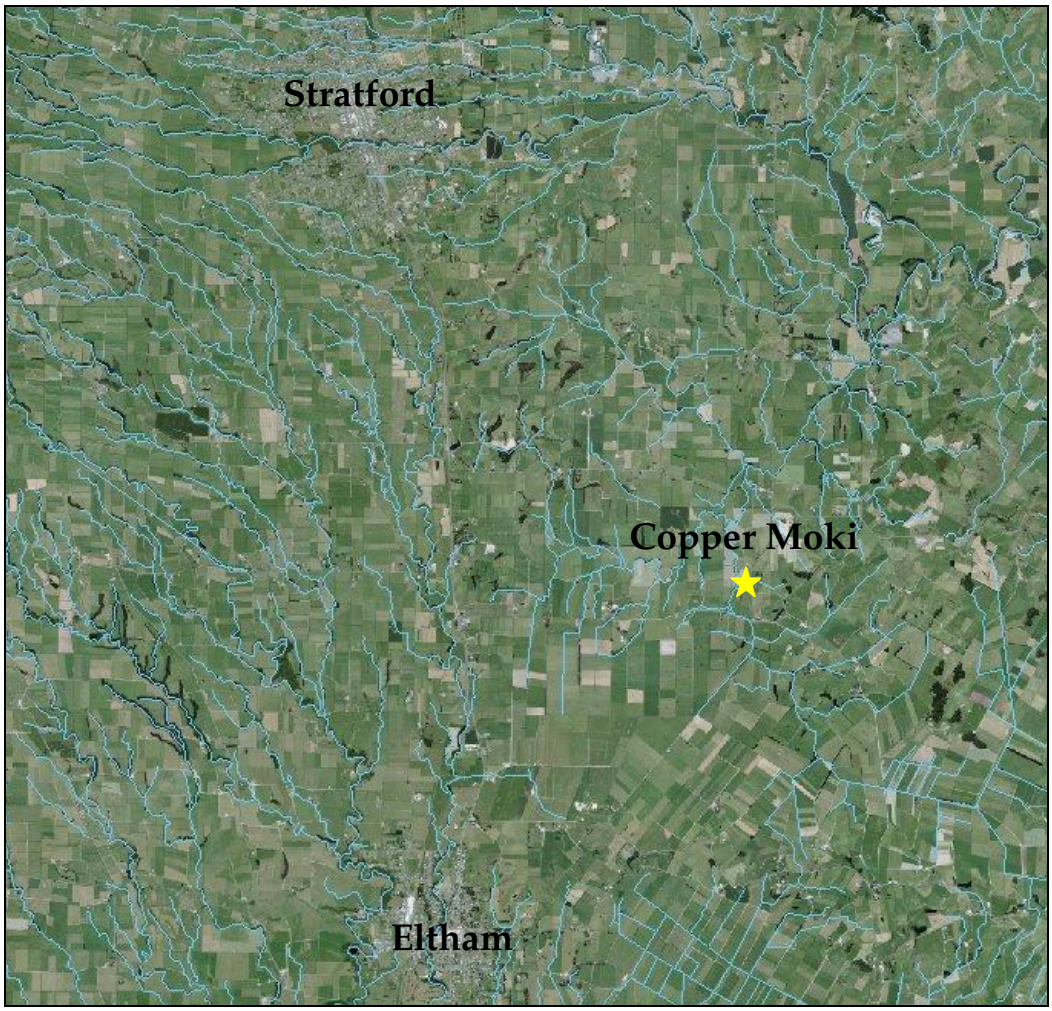
Production tubing is then fitted within the steel casing to the target depth. A packer is fitted between the production tubing and casing to stop oil/gas/produced water from entering the annulus (the space between the production tubing and the casing). The packer is pressure tested to ensure it is sealed.

Once the well is sealed and tested, the casing is perforated at the target depth, allowing fluids and gas to flow freely between the formation and the well. The Copper Moki well site currently has 4 wells.

The surrounding land use is predominantly agricultural, there are also a number of wellsites and pipelines associated with hydrocarbon exploration, production, and processing located within a 10 km radius of the site (including the Cheal and Waihapa wellsites and the Waihapa Production Station).

The topography of the surrounding area can be described as flat to rolling hill country; the wellsite is located in an area of reasonably flat land. An unnamed tributary of the Ngaere Stream is located immediately to the east of the site and flows for approximately 1 km before entering the Ngaere Stream.

There are no known archaeological sites located within the subject site.



Photograph 1 Approximate location of Copper Moki wellsite and proximity to Stratford and Eltham

Management of stormwater, wastewater and solid drilling waste
The Copper Moki wellsite is situated approximately 50m from an unnamed tributary of the Ngaere Stream. Management systems have been put in place to avoid any adverse effects on the surrounding environment from exploration and production activities at the wellsite. There are several potential sources of contamination from water and solid waste material which require appropriate management through resource consent conditions and good oilfield practice. These being:

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

Important requirements of the site establishment are to ensure that the site is contoured so that all stormwater and any runoff from 'clean' areas of the site flow into perimeter drains. The drains direct stormwater into a skimmer pit system on site consisting of 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.

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 was reused in the drilling process. Cuttings were collected in bins located at the base of the shaker and disposed of off site.

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

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

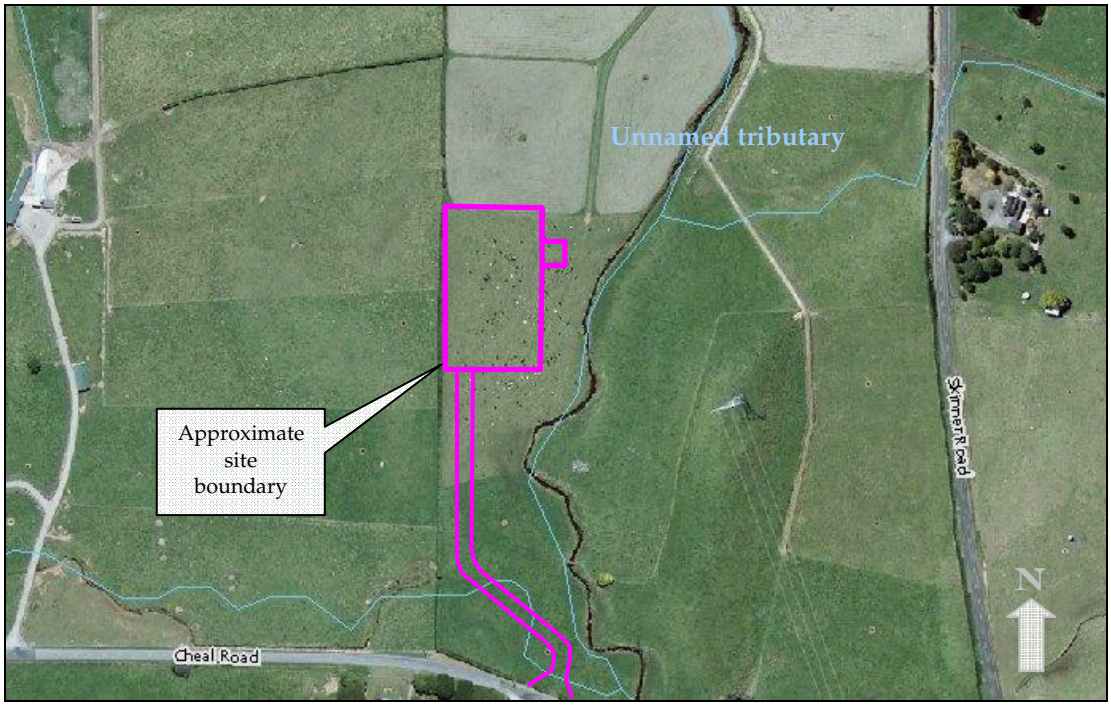


Figure 1 Location of wellsite and access

1.3 Resource consents

1.3.1 Background

Taranaki Ventures Limited holds seven resource consents related to exploration activities at the Copper Moki site. All of the consents were granted on the 19 January 2011. The consent applications were processed on a non-notified basis as the Company had obtained the landowners' approval as an affected party, and the Council was satisfied that the environmental effects of the activity would be minor.

All seven consents were transferred from Green Gate Limited to Taranaki Ventures Limited on 1 April 2011.

The consents are discussed below.

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

Site construction was permitted under Rule 25 of the Regional Fresh Water Plan for Taranaki which allows for the discharge of stormwater and sediment that has derived from soil disturbance activities of 1ha or less.

1.3.2 Water abstraction permit

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

As Taranaki Ventures Limited was unable to estimate the rate or volume of the take, and as such, might exceed the limits of the permitted activity Rule [Rule 48 of the RFWP], the take of groundwater fell for consideration under Rule 49 of the RFWP as a controlled activity.

The standards of Rule 49 require that:

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

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

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

- Volume and rate of abstraction;
- Daily timing of abstraction;
- Effect on adjacent bores, the aquifer, river levels, wetlands and sea water intrusion;
- Fitting of equipment to regulate flows and to monitor water volumes, levels, flows and pressures;
- Payment of administrative charges;
- Monitoring and reporting requirements;
- Duration of consent;
- Review of the conditions of consent and the timing and purpose of the review.

Taranaki Ventures Limited holds water take permit **7762-1** to take groundwater, which is encountered as produced water during drilling at the Copper Moki wellsite.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2028.

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

Consent conditions were imposed on Taranaki Ventures Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 4, Chapter 3.3.

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

1.3.3 Surface water take

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

The taking and use of surface water falls for consideration under Rule 16 of the RFWP as a discretionary activity as the standards of Rule 15 cannot be met.

Provided the activity was to be conducted in a sensible manner, and in accordance with the recommended special conditions, then no significant effects were anticipated.

Taranaki Ventures Limited holds water take permit **7763-1** to take water from an unnamed tributary of the Ngaere Stream for wellsite and well drilling activities.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2022.

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

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

1.3.4 Water discharge permit (treated stormwater)

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

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

Taranaki Ventures Limited holds water discharge permit **7761-1** to discharge treated stormwater, produced water and drilling water from hydrocarbon operations on the wellsite.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2028.

The discharge of stormwater may result in contaminants (e.g. sediment) entering surface water. These contaminants have the potential to adversely affect in-stream flora and fauna. On site management of stormwater, as discussed in Section 1.2.1, is necessary to avoid/remedy any adverse effects on water quality.

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

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

1.3.5 Water discharge permit (stormwater and sediment – construction)

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

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

The standard term/condition of Rule 27 require that:

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

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

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

Taranaki Ventures Limited holds water discharge permit **7760-1** to discharge stormwater and sediment onto and into land associated with earthworks for the construction of the wellsite.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2016.

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

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

1.3.6 Air discharge permit (exploration activities)

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

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

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

Taranaki Ventures Limited holds air discharge permit **7764-1** to discharge emissions to air from flaring associated with well clean up, well testing, and miscellaneous activities.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2028.

Consent conditions were imposed on Taranaki Ventures to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 6, Chapter 3.3.

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

1.3.7 Air discharge permit (production activities)

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

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

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

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

Taranaki Ventures Limited stated that they would undertake the best practicable option. As such, Council was satisfied that the above standard/term/condition would be met.

Taranaki Ventures Limited holds air discharge permit **7765-1** to discharge emissions to air during flaring from well workovers and in emergency situations.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2028.

Consent conditions were imposed on Taranaki Ventures Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 7, Chapter 3.

Copies of the permits are attached to this report in Appendix I.

1.3.8 Mix-bury-cover

Sections 15(1)(b) and (d) of the Resource Management Act stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The discharge of drilling muds, drilling cuttings and drilling wastes onto or into land from hydrocarbon exploration is a Discretionary Activity under Rule 42 of the RFWP.

Rule 42 of the RFWP has four standard terms/conditions to be met:

- The discharge shall not result or be liable to result in any contaminant entering surface water;
- The discharger must at all times adopt the best practicable option to prevent or minimise any adverse effects of the discharge or discharges to any water body or soil;
- The discharge shall contain less than 15mg/kg oil and grease; and
- There shall be no adverse chemical effects on groundwater beyond the site.

Provided the activity was to be conducted in a sensible manner, and in accordance with the recommended special conditions, then no significant effects were anticipated.

Taranaki Ventures Limited holds water take permit **7766-1** to discharge drilling waste from hydrocarbon exploration onto and into land via mix bury cover at the Copper Moki wellsite.

This permit was issued by the Taranaki Regional Council on 19 January 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2028.

Consent conditions were imposed on Taranaki Ventures Limited to ensure that adverse effects are avoided in the first instance. A summary can be viewed in Table 8, Chapter 3.3.

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

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the Resource Management Act sets out obligations upon the Taranaki Regional Council to: gather information, monitor, and conduct research on the exercise of resource consents and the effects arising, within the Taranaki region and report upon these.
The Taranaki Regional Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

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

- Programme liaison and management
- Site inspections
- Chemical sampling
- Solid wastes monitoring
- Air quality monitoring
- Discharges to land (in the case of any hydraulic fracturing)
- Ecological surveys

The seven components are discussed below.

1.4.2 Programme liaison and management

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

1.4.3 Site inspections

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

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

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

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

During each inspection the following are checked:

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

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

1.4.4 Chemical sampling

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

1.4.5 Solid wastes

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

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

1.4.6 Air quality monitoring

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

1.4.7 Discharges to land (hydraulic fracturing)

No hydraulic fracturing was carried out at the Copper Moki site.

1.4.8 Ecological surveys

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

2. Results

2.1 Water

2.1.1 Inspections

The Copper Moki site, adjacent land and streams were inspected 34 times from the site construction phase through to the drilling and flaring phases.

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

8 February 2011
An inspection was undertaken during wet weather. It was found that earthworks associated with the construction of the Copper Moki wellsite had finished and drilling had commenced approximately 15 days prior to this inspection.

The bulk fuel tank was double lined and bunding was in place around chemicals stored on-site. The chemicals were also covered with tarpaulins. The ring drains were mostly dry. A spill of drilling mud had occurred on site with drilling mud entering the ringdrain and both skimmer pits. The butterfly valve on the exit pipe from the second skimmer pit was closed; no contaminants had left the site. Sawdust had been placed on the ground to soak up the mud. The skimmer pits and ring drains were to be pumped out and the sawdust removed. Photos of the spill were taken. Areas where further bunding would reduce the likelihood of contaminants entering the ringdrains were discussed with staff on site. The sewage tanks looked satisfactory. Drilling mud/waste was being removed from the site. The site looked tidy and clean.

Condition 3 of consent 7761-1 was not complied with as notification was not received stating that drilling operations were to commence. Notification was received from BTW that earthworks had commenced under rule 25 of the Regional Freshwater Plan. However, condition 5 of consent 7760-1 had not been complied with as the required 7 days notification was not given.

The consent holder was instructed to ensure that all future notifications were given to TRC, as required by consent conditions.

9 February 2011
A follow up inspection was carried out to observe how the clean up of spilt drilling mud was progressing. The second skimmer pit had been half emptied and was to be completely emptied. The ring drain adjacent to the pit was to be reshaped to ensure all stormwater was directed to the first skimmer pit. The sawdust on the site was to be cleaned up once drilling had been completed. Bunding of the sewage tanks had been carried out as discussed.

11 February 2011
A second re-inspection of the site was carried out following a spill of drilling waste. The second skimmer pit was completely pumped out and the side walls and bottom of the pit were scraped clean. The ring drains had been cleaned and reformed.

Bunding had been placed around the drilling waste D tanks to prevent any further leaks from escaping to the ring drain. Bunding had also been placed around the cement and sewage tanks.

16 February 2011
An inspection was undertaken during fine weather. The site was clean and tidy with no spills observed. The sewage system was working well. The ring drain was dry but the skimmer pits were near full. The second pit was not discharging at the time of inspection. The sump for the chemical bund was full and had created a track through the back of the bund and into the ring drain, making the bund redundant. Staff were advised of this and it was fixed immediately.

21 February 2011
An inspection of the site was undertaken during fine weather. Drilling of the well had been completed and the rig and camp had been removed from site. All pipe work associated with the sewage system had been removed. The ring drains were dry. Both skimmer pits were half full and the valve on the exit pipe from the second pit was open. The chemical bund still contained chemicals. The chemical bund still appeared to be ineffective as the bund had a gap in it created by stormwater escaping and forming a track to the ring drain. The mud D tanks have been removed from site. Cement had entered the ring drain from a pipe that was placed into the ring drain approximately 1 week earlier. The cement needed to be removed. The area around the cement/Halliburton bund needed to be scraped, as did the area around the mud D tanks, chemical bund, and the area affected by the drilling mud spill that had occurred earlier in the drilling programme.

8 March 2011
Inspection of the site was undertaken during fine weather. All equipment had been removed from the site. The gates were closed at time of inspection. The ring drain and area around the cement tanks still contained cement and oil. There was sawdust and mud on the ground in the area of the mud tanks and bunded area. The rest of the site looked to be in good order. The skimmer pits were three quarters full and had been discharging recently. The ring drains were dry at time of inspection.

The consent holder was instructed to ensure that the cement, sawdust and mud were removed.

28 July 2011
An inspection was undertaken during fine but overcast weather**.** The inspecting officer discussed resource consents for the site and the attached conditions with site staff. The site was inspected and the proposed layout discussed. The skimmer pits were discoloured. It was recommended that hay bales or silt cloth be placed in the ring drains to reduce the amount of silt/sediment entering the skimmer pits. The flare pit contained clear water. The rig was being moved onto site.

11 August 2011
An inspection was carried out during fine weather**.** All resource consent conditions were being complied with at the time of inspection. There was no stormwater discharging from the site. Flaring of gas was occurring at the time of inspection. There appeared to be no solid or liquid hydrocarbons in the flare pit. There was no objectionable or offensive smoke or odour noted.

16 August 2011
Inspection of the site was carried out during fine weather. Resource consent conditions were being complied with at the time of inspection. No flaring of hydrocarbons was taking place and no stormwater was discharging from site. The site was very clean and tidy. There was good bunding in place.

22 August 2011
An inspection was undertaken during fine weather**.** All consent conditions were being complied with at the time of inspection. No stormwater was discharging from the site and no flaring was occurring at the time of inspection.

29 August 2011
An inspection of the site was carried out during fine weather. All consent conditions were being complied with at the time of inspection. No stormwater was discharging from the site and no flaring was occurring. The site was clean and tidy. It was observed that the skimmer pits were filling up with sediment. The Company representative stated that the skimmer pits would be cleaned out.

7 September 2011
An inspection was undertaken during fine weather. The drill rig and all associated equipment had been removed from the site. A large cage had been placed around the wellhead. The site had been cleaned. The ring drains were dry at time of inspection. The first skimmer pit had been pumped out and cleaned. The second pit was only half full and not discharging. The flare pit contained clean groundwater.

It appeared that all consent conditions were being complied with at the time of inspection.

11 October 2011
An inspection of the site was undertaken during fine but overcast weather. The stormwater in the ring drain was clean. Water in the skimmer pits was also clean and was not discharging at the time of inspection. The oil and produced water storage containers were well bunded. The site was clean and tidy. Gas was being flared at the time of inspection. The gas was clean with no smoke observed. There was no hydrocarbon sheen on the surface of the water in the flare pit. It appeared that all consent conditions were being complied with at the time of inspection.

20 October 2011
An inspection of the site was carried out during fine weather. Production testing had ceased and the last of the equipment was being removed from site. No activity was occurring on site at the time of inspection. The skimmer pits were near full but not discharging. The flare pit contained clean stormwater, with a black/dark sheen on the surface.

The consent holder was instructed to ensure that the ring drains are scraped, as a lot of silt/sediment had built up within them.

14 November 2011
An inspection of the site was undertaken during fine weather. Works to increase the size of the site had been undertaken and completed. The flare pit had been repositioned and both ends of the site enlarged. The new stormwater catchment area appeared to be less than 1 hectare. The exposed soil needed to be stabilised as required by condition 4 of resource consent 7760-1. The site, skimmer pits and ring drains were dry with no stormwater discharging from site. No activity was occurring on site at the time of inspection.

The consent holder was instructed to ensure that all exposed soil was stabilised vegetatively.

9 January 2012
An inspection was carried out during fine but overcast weather. Consent 7761-1 [discharge of stormwater] was being exercised at the time of inspection. The ring drains and site were mostly dry. Both skimmer pits were full and had recently discharged to land only. Silt cloth was to be placed within ring drains to help control silt entering the skimmer pits. All hazardous substances were bunded. The site was clean and tidy.

Consent 7764-1 [flaring] was being exercised at the time of inspection. Any smoke emitted from the flare pit quickly dispersed. A Vause employee advised that the latest testing phase had been ongoing for one month and was likely to continue for a further 6 months. Flaring was continuous. If flaring continued then it is likely that condition 1 would be breached, in that flaring would occur for more than 45 days cumulatively, per zone for each well.

19 January 2012
An inspection of the site was carried out during fine but overcast weather. Only one of the consents was being exercised at time of inspection. No earthworks were taking place. All stormwater was contained onsite. The site was dry and no stormwater/produced water was discharging from site. Flaring was taking place at the time of inspection, and no issues were raised concerning objectionable smoke. No groundwater had been encountered. All drilling wastes are being disposed of offsite.

24 January 2012
An inspection of the site was carried out during fine weather. The site was clean and tidy. The ring drains were dry and the skimmer pits contained a low volume of stormwater. No stormwater was discharging from the site. Flaring was occurring at the time of inspection. The flare was small with some grey coloured smoke noticeable. The smoke quickly dispersed into the air and was not considered objectionable. Drilling wastes were being disposed of offsite.

1 February 2012
An inspection was undertaken during fine weather. Two consents were being exercised at the time of inspection. Flaring associated with consent 7765-1 was occurring. All gas was separated prior to being flared. Only gases originating from the well stream were being combusted. No offensive or objectionable odour or smoke was being discharged.

Water was also taken from a nearby stream. The consent holder was instructed to ensure that a record of abstraction was kept, and included date, rate, pumping hours and daily volume, as required by condition 2 of consent 7763-1.

8 February 2012
An inspection of the site was undertaken during fine weather. No stormwater was being discharged from the site. The skimmer pits were almost dry, the ring drains and site were dry. Water was being extracted from the nearby stream and used onsite. Flaring continued onsite. The site was neat and tidy. It appeared that all consent conditions were being complied with.

It was noted that the second skimmer pit contained ground water. During previous site visits it had been noted that water within the skimmer pits appears to discharge to ground rather than discharging via the exit pipe. It was recommended that the pits be lined with clay or plastic to ensure that contaminants cannot discharge to ground water.

20 February 2012
An inspection of the site was carried out during fine weather. No earthworks were occurring on site at time of inspection. Notification had been received advising that the site was to be increased in size. The consent holder was instructed to ensure that the stormwater catchment area was no greater than 1ha after earthworks were completed, otherwise a change to consent conditions would be required. The site was dry and skimmer pits were not discharging at time of inspection.

No groundwater was being taken. The consent holder was instructed to ensure that a record of abstraction from the stream was being maintained as required by condition 2 of consent 7763-1.

Both wells were being tested. The volume of gas being burnt had increased. There was not enough oxygen to create a clean flare and black smoke was being released in billows that extended 150m in the air before completely dissipating. The smoke was not considered to be offensive or objectionable at the time of inspection. Staff on site were taking steps to reduce or prevent the smoke from being generated.

28 February 2012
The site was very clean and tidy. The skimmer pits contained water but were not discharging. Earthworks were taking place to enlarge the site. It was raining at the time of inspection, however, no runoff was observed from exposed areas. No silt control measures were observed to have been installed. Water was being taken from the stream and a water meter had been installed to measure the volume of water abstracted. Hydrocarbon gas was being flared at the time of inspection. A water cannon had been set up to spray water over the flare to reduce smoke emissions. This method was working, and only minimal smoke emissions were observed.

The consent holder was instructed to ensure that any runoff from exposed areas of soil passed through settlement ponds as required by condition 2 of consent 7760-1.

6 March 2012
An inspection of the site was undertaken during fine weather. The site was tidy and being well managed. No flaring was occurring at the time of inspection. All

stormwater from the site including the new earthworks area on the eastern side discharged into the skimmer pits. The skimmer pits were full and discharging. The discharge flowed across land for approximately 10 metres before flowing into a manhole and mixing with groundwater. Drilling wastes were still being disposed of off site. Water was also being taken from the nearby stream.

It was observed that cement washings from the Halliburton truck had been discharged to ground, adjacent to the ring drain; some of the washings had entered the ring drain. The drilling contractor had identified this practice as unacceptable and had taken steps to prevent this from happening again. The skimmer pits were to be pumped out in case any contaminants reached them.

26 March 2012
An inspection of the site was carried out during fine weather. The rig was being moved onto well 4. The site had been raised. Stormwater within the ring drains looked clear. The skimmer pits looked discoloured as did the discharge onto land. No effect was observed in the nearby stream. No water was being pumped at time of inspection. Gas was being flared at time of inspection; the flare was clean with wisps of black smoke observed. The smoke was dissipating quickly with no effects observed. Earthworks on site appeared to have been completed.

16 April 2012.
An inspection was undertaken during fine weather. Ambient monitoring of flaring was undertaken as a result of concerns regarding continuous flaring. Compliance in regard to TRC Resource Consent special conditions pertaining to smoke and odours was being achieved. Separation equipment had been installed and was operating effectively.

17 April 2012
Officers of Taranaki Regional Council entered the Copper Moki wellsite following a self notification from Kevin Stott of Vause, that crude oil had entered the Ngaere Stream. TRC staff entered the site from 4.20pm. Inspection, physicochemical, and biological monitoring were carried out. Spill recovery equipment was deployed. The flare was shut down and the well shut in. Transpacific were employed to suck out oil from the manhole and clean the two pipes that flowed into it. This matter became the subject of Environment Court proceedings (see Section 2.5 below).

18 April 2012
Officers of Taranaki Regional Council entered the Copper Moki wellsite and continued to provide support and advice where necessary with the clean up of crude oil from the Ngaere Stream tributary. Company staff and contractors were onsite helping with the removal of crude oil from the stream, and with stopping hydrocarbons discharging from the site and removing contaminated soil from the flare pit. Remedial actions had been identified.

19 April 2012
Council officers again entered the Copper Moki wellsite and continued to provide support and advise where necessary with the clean up of crude oil from the Ngaere Stream. Work was continuing on redirecting offsite discharges to the skimmer pits, and on recovering crude oil out of the stream from collection points (booms). Staff had also been employed to remove oil that had been caught on vegetation.

The consent holder was instructed to ensure that every effort was made to remove all of the oil that was visible in the stream. The booms were to remain in the stream until no oil was observable within the containment areas.

20 April 2012
An inspection was undertaken during overcast weather. A site inspection was undertaken to ensure compliance with resource consents and to see how the removal of oil from the stream was progressing.

The drilling of well 4 had been completed and the rig and associated equipment had been removed from the site. All drilling waste was disposed of offsite. A new manhole had been installed that collected stormwater from the tile drain that runs underneath the flare pit. All stormwater/contaminants entering the manhole were pumped to the skimmer pits. The skimmer pits were discharging to land only at the time of inspection. The site appeared tidy. All earthworks areas were becoming stabilised vegetatively and there was no sediment entering the stream. Water was being taken from the stream and used to dampen flare emissions. There were no visible downstream effects as a result of water being extracted. The intake was screened. Production flaring continued, with two separators being used. The gas was wet and generating black smoke when flared. The smoke plume was observed to rise for 100m before dissipating. The plume was not considered objectionable.

The booms in the stream were continuing to capture crude oil and were to remain in situ until no further oil was capture, unless the weather prevented the use of booms.

The consent holder was instructed to continue to record water abstraction data (date, rate, pumping hours and daily volume).

24 April 2012
An inspection of the site was undertaken during fine and windy weather. An inspection was carried out to assess the crude oil clean up operation and monitor any effects that may have occurred. It was observed that oil was being captured within the new manhole; approximately 1.5 square metres of oil had collected in the manhole. Some oil was also observed floating in the skimmer pit. A small amount of crude oil was still being collected in the booms on the stream. Transpacific arrived on site during the inspection to pump oil from the skimmer pit and manhole. The booms would remain in situ for another couple of days at least.

30 April 2012
An inspection of the site was carried out during overcast and windy weather. The testing rig was still being set up on well 3. A third separator was being installed. The flare pipe within the pit was going to be modified to help minimise smoke emissions. Smoke was being generated through the gas flare process. At times this smoke was quite dark, however, it was not considered offensive at the time of inspection. The water pump was not on site. Water was being taken from the skimmer pit. No stormwater was being discharged from site. The stream looked discoloured from silt/sediment entering upstream. No hydrocarbon sheen or crude oil droplets were observed in the stream. The booms had been removed. The new manhole was clean. A large pile of earth excavated during the recent site extension had been placed adjacent to the Ngaere Stream tributary. Any runoff from the pile had to pass

through settlement ponds, as required by condition 2 of consent 7760-1. Condition 4 had not been complied with, as it required that all earthworks areas be stabilised vegetatively as soon as is practicable. Also condition 1, which required that the consent holder adopt the best practicable option, had not been complied with. The consent holder was instructed to ensure that the pile of earth was stabilised or removed immediately.

10 May 2012
An inspection of the site was undertaken during wet and windy weather. Works had begun to remove soil which was placed adjacent to the stream. Water was being pumped from the skimmer pits and sprayed onto the flare to minimise smoke emissions. No water was being taken from the stream. The skimmer pits were not discharging at the time of inspection. The site was tidy. A large volume (10 litres) of oil was captured in the manhole; this was removed. Flaring was occurring at the time of inspection. The consent holder was instructed to ensure that no silt or sediment enters the stream as a result of earthworks.

17 May 2012
An inspection of the site was carried out during overcast weather. The site had been subject to heavy rain over the past few days. There were a few puddles on the site; however it had drained very well. The ring drains were running clear. The skimmer pits were full and discharging offsite. A discharge sample and stream samples were taken. The stream was discoloured. No visual effect was observed downstream of the discharge point. No water was being abstracted from the stream at the time of inspection. Water was being pumped out of the skimmer pits and sprayed onto the flare. The flare was not considered objectionable. Some smoke was visible. It was necessary to put silt control measures in place to reduce/stop silt and sediment from entering the stream as a result of the most recent earthworks.

24 May 2012
An inspection of the site was carried out during fine weather. The only consents being exercised at the time of inspection were the flaring consents. Water from the skimmer pits was being pumped to the flare pit to help reduce visible flare emissions. A goose neck pipe had been placed between the skimmer pits to improve the treatment efficacy. The pile of earth that was removed from the site and placed adjacent to the stream was being spread onto a field.

2.1.2 Results of discharge monitoring

During the period under review (34 inspections over 16 months) stormwater was only observed discharging from the skimmer pits on four occasions. During one inspection a discharge sample was collected along with upstream and downstream samples.

Results (see Table 1) found that the concentration of chloride was within the discharge limits set by condition 5 of resource consent 7761-1. The levels of hydrocarbons, pH and suspended solids in the discharge were well below the point at which concentrations adversely affect water quality.

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

Cementing wastes were contained and disposed of offsite.

During exploration activities on the site, WBM/drill cuttings were removed from the site by a contractor and disposed of at the Waikaikai land farm.

Water was abstracted from an unnamed tributary of the Ngaere Stream in accordance with special conditions attached to Resource Consent 7763-1. Some water recycling was undertaken on site.

Inspections of the stormwater discharge found it to be mostly clear. No hydrocarbon sheens were observed and no odours were found to be associated with the discharge.

Table 1 Results of water samples taken on 17 May 2012

	Upstream Sample	Discharge Sample	Downstream Sample
Chloride (g/m^3)	17.3	21.1	17.3
Hydrocarbons (g/m^3)	<0.5	0.8	<0.5
pH	6.3	6.6	6.4
Suspended Solids (g/m^3)	17	73	18
Temperature (°C)	11.4	10.2	11.4

2.1.3 Results of receiving environment monitoring

Any discharge from the skimmer pit system flows across land in an easterly direction towards an unnamed tributary of the Ngaere Stream. The receiving water was visually inspected in conjunction with site inspections. No effects were observed in the stream.

The receiving water body was sampled once during the monitoring period as a planned monitoring activity. Results showed that chloride was naturally present in the stream at a concentration of $17.3g/m^3$. Even with stormwater from the wellsite entering the stream, chloride levels downstream of the discharge did not change ($17.3g/m^3$).

The concentration of chloride in the discharge was well below the limit of $50g/m^3$ set for stormwater discharges from the site by special condition 5 of consent 7761-1.

Water was abstracted from the unnamed tributary of the Ngaere Stream. The report relating to this abstraction required by consent 7763-1 special condition 2 was received in May 2011.

Biomonitoring of the Ngaere Stream tributary was not initially undertaken, as the controls implemented by Taranaki Ventures Limited did not give rise to any concerns with regard to water quality.

However, following a crude oil spill on 17 April 2012 biological surveys and physiochemical sampling were carried out at various sites in the Ngaere Stream tributary.

A biological survey was performed to investigate the effects of the crude oil discharge on the macroinvertebrate communities living in the stream.

Four sites were sampled in this biological survey undertaken on 17 and 18 April 2012. The control site (site 1) was established in the tributary, approximately 70 metres upstream of the apparent discharge point; a primary impact site was established immediately below the point of discharge (site 2); A second impact site was established approximately 180 metres below the discharge point (site 3); and a third impact site approximately 270 metres further downstream (site 4).

This matter became the subject of Environmental Court proceedings.

Physicochemical sampling was also performed as part of the investigation into the environmental effects of the crude oil discharge into the stream.

All water and water/solid combined samples collected by Council officers were analysed by the Taranaki Regional Council laboratory for pH, turbidity and conductivity. All samples were also visually assessed for the presence of hydrocarbons. The samples were then split to separate out the solid fractions from the water and sent to R J Hill Laboratories to be tested for levels of Total Petroleum Hydrocarbons (TPH), and for the presence of the Benzene, Toluene, Ethylbenzene and Xylene (BTEX) group of Volatile Organic Compounds (VOCs).

Further monitoring of the stream, which includes biological surveys and physiochemical sampling are being undertaken as part of a monitoring programme for the production station that was established on the site.

2.2 Air

2.2.1 Air inspections

Air quality monitoring inspections were carried out in conjunction with general compliance monitoring inspections.

Flaring was undertaken at the Copper Moki wellsite during the period under review. Due to the crude oil having a high pour point it was difficult for site operators to completely separate oil from gas. As a result the gas that was directed to the flare pit was “wet” and did not burn cleanly. This caused smoke to discharge from the flare pit. The operators onsite used numerous strategies to reduce the amount of smoke generated by the flaring of gas, including increasing the air/gas ratio and spraying water over the flare to suppress the smoke. The discharge of smoke from the site was monitored closely by Council officers. No effects were noted during the monitored period. One complaint was received regarding continuous flaring being undertaken at the site. The Council’s investigation found the flaring complied with resource consent conditions.

Photograph 2 Flaring undertaken at the Copper Moki wellsite

2.2.2 Results of discharge monitoring

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

No chemical monitoring of air quality was undertaken by Council at the Copper Moki site, but visual inspections of the site and the location of the flare pit would have precluded any effects. Assessments made by officers of the Council during site inspections included confirming the site layout, particularly the flare pit location, the provision of liquid separation equipment, and the logging of any flaring or emission incidents. The vicinity of the site was checked for odour.

There are no dwellings within a 300m radius of the flare pit.

2.2.3 Results of receiving environment monitoring

2.2.3.1 Deposition gauging

No deposition gauges were deployed as inspections found no offensive or objectionable odours, smoke or dust that was associated with activities at the site.

2.2.3.2 Other ambient monitoring

URS undertook ambient (receiving environment) air quality monitoring in the vicinity of the Copper Moki I wellsite, on behalf of the consent holder to confirm that the consent holder was complying with consent conditions. The sampling was undertaken on 17 October 2011. The Company undertook measurements of carbon monoxide (CO) and inhalable particulate matter (PM_{10}), contaminants formed when there is incomplete combustion. Measurements were compared with the National Environmental Standard for air quality. Sampling was undertaken both upwind and downwind of the site, during a flaring episode. The wind speed during testing was

light to moderate, offering a relatively low level of dispersion and mixing. Sampling was undertaken at sites lying between 70 and 180 metres downwind of the flarepit.

No difference could be observed in PM_{10} between sites upwind and downwind of the flare. Average concentrations were around 10% of the NES limit (which is a 24-hour average exposure limit), with all peak values (1-2 minute peaks) less than half the NES standard.

No carbon monoxide could be measured, at the limit of detection of the instrument (which was 10% of the NES 8-hour exposure limit).

The field technician undertaking the study then moved to within 10 metres of the flare. All PM_{10} readings were still below the NES limit, even on an short term basis, and no carbon monoxide could be detected. It was considered that given these results, then even under worst-case conditions, concentrations at the boundary (the closest boundary for the wellsite was 40 metres from the flarepit) would remain well below guideline values.

It was concluded that consent conditions were being complied with. A copy of the report can be viewed at Appendix II.

No other ambient monitoring was undertaken, as the controls implemented by Taranaki Ventures Limited did not give rise to any concerns with regard to air quality in the locality.

2.3 Land

2.3.1 Land status

The site has not been reinstated. At the time of writing this report production testing operations have been ongoing. Further exploration may be undertaken at the site.

2.4 Contingency plan

A site specific contingency plan was received, reviewed and approved in January 2011.

2.5 Investigations, interventions, and incidents

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

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned

has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

During the period under review, there were three incidents recorded by the Council that were associated with operations at the Copper Moki site.

Notification was not received 7 days prior to drilling operations commencing at the site as per condition 3 of resource consent 7761-1. A letter of explanation was received from BTW. The non-notification was a result of inexperience of a new BTW staff member, tight time frames to undertake the drilling operation to ensure compliance with the applicable MED permit, and a misunderstanding of the resource consent. As a result of this consent non-compliance an infringement notice was issued to BTW.

A complaint was received regarding air pollution caused by continuous black smoke being emitted during flaring. Resource consents are held for the discharge of emissions to air associated with exploration and production activities at the site, provided certain conditions are met. Monitoring undertaken by a consultancy company found that concentrations of known pollutants at the boundary of the site were below guideline values and complied with all resource consent conditions. Council monitoring gave the same conclusions. It is considered that concentrations of air pollutants did not exceed national environmental standards and resource consent conditions were being complied with.

Self notification was received on 17 April 2012 that crude oil had discharged into the Ngaere Stream allegedly as a result of a separator failing to operate. The crude was heated and then leaked to, at the time, an unknown subsurface drain, through which some oil entered an unnamed tributary of the Ngaere Stream. The total volume involved was calculated as being 50 litres, more or less. This matter became the subject of Environmental Court proceedings, resulting in a guilty plea by the Company.

Reports by Council staff who investigated the incident are attached as Appendices III and IV to this report.

Taranaki Ventures Limited was fined $20,000. The level of fine is low relative to the maximum available under the Resource Management Act for a company ($600,000), and reflects the low level of environmental effects of the discharge, the circumstances of the case, and the rapid and effective spill response and clean-up undertaken. The presiding judge noted his rationale for the fine imposed. He noted that the harm that was done was transitory and minor, and no lasting damage was caused to ecosystems. The Company had a previously unblemished record. The offence was not deliberate. In terms of its attempts to make good the damage that was done, the company's reaction was exemplary. These factors were taken into account in the degree of penalty involved. An intention to plead guilty was signalled very early on by the Company. The Company also met the Council's clean-up and investigation

costs, which were in the order of $27,400, as well as re-configuring the site and lining the flare pit to prevent any further leakages.

Appendix V details the remedial actions instigated by the Company.

3. Discussion

3.1 Discussion of consent compliance

Of the seven resource consents relating to the Copper Moki site, consents 7760-1, 7761-1, 7762-1, and 7763-1 were actively monitored. Flaring occurred during the monitoring period as permitted by consents 7764-1 and 7765-1. No non-complying effects were noted. Consent 7766-1 was not exercised, as all drilling wastes were disposed of offsite.

Taranaki Ventures Limited provided TRC with the following plans and information in compliance with the consents:

- A spill contingency plan for accidental spillage or discharge of contaminants
- Maximum stormwater catchment area
- Advice of drilling muds' and fluids' components
- Final site layout plan

As discussed in 2.5 above, notification was not received 7 days prior to drilling operations commencing at the site and as a result of the consent non-compliance BTW received an infringement notice. A letter of explanation was received from the Company.

A complaint was received regarding air pollution caused by continuous flaring emitting black smoke. Investigations found that concentrations at the boundary of the site were below guideline values and complied with all resource consent conditions. This incident is discussed in more detail at 2.5 above.

Notification was received regarding an alleged spill of crude oil to an unnamed tributary of the Ngaere Stream. A prosecution was laid against Taranaki Ventures Limited, Vause Oil Production Services and a contractor. This incident is discussed in more detail at 2.5 above.

As a result of this and other incidents in the Taranaki Region, a letter was sent to the oil and gas industry. The letter reminded operators that unless authorised by a resource consent, all discharges into land in flare, skimmer and waste pits, on exploration and production sites would represent breaches of the RMA. Operators were advised that the base and walls of such facilities must be impermeable to comply with the requirements of the RMA and this could be achieved through the use of materials like high density plastic liners (or a combination of plastic liners and compacted clay).

In response to this reminder letter, flare, skimmer and waste pits are now being lined with impermeable materials to prevent contaminants from discharging into land.

During an inspection on 30 April 2012 it was noted that conditions 1 and 4 of consent 7760-1 (stormwater discharge - earthworks) were not being complied with. The non-compliances related to soil stabilisation and adopting the best practicable option. Council officers noted on inspection notices that further work was required in order to comply with consent conditions. These works were considered neither urgent nor

critical, and follow-up inspections showed they had been/were being dealt with. No effects were observed as a result of the non compliance.

3.2 Environmental effects of exercise of consents

Stormwater

The discharge of stormwater from earthworks had the potential for sediment to enter surface water where it may have smothered in-stream flora and fauna. To mitigate discharges that might lead to these effects, perimeter drains were established during the construction of the wellsite.

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

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

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

- All stormwater was directed via perimeter drains to the skimmer pits for treatment prior to discharge;
- Additional bunding was constructed around the bulk fuel tank, chemical storage area and other areas where there was a possibility of runoff from areas containing contaminants;
- Regular inspections of the interceptor pits occurred, and
- Repairs and maintenance were carried out if required.

Interceptor pits did not discharge directly to surface water, and instead discharged onto and into land where the discharge usually flowed into a manhole before reaching surface water.

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

Groundwater

Small amounts of groundwater may have been encountered as produced water during drilling. It was anticipated that the abstraction of groundwater would not impact on any groundwater resource and that shallow groundwater would not be affected as it will be protected by the well casing. No adverse effects were observed during the monitoring period and no complaints were received with regard to this activity.

Flaring

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

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[1]. More recently two studies have focused on field investigations and modelling of emissions from flares involving fracturing fluids.[2]

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

- The use of a test separator to separate solids and fluids from gas during all well clean ups, and workover activities where necessary, thus reducing emissions to air. In particular, this would eliminate the heavy smoke incidents associated with elevated PAH and dioxin emissions;

- All residents with dwellings within 1 km of the site were to be notified at least 24 hours prior to any flaring commencing wherever possible;

- Records of flaring events were kept by Taranaki Ventures Limited and provided to the Council if required;

- Every endeavour was to be made by Taranaki Ventures Limited to minimise the total volume of gas flared while ensuring that adequate flow and pressure data is gathered to inform a prudent investment decision;

- Every endeavour was to be made by Taranaki Ventures Limited to minimise smoke emissions from the flare.

Odour and dust

Wet suppression of dust was to be considered if it was apparent that dust may be travelling in such a direction to adversely affect off-site parties. Odour may stem from the product, flare, or some of the chemicals used on site. Care was taken to minimise the potential for odour emissions [e.g. by keeping containers sealed, and ensuring the flare burns cleanly].

Hazardous substances

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

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[1] Taranaki Regional Council; *Fletcher Challenge Energy Taranaki Ltd, Mangahewa 2 Gas Well Air Quality Monitoring Programme Report 1997 – 98*, August 1998.
[2] 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.

Taranaki Ventures Limited proposed the following mitigation measures:

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

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Tables 2 to 8 below.

Table 2 Summary of performance for Consent 7760-1 to discharge stormwater and sediment onto and into land associated with earthworks for the construction of the Copper Moki wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practicable option	Visually inspecting site, procedures & processes	**No**
2. Run off from areas of exposed soil to be directed to settling ponds	Visually inspecting the site to see that the stormwater travels to the settling ponds	**No**
3. Condition 2 ceases to apply when site is stabilised	Visually inspecting the site to ensure that it is stabilised	Yes
4. Earthwork areas to be stabilised as soon as practicable	Visual inspection	**No**
5. Notify Council 7 days prior to commencement of earthworks	By confirming if works commenced before/after 7 days from date notice was given	**No**
6. Consent lapse	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Improvement desirable**

N/A = not applicable

Table 3 Summary of performance for Consent 7761-1 to discharge treated stormwater, produced water and surplus drilling water from hydrocarbon exploration and production operations at the Copper Moki wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practicable option	Visually inspecting site, procedures & processes	Yes
2. Maximum stormwater catchment area	By comparing submitted & approved plans with the built site	Yes
3. Notify Council prior to works commencing and again prior to drilling operations commencing	Notification received prior to works commencing, notification not received prior to drilling operation	**No**
4. Contingency planning	Plan received, reviewed and approved	Yes
5. Stormwater and produced water to be directed to skimmer pits	Visual inspection of stormwater system. A discharge of oily wastes occurred through the flarepit to surface water.	**No**
6. Containment of hazardous substances	Visual inspections	Yes
7. Notification prior to reinstatement	Site not yet reinstated	N/A
8. Consent lapse	N/A	N/A
9. Review, amend, delete, or add to conditions	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Poor**

Table 4 Summary of performance for Consent 7762-1 to take groundwater that may be encountered during hydrocarbon exploration and production operations

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Abstraction not to cause lowering of static water level	Inspection of Company records	Yes
2. Abstraction does not cause intrusion of salt water	Inspection of Company records	Yes
3. Summary well log to 1000 metres	Inspection of Company records	Yes
4. Consent lapse	N/A	N/A
5. Review, amend, delete or add to conditions of consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**

Table 5 Summary of performance for Consent 7763-1 to take and use water from an unnamed tributary of the Ngaere Stream for hydrocarbon exploration purposes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Maximum volume of water to be abstracted	Inspection of Company records	Yes
2. Maintain abstraction records	Inspection of Company records	Yes
3. Avoid, remedy or mitigate any adverse effects	Visually inspecting site, procedures & processes	Yes
4. Properly screen the intake structure	Inspecting the intake screen	Yes
5. Consent lapse	N/A	N/A
6. Review, amend, delete or add to conditions of consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**

Table 6 Summary of performance for Consent 7764-1 to discharge emissions to air associated with exploration activities at the Copper Moki wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Flaring not to occur on more than 45 days, per zone	Inspection of records	Yes
2. Notify Council prior to flaring of each zone	Notification by Company, site inspections	Yes
3. Notify residents prior to flaring	Inspection of Company records	Yes
4. Liquid and solid separation prior to flaring	Inspections of records/Site inspection	**No** – oil discharged to flare pit on more than one occasion
5. Adopt best practicable option	Visually inspecting site, procedures & processes	Yes
6. Hydrocarbons from well stream to be flared	Inspections of records	Yes
7. No objectionable odour or smoke beyond boundary	Inspections of site & via complaints	Yes
8. Control emissions of carbon monoxide	Inspections of Company records	Yes
9. Control emissions of nitrogen oxides	Inspection of Company records	Yes
10. Control all other emissions	Inspections of Company records	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
11. Analysis of typical gas and condensate stream from the field	Available upon request	N/A
12. Keep flaring log	Inspections of Company records	Yes
13. Consent lapse	N/A	N/A
14. Review, amend, delete or add to conditions	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Improvement desirable**

Table 7 Summary of performance for Consent 7765-1 to discharge emissions to air associated with production activities at the Copper Moki wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Notify Council when continuous flaring is to occur	Notification by Company, site inspection	Yes
2. Notify all residents within 300m of flaring	Inspection of Company records	Yes
3. Liquid and solid separation prior to flaring	Inspection of records	Yes
4. Hydrocarbons from well stream to be flared	Inspections of records	Yes
5. Adopt best practicable option	Visually inspecting site, procedures & processes	Yes
6. No objectionable odour or smoke beyond the boundary	Inspections of site & via complaints	Yes
7. Hydrocarbon storage vessels to be fitted with vapour recovery systems	Inspections of site and records	N/A
8. Control emissions of carbon monoxide	Inspections of Company records	Yes
9. Control emissions of nitrogen oxides	Inspection of Company records	Yes
10. Control all other emissions	Inspections of Company records	Yes
11. Analysis of typical gas and condensate stream from the field	Available upon request	Not requested
12. Keep flaring log	Inspections of Company records	Yes
13. Consent lapse	N/A	N/A
14. Review, amend, delete or add to conditions	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**

Table 8 Summary of performance for Consent 7766-1 to discharge drilling waste from hydrocarbon exploration onto and into land via mix bury cover at the Copper Moki wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt the best practicable option	Visually inspecting site, procedures & processes	N/A
2. TRC to be notified 48hrs prior to each MBC discharge	Ensure notification is received prior to each discharge	N/A
3. The volume of waste discharged shall not exceed 1500m^3	Visually inspecting site, procedures & processes	N/A
4. Waste from each well to be kept separate and distinct	Visually inspecting site, procedures & processes	N/A
5. All fluids to be removed from the waste prior to discharge	Visually inspecting waste prior to discharge	N/A
6. All sumps are to be permeable	Visually inspecting sumps	N/A
7. Drilling waste to be mixed with uncontaminated soil	Sampling soil prior to mixing	N/A
8. The waste/soil mixture shall be covered with 1m of uncontaminated soil	Visually inspecting depth of mixture before it is covered	N/A
9. Each MBC to be revegetated and maintained with pasture growth	Visual inspection of site	N/A
10. All stormwater to be directed away from the MBC area	Visual inspection of site	N/A
11. The MBC to be as far above the groundwater table as practicable	Visual inspection of site	N/A
12. The MBC must be 30m from any water body, spring or bore	Visual inspection of site	N/A
13. Trace elements in the MBC to be below agreed limits	Sample MBC to ensure compliance	N/A
14. Chloride levels in each MBC shall not exceed 1,600kg	Sample MBC to ensure compliance	N/A
15. Nitrogen levels in each MBC shall not exceed 400kg	Sample MBC to ensure compliance	N/A
16. The hydrocarbon content of solid drilling waste shall not exceed 1000mg/kg	Sample MBC to ensure compliance	N/A
17. Various parameters in the soil covering the MBC to be below agreed limits	Sample MBC to ensure compliance	N/A
18. Requires trace elements in the soil covering the MBC to be below agreed limits	Sample MBC to ensure compliance	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
19. Hydrocarbon concentrations in the soil covering the MBC shall comply with agreed guideline values	Sample MBC to ensure compliance	N/A
20. Level of salts in surface & ground water not to exceed 2500g/m3	Sample MBC to ensure compliance	N/A
21. Consent lapse	Notification of flaring received/not received	N/A
22. Notice of Council to review consent	Notice of intention served/not served	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**

During the year, the Company overall demonstrated a "Poor" level of environmental performance and compliance with the resource consents.

3.4 Exercise of optional review of consent

The first optional review date for consents relating to operations at the Copper Moki wellsite is June 2016.

4. Recommendations

1. THAT this report be forwarded to the Company, and to any interested parties upon request; and

2. THAT the Company be asked to inform the Council of any future intention to either drill, test or undertake reinstatement.

3. THAT the monitoring of any future consented activities at the Copper Moki wellsite be extended from that as implemented during the February 2011-May 2012 monitoring period, by the addition of shallow groundwater and surface water analyses and by bio-monitoring surveys of surface water ecosystems in the vicinity.

4. THAT subject to the findings of monitoring of any further activities at the Copper Moki wellsite, consents 7760-1, 7761-1, 7762-1, 7766-1, 7764-1, 7765-1 and 7763-1 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	elevated flow in a stream, such as after heavy rainfall
g/m^3	grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
incident	an event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred
intervention	action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring
investigation	action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident
l/s	litres per second

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_4	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH_3	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
NO_3	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_{10}	relatively fine airborne particles (less than 10 micrometre diameter
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and subsequent amendments
SS	suspended solids,
Temp	temperature, measured in °C (degrees Celsius)
Turb	turbidity, expressed in NTU
UIR	Unauthorised Incident Register entry- an event recorded by the Council on the basis that it had 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 held by Taranaki Ventures Limited (previously Green Gate Limited)

Consent 7760-1

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Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To discharge stormwater and sediment onto and into land associated with earthworks for the construction of the Copper Moki-1 wellsite at or about (NZTM) 1715293E-5638912N
Expiry Date:	1 June 2016
Review Date(s):	
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [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 [the 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.

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.

6. This consent shall lapse on 31 March 2016, 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.

Transferred at Stratford on 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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Discharge Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To discharge treated stormwater, produced water and surplus drilling water from hydrocarbon exploration and production operations at the Copper Moki-1 wellsite onto and into land at or about (NZTM) 1715316E-5638937N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [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 [the 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. Stormwater discharged shall be collected from a catchment area of no more than 1 ha.

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

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

5. All stormwater and produced water [with a maximum chloride concentration of 50 ppm] shall be directed for treatment through the skimmer pit[s] before being discharged.

6. Any significant volumes of hazardous substances [e.g. bulk fuel, oil, drilling fluid] on site shall be:

   a) contained in a double skinned tank, or

   b) stored in a dedicated bunded area with drainage to sumps, or to other appropriate recovery systems, and not directly to the site stormwater system.

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

8. This consent shall lapse on 31 March 2016, 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.

9. 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 2016 and/or June 2022, 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 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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Water Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To take groundwater that may be encountered during hydrocarbon exploration and production operations at the Copper Moki-1 wellsite at or about (NZTM) 1715293E-5638912N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [Site of take & use]
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 [the 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 ensure the abstraction does not cause more than a 10% lowering of static water-level by interference with any adjacent bore.

2. The consent holder shall ensure the abstraction does not cause the intrusion of salt water into any freshwater aquifer.

3. The consent holder shall submit a summary well log to a depth of 1000 metres, within three months of the completion of drilling. The report shall:

   a) provide a log to show the true vertical depth to all geological formation tops intersected within the freshwater zone;

   b) identify the true vertical depth to, and thickness of, any freshwater aquifers intersected by the well;

   c) identify the true vertical depth to the freshwater- saline water interface in the well.

4. This consent shall lapse on 31 March 2016 unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

5. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, 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 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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Water Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To take and use water from an unnamed tributary of the Ngaere Stream for hydrocarbon exploration activities at the Copper Moki-1 wellsite at or about (NZTM) 1715343E-5638871N
Expiry Date:	1 June 2022
Review Date(s):	June 2016
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [Site of take & use]
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 [the 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 volume of water taken shall not exceed 100 cubic metres per day and at a rate not exceeding 25 litres per second over a maximum period of 60 days.

2. The consent holder shall maintain a record of the abstraction including date, rate, pumping hours and daily volume abstracted and supply these records to the Chief Executive, Taranaki Regional Council, no later than 31 July of each year, or earlier upon request.

3. Notwithstanding the terms and conditions of this consent the consent holder shall take all reasonable steps to avoid, remedy or mitigate any adverse effect on the environment arising from the exercise of this consent, including, but not limited to, the efficient and conservative use of water.

4. The consent holder shall ensure that the intake structure is appropriately screened to avoid the entrainment of fish.

5. This consent shall lapse on 31 March 2016, 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.

6. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 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 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To discharge emissions to air associated with exploration activities at the Copper Moki-1 wellsite, including flaring of hydrocarbons associated with well clean-up and well testing, and miscellaneous activities at or about (NZTM) 1715290E-5638967N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [Discharge source & site]

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council [the 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. Flaring shall not occur on more than 45 days, cumulatively, per zone for each well [with a maximum of 4 zones per well], for up to eight wells.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, at least 24 hours before the initial flaring of each zone being commenced. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

3. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to all residents within 300 metres of the wellsite of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and complaints received in respect of any flaring activity.

4. To the greatest extent possible, all gas that is flared must first be treated by effective liquid and solid separation and recovery.

5. Only gaseous hydrocarbons originating from the well stream shall be combusted within the flare pit.

6. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare, including, but not limited to, having regard to the prevailing and predicted wind speed and direction at the time of initiation of, and throughout, any episode of flaring so as to minimise offsite effects [other than for the maintenance of a pilot flare flame].

7. The discharge shall not cause any objectionable or offensive odour or smoke at or beyond the boundary of the property where the wellsite is located.

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

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

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

    a) by more than $1/30^{th}$ 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].

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

12. The consent holder shall record and make available to the Chief Executive, Taranaki Regional Council, a 'flaring log' that includes:

    a) the date, time and duration of all flaring episodes;

    b) the zone from which flaring occurred;

    c) the volume of substances flared;

    d) whether there was smoke at any time during the flaring episode and if there was, the time, duration and cause of each 'smoke event'.

13. This consent shall lapse on 31 March 2016, 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.

14. 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 2016 and/or June 2022, for any of the following purposes:

    a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or

    b) requiring the consent holder to adopt specific practices in order to achieve the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or

    c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant.

Transferred at Stratford on 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Consent 7765-1

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
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PHONE: 06-765 7127
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Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To discharge emissions to air associated with production activities at the Copper Moki-1 wellsite, including flaring from well workovers, and in emergency situations, and other miscellaneous activities at or about (NZTM) 1715290E-5638967N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [Discharge source & site]

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council [the 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. Other than in emergencies, the consent holder shall notify the Chief Executive, Taranaki Regional Council, whenever the continuous flaring of hydrocarbons [other than purge gas] is expected to occur for more than five minutes in duration. Notification shall be no less than 24 hours before the flaring commences. Notification shall include the consent number and be emailed to worknotification@trc.govt.nz.

2. At least 24 hours before any flaring, other than in emergencies, the consent holder shall provide notification to all residents within 300 metres of the wellsite of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and complaints received in respect of any flaring activity.

3. To the greatest extent possible, all gas that is flared must first be treated by effective liquid and solid separation and recovery.

4. Only gaseous hydrocarbons originating from the well stream shall be combusted within the flare pit.

5. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare, including, but not limited to, having regard to the prevailing and predicted wind speed and direction at the time of initiation of, and throughout, any episode of flaring so as to minimise offsite effects [other than for the maintenance of a pilot flare flame].

6. The discharge shall not cause any objectionable or offensive odour or smoke at or beyond the boundary of the property where the wellsite is located.

7. All permanent tanks used as hydrocarbon storage vessels, shall be fitted with vapour recovery systems.

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

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

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

    a) by more than $1/30^{th}$ 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].

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

12. The consent holder shall record and make available to the Chief Executive, Taranaki Regional Council, a 'flaring log' that includes:

    a) the date, time and duration of all flaring episodes;

    b) the zone from which flaring occurred;

    c) the volume of substances flared;

    d) whether there was smoke at any time during the flaring episode and if there was, the time, duration and cause of each 'smoke event'.

13. This consent shall lapse on 31 March 2016, 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.

14. 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 2016 and/or June 2022, for any of the following purposes:

    a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or

    b) requiring the consent holder to adopt specific practices in order to achieve the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or

    c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant.

Transferred at Stratford on 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
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Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Taranaki Ventures Limited P O Box 24147 WELLINGTON 6142
Decision Date:	19 January 2011
Commencement Date:	19 January 2011

Conditions of Consent

Consent Granted:	To discharge drilling wastes from hydrocarbon exploration activities onto and into land via mix-bury-cover at the Copper Moki-1 wellsite at or about (NZTM) 1715293E-5638912N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Copper Moki-1 wellsite, Cheal Road, Ngaere [Property owner: RC & DM Howells]
Legal Description:	Lot 2 DP 335676 [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 [the 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, including but not limited to effects on any water body or soil.

2. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to the commencement of each mix-bury-cover discharge. Notification shall include:

   a) the consent number;

   b) the volume, and weight or density of the drilling wastes;

   c) the composition of the drilling wastes [including concentrations of nitrogen, chloride, hydrocarbons, and trace elements], to show that the discharge complies with conditions 13 to 18;

   d) the location of the discharge area;

   and be emailed to worknotification@trc.govt.nz.

3. The volume of solid drilling wastes discharged shall not exceed 1500 m^3 per well from up to 8 wells.

4. Mix-bury-cover discharge areas for wastes from individual wells shall be kept separate and distinct.

5. As far as practicable, all fluids shall be removed from the drilling wastes prior to discharge.

6. If the mix-bury-cover discharge is to occur in a lined sump, the impermeable liner shall be perforated or removed where possible.

7. The solid drilling wastes shall be mixed with uncontaminated soil in a mixing ratio of 1 part solid drilling wastes to a minimum of 3 parts uncontaminated soil.

8. The mixture of solid drilling wastes and uncontaminated soil shall be covered by at least one metre of uncontaminated soil.

9. Each mix-bury-cover discharge area shall be revegetated, and thereafter maintained with pasture cover:

   a) within 6 months of the completion of the discharge, or

   b) if the discharge area is part of the active wellsite area, upon reinstatement of the site.

10. The consent holder shall compact, contour, and maintain the soil overlying the mix-bury-cover discharge to ensure that stormwater is directed away from the mix-bury-cover discharge area.

11. The mix-bury-cover discharge shall occur as far above the groundwater table as practicable.

12. The edges of the mix-bury-cover discharge area shall be at least 30 metres from any surface water body, spring, or any pre-existing groundwater supply bore.

13. The total loading of trace elements in the solid drilling wastes for each distinct mix-bury-cover discharge area shall not exceed the total loading limits shown in the following table:

Trace element	Total loading limit
boron	10 kg
cadmium	3 kg
chromium	200 kg
copper	400 kg
lead	200 kg
nickel	50 kg
vanadium	200 kg
zinc	600 kg

14. The loading of chloride shall not exceed 1,600 kg for each distinct mix-bury-cover discharge area.

15. The loading of nitrogen shall not exceed 400 kg for each distinct mix-bury-cover discharge area.

16. The hydrocarbon content of the solid drilling waste shall not exceed 1000 mg/kg on a dry weight basis.

17. Parameters in the soil covering the mix-bury-cover discharge area [less than 0.5 metre depth] shall not exceed the limits shown in the following table:

Parameter	Limit
Conductivity	290 mSm^{-1}
Total dissolved salts	2500 mg kg^{-1}
Sodium	460 mg kg^{-1}
Chloride	700 mg kg^{-1}

18. The concentrations of metals in the soil covering the mix-bury-cover discharge area [less than 0.5 metre depth] shall comply with the limits shown in the following table:

Metal	Limit
arsenic	20 mg kg^{-1}
cadmium	1 mg kg^{-1}
chromium	600 mg kg^{-1}
copper	100 mg kg^{-1}
lead	300 mg kg^{-1}
mercury	1 mg kg^{-1}
nickel	60 mg kg^{-1}
zinc	300 mg kg^{-1}

19. The concentrations of hydrocarbons in the soil covering the mix-bury-cover discharge area [less than 0.5 metre depth] shall comply with the guideline values for the appropriate soil type in the surface layer 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], appended to this consent.

20. The exercise of this consent shall not cause the level of total dissolved salts within any surface water or ground water to exceed 2500 gm^{-3}.

21. This consent shall lapse on 31 March 2016, 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.

22. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month following each mix-bury-cover discharge, and/or during the month of June 2016 and/or June 2022, 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 1 April 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix 1: Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand

Table 4.12 Tier 1 soil acceptance criteria *Agricultural use* [1,3,6] ALL PATHWAYS (all values mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
SAND			
MAHs			
Benzene	1.1 [v]	1.9 [7,v]	2.4 [7,v]
Toluene	(68) [4,v]	(94) [4,m]	(230) [4,v]
Ethylbenzene	(53) [4,v]	(92) [4,7,v]	(120) [4,v]
Xylenes	(48) [4,v]	(130) [4,7,v]	(180) [4,v]
PAHs			
Naphthalene	7.2 [p]	70 [v]	80 [v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
SANDY SILT			
MAHs			
Benzene	1.1 [v]	1.9 [v]	2.4 [v]
Toluene	(82) [4,v]	(170) [4,v]	(240) [4,v]
Ethylbenzene	(59) [4,v]	(92) [4,v]	(140) [4,v]
Xylenes	(59) [4,v]	(130) [4,v]	(180) [4,v]
PAHs			
Naphthalene	7.2 [p]	83 [v]	(130) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
SILTY CLAY			
MAHs			
Benzene	1.7 [v]	4.6 [v]	12 [v]
Toluene	(210) [4,v]	(950) [4,v]	(3,000) [4,v]
Ethylbenzene	(110) [4,v]	(800) [4,v]	(2,800) [4,v]
Xylenes	(160) [4,v]	(710) [4,v]	(2,200) [4,v]
PAHs			
Naphthalene	7.2 [p]	(330) [4,v]	(1,100) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]

NOTES:

1. Based on protection of human health. Refer to Table 4.20 for protection of groundwater. Site-specific consideration of aesthetic and ecological impacts is required.
2. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
3. Surface soil acceptance criteria are based on the lower value of volatilisation criteria (Table 4.16), other pathway criteria (Table 4.18) and criteria for the protection of maintenance workers (Table 4.19). Criteria for soils at 1 m are based on the lower value of those arising from volatilisation and maintenance criteria. Criteria for soils at 4 m are based on volatilisation only.
4. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
5. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on benzo(a)pyrene equivalent concentration. Refer to Section 4.4.3 for details of the calculation of Benzo(a)pyrene equivalent concentrations.
6. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion, d - Dermal, p - Produce, m - Maintenance/Excavation
7. Due to the nature of boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for silt soil type. Therefore, the criteria for sand are set equal to the criteria for silt. Refer Appendix 4D for details.

Table 4.12 (CONTINUED)
Tier 1 soil acceptance criteria *Agricultural use* [1,3,6] ALL PATHWAYS (all values mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
CLAY			
MAHs			
Benzene	2.7 [v]	8.8 [v]	(26) [4,v]
Toluene	(320) [4,v]	(2,400) [4,v]	(8,500) [4,v]
Ethylbenzene	(160) [4,v]	NA [2]	NA [2]
Xylenes	(250) [4,v]	(1,800) [4,v]	(6,500) [4,v]
PAHs			
Naphthalene	7.2 [p]	(360) [4,v]	(1,200) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
PUMICE			
MAHs			
Benzene	1.2 [v]	2.4 [v]	3.1 [v]
Toluene	(73) [4,v]	(240) [4,v]	(350) [4,v]
Ethylbenzene	(48) [4,v]	(140) [4,v]	(220) [4,v]
Xylenes	(53) [4,v]	(180) [4,v]	(260) [4,v]
PAHs			
Naphthalene	7.2 [p]	140 [v]	(220) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
PEATS AND HIGHLY ORGANIC SOILS			
MAHs			
Benzene	5.7 [v]	10 [v]	13 [v]
Toluene	(2,500) [4,v]	(2,900) [4,v]	(3,800) [4,v]
Ethylbenzene	(2,200) [4,v]	(2,500) [4,v]	(3,200) [4,v]
Xylenes	(1,700) [4,v]	(2,000) [4,v]	(2,600) [4,v]
PAHs			
Naphthalene	7.2 [p]	(2,700) [4,v]	(3,500) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]

NOTES:

1. Based on protection of human health. Refer to Table 4.20 for protection of groundwater. Site-specific consideration of aesthetic and ecological impacts is required.
2. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
3. Surface soil acceptance criteria are based on the lower value of volatilisation criteria (Table 4.16), other pathway criteria (Table 4.18) and criteria for the protection of maintenance workers (Table 4.19). Criteria for soils at 1 m are based on the lower value of those arising from volatilisation and maintenance criteria. Criteria for soils at 4 m are based on volatilisation only.
4. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
5. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on benzo(a)pyrene equivalent concentration. Refer to Section 4.4.3 for details of the calculation of Benzo(a)pyrene equivalent concentrations.
6. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion, d - Dermal, p - Produce, m - Maintenance/Excavation

Table 4.15 Tier 1 soil acceptance criteria for TPH[1,3,5,6] *Agricultural use* ALL PATHWAYS
(all values in mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
SAND			
C_7-C_9 [4]	120 [m]	120 [m]	(3,800) [7,8,v]
C_{10}-C_{14}	58 [x]	(560) [7,x]	(650) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
SANDY SILT			
C_7-C_9 [4]	(500) [7,m]	(500) [7,m]	(3,800) [7,v]
C_{10}-C_{14}	58 [x]	(670) [7,x]	(4,900) [7,v]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
SILTY CLAY			
C_7-C_9 [4]	(2,700) [7,v]	(7,300) [7,v]	(19,000) [7,v]
C_{10}-C_{14}	58 [x]	(2,700) [7,x]	(8,900) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
CLAY			
C_7-C_9 [4]	(15,000) [7,v]	NA [2]	NA [2]
C_{10}-C_{14}	58 [x]	(2,900) [7,x]	(9,700) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
PUMICE			
C_7-C_9 [4]	(810) [7,m]	(810) [7,m]	(4,800) [7,v]
C_{10}-C_{14}	58 [x]	(1,100) [7,x]	(1,800) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
PEATS AND HIGHLY ORGANIC SOILS			
C_7-C_9 [4]	(6,700) [7,m]	(6,700) [7,m]	NA [2]
C_{10}-C_{14}	58 [x]	NA [2]	NA [2]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]

NOTES:

1. Criteria for C10 - C14 and C15 - C36 are based on consideration of aliphatic component of TPH measurement and consideration of TPH as a surrogate measure for PAH, consideration of PAHs completed by extrapolation of PAH content of diesel and PAH criteria (refer Table 4.10)
2. NA indicates estimated criterion exceeds 20,000 mg/kg. At 20,000 mg/kg residual separate phase is expected to have formed in soil matrix. Some aesthetic impact may be noted.
3. Based on protection of human health only. Site specific consideration of aesthetic and ecological impact is required.
4. Based on health effects associated with aliphatic component only. Separate consideration of the health effects associated with the aromatic component (i.e. BTEX) is required.
5. Soil acceptance criteria are based on the lower value of criteria based on volatilisation (Table 4.16), other pathways (Table 4.18), criteria for the protection of maintenance workers (Table 4.19) and TPH criteria developed as surrogates for PAHs (Table 4.22). Surface soils criteria are based on all three pathways, criteria for soils at 1 m are based on volatilisation and maintenance workers, and criteria for soils at 4 m are based on volatilisation only. PAH surrogate considerations apply at all depths.
6. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion d - Dermal, p - Produce, m - Maintenance/Excavation, x - PAH surrogate
7. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
8. Due to the nature of boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for silt soil type. Therefore, the criteria for sand are set equal to the criteria for silt. Refer Appendix 4D for details.

Appendix II

URS Air Quality Monitoring Report

URS

1 November 2011
Project No. 42057385

NM Associates Limited
Level 4, 326 Lambton Quay,
PO Box 5218,
Wellington 6145

Attention: Marilyn Hight Brown
Director

Dear Marilyn

Subject: New Zealand Energy Corporation Air Quality Monitoring – Copper Moki

URS New Zealand Limited (URS) has been engaged by New Zealand Energy Corporation (NZ Energy Corp) to assess ambient concentrations of selected air pollutants associated with the combustion of natural gas from the exploratory oil well at Copper Moki 1. In addition to this monitoring, URS was requested to assess the background concentration of selected air pollutants at the nearby proposed Copper Moki 3 well site, in order to determine the likely background concentrations prior to the commissioning of this well.

Figure 1 shows a picture of the gas flare in operation.

Figure 1: Copper Moki 1 Gas Flare

This letter report contains the results of ambient air monitoring conducted at each site on 17 October 2011 and compares them with National Environmental Standards (NES) promulgated by the Ministry for the Environment (MfE) as well as conditions in Copper Moki 1's air discharge permit.

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1 Assessment Criteria

1.1 National Environmental Standards

The NES applies standards to five air pollutants, of these pollutants only four are related to the combustion of natural gas; Particulate matter with an aerodynamic diameter <10 µm (PM_{10}), carbon dioxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2).

Given the very low quantity of sulphur found in the natural gas combusted at the Copper Moki 1 gas flare, URS considers that it is not necessary to measure boundary concentrations of SO_2.

In addition, due to the relatively short timeframe provided to carry out monitoring, along with the complexities in measuring NO_2, URS was only able to determine ambient concentrations of PM_{10} and CO at the boundary of the site. However, it is generally considered that if concentrations of PM_{10} and CO are below air quality guidelines then it is likely that concentrations of NO_2 will be as well. The NES guideline values for PM_{10} and CO are presented in Table 1.

Table 1: NES- Relevant Assessment Criteria

Contaminant	Averaging Period	Air Quality Criteria (µg/m³)
PM_{10}	24-hour	50 µg/m³
CO	8-hour	10 mg/m³

1.2 Air Discharge Consent Conditions

NZ Energy Corp has an air discharge permit (Consent 7764-1), for the flaring of gas associated with the Copper Moki 1 exploratory oil well, which contains conditions requiring the consent holder to control emissions of CO, PM_{10} and NO_2 so that maximum ground level concentrations do not exceed the air quality guidelines presented in Table 1.

2 Methodology

A URS staff member visited Copper Moki on 17 October 2011 to determine PM_{10} and CO concentrations at selected locations along the boundary of the two sites. PM_{10} measurements were conducted using a portable TSI DustTrak 8530 light-scattering laser photometer fitted with a PM_{10} cyclone. CO measurements were conducted with a TSI Q Trak 8550 hand-held analyser.

Wind conditions at the time of measurement were determined from hourly measurements recorded by the Stratford Automatic Weather Station (AWS) located approximately 7 km to the northwest of the Copper Moki 1 site.

After arriving at Copper Moki the field staff member determined that the predominant wind direction was from the north and set out conducting measurements upwind of the flare to determine the

background concentrations for the area without any influence from the flare. The upwind sampling location (Upwind) was located approximately 70 m to the north of the gas flare. Sampling at this location (and at all other locations) occurred for 1 hour before the instruments were relocated downwind of the flare.

The first downwind sampling location (Downwind 1) was approximately 90 m south of the flare on the small embankment 3 m south of the site office. At the time of testing the field staff member was unable to determine the legal boundary of the site so it was decided to use the southern boundary of the plant site as well as the road boundary (Downwind 3). At the conclusion of sampling at this location the field staff member determined that the wind direction had changed to the north northeast. Therefore a second downwind location (Downwind 2) was selected to the southwest of the gas flare, adjacent to the site boundary approximately 70 m from the flare. The last downwind location (Downwind 3) was adjacent to Cheal Road approximately 180 m south southwest of the gas flare.

The sampling locations relative to the gas flare are shown in Figure 2.

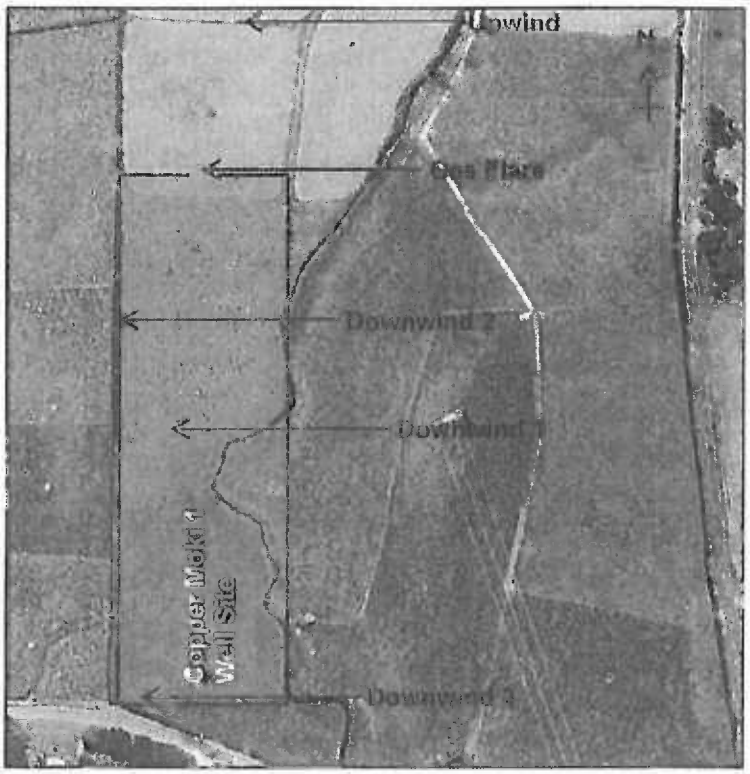

Figure 2: Copper Moki 1 Sampling Locations

At the conclusion of monitoring at Copper Moki 1 sampling equipment was relocated to the proposed Copper Moki 3 site where sampling was conducted for 1 hour.

3 Meteorology

The wind direction on the day of testing were predominantly from the north however at 15:00 the wind direction changed slightly to north-northeast. Figure 3 presents the wind direction collected by the Stratford meteorological station between 09:00 and 16:00. The wind speed was reasonably consistent in terms of strength with an average speed of 5 m/s. The wind speed data is presented in Figure 4.

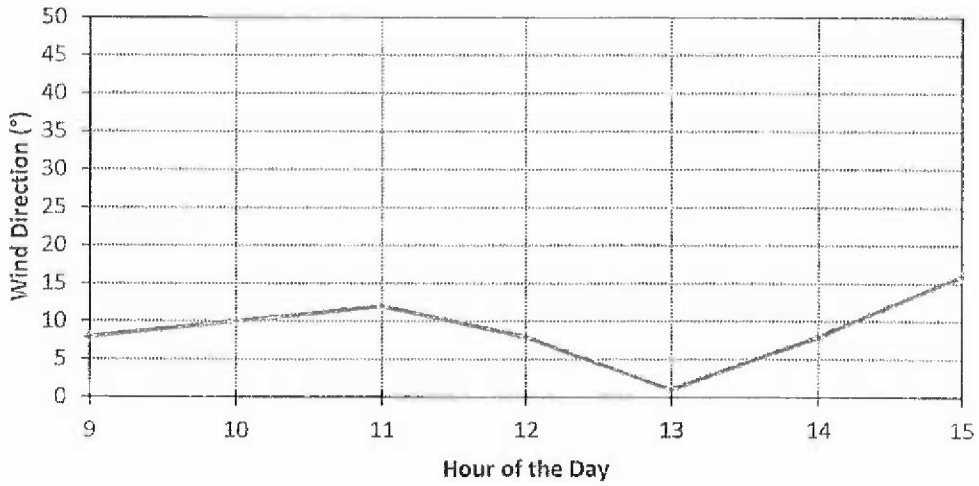

Figure 3: Wind direction for Stratford AWS 17 October 09:00 – 16:00

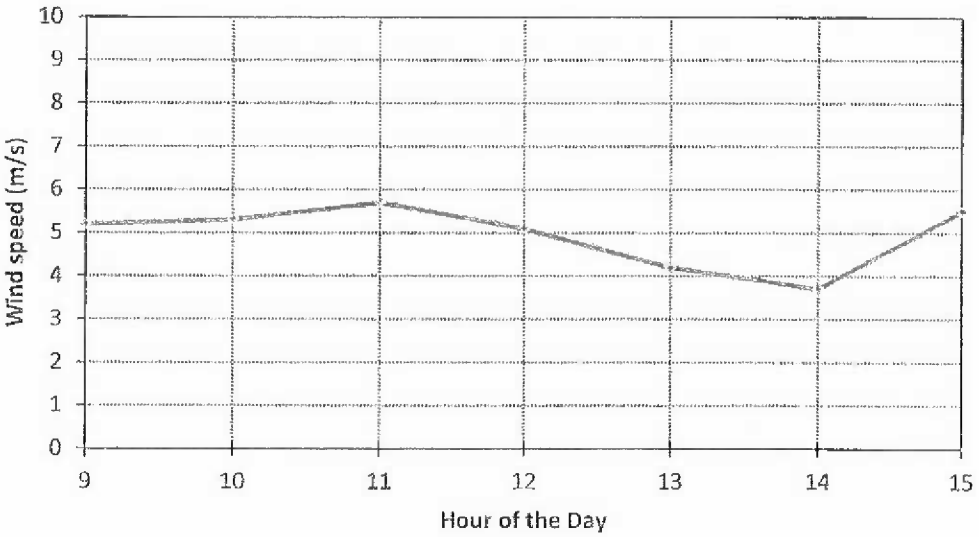

Figure 4: Wind speed for Stratford AWS 17 October 09:00 – 16:00

4 Results

Ambient PM_{10} Concentrations

The results of sampling show that there is very little difference in the average concentration determined between the selected sampling locations. The average concentrations measured are well below the guideline value of 50 µg/m³ (as a 24-hr average). Maximum values approached half of the guideline, however these spikes in concentration occurred for a relatively short period of time (<1 min) and it is not appropriate to compare them with the guideline value. Table 2 presents the results of ambient PM_{10} monitoring.

Table 2: PM_{10} Monitoring Results µg/m³

Sampling			Minimum	Average	Maximum
Location		Time			
Copper Moki 1	Upwind	(09:45 - 10:45)	4	6	9
	Downwind 1	(11:05 - 12:05)	2	5	21
	Downwind 2	(12:05 – 13:05)	1	5	25
	Downwind 3	(13:10 – 14:10)	5	7	12
Copper Moki 3		(14:24 -15:24)	4	6	18

Ambient CO Concentrations

CO measurements conducted at all of the sampling locations were below the detection limit of the instrument which is 1 mg/m³ and are therefore below the guideline value of 10 mg/m³ (as a 8-hr average).

5 Discussion

The meteorological conditions at the time of testing are unlikely to give rise to the highest off-site concentration of air pollutants associated with the operation of the flare. This is due to the moderate to high wind speeds present on the day of testing, with calm conditions most likely to give rise to the highest off-site conditions. Wind speeds on the day of testing averaged 5 m/s, which compares with the average wind speed measured in 2010 at Stratford of 3.4 m/s. However wind conditions at the time of testing are not untypical and occurred about 20 % of the time in 2010.

In addition to the test results presented in Table 2 the URS staff member took measurements approximately 10 m downwind of the flare and found PM_{10} concentrations averaged 15 µg/m³, with a maximum value recorded of 47 µg/m³. CO measurements were below the detection limit of 1 mg/m³. Given that at this location the flare's plume has limited opportunity to mix with the surrounding air and dilute the concentrations of air pollutants, it is likely that even under worst-case (low wind speed, limited mixing) meteorological conditions, concentrations at the boundary (closest boundary is approximately 40 m away) will be below guideline values.

6 Conclusion

The results of monitoring show that at the time of testing CO and PM_{10} concentrations at the boundary of the site were below guideline values and complied with conditions of the air discharge permit.

7 Recommendations

If there is continued concern over the concentration of air pollutants at the boundary of the site monitoring should be repeated in order to assess ground level concentrations of CO, PM_{10} and NO_2 during worst-case wind conditions (low wind speed and low dispersive conditions).

8 Limitations

URS New Zealand Limited (URS) has prepared this letter report in accordance with the usual care and thoroughness of the consulting profession for the use of New Zealand Energy Corporation. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated October 2011.

The methodology adopted and sources of information used by URS are outlined in this letter report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report provided to URS was incorrect.

This letter report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

9 Closure

If you have any questions regarding the results please contact Peter Stacey by phone on 09 355 1331.

Yours sincerely
URS New Zealand Limited

Peter Stacey
Air Quality Scientist

Andrew Curtis
Principal Air Quality Engineer

Appendix III

Officer's report- investigation of incident 17 April 2012

Memorandum

To BE Pope, Compliance Manager
GK Bedford, Director-Environment Quality
From D Olson, Scientific Officer
Document 1047292
Date 18 May 2012

Physicochemical Monitoring in Response to Copper Moki Unauthorized Incident IN/22664 Job 340112-481

Introduction

Physicochemical sampling was performed as part of an investigation into the environmental effects of an unauthorised discharge into an unnamed tributary of the Ngaere Stream. This discharge has been treated as a crude oil spill from the Copper Moki-1 wellsite, which is located in close proximity to the tributary. The discharge of crude oil to water is not authorised by any resource consent. This report addresses the physicochemical effects of the aforementioned discharge on the receiving environment of the unnamed tributary of the Ngaere Stream. Several water quality and solid samples were taken in response to this incident, the analyses results are discussed later in this report.

This report is structured to present a brief background to the sampling component of the Copper Moki-1 Incident. This is followed by a description of the site investigated, the description of methods used in the collection and processing of physiochemical samples. The results are then presented and discussed, including the likely effects on the receiving environment.

Background

Section 107 of the Resource Management Act (RMA) (1991) states that a consent authority shall not grant a discharge permit allowing:

(a) the discharge of a contaminant or water into water; or
(b) a discharge of a contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water

if, after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to all or any of the following effects in the receiving waters:

(c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials:

(d) any conspicuous change in the colour or visual clarity;
(e) any emission of objectionable odour;
(f) the rendering of fresh water unsuitable for consumption by farm animals;
(g) any significant adverse effects on aquatic life.

This is also covered under Rule 21 of the Regional Fresh Water Plan for Taranaki (RFWP), which only permits the discharge of water to surface water providing that none of the above effects are seen in the receiving water.

Additionally, Rule 23 of the RFWP states that:
a discharge of stormwater into water is permitted subject to the discharge not exceeding the following levels:

pH	6.0-9.0
oil and grease	15 g/m^3
suspended solids	100 g/m^3
BOD	5 g/m^3
unionized ammonia	0.025 g/m^3
free chlorine	0.2 g/m^3

and not giving rise to the effects aforementioned in RMA Section 107 and RFWP Rule 21.

Rule 41 of the RFWP is specific to discharges from hydrocarbon exploration. It states that a discharge to water from hydrocarbon exploration activities requires a resource consent, and in order for it to be a controlled activity, the discharge must not:

- contain more than 15 g/m^3 of oil and grease,
- contain more than 100 g/m^3 suspended solids;

and shall not give rise to the effects previously outlined in the other rules.

Taranaki Ventures Limited hold resource consent 7766 to discharge drilling wastes from hydrocarbon exploration activities onto and into land via mix-bury-cover at the Copper Moki-1 wellsite on Cheal Road, Ngaere in the Patea catchment (Property owner: RC & DM Howells). This resource consent was granted on 19 January 2011.

The consent permits discharge to land only. Special condition 1 of consent 7766 states:

> 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, including but not limited to effects on any water body or soil.

On 17 April 2012 the Council received notification of an apparent unauthorized spill from the Copper Moki wellsite into a neighbouring stream. Technical Officer Ray Harris (RH) and I collected water and mixed water/solid samples for lab analysis over a two day period on 17 and 18 April, as described in further detail below.

Clinton Carre (CC) and Tim Payne (TP) from the TRC Inspectorate Section also collected samples of the solid matter from the wellsite. The results of analyses of these samples have been compared below with the samples taken by RH and me, to establish whether the samples from on the site match the nature of the samples collected from the downstream environment.

On-site sampling activities

On Tuesday 17th of April 2012 at approximately 15:45 I was called into a meeting in Gary Bedford's (GB) office (Director-Environment Quality) with Katrina Spencer (KS) from the freshwater biology team and John Cooper (JC) and Clinton Carre (CC) from Inspectorate. I was asked to accompany the Inspectorate Officers to collect water samples for analysis from the site. After collecting sampling equipment from the TRC laboratory, I accompanied JC to the site in his vehicle.

We arrived onsite at approximately 16:45 and put on appropriate PPE. I located the HSE cabin, signed in and showed my warrant to the HSE representative of the Company. We joined CC and the Company representative at the manhole just outside of the site boundary. CC, JC and I briefly inspected the flare pit onsite, and the manhole and stream offsite. The manhole had orange sludge in the bottom and a distinct hydrocarbon odour. I noted Inspectorate took photographs of the manhole. We were informed by the Company representative that there had been a problem with one of the separators (identified in Figure 1, A) three days earlier which had produced a quantity of crude oil that had been redirected to the flare pit to be burnt off with the excess gas (Figure 1, B). It was suggested by the Company representative that this crude had likely infiltrated the soil and entered an underlying tile drain. According to what the Company representative told us, from here it may have entered into the stream discharge drain and finally the stream, which was a tributary of the Ngaere Stream (Figure 1, D).

I was joined onsite by Ray Harris (RH) and Katrina Smith (KS) from Technical Services. RH, KS and I began to formulate a sampling strategy. We followed the unnamed tributary downstream from the wellsite to do a visual assessment. As we were preparing to sample, we were approached by Bruce Pope (BP) from inspectorate who was leading the incident response. I attended a brief meeting with BP, JC and Tim Payne (TP) from inspectorate. They advised me as to their sampling requirements. I rejoined KS and RH approximately 270m downstream of the discharge point where they had discovered a substantial accumulation (5-6m^2 in area) of orange waxy solids trapped by foliage in the stream. It appeared a fallen branch had acted as a natural boom collecting much of the solid material (Figure 3, Photo C). There was a distinct odour coming from accumulation. RH and I were in agreement that it was a hydrocarbon odour, both on the basis of our previous experience in the petrochemical industry.

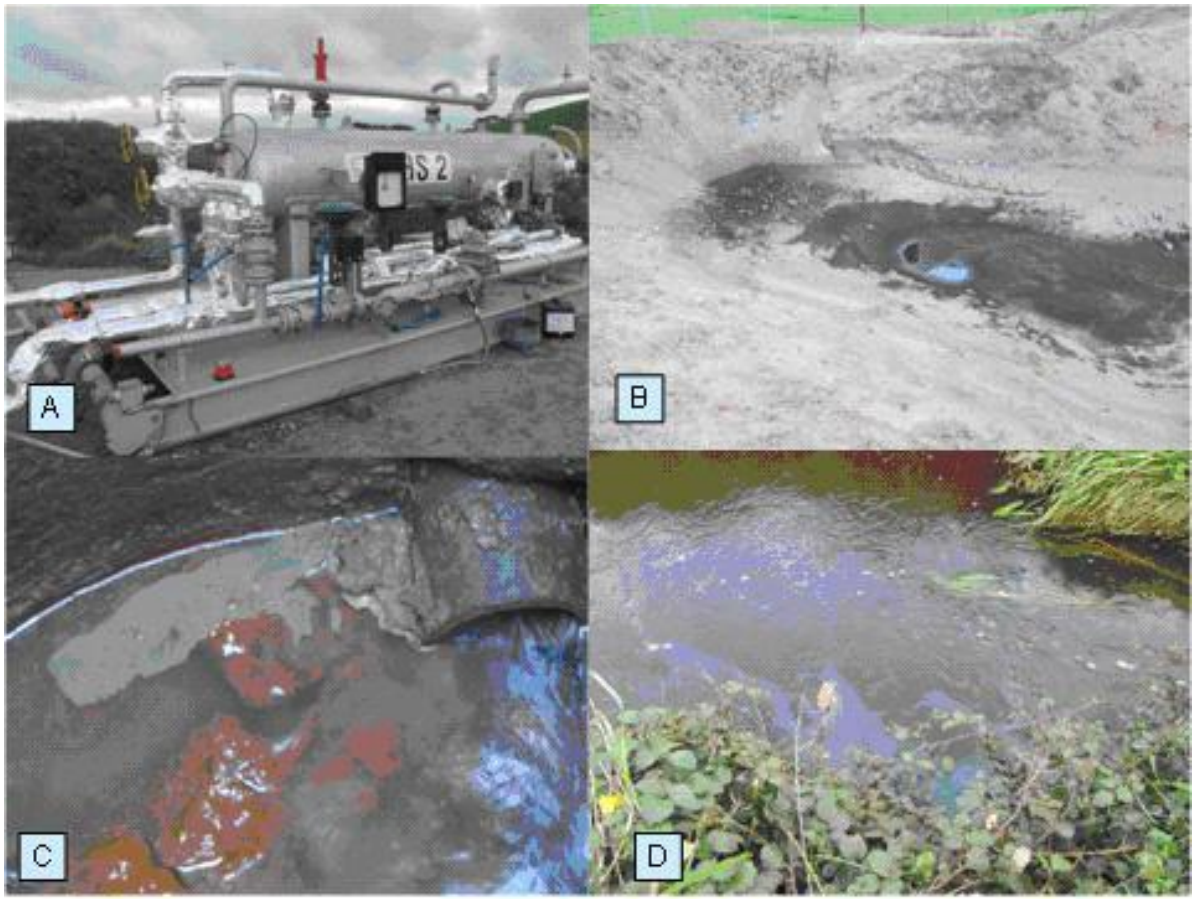

Figure 1 Site photos showing the malfunctioning separator (A), the flare pit (B), crude oil in the tile drain manhole (C), and the discharge point showing both waxy solids and a distinct hydrocarbon sheen. (Photographs taken by Clinton Carre on 17 April 2012 accessed from the TRC document database).

Site description

The area sampled in the investigation is shown in Figure 2. The established sample sites are also identified on this map, as is the approximate location of the Copper Moki-1 wellsite. Sampling site details are presented in Table 1. The discharge point is shown as NGR000317 to the east of the wellsite.

The discharge point was a drainpipe protruding from the true left stream bank. It was partially obscured by vegetation including blackberry plants. I inspected it from the stream bank, and KS inspected from in the stream looking up the pipe. It was difficult to ascertain whether the pipe was actively discharging at the time of investigation, as it was partially submerged in the stream and flow direction/rates were difficult to determine. I observed a significant accumulation of yellow wax solids in the vegetation around the pipe, and there was a distinctive oily sheen on the stream surface from the pipe outlet migrating downstream for 50-100m, which is visible in Figure 1 (Photo D).

Figure 2 Showing the approximate location of Copper Moki wellsite and the sampling sites in the Unnamed Tributary of the Ngaere Stream, sampled in relation to the unauthorised discharge from the wellsite. Sampling site NGR000317 is identified as the point of discharge.

Table 1 Sample sites in the Unnamed Tributary of the Ngaere Stream in relation to the unauthorised discharge

Site number	Site code	Grid reference	Identifier	Location
1	NGR000315	1715341E-5638886N	Upstream control	70 metres upstream of discharge
2	NGR000317	1715370E-5638950N	Discharge	Immediately downstream of discharge
3	NGR000319	1715410E-5639016N	Impact 1	180 metres downstream of discharge
4	NGR000322	1715386E-5639161N	Impact 2	270 metres downstream of discharge
5	NGR000324	1715415E-5639325N	Impact 3	410 metres downstream of discharge
6	NGR000327	1715343E-5639559N	Impact 4	720 metres downstream of discharge
7	NGR000330	1715373E-5639790N	Impact 5	1055 metres downstream of discharge

At the time of sampling, the weather was fine, with a Southerly breeze. There had been no rainfall in the previous two days. Sampling began at 17:50 just prior to the onset of darkness. Stream flow was steady. Stream width was between 1.5 and 5m, with an average width of approximately 2.5m over the reaches sampled. Depth was between 0.5 and 0.75m. The water had a brown and turbid appearance at all sites. I observed accumulations of waxy material at sites NGR000317 (Figure 3, B) NGR000319 and NGR000322 (Figure 3, C). I observed that Site NGR000315 upstream of the discharge point showed no evidence of any contamination (Figure 3, A). Further downstream sites NGR000324-330 showed no significant signs of contamination (Figure 3, D). While we were collecting samples, Inspectorate installed booms in the stream. Sites NGR000327 (Impact 4) and NGR000330 (Impact 5) were downstream of the southern boom, and were sampled the following day. Impact site 3 was immediately upstream of the southern boom pictured in Figure 3 (Photo D).

Figure 3 Visual record of sites NGR000315 (Control site, photo A), NGR000317 (Discharge point to stream, photo B), NGR000322 (Impact 2, photo C) and NGR000324 (Impact 3, photo D). Photos A-C were taken on 17 April on the initial sampling run, photo D was taken the following day. Note the accumulation of solids in the stream in photos B and C, and the absence of solids in photo A of the upstream site. Photo D also shows the use of booms to catch surface contaminants. The end of the discharge pipe is identified in Photo B. It was obscured by vegetation at the time of sampling, but yellow solids can be seen in the water in front of the pipe.

Methodology

Sample collection

Sampling was conducted by RH, Katrina Smith (KS) and me. KS focussed on the biomonitoring aspect of sampling, conducting macroinvertebrate surveys. The results of her sampling are addressed in a separate report. The three of us worked as a team to establish sites and collect the samples. RH collected two initial samples from an accumulation of waxy orange solids from site NGR000322 (which we termed our Impact 2 site), before we were advised to sample downstream from above the discharge point. We established an upstream control site at NGR000315, 70m upstream from the pipe outlet identified as the probable discharge point. From here, we worked downstream establishing the sites identified in Figure 2 and Table 1, to assess the extent of the impact of the discharge to the stream.

Site details were recorded photographically and in written form on lab fieldsheets. All site locations were recorded using a handheld GPS. The establishment of suitable site locations

was the result of collective decisions between KS, RH and me, based on a visual inspection of the stream.
Samples were retrieved from the stream using an extension pole. At each site, a glass hydrocarbon bottle was collected. These samples were taken from the surface, no bottle rinsing was performed, and 1-2 inches of headspace was left for the required lab analyses. Additionally, at each site a plastic 1L bottle was taken to test for common water quality parameters (pH, turbidity and conductivity). These bottles were rinsed and samples were again taken from the surface and filled to capacity (Figure 4).

Figure 4 KS and RH retrieving samples from the discharge site NGR000317 (left) and the accumulation at NGR000322 (Impact 2) (Right)

Temperatures and time of sampling were recorded for each sample. Samples were stored in a TRC cooler and transported back to TRC laboratory for processing. Sample security was adhered to as per Council procedures. Samples and fieldsheets from 17 April 2012 were handed over to John Williams, Laboratory Manager, at 20:52 the same evening.

Due to time restrictions and the difficulty in sampling in the dark, only five physiochemical samples were taken on the initial day. RH returned to the unnamed tributary the following day to collect additional samples further downstream to further assess the extent of the impact of the discharge. I was unable to return to site due to prior work commitments. RH took a further two water samples and established sites further downstream towards the confluence where the tributary joined the Ngaere Stream.

Sample Analysis

All water and water/solid combined samples collected by RH and me were analysed by the TRC laboratory for pH, turbidity and conductivity. All samples were also visually assessed for the presence of hydrocarbons. The samples were then split to separate out the solid fractions from the water and sent to R J Hill Laboratories to be tested for levels of Total Petroleum Hydrocarbons (TPH), and for the presence of the Benzene, Toluene, Ethylbenzene and Xylene (BTEX) group of Volatile Organic Compounds (VOCs).

Both the TRC and R J Hill laboratories are International Accreditation New Zealand (IANZ) accredited.

R J Hill Laboratories used the following analytical methods in their assessments:

Table 2 R J Hill test methods and descriptions

Test	Method description
Solids	
Total Petroleum Hydrocarbons in Soil, 3-7 GC	Sonication extraction, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air 3-7 dry), gravimetry. US EPA 3550. (Free water removed before analysis). 0.10 g/100g as rcvd
Water samples	
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B - 1-2
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis 1-2 US EPA 8015B/MfE Petroleum Industry Guidelines

Results

Crude floating solids results

Three of the solid matter samples collected by CC and TP from the probable sources (the tile drain manhole, the flare pit and ultimately the separator) were compared with the solid fractions of the samples taken from the stream by RH and me. The material was tested for total hydrocarbon content and hydrocarbon fraction constituents using a flame ionisation gas chromatograph. The results are presented in Table 3, in the order the crude allegedly travelled from the initial source at the separator, through the flare pit, into the tile drain and eventually into the stream. Firstly, these results verify that the material in question was hydrocarbon at all sites sampled. The concentrations of total hydrocarbons in the samples were in the range of 1,890,000 to 8,900,000 mg/kg. The sample taken from the accumulation of material at site Impact 2 had the highest total hydrocarbon concentrations.

Further analysis of the constituents of the hydrocarbon material was undertaken and is presented in Figure 5.

Table 3 Total hydrocarbons and hydrocarbon fraction results for solid matter samples

Sample Name Source		121186 Separator	121191 Flare Pit	121189 Manhole	121178 Discharge	121176 Impact Site 2
	Units					
Dry Matter	(g/100g)	41	18	31	33	3.6
C7-C9	mg/kg dry wt	240,000	36,000	107,000	90,000	81,000
C10-C11	mg/kg dry wt	163,000	116,000	146,000	120,000	200,000
C12-C14	mg/kg dry wt	220,000	300,000	250,000	220,000	770,000
C15-C20	mg/kg dry wt	520,000	890,000	610,000	550,000	2,800,000
C21-C25	mg/kg dry wt	330,000	660,000	400,000	370,000	2,100,000
C-26-C29	mg/kg dry wt	250,000	520,000	300,000	280,000	1,530,000
C30-C44	mg/kg dry wt	260,000	560,000	330,000	270,000	1,450,000
Total hydrocarbons (C7-C44)	mg/kg dry wt	1,980,000	3,100,000	2,100,000	1,890,000	8,900,000

The chemistry of the solid samples was analysed to show the proportions of each fraction relative to each other for each site. Figure 5 shows a comparison of the chromatograph breakdowns for each sample. All samples show a very consistent profile with most of the material consisting of heavier hydrocarbons in the C15-20 through to C30-C44 fractions, with 25-32% of all samples consisting of the C15-C20 hydrocarbon fraction. The sample collected from the likely initial source at the separator had a higher proportion of the lighter fractions (C7-C9 and C10-C11).

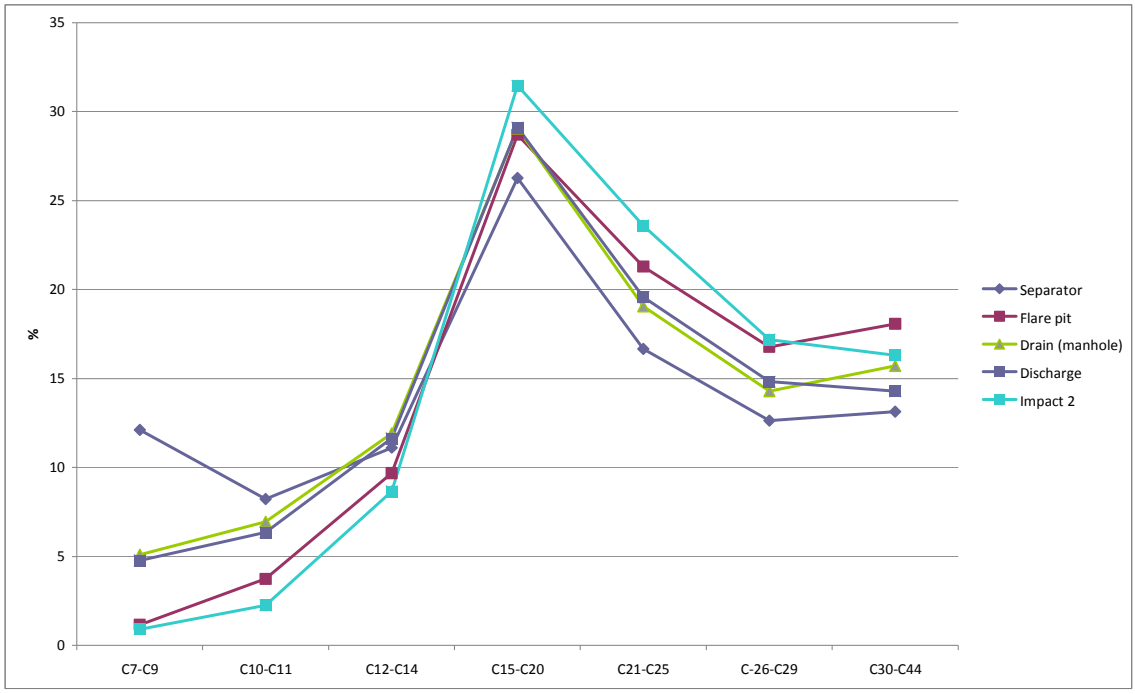

Figure 5 Comparison of hydrocarbon chromatograms for solid crude samples taken from the separator, flare pit, drain manhole, discharge pipe and stream. This figure shows the percentage of each hydrocarbon fraction for each sample. Results indicate all samples contain higher proportions of heavier hydrocarbons in the C15-20 through to C30-C44 fractions.

Water Quality Results

Seven water samples were analysed by R J Hill Laboratories for TPH and BTEX. The results are presented in Table 4. These results are compared in Table 4 with Taranaki background surface water values for pH, turbidity and conductivity from Duncan (1999), and with trigger values taken from the Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines for Fresh and Marine Water Quality (2000) for BTEX. The trigger values used are for 95% species protection levels. The ANZECC Guidelines do not have trigger values for TPH or individual hydrocarbon fractions however. This is because assessing the toxicity of TPH is limited by the heterogeneity of the numerous constituents of the TPH group. Rather than giving trigger values, these guidelines suggest a TPH chronic toxicity limit of 0.007 g/m^3 based on derivations by Tsvetnenko (1998) (in ANZECC, 2000). Under Rule 41 of The Regional Freshwater Plan for Taranaki, discharges from hydrocarbon exploration must contain less than 15 g/m^3 of oil and grease. Although this condition is not specific to TPH, it also provides a limit of oil concentration in surface freshwater that may be comparable to the results presented in this investigation.

The water quality parameters of pH, turbidity and conductivity are all within the normal range for surface water in Taranaki and similar between all sites. There are slight increases in conductivity and turbidity at the discharge site, but these results are well within the normal ranges and unlikely to cause any significant effects to the stream. BTEX was not detected in the upstream sample, the Impact 1, and Impact 3-5 samples. There were traces of BTEX in the discharge sample, but all were well within guideline values. There was a significant presence of BTEX in the Impact 2 site. The level of m & p Xylene in particular was high (0.112 g/m^3), and Toluene, Ethylbenzene and o Xylene were significantly above the background levels shown in the other samples.

TPH was not detected in the samples taken from the upstream control site or the downstream impact sites 3 and 5 (Table 4). The discharge and impact 4 samples show traces of hydrocarbons, particularly in the C15-C36 fraction. Impact 2 again has significantly higher contaminant levels. The total hydrocarbon concentration in water is 30 g/m^3, 87% of which is made up of the heavier C15-C36 hydrocarbon fraction.

Table 4 Water quality results for Ngaere Stream tributary

Sample		121177	121178	121179	121176	121180	121196	121197	Taranaki background Fresh surface water values
Sampling site		NGR000315	NGR000317	NGR000319	NGR000322	NGR000324	NGR000327	NGR000330	
Site details	units	Control upstream	Discharge	Impact 1	Impact 2	Impact 3	Impact 4	Impact 5	
CONDY-1	mS/m	14.9	15.5	14.9	14.9	14.9	14.9	14.9	0 - 40
PH-1	pH	7	7.1	6.9	7.1	6.9	7	7.1	6 - 9.5
TEMP-1	Deg.C	13.7	13.6	13.6	13.7	13.5	13.4	13.5	
TURBY-2	NTU	9.6	30	9.4	9.8	9.9	11	8	0 - 500
BTEX									**Guideline values (ANZECC)**
Benzene	g/m^3	<0.0010	0.0021	<0.0010	0.0016	<0.0010	<0.0010	<0.0010	0.95
Toluene	g/m^3	<0.0010	0.0098	<0.0010	0.038	<0.0010	<0.0010	<0.0010	Insufficient data
Ethylbenzene	g/m^3	<0.0010	<0.0010	<0.0010	0.012	<0.0010	<0.0010	<0.0010	Insufficient data
m&p Xylene	g/m^3	<0.002	0.006	<0.002	0.112	<0.002	<0.002	<0.002	0.2
o Xylene	g/m^3	<0.0010	0.0042	<0.0010	0.042	<0.0010	<0.0010	<0.0010	0.35
TPH									
C7-C9	g/m^3	<0.10	<0.15	<0.15	0.57	<0.10	<0.10	<0.10	
C10-C14	g/m^3	<0.2	<0.4	<0.4	3.5	<0.2	<0.2	<0.2	
C15-C36	g/m^3	<0.4	<0.8	<0.8	26	<0.4	0.7	<0.4	
Total Hydrocarbons (C7-C44)	g/m^3	<0.7	<1.4	<1.4	30	<0.7	0.7	<0.5	

Discussion

There was clear visual evidence of the accumulation of hydrocarbons in the unnamed tributary, from the point of discharge for a distance of 270 metres downstream to Impact 2. There was a strong hydrocarbon odour associated with this material located at the discharge point from the tile drain into the stream and at the accumulation of material at the Impact 2

downstream site. This material was consistent in appearance with material I observed in the manhole. There were no visual indications of any hydrocarbon material or any alternative source that could have given rise to the discharge as observed or anything unusual upstream of the discharge point.

Hydrological data taken from the representative telemetry station on the Waingongoro at Eltham Road shows that flows were high at the time of discharge. The flow rate at this site was 1.1 m^3/sec, which is higher than the D55 flow rate for this stream for the month of April from 1974 to present. If the stream flow rates were lower, the potential for adverse effects would have been much higher as dilution rates would have been decreased. It was therefore fortunate that the stream flow was elevated at the time of the discharge, but the results show there were significant environmental effects nonetheless.

Crude solid analysis

The chemical analysis of the solid material presented in the results section indicates the chemical make-up of the solid material is consistent from the source through to the environmental impact sites. Comparison of chromatogram profiles for the breakdown of hydrocarbons from each sample showed a consistent profile shape, with all samples consisting of a higher proportion of heavy hydrocarbons, consistent with the presence of crude oil. The separator sample deviated slightly from the other profiles only in that it had a higher light hydrocarbon content. One likely explanation for this is that the lighter fractions may have been combusted in the flare pit, as the intention of pumping the excess crude into the pit was for flaring. Alternatively, there may have been less evaporation of the most volatile light fractions from the material within the separator, by comparison with the other samples. The flare pit, drain and stream samples displayed very similar chemical characteristics, indicating there was every likelihood the stream contaminants were sourced from the separator and flare pit at Copper Moki-1. No alternative plausible source has been identified.

Environmental Impacts of BTEX

BTEX was present in the water sample for site NGR000322 (Impact 2). BTEX compounds are highly toxic to aquatic organisms and are relatively soluble in water. Because of the volatility of BTEX, the time exposure to aquatic organisms in this case may have been short enough to avoid toxic effects. However, BTEX are generally neurotoxic to target organisms. Benzene, in particular, has also been found to be carcinogenic to mammals and humans.

The levels of BTEX detected in the Impact 2 sample were all within the recommended limits set in the ANZECC water quality guidelines (2000). However, the levels of m & p Xylene were approaching the guideline limit. It should also be noted that the stream was flowing at a steady rate, as opposed to a stagnant body of water, and the discharge may have been initiated at any point in the three days between the separator malfunction and the initial sampling run, and that the flow in the stream afforded considerable dilution capacity. This means the levels of BTEX may have been potentially significantly higher that what was picked up in the samples; and further, if such toxic effects had not occurred, it would have been because of the dilution capacity of the stream rather than lack of toxicity of the discharge. If the flows in the tributary had been lower at the time of the discharge, the likelihood of adverse toxic effects would have been considerably higher.

Given the toxicity of BTEX compounds, their presence in the stream over a distance of 270m from the discharge point was potentially likely to have had significant environmental effects on water quality as a result of this incident.

Environmental impacts of TPH

The unauthorized discharge of petroleum hydrocarbons can result in a range of direct and indirect impacts on aquatic ecosystems. Having a lower density than water, hydrocarbons form a surface layer on the water, which can reduce oxygen transfer and thus reduce dissolved oxygen in the water column. The presence of a waxy solid surface layer, and a hydrocarbon sheen seen at some of the sampling sites suggests that there was potential for some of these effects to impact aquatic organisms in the tributary.

Assessing the toxicity levels of TPH is problematic as there are numerous chemicals included within the TPH group. According to the ANZECC guidelines, lighter fractions including petroleum and diesel, appear to be the most toxic (ANZECC 2000).
The water quality results presented in this report show there was a significant concentration of hydrocarbons at Impact site 2, at a distance of 270 metres downstream of the discharge, where a 5-6m^2 area of the stream was covered by an accumulation of waxy hydrocarbon solids. This sample had a total hydrocarbon concentration of 30 g/m^3. This is significantly higher than the chronic value given by the ANZECC guidelines based on Tsvetnenko (1998) (ANZECC, 2000) of 0.007 g/m^3. Given the spill was of a relatively small quantity of crude, where exposure time was up to three days, before the substance was cleaned up, the chronic limit may not be as appropriate as the oil and grease limit given in the Taranaki Regional Freshwater Plan. This limit is 15 g/m^3, the receiving environment concentration at site Impact 2 is double this (30 g/m^3).

In addition to the BTEX and TPH levels in the stream, this unauthorised discharge has given rise to several of the effects outlined as being prohibited in the RMA and RFWP, listed in the background section of this report. In particular, the following effects were observed:

- The production of an oily film and floatable materials (waxy solids);
- emissions of an objectionable odour.

It is also reasonable to suggest this discharge may have had significant adverse effects on aquatic life, had flow levels or hydrologic conditions within the stream been different at the time of discharge.

Summary

Field observations and physiochemical sampling has verified that a quantity of crude oil from the Copper Moki-1 wellsite had discharged into a tributary of the Ngaere Stream. Chemical fingerprinting has shown the solid crude fractions of samples taken are consistent from source to eventual impact sites. Water samples from the tributary have shown the presence of TPH in concentrations which may cause significant adverse environmental

effects on aquatic organisms. The presence of the highly toxic BTEX group of VOCs was also detected in significant levels at one of the downstream impact sites, likely causing further adverse environmental effects and reducing water quality in the Ngaere Stream tributary. Effects were observed to a distance of at least 270 metres downstream, with visual evidence of floatable solids noted further downstream.

David Olson

Scientific Officer-Compliance and Environmental Monitoring

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Appendix IV

Report on stream ecological effects – investigation of incident 17 April 2012

To Compliance Manager, Bruce Pope;
From Scientific Officer - Freshwater Biology, Katrina Smith
Document 1045338
Report No KS004
Date 8 August 2013

Biomonitoring of an unnamed tributary of the Ngaere Stream in relation to an unauthorised discharge of crude oil from the Copper Moki wellsite, April 2012.

Introduction

On 17thApril 2012, an incident was reported to Council involving an unauthorised discharge of crude oil from the Copper Moki wellsite (owned and operated by New Zealand Energy Corporation) to an unnamed tributary of the Ngaere Stream.

This biological survey was performed to investigate the effects of the unauthorised discharge on the macroinvertebrate communities of an unnamed tributary of the Ngaere Stream. The discharge of crude oil, to water is not authorised by any resource consent or by the Regional Fresh Water Plan. The crude oil was apparently discharged to the unnamed tributary from a drainage pipe originating at the Copper Moki wellsite near Ngaere. Prior to this biological survey, product had been discharging from the drainage pipe into the unnamed tributary.

Methods

Four sites were sampled in this biological survey undertaken on 17 April 2012. The control site (site 1) was established in the tributary, approximately 70 metres upstream of the apparent discharge point. A primary impact site was established immediately below the point of discharge (site 2), a second impact site was established approximately 180 metres below the discharge point (site 3) and a third impact site approximately 270 metres further downstream (site 4).

The sampling site locations are presented in Table 1 and Figure 1.

Table 1 Sample sites in the Unnamed Tributary of the Ngaere Stream in relation to the unauthorised discharge

Site number	Site code	Grid reference	Location	Sampling method
1	NGR000315	1715341E-5638886N	70 metres upstream of discharge	Kick/sweep
2	NGR000317	1715370E-5638950N	Immediately downstream of discharge	Sweep
3	NGR000319	1715410E-5639016N	180 metres downstream of discharge	Sweep
4	NGR000322	1715386E-5639161N	270 metres downstream of discharge	Sweep

The standard 400 ml 'sweep-net' sampling technique was used to collect streambed macroinvertebrates from sites 2, 3 and 4. The 'sweep-net' sampling technique is very similar to Protocol C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

A combination of 'vegetation sweep' sampling and 'kick sampling' was used at site 1. The standard 'kick-sampling' technique is very similar to protocol C1 (hardbottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

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

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

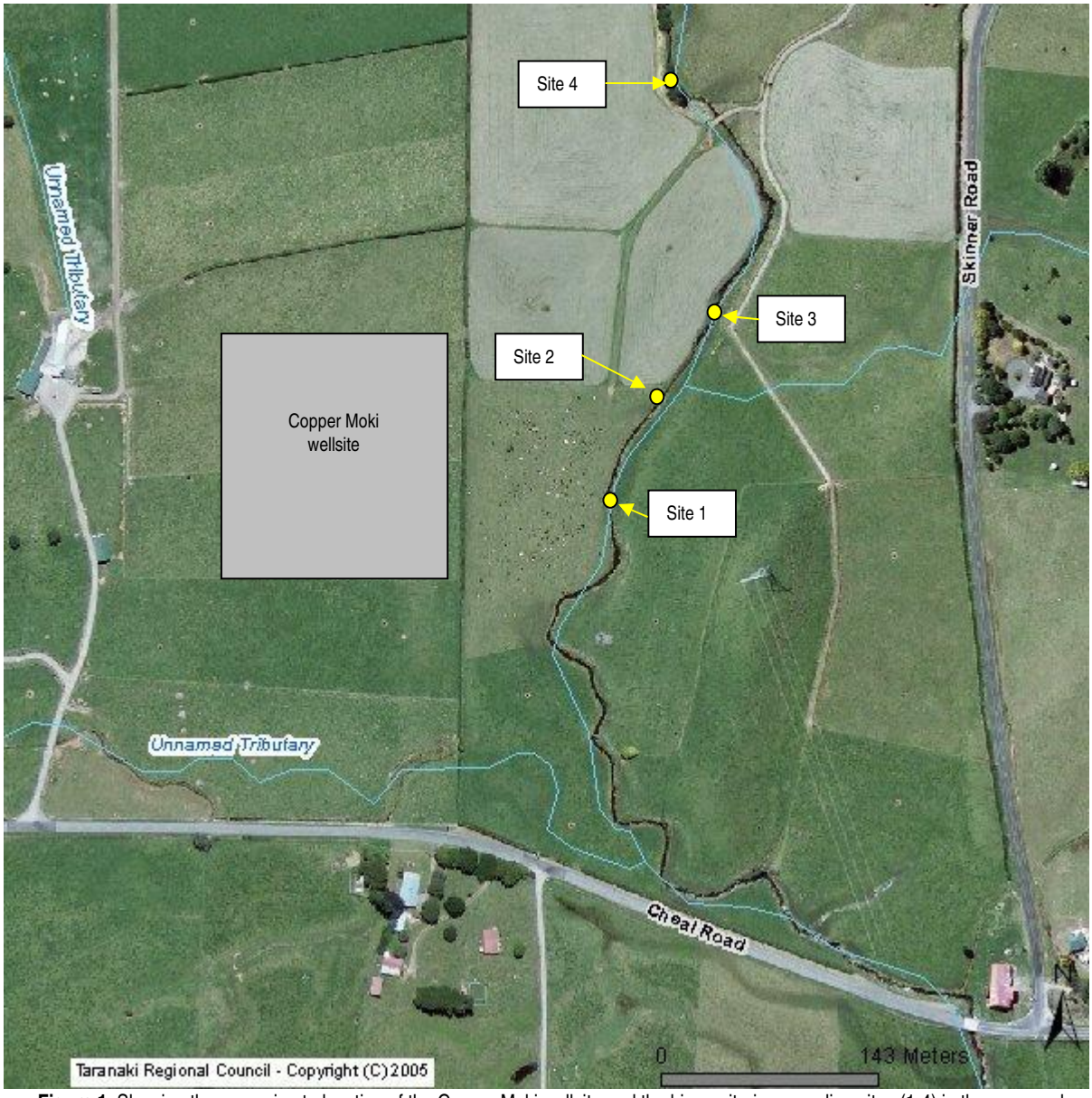

Figure 1 Showing the approximate location of the Copper Moki wellsite and the biomonitoring sampling sites (1-4) in the unnamed tributary of the Ngaere Stream, sampled in relation to the unauthorised discharge from the wellsite. Site 2 is located immediately downstream of the discharge point.

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

The MCI is not well suited to assessing impacts of toxic discharges, such as that which occurred in this case, but as the $SQMCI_s$ considers the relative abundance of invertebrates, it can provide an indication of non-organic and/or toxic pollution.

In addition to this, live sampling of the macroinvertebrate communities was undertaken at all four sites on 18 April 2012. This sampling was undertaken to provide an indication of what macroinvertebrates were likely to have been alive at the time of sampling on the previous day, as this cannot be determined from preserved samples. As the live sorting was not performed using magnification, the level of identification was restricted to those invertebrates that could be easily identified to a higher level e.g. *Austrosimulium* (sandfly).

Results and discussion

At the time of this evening (1805 to 1940 NZST) survey there was a moderate flow all sites. The unnamed tributary had a flow that was brown and cloudy at all four sites which is common for a stream that drains the Ngaere Swamp.

The banks of the tributary at sites 1, 3 and 4 primarily consisted of long grass encroaching on the stream. Submerged and floating macrophytes were recorded on the bed of the tributary at these three sites and were most abundant at site 3 and 4. At site 2 immediately below the discharge point, the stream banks were vegetated with a mixture of long pasture grass and blackberry. Small patches of macrophytes (both submerged and floating) were recorded on the bed of the stream at site 2.

The substrate at all four sites primarily consisted of silt, sand and fine gravel although at site 1 a small quantity of coarse gravel and cobble was also recorded. Site 2 also had a small amount of coarse gravel present. The banks of the tributary at all four sites appeared to be relatively stable and were fenced off from stock.

Overall, the habitat sampled at all four sites was consistent. The substrate composition at all four sites was predominated by silt, with lesser quantities of sand and fine gravel also recorded. Floating and submerged macrophytes were also a consistent feature of all four sample sites. However, macrophytes were notably less abundant at site 2 compared to the other three sites (1, 3 & 4). This meant that there was less suitable habitat to sample at site 2 compared to the other sites.

I observed waxy hydrocarbon material entering the tributary from the alleged discharge pipe which was immediately upstream of site 2. The waxy hydrocarbon material was observed floating on the surface of the water in and around the discharge point. Some of this material coated overhanging vegetation at site 2. Floating waxy hydrocarbon material was also noted at

site 3 and site 4. Site 4 was located approximately 3 metres down stream of a major accumulation of product which had become naturally impounded by a log jam. A strong hydrocarbon odour was detected whilst sampling sites 2 and 4.

Figure 2 A -site 1, 70 metres u/s of discharge; B -site 2, immediately d/s; C-site 3, 180 metres d/s of discharge; D -site 4, 270 metres d/s of the discharge.

Macroinvertebrate communities

Table 2 provides a summary of the results from the sites sampled in this survey. Table 3 summarises statistics for lowland stream control sites located at a similar altitude to the sample sites ((TRC, 1999 (updated 2011)). The full results of the current survey are presented in (Table 4).

Table 2 Number of taxa, MCI and SQMCIs scores for the unnamed tributary of the Ngaere Stream, sampled in relation to the unauthorised discharge of product (crude oil) from the Copper Moki wellsite.

Site No.	Site Code	No. of taxa	MCI value	$SQMCI_s$ value
1	NGR000315	16	85	2.5
2	NGR000317	15	81	3.5
3	NGR000319	18	79	5.0
4	NGR000322	18	83	4.5

Table 3 Range and median number of taxa, MCI values and SQMCIs scores for smaller lowland stream control sites at a similar altitude ((TRC, 1999 (updated 2011)). The figures given in the brackets represent the total number of samples.

	No. of taxa	MCI value	$SQMCI_s$ value
Range	5-29 (159)	52-108 (159)	1.5-6.3 (75)
Median	18	78	4.1

Site 1 - Upstream of discharge

Sixteen taxa were recorded at this site 1 (Table 2). This richness was close to the median number of taxa (18) recorded at other lowland stream control sites (Table 3). The community was dominated by oligochaete worms which were recorded as extremely abundant consistent with the silty nature of the habitat. Two 'moderately sensitive' taxa, the amphipod *Paracalliope* and the mayfly *Austroclima* were recorded as very abundant. The 'tolerant' snail, *Potamopyrgus* was also found to be abundant.

The MCI score of 85 units reflected the moderate proportion of 'sensitive' taxa (50% of taxa richness) in the community (Table 3). Considering the nature of this stream and the habitat sampled, this is indicative of reasonable preceding water quality conditions. The $SQMCI_s$ score of 2.5 units recorded at this site is considerably lower than the other three sites and also compared to the median value for lowland control site of 4.1 units. This related to the numerical dominance of 'tolerant' oligochaete worms in the community.

Live sampling undertaken at the site on 18 April 2012 found that mayflies and amphipods were abundant. Sandfly *Austrosimulium*, snails, and cased caddisfly, *Triplectides* were also observed.

Site 2 - Immediately downstream of discharge

Fifteen taxa were recorded at site 2, a decrease of one taxon from site 1. This community was dominated by two 'tolerant' taxa (oligochaete worms and the snail *Potamopyrgus*) and the moderately 'sensitive amphipod, *Paracalliope*. There was little change in the proportion of moderately 'sensitive' taxa recorded at site 2 (46%) compared to site 1 (50%) which was reflected in the similar MCI score at site 2 of 81 units.

The $SQMCI_s$ score for site 2 of 3.5 units represented a statistically significant increase (Stark, 1998) from site 1 which is in part due to the marked change in abundance of oligochaete worms between the two sites with site 1 recording the worms as extremely abundant decreasing to abundant at site 2.

Of all the sites sampled, site 2 had the least amount of suitable macrophyte habitat. This was reflected in the significant decrease in the abundance of the macrophyte associated mayfly *Austroclima* between site 1 and 2 (very abundant at site 1 to rare at site 2).

Small amounts of waxy hydrocarbon material were observed floating at the site during sampling. Despite this, results from the live sampling showed that amphipods, mayflies, snails, worms, and cased caddisfly *Triplectides* were all recorded downstream of the unauthorised discharge two days after the incident was reported to Council.

Overall, it appears that the macroinvertebrate community at site 2 differed from that at site 1 (which is supported by the statistically significant difference in the $SQMCI_s$ scores observed between sites 1 and 2). This is likely to be due to that there was less suitable habitat compared to site 1 rather than due to the unauthorised discharge.

Table 4 Macroinvertebrate fauna of an unnamed tributary of the Ngaere Stream, sampled on 17 April 2012, relating to an unauthorised discharge.

Taxa List	Site Number	MCI score	Site 1	Site 2	Site 3	Site 4
	Site Code		NGR000315	NGR000317	NGR000319	NGR000322
	Sample Number		FWB12219	FWB12220	FWB12221	FWB12222
PLATYHELMINTHES	*Cura*	3	-	R	R	R
NEMATODA	Nematoda	3	R	-	-	-
ANNELIDA	Oligochaeta	1	XA	A	A	VA
	Lumbricidae	5	-	-	-	R
HIRUDINEA	Hirudinea	3	-	-	-	R
MOLLUSCA	Lymnaeidae	3	-	R	-	-
	Potamopyrgus	4	A	A	VA	XA
CRUSTACEA	Ostracoda	1	R	-	R	R
	Paranephrops	5	-	-	R	R
AMPHIPODS	*Paracalliope*	5	VA	A	XA	XA
	Paraleptamphopidae	5	C	R	A	A
EPHEMEROPTERA	*Austroclima*	7	VA	R	VA	A
	Zephlebia group	7	C	R	C	R
ODONATA	*Xanthocnemis*	4	-	-	R	-
HEMIPTERA	*Microvelia*	3	-	-	R	-
COLEOPTERA	Elmidae	6	R	-	-	-
	Hydrophilidae	5	-	R	-	-
TRICHOPTERA	*Aoteapsyche*	4	C	R	C	R
	Hydrobiosis	5	R	R	R	C
	Oxyethira	2	R	R	R	R
	Pycnocentria	7	-	-	-	R
	Triplectides	5	R	R	C	R
DIPTERA	*Harrisius*	6	R	-	-	-
	Orthocladiinae	2	-	R	R	-
	Empididae	3	-	-	-	R
	Austrosimulium	3	C	C	C	A
	Tanyderidae	4	R	-	-	-
ACARINA	Acarina	5	-	-	R	-
		No of taxa	16	15	18	18
		MCI	85	81	79	83
		SQMCIs	2.5	3.5	5.0	4.2
		EPT (taxa)	5	5	5	6
		%EPT (taxa)	31	33	28	33

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

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

Site 3 - 180 metres downstream of the discharge

The third site, located approximately 180m downstream of the discharge, had a community richness of 18 taxa, which was slightly higher than at both sites 1 and 2. This community was dominated by the 'moderately sensitive' amphipod, *Paracalliope* which was extremely abundant. The snail *Potamopyrgus* and mayfly *Austroclima* were both very abundant in the community. *Oligochaete* worms and the 'moderately sensitive' amphipods *Paraleptamphopidae* were abundant.
There was a notable increase in abundance of the macrophyte associated macroinvertebrates such as *Paracalliope, Austroclima* and *Potamopyrgus* at site 3 compared to sites 1 and 2 which reflects the presence of more suitable macrophyte habitat at site 3. The presence of oligochaete worms also indicates the presence of sediment at the site.

The MCI score of 79 units for this site reflects the moderate proportion of 'sensitive' taxa in the community but it was insignificantly lower than the MCI scores for sites 1 and 2. However, this MCI score is similar to the median recorded for lowland stream control sites of 78 units (Table 3).

The $SQMCI_s$ score of 5.0 units for site 3 is statistically significantly (Stark, 1998) higher than the $SQMCI_s$ scores for sites 1 and 2. This result is largely due to the extreme abundance of the moderately 'sensitive'amphipod *Paracalliope*.

An abundance of amphipods and mayflies along with live, caddisflies, snails, worms, and sandfly *Austrosimulium* were recorded during the live sample at site 3. A small number of dead mayflies and amphipods were recorded in this sampling of 18 April 2012, which may have resulted from the unauthorised discharge. Small quantities of product were observed floating on the water at site 3 during the live sampling survey.

Site 4 - 270 metres downstream of the discharge

A total of eighteen taxa were recorded at site 4 which is equal to the number at site 3 but slightly higher than sites 1 and 2. The community was co-dominated by the snail *Potamopyrgus* and the amphipod *Paracalliope* which were both recorded as extremely abundant. Oligochaete worms and the mayfly *Austroclima* were found to be very abundant and abundant in the community respectively.

As at site 1, 50% of the community was comprised of 'sensitive' taxa, and consequently the MCI score of 83 was similar to that recorded at site 1 and slightly higher than at sites 2 and 3. The $SQMCI_s$ score of 4.2 units for this site is comparable to the median $SQMCI_s$ score of 4.1 units for lowland stream control sites at a similar altitude and reflects the reasonable macrophyte habitat at this site. This $SQMCI_s$ score was statistically different to the scores at the other three sites. This is likely to reflect the variability in the habitat at these sites.

Crude oil was observed at this site while live sampling was being undertaken. Despite this, live amphipods were found to be abundant and mayflies, sandfly (*Austrosimulium*), snails, and caddisflies were also found. There was no evidence of any dead macroinvertebrates at this site.

Conclusions

This April 2012 biological survey of an unnamed tributary of the Ngaere Stream indicated that there had been minimal effects on the macroinvertebrate communities of the stream following the unauthorised discharge of crude oil.

During sampling on both the 17 and 18 April 2012, product was observed floating on the surface of the water at all three downstream sampling sites and some minor accumulation of product on overhanging vegetation at site 2. Despite this, no significant differences in taxa richness or MCI scores were recorded between upstream and downstream sites. However, statistically significant differences were recorded in the $SQMCI_s$ scores between most sites. In general, this is attributed to the variation in the amount of macrophyte habitat sampled. For example, sites 2 and 3 had lower amounts of macrophyte habitat and these sites had the lowest $SQMCI_s$ scores.

A small number of dead mayflies and amphipods were found in the live sampling undertaken approximately 180 metres downstream of the discharge point on 18 April 2012 which may have occurred as a result of the unauthorised discharge of product into the tributary. Therefore the effects of the discharge are considered to be minimal. Despite this, the tributary had some ecological values that are typical of lowland streams draining swamp land. These values had potential to be degraded by a toxic discharge.

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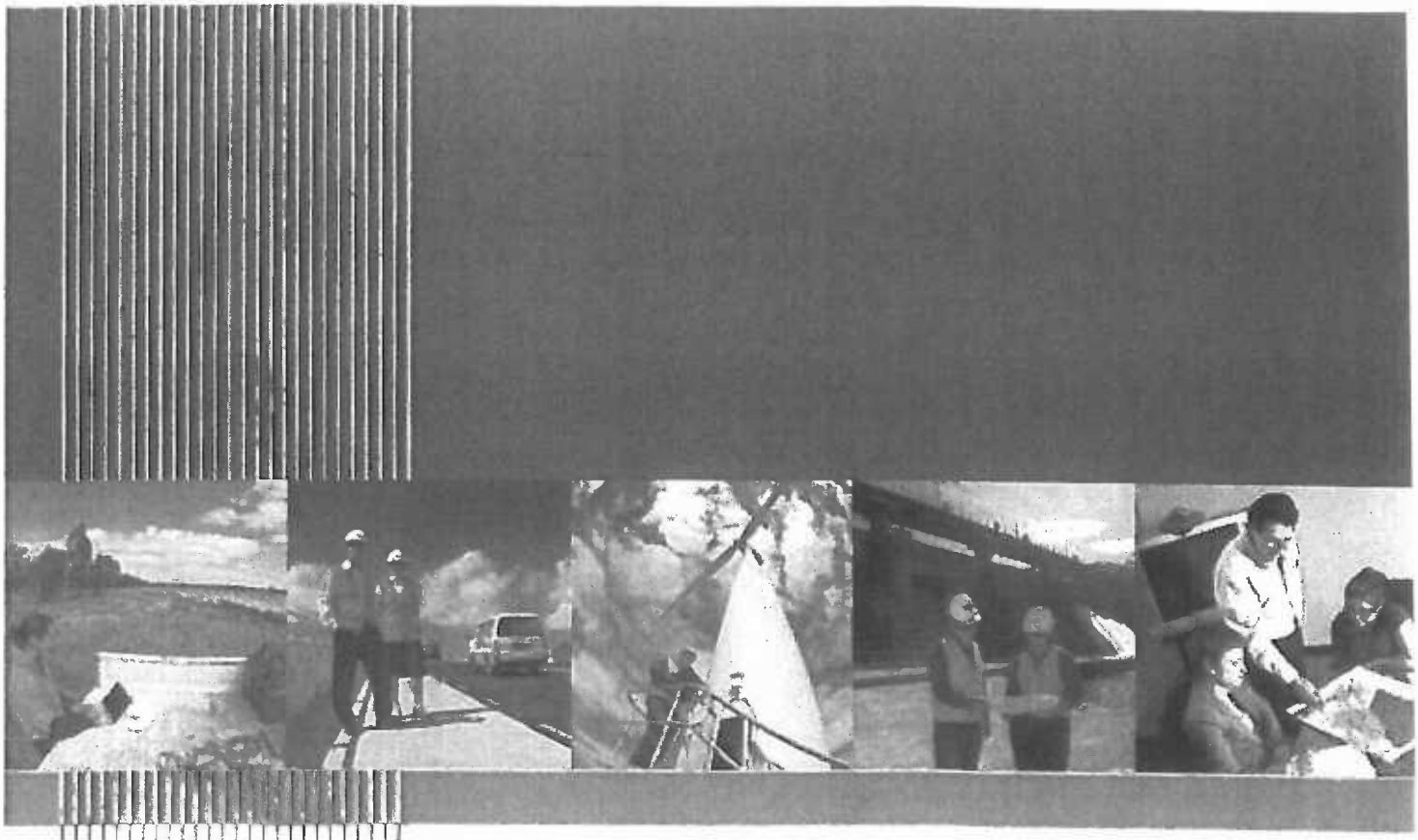
Appendix V

URS report (excerpt) on Copper Moki Incident 17 April 2012



Report

Copper Moki Incident (17 April 2012)

6 JUNE 2012

Prepared for

Taranaki Ventures Ltd

Level 2 86-96 Victoria St
PO Box 24-147
Wellington
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42058425

URS

4

Recommendations

The following section details the actions taken to date to address the causes of the incident, and provides additional recommendations to prevent a re-occurrence.

4.1 Actions Taken after the Incident

Numerous measures were implemented following the incident to prevent a repeat occurrence. These are summarised below:

1. The oil/gas interface level controller on the Copper Moki 2 separator was insulated to ensure that sufficient heat was available at the device to prevent a build-up of wax around the mechanism which could cause the controller to malfunction.
2. Contaminated soil was removed from the flare pit and the pit was relaid with a layer of clay, a layer of bentonite, another layer of clay and then finally a disused truck body was placed in the pit. These layers are deemed adequate for containment of any further carryover of oil to the flare, should this re-occur.
3. A new concrete riser was installed to intersect the field tile drain that runs underneath the flare pit. The drain pipe between the new riser and the existing field tile sump was cut off to prevent ingress of any remaining oil into the downstream sump which could then otherwise flow to the Ngaere stream. A submersible pump was installed in the new riser, operated by level switch. Water is pumped from the riser to the skimmer pits. Any residual oil migrating to the riser is collected and disposed. This riser therefore acts as containment for any remaining spilt oil that migrates into the field tile drain running underneath the flare pit.
4. Booms and absorbent pads have been placed in the original field tile sump to collect any oil that could find its way to the sump (although as described above it is not expected that this would now occur).

4.2 Further Actions to be taken to Prevent Reoccurrence

The following actions are currently in the process of being implemented. Whilst neither is a direct result of the incident and were planned to proceed anyway, it is fortuitous that both greatly reduce the possibility of a re-occurrence of the incident.

4.2.1 Alternative Routes for Gas Disposal

Gas produced at the Copper Moki well-site is currently all disposed through flaring. Commencing June 2012 gas is to be piped from the site to the Waihapa Production Station. TVL have also purchased a thermal oxidiser which is to be installed in early August 2012 at the site for decomposition of the gas. The oxidiser will be used during the times when production constraints at Waihapa prohibit the directing of gas from Copper Moki to Waihapa. A liquids knock-out vessel is to be located at the upstream end of the Copper Moki to Waihapa pipeline to prevent any liquids from Copper Moki entering the pipeline.

Therefore, the order of preference for disposal of gas produced at Copper Moki going forward is:

1. Direct gas to Waihapa Production Station.
2. Decompose gas in the site located thermal oxidiser.
3. Flare the gas (only utilised if for any reason options 1. and 2. are unavailable).

With options 1 and 2 above, the probability of a reoccurrence of this incident is nil.

4.2.2 High Level Switch in Separators

In permanently installed oil production facilities, separators normally have two or three levels of overfill protection for each interface. A typical arrangement for the gas/oil interface for a separator with three levels of protection would be as follows:

- *Normal fill level*: level at which the controlling device normally maintains the level. The controller receives its signal from the main level sensing device.
- *High level*: if the controlling device fails and the liquid level reach the high level then an alarm will sound to notify the operator, who will be compelled to act to mitigate the risk of, overfill. The signal is initiated from the main level sensing device.
- *High high level:* if the high high level is reached due to level controller failure and/or failure of the operator to intervene, a signal will initiate closing of the inlet valve in the pipeline through which product is being fed to the vessel. This action is typically initiated from a separate, independent level sensing device (level switch).

New separators are to be installed with other permanent production facilities at Copper Moki. These separators are to be fitted with high level switches that will initiate shut-in of the wellhead.

4.3 Recommended Further Actions

The following actions are recommended to further address the root causes identified in the root cause analysis and to provide a more effective response to any future incidents:

1. Review all piping and instrumentation in oil service at the site to determine where it is uninsulated. Where this is the case determine whether insulation is required and install as necessary.
2. Procedures and practices for heat tracing and insulating piping and instrumentation in waxy oil service should be improved to ensure all equipment installed in the future that requires tracing and insulation is identified and traced/insulated accordingly.
3. Contaminated soil from the flare pit has been removed and trucked from site. However it is not known if the removed soil represents the entirety of the material contaminated as a result of the incident, and further analysis of all soil surrounding the flare pit will be required when the flare is decommissioned.
4. The Operator's Safety Management System and Emergency Management Plan should be independently reviewed and if necessary modified to ensure that the documents include comprehensive instructions for:

   a) responding to near misses and incidents on site, and
   b) dealing effectively with any loss of containment on site.

   Training should be provided to operators to improve understanding of the Safety Management System and Emergency Management Plan particularly with regard to response to near misses and incidents.
5. A review of the spill response kit kept on site should be undertaken to ensure that the kit contains the necessary equipment to enable a prompt and effective response following a loss of containment.

4.4 Recommended Actions from Lessons Learnt for Implementation at Future Sites

The following actions, based on the findings from the root cause analysis are recommended for any major re-configurations of the existing site (if applicable) and for establishment and operation of any future exploration and testing sites:

1. A review of possible pit linings for the flare pits should be undertaken to determine the most practical base that should be installed, with the highest practical degree of impermeability. Different types of clay, bentonite and other absorbent materials should be considered.
2. Consideration should be given to installing high level trip functionality for gas/oil interfaces in separators used during the exploration and testing phases of well development, to supplement the normal level control.
3. Consideration should be given to undertaking a detailed hazard analysis for the production process prior to start-up, focussing on identifying potential causes of deviations from normal operation and associated consequences and mitigation, and identifying associated potential paths for loss of containment of oil, gas or chemicals to the environment. It is envisaged that this analysis would be structured similar to a HAZOP, with a team of relevant personnel undertaking the review as a desk-top exercise.
4. The responsibility and processes for identifying underground services should be revised to ensure that when future sites are developed, all underground services including field tile drains are correctly located and identified on the site layout drawing.