Todd Taranaki Limited
Deep Well Injection
Monitoring Programme
Annual Report
2012-2013

Technical Report 2013-50

ISSN: 0114-8184 (Print)
ISSN:1178-1467 (Online)
Document: 1219440 (Word)
Document: 1251873 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

November 2013

Executive summary

The following Annual Report by the Taranaki Regional Council (the Council) encompasses the monitoring period 1 July 2012 – 30 June 2013. The report details the deep well injection (DWI) consents held by Todd Taranaki Limited (the Company) during the period under review. The report also outlines the Company's DWI activities during this period, discusses the monitoring programme implemented by the Council and its results, and also provides an assessment of Company performance with regard to consent compliance.

During the period under review, the Company held four resource consents for the injection of fluids by DWI, permitting discharges from three separate wellsites in northern Taranaki. The consents permit the discharge of a range of fluids, including waste drilling fluids, produced water, contaminated stormwater, hydraulic fracturing (HF) fluids and production sludges. The consents include a number of special conditions which set out specific requirements with which the Company must comply.

During the 2012-2013 monitoring period, the Company exercised DWI consents 1315-1 and 4182-2. Consent 1315-1 permits the discharge of waste drilling fluids by DWI at the Tuhua-B wellsite, Otaraoa Road, Tikorangi. Consent 4182-2 permits the discharge of waste drilling fluids, HF fluids, water, produced water, stormwater and production sludges by DWI, at the McKee-A wellsite, Otaraoa Road, Tikorangi.

The monitoring programme implemented by the Council in respect of the Company's DWI activities included inspections of injection operations, and the review and assessment of injection data submitted by the Company.

The Council carried out two inspections of the Company's active DWI sites during the period under review. Inspection visits comprised liaison with on-site staff, identification of the active injection well, viewing the injection well monitoring equipment and injection logs, and spot sampling of the injectate.

As required by the special conditions of the consents held by the Company, process monitoring data and injection records have been supplied to the Council, and were reviewed on submission. In total 83,546 cubic metres (m^3) of fluids were discharged under consent 1315-1, and 8,373 m^3 under consent 4182-2. The volume of fluid discharged, and the pressure at which it was injected into the receiving formations, were within the limits specified in the respective resource consents.

The information gathered during inspection visits and the data supplied by the consent holder for Council audit have been used in compiling this report.

The Council did not receive any complaints or register any unauthorised incidents associated with any of the Company's DWI activities during the 2012-2013 monitoring period. The Company has demonstrated a **high** level of environmental performance and compliance with the resource consents exercised during this period.

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

This report includes recommendations to be implemented during the 2013–2014 monitoring period.

Table of contents

List of tables

List of figures

List of photos

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

The following Annual Report covers the monitoring period 1 July 2012 – 30 June 2013. During the period under review, Todd Taranaki Limited (the Company) held four resource consents for the disposal of wastes by deep well injection (DWI) from three separate wellsites across the northern Taranaki area. The resource consents held by the Company permit the discharge of a range of fluids by DWI, including waste drilling fluids, produced water, contaminated stormwater, hydraulic fracturing (HF) fluids, and production sludges. The consents include a number of special conditions which set out specific requirements with which the Company must comply.

The following report provides details of the DWI consents held by the Company during the period under review, outlines the Company's DWI activities during this period, and discusses the monitoring programme implemented by the Council and its results. The report also provides an assessment of Company performance with regard to consent compliance and makes recommendations regarding the future monitoring of the Company's DWI activities.

1.1.2 Structure of this report

The following report comprises five sections as follows:

- Section 1 of this report is a background section. It sets out general information about compliance monitoring under the relevant legislation and the Council's obligations and general approach to monitoring sites through dedicated monitoring programmes. Also covered in this section are the details of the individual resource consents held by the Company, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted on the Company's well sites;
- Section 2 presents the results of monitoring during the period under review, including technical data;
- Section 3 outlines any incidents, interventions and incidents that occurred during period under review;
- Section 4 discusses the results, their interpretation, and their significance for the environment; and
- Section 5 presents recommendations to be implemented in the 2013 - 2014 monitoring period.

A glossary of common abbreviations and technical terms, a bibliography and appendices are presented at the end of the report.

1.1.3 The Resource Management Act (1991) and monitoring

The Resource Management Act (the 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 (eg, recreational, cultural, or aesthetic); and
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of `effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Act to assess the effects of the exercise of consents. In accordance with section 35 of the Act, 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), also enables the Council to continuously assess its own performance in resource management as well as that of resource users, particularly consent holders. It also enables the Council to continually re-evaluate its approach to resource management, and ultimately, through the refinement of methods, and considered responsible resource utilisation, to move closer to achieving sustainable development of the regions resources.

1.1.4 Evaluation of environmental performance

In addition to discussing the various details of the performance and extent of compliance by the Company during the period under review, this report also assigns an overall compliance rating. The categories used by the Council, and their interpretation, are as follows:

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

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

- **improvement desirable (environmental)** or **improvement desirable (administrative compliance)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there

were matters that required urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.

- **poor performance (environmental)** or **poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

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

1.2 Process description

1.2.1 Background

The Taranaki Basin occupies an area of approximately 100,000 square kilometres and is the most explored and commercially successful hydrocarbon producing area in New Zealand. Oil and gas exploration and development has been on-going in the region for nearly 150 years. Since the first well in 1865, over 600 exploration and production wells have been drilled. While the majority of the basin is offshore, the majority of the producing wells are onshore. The geology of the basin is derived from diverse episodes of tectonic activity. The Cretaceous to Quaternary basin fill is up to 9,000 m thick in places.

The modern era of exploration began in New Zealand in 1955 when a Shell-BP-Todd consortium explored a large part of the Taranaki region. The groups first well (Kapuni-1), discovered gas-condensate in Late Eocene Kapuni Group strata, and marked the beginning of New Zealand's natural gas industry. The Kapuni Field commenced commercial production in 1970. The next major discovery was the off-shore Maui field in 1969, which was in full production by 1979. Maui is New Zealand's largest hydrocarbon field to date. Many smaller fields were discovered between 1979 and 1999, including the McKee, Mangahewa, Ngatoro, Kaimiro and Rimu fields. More recent discoveries include the Pohokura gas field in 2001.

Overall, the Taranaki Basin remains relatively under-explored compared to many comparable rift complex basins of its size and potential.

1.2.2 Deep well injection (DWI)

DWI is often utilised as liquid waste disposal technology and provides an alternative to the surface disposal of such material. The DWI process utilises specially designed injection wells to pump liquid waste into deep geological formations, hydrocarbon reservoirs or confined saline aquifers. The receiving formations generally contain water that is too saline to be of any potential use.

Impermeable geological seals overlying the injection intervals restrict any potential vertical migration of injected wastes into shallow freshwater aquifers.

A typical injection well consists of concentric pipes, cemented into the surrounding rock, which extend into permeable saline formations, at depths far below the base of potentially useable freshwater aquifers. Waste is then injected into the receiving formation by pressure generated by surface pumps. International standards (adopted in the Taranaki Region) for the construction of disposal wells emphasise the importance of surface casing extending to depths below the base of the freshwater zones and being cemented back to surface. The standards also highlight the requirement for internal casing strings to be cemented back up the hole to seal off and isolate the disposal interval from the overlying fresh water zones, providing a multi-barrier approach to the protection of freshwater resources. As part of the resource consent application procedure for DWI activities, applicants are required to submit information that details both the design and construction specifications of the injection well(s) and illustrates well integrity and the isolation of the well bore from surrounding formations.

In Taranaki, contaminants disposed of by DWI are generally limited to produced water, saline groundwater, contaminated stormwater, waste drilling fluids, hydraulic fracturing (HF) fluids, and production sludges. The Council has approved, on specific occasions, the discharge of small volumes of other specified contaminants by DWI. Any application to discharge waste material not specifically licenced by the relevant resource consent is assessed by the Council on a case by case basis. The Council will assess the composition of the waste for consistency with those specifically approved for disposal. In some cases, a new consent may be required.

Produced water makes up the greatest volume of waste fluids generated by oil and gas exploration and production activities. Produced water is water that is present in a hydrocarbon bearing reservoir, brought to the surface as crude oil or natural gas is abstracted from it. When hydrocarbons are abstracted from a reservoir, they are brought to the surface as a produced fluid mixture. The composition of this produced fluid is dependent on whether crude oil or natural gas is being produced and generally includes a mixture of either liquid or gaseous hydrocarbons, formation water, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that may have been placed in the formation as a result of exploration, hydraulic fracturing, and/or production activities. Produced waters may contain, in addition to salts, hydrocarbon residues and free oil, and traces of process additives including anti-scaling agents, anti-corrosion agents and biocides. Proportionally, higher quantities of water are produced from a hydrocarbon field as more oil or gas is abstracted, and the productive life of the field diminishes. The issue of produced water disposal is therefore expected to increase as many producing fields approach the end of their lives, and as more fields are discovered and developed.

Produced water and drilling fluid wastes are typically highly saline and contain hydrocarbon residues and system additives. Without treatment to an acceptable standard, the surface disposal of large volumes of produced water is not a suitable disposal option, particularly where the discharge can enter surface or groundwater systems. The salts and other contaminants contained within the discharge can adversely affect soil or freshwater biological systems and the quality of water resources used for supply purposes.

Although there are methods to treat produced waters to a suitable standard for surface disposal, such as gas/steam stripping, biological and chemical adsorption, and activated carbon, they are generally not practical or economically viable. The injection of produced waters into deep geological formations by DWI is presently the most cost-effective option for the disposal of this type of waste, and more importantly, is an environmentally sound disposal option.

Produced waters have been disposed of by DWI in Taranaki since the development of the Kapuni Field in 1970. The collection, handling, treatment and disposal of produced water from a producing field are major undertakings and, if not appropriately managed, can have lasting adverse environmental effects. However, under appropriate geological and operational conditions, the disposal of produced waters by DWI should have no more than negligible environmental effects.

The injection of fluids into hydrocarbon bearing reservoirs is also an established oilfield technique for regulating reservoir pressure and/or as a means of enhancing the rate of oil recovery from a reservoir. This process is often referred to as water flooding. Water flooding is a secondary recovery process that is often implemented when natural reservoir pressures decline due to the removal of reservoir fluids during production. The injection of produced fluids back into the reservoir can increase reservoir pressure and stimulate production by driving reserves toward a production well. In certain cases, injected water is heated and injected through a well annulus to reduce oil viscosity, improving oil deliverability through the wellbore. Typically, either produced waters or fresh water, or a combination of the two, are used for water flooding.

Regional councils are responsible for monitoring environmental effects from hydrocarbon exploration and development activities under the Act. Sections 15 and 30 of the Act give regional councils the responsibility for regulating the discharge of contaminants into the environment. The discharge of contaminants onto or into land that may result in water contamination may not take place unless expressly allowed by a rule in a regional plan, resource consent or other relevant regulations. The control of DWI activities through the resource consenting process and subsequent compliance monitoring is an appropriate regulatory regime. In the Taranaki region, the discharge of contaminants by DWI requires resource consent from the Council. The activity falls under Rule 51 of the Regional Freshwater Plan for Taranaki and is classified as a discretionary activity. The application may be non-notified if no parties are deemed to be adversely affected by the proposed activity.

At the time of writing, there were a total of 18 current resource consents for DWI in Taranaki. However, several resource consents have been issued for relatively short-term activities during exploration phase drilling, and several others have not been, and may never be exercised.

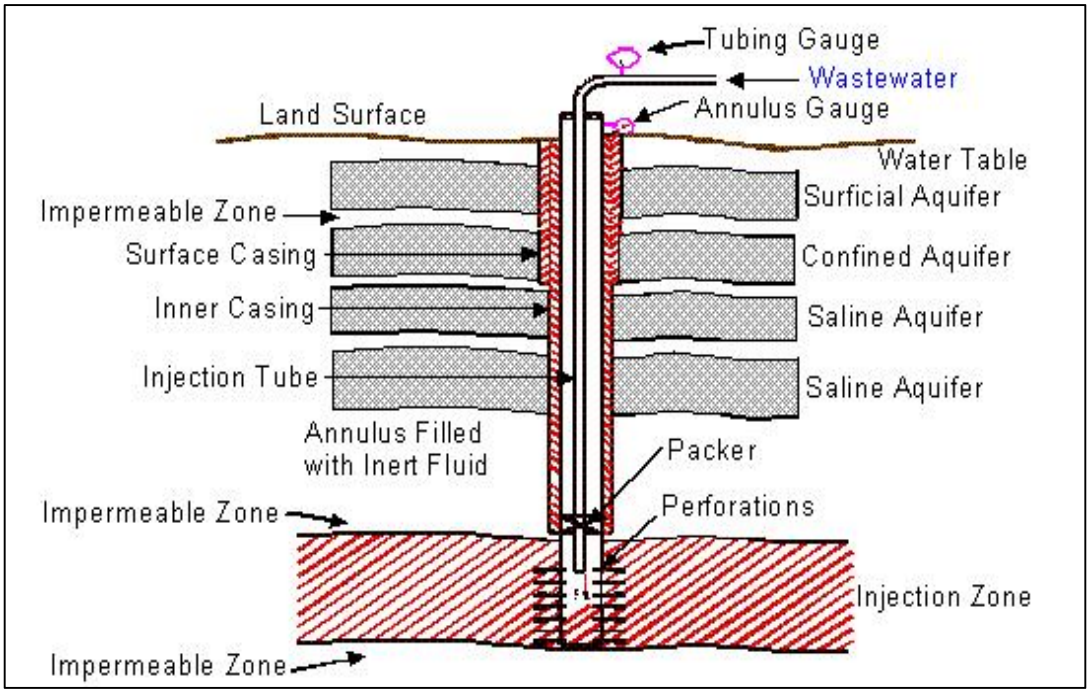


Figure 1 DWI schematic representative of Taranaki sites[1]

1.3 Potential environmental effects of exercising a DWI consent

The main potential environment effect of discharging waste fluids by DWI is the contamination of freshwater aquifers during or following the discharge. Potential pathways for contamination of a freshwater aquifer can be created by the rupture of geological seal confining the injection zone, or failure of the grout seal in either the disposal well or any other well that penetrates the disposal interval. There is also potential for fluids to be forced upward from the injection zone through transmissive faults or fractures in the geological formations overlying the injection zone. Faults or fractures may have formed naturally prior to injection, or may be created by the waste dissolving the rocks of the confining zone. Artificial fractures may also be created by injecting wastewater at excessive pressures or by thermal processes.

There is also the potential for shallow groundwater to be contaminated by surface activities associated with DWI operations, particularly the handling, storage and transport of waste fluids. In all cases, the risk of contamination by spillage or unintended discharge of fluids being managed can be adequately mitigated by ensuring wastes are stored and transported in appropriately constructed and tested storage vessels and pipelines.

In each of the scenarios outlined above, the potential risk can be adequately mitigated by appropriate assessment, design, operation and monitoring of DWI activities. Appropriately engineered technology, regional and local geologic characterisation, and site specific modelling are typically combined at the planning stage of a disposal well to ensure that fluids discharged by DWI will be contained within the intended disposal interval. The assessment of resource consent applications and setting of appropriate conditions address these issues.

[1] http://web.deu.edu.tr/atiksu/ana58/deepwell.html

1.4 Resource consents

The protection of groundwater quality is of primary concern to the Council when processing resource consent applications for DWI activities. Section 15(1)(b) of the Resource Management Act stipulates that no person may discharge any contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant originated as a result of natural processes from that contaminant) entering water, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or national regulations.

Table 1 lists the consents held by the Company during the period under review, the wellsites to which the consents relate and the disposal wells in use at each site. All of the resource consents were issued by the Council under Section 87(e) of the Act.

Table 1 Summary of DWI consents held by the Company during the 2012-2013 period

Consent Number	Wellsite	Injection Well(s)	Formation
1315-1	Tuhua-B	McKee Disposal-1	Mount Messenger
3895-2	Tuhua-B	All other wells	Mount Messenger
4182-2	McKee-A	McKee-1	McKee
5052-1	McKee-B	McKee-4	Matemateaonga

A summary of the consents held by the Company for DWI activities during the 2012-2013 monitoring period is included below.

Resource Consent: 1315-1

"To discharge up to 1,000 cubic metres/day of waste drilling fluids from hydrocarbon exploration and production operations by deepwell injection via the Mckee disposal-1 well at the Tuhua-B wellsite into the Mount Messenger Formation"

Background:
Consent 1315-1, which permits the discharge of waste fluids by DWI at the Tuhua-B wellsite, Foreman Road, Tikorangi, was originally granted to Petrocorp Exploration Ltd. (Petrocorp) on 8 August 1984.

The original consent allowed for the discharge of up to 392 m^3/day of wastewater into the Waikiekie Formation, via any well drilled on the named wellsite. An application was received from Petrocorp on 21 January 1985, seeking an increase in the permitted injection volume to 897.75 m^3/day. A revised consent was granted on 13 March 1985.

Following their procurement of the site, the consent was transferred to Fletcher Challenge Energy Taranaki (FCET) in 1999. There is no record of the consent being exercised under their ownership. On 11 January 1999, an application was received from FCET to increase the permitted discharge volume to 1,000 m^3/day, and amend the legal description of the consented location and the name of the injection formation from Waikiekie to the Mount Messenger. A revised consent was granted on 8 February 1999.

The consent was transferred to Shell Todd Oil Services Ltd. (STOS) in March 2002, but was not exercised under their tenure.

The consent was transferred to Todd Taranaki Limited on 31 May 2006.
The injection of waste under consent 1315 is carried out via the Mckee Disposal-1 well. The injection well is perforated between 1,267 metres below ground level (mbgl) and 1,350 mbgl, and this is the zone into which injection occurs.

The Council waived its option to review this consent in June 2003 and June 2009 as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity. There are no further optional review dates prior to consent expiring on 1 June 2023.

The current consent has four special conditions, as summarised below:

- Special conditions 1 and 3 refer to information requirements;
- Special condition 2 prohibits the discharge from endangering or contaminating any freshwater aquifer; and
- Special condition 4 is a review provision.

Photo 1 The Tuhua-B wellsite and McKee Disposal-1 well

Resource Consent: 3895-2
"To discharge waste drilling fluids, water, produced water and stormwater from hydrocarbon exploration and production operations by deepwell injection at the Tuhua-B Wellsite"

Background:
Consent 3895, which permits the discharge of waste fluids by DWI at the Tuhua-B wellsite, Foreman Road, Tikorangi, was originally granted to Petrocorp on 19 December 1990. The original consent permitted the discharge of up to 50 m^3/day of waste drilling fluids by DWI into the Urenui and Waikiekie (Mount Messenger) Formations.

While the original consent specified Tuhua-5 as the disposal well, the Council later confirmed that the discharge could occur via any well drilled on this wellsite.

The consent was transferred to FCET in 1999, and there is no record of it being exercised during their ownership.

The consent was subsequently transferred to STOS in March 2002, but was not exercised under their ownership. In November 2003, STOS applied for the consent to be renewed and for the conditions of the consent to be varied. STOS also applied for the consent to cover the discharge of waste sourced from other sites.

On 31 May 2006, the consent was transferred to Todd Taranaki Limited.

The McKee Disposal-1 well is currently being used for the injection of waste at the site, operating under consent 1315-1 (see above).

The Council waived its option to review this consent in June 2009 as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity. The next optional reviews are provided for in June 2015, June 2021 and June 2027. The consent is due to expire on 1 June 2033.

The current consent has nine special conditions, as summarised below:

- Special conditions 1, 3, 4, 6, and 7 refer to information requirements;
- Special condition 2 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special condition 5 limits injection pressures to those which do not fracture the injection formation, and requires the Company to notify the Council of any event that could indicate failure of the well or injection zone;
- Special condition 8 is a lapse clause; and
- Special condition 9 is a review provision.

There is no record of the consent 3895 ever being exercised, as all injection from the Tuhua-B wellsite has been via the McKee Disposal-1 well, under consent 1315-1.

Resource Consent: 4182-2

"To discharge waste drilling fluids, fraccing fluids, water, produced water, stormwater and production sludges from hydrocarbon exploration and production operations by deepwell injection at the McKee-A wellsite via McKee-1 well"

Background:
Consent 4182-2, which permits the discharge of waste fluids by DWI at the McKee-A wellsite, Otaraoa Road, Tikorangi, was originally granted to Petrocorp on 2 December 1992. The original consent permitted the discharge of up to 1,021 m^3/day of produced water and treated stream water by DWI into the McKee Formation for reservoir water-flooding purposes.

The consent was later transferred to FCET in 1999. On 11 January 1999 an application was received seeking an increase in the maximum permitted injection volume to 1,500 m^3/day. A revised consent was granted on 8 February 1999.

On 7 September 1999 an additional application was received seeking an increase in the maximum permitted injection volume to 4,000 m^3/day. A revised consent was granted on 20 September 1999.

The consent was transferred to STOS on 27 March 2002 and renewed in June 2003 with revised conditions, allowing for the discharge of waste sourced from other sites.

Consent 4182 was transferred to Todd Taranaki Limited on 31 May 2006. In May 2009, the consent holder lodged an application to the Council for a change of consent purpose and conditions. The Company proposed to use an existing well (McKee-1) on the McKee-A wellsite for the DWI of hydrocarbon contaminated production sludges, recovered from the McKee-A flare pit and the McKee-Mangahewa Production Station, into the McKee Formation. The variation specifically sought to amend the purpose of the consent to allow for the disposal of a greater range of waste material including waste drilling fluids, HF fluids, water, produced water, stormwater and production sludges. A revised consent was granted on 22 June 2009.

The McKee-1 well is perforated between 2,305 mbgl and 2,392 mbgl, and this is the zone into which injection occurs.

The Council waived its option to review this consent in June 2009 as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity. Optional reviews of the consent and its conditions are provided for in June 2015, June 2021 and June 2027. The consent is due to expire on 1 June 2033.

The current consent has nine special conditions, as summarised below:

- Special conditions 1, 3 and 7 refer to information and recording requirements;
- Special condition 2, addresses the protection of any and all potential usable freshwater aquifers;
- Special conditions 4 and 5, deal with monitoring provisions;
- Special condition 6 refers to the control of propagation of fractures into confining layers;
- Special condition 8 is a lapse clause; and
- Special condition 9 is a review provision.

Resource Consent: 5052-1

"To discharge waste drilling and fraccing fluids and/or up to 3,000 cubic metres/day of produced water from hydrocarbon exploration and production operations by deepwell injection into the Matemateaonga formation via the McKee-4 well at the McKee-B wellsite"

Background:
Consent 5052-1, which permits the discharge of waste fluid by DWI at the McKee-B wellsite, Otaraoa Road, Tikorangi, was originally granted to FCET on 13 November 1996. The original consent permitted the discharge of up to 750 m^3/day of water and/or produced water into the McKee Formation via the McKee-2A and McKee-4 wells for reservoir water-flooding purposes.

An application was received on 11 January 1999 seeking a change in the conditions of consent to allow for a maximum permitted injection volume of 3,200 m^3/day for water flooding purposes. A revised consent was granted on 8 February 1999.

On 11 May 2000, the consent holder applied for a change in consent conditions to allow for the discharge of up to 3,000 m^3/day of produced water via McKee-4 into the Matemateaonga Formation for waste disposal purposes, as water-flooding of the McKee reservoir was no longer required. A revised consent was granted on 17 May 2000.

On 27 March 2002, consent 5052 was transferred to STOS, but was not exercised under their ownership.

On 31 May 2006, the consent was transferred to Todd Taranaki Limited A revised consent was issued to the consent holder on 17 May 2007, allowing for the disposal of waste drilling and HF fluids, in addition of up to 3,000 m^3/day of produced water via the McKee-4 well.

The McKee 4 well is perforated between 970 mbgl and 1,162 mbgl, and this is the zone into which injection occurs. The McKee-4 well has not been used for injection activities since 31 August 2008.

The Council waived its option to review this consent in June 2009 as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity. There are no further optional review dates prior to consent expiring on 1 June 2023.

The consent has eight special conditions, as summarised below:

- Special conditions 1 and 3 refer to information requirements;
- Special condition 2 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 4 and 5 refer to the monitoring of injected wastes and pressures;
- Special condition 6 deals with the exercising of the consent to be conducted according to the supporting documentation provided in the application;
- Special condition 7 contains review provisions; and
- Special condition 8 details the consent lapse and expiry dates.

Figure 2 shows the location of the DWI consents held by the Company during the period under review. Copies of the consent certificates are attached in Appendix I.

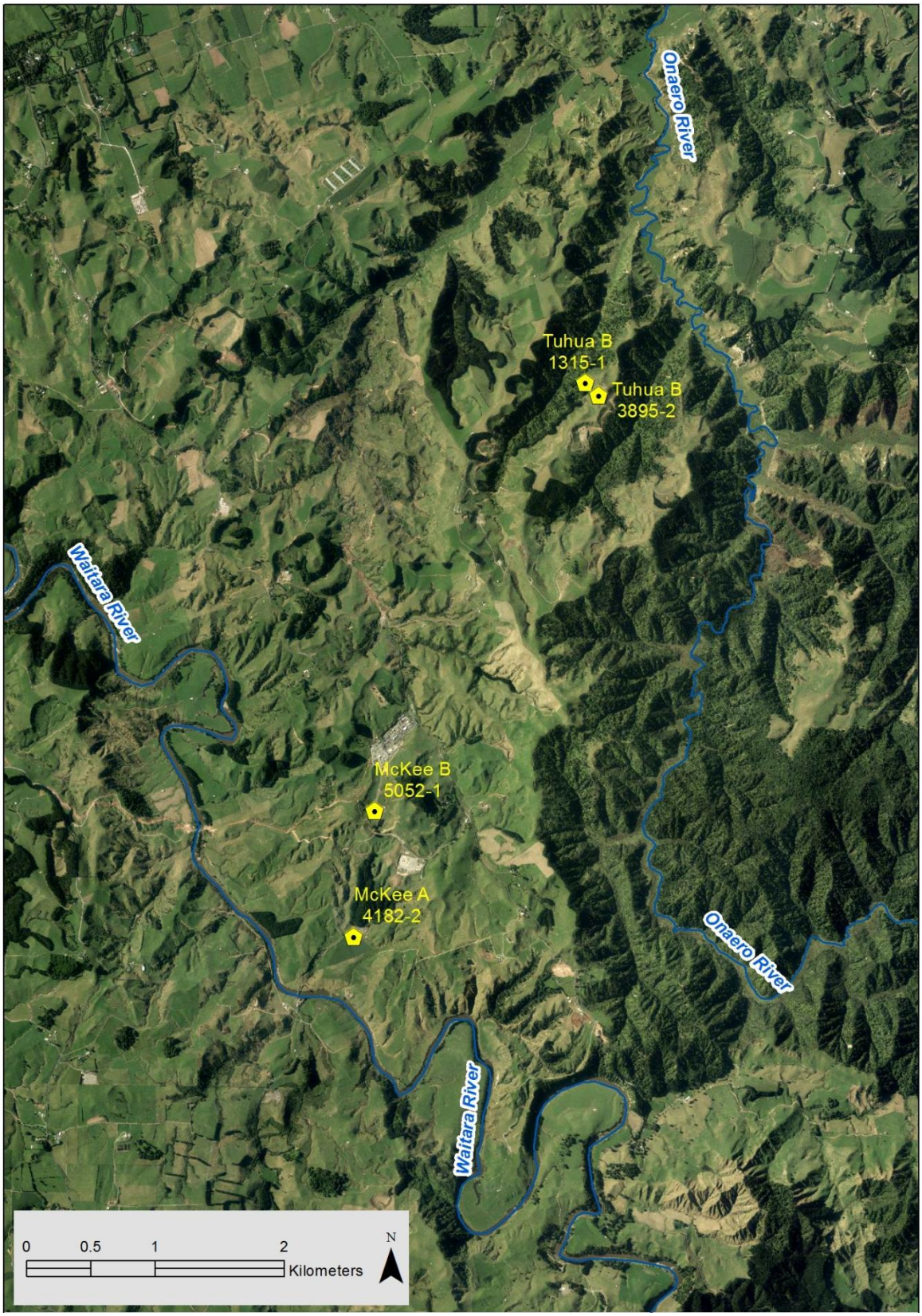


Figure 2 Resource consents for DWI held by the Company during the period under review

1.5 Monitoring programme

1.5.1 Introduction

Section 35 of the Act sets obligations upon the Council to gather information, monitor, and conduct research on the effects arising from consented activities within the Taranaki region and report upon these.

To perform its statutory obligations, the Council may be required to take 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 implemented by the Council in relation to the Company's DWI activities consisted of four main components:

- Programme design, liaison and management;
- Site inspections and injectate sampling;
- Assessment of data submitted by the consent holder; and
- Groundwater quality monitoring.

Each component of the monitoring programme is discussed in further detail below.

1.5.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council during annual reviews of existing monitoring programmes, and the scoping and design of future monitoring requirements. Significant time is spent managing compliance monitoring programmes throughout the monitoring year, and liaising with resource consent holders over consent conditions, their interpretation and application. The Council also undertakes discussion during preparation for any consent reviews, renewals, or new consent applications, and provides advice on environmental management strategies, the content of regional plans, and various other associated matters.

1.5.3 Site inspections and injectate sampling

The monitoring programme provides for physical inspections to be undertaken at all active DWI sites operated by the Company. The inspections include an examination of the injection wellhead, viewing the monitoring equipment and the spot sampling of the injectate for laboratory analysis. The sampling of injectate is carried out in order to characterise the general chemical nature of the discharge and also the variation in its chemical composition across the monitoring period. Samples of the injectate were collected from a storage tank located at the McKee Production Station, which stores fluids prior to injection. The tank is identified by the Company as tank T100.

Table 2 Location of injectate sampling sites

Consent	Wellsite	Injection well	Site code	Sample point
1315-2	Tuhua-B wellsite	McKee-Disposal-1	GND1749	Tank T100 (McKee Production Station)
4182-2	McKee-A wellsite	McKee-1	GND0443	Tank T100 (McKee Production Station)

Samples of injectate were submitted to Council laboratory for analysis. Samples were analysed for the following parameters:

- pH;
- Conductivity;
- Alkalinity;
- Suspended solids;
- Chlorides; and
- Total petroleum hydrocarbons.

1.5.4 Consent holder data submission requirements

The resource consents held by the Company for DWI include conditions which require the Company to submit injection data and supporting information to the Council within specified timeframes. The injection data submitted by the consent holder forms the basis for assessing consent compliance. The major information requirements are as follows:

1. Information on the disposal well and injection zone

The conditions of the resource consents exercised by the Company required them to submit management plans for the operation of each injection well(s). The plans were required to include the operational details of the injection activities and to identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plans are also required to detail the action(s) to be taken by the consent holder if trigger conditions are reached. The information requested is required to demonstrate that the exercise of the consent will not contaminate or endanger any actual or potentially useable freshwater aquifer.

The Council holds a significant volume of information regarding the Company's Mangahewa wells and the underlying geology in the Mangahewa/McKee area. Data has been gathered where submitted as part of resource consent applications, during specific site investigations, and as part of various compliance monitoring programmes.

2. Discharge records

For each well used for DWI during the period under review, the consent holder was required to provide discharge records. Specific data requirements included the following:

- Injection volumes;
- Injection pressures;
- Injection rate; and
- Analytical results for injectate samples.

The Company provided all discharge records required by consents 1315-1 and 4182-2 during the reporting period. However, the Company did not analyse their injectate samples for the full range of parameters stipulated in the consents, or at the intervals required. The Council is satisfied that the data provided by the Company, in conjunction with the results of the analysis of injectate samples obtained by the Council, provides a representative assessment of fluids injected during the 2012-2013 monitoring period.

3. Annual reporting

The Company was required to submit annual written reports to the Council providing a summary of all injection data gathered over the previous 1 July to 30 June period. Annual reports also require the Company to detail how compliance has been achieved with the special conditions of consents exercised during the monitoring period. The Company's annual written report for the 2012-2013 period was received by the Council on 29 May 2013. The report met the reporting requirements of the relevant resource consents.

1.5.5 Groundwater quality monitoring

A programme of groundwater monitoring in the vicinity of the Company's active injection sites was initiated during 2012/2013 period. The programme provides for biannual sampling of groundwater from selected groundwater abstraction sites during each monitoring year.

In order to select suitable sampling sites for inclusion in the monitoring programme, surveys of water abstraction sites within a 1 km radius of the Tuhua-B and McKee-A wellsites were carried out. Initially, a desktop review of data held by the Council was conducted, including a search of the Council 'wells' database. The desktop review indicated that the Council held no records of groundwater abstractions in the areas of investigation. Following the desktop review, a field survey was undertaken to identify any groundwater abstraction sites that may not have been registered with the Council. No suitable groundwater sampling sites were located during the field survey.

The Council is currently in discussions with the Company over the installation of suitable monitoring wells in the vicinity of active injection wells.

2. Results

2.1 Site inspections and injectate sampling

During the period under review, the Council carried out two routine DWI inspections at the McKee Production Station. The production station serves as a central fluid collection and storage facility, and is also the site from which all injection is controlled and monitored. Routine DWI inspections included undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment. No operational issues were identified during the inspections and all equipment appeared in good condition. Company personnel were able to assist by detailing the status of injection equipment, outlining the injection operations being carried out by the Company at that time, and also providing real-time monitoring data on request.

As part of the monitoring programme, spot samples of the injectate were obtained during inspection visits on 13 September 2012 and 12 April 2013. The injectate samples were submitted to the Council's IANZ accredited laboratory for physicochemical analysis. The results of the analysis are included below in Table 3.

The concentrations of each analyte are within the expected range for produced water samples.

Table 3 Results of injectate sampling undertaken by the Council (2012-2013)

Parameter	Unit	Site GND1455 (Sample point T100)	
		13/09/12	12/04/13
Time	NZST	10:40	09:50
TRC sample number	-	122876	135587
pH	pH Units	8	7.7
Conductivity @ 20°C	mS/m @ 20^{0}C	1,910	2,130
Alkalinity	g/m^3 $CaCO_3$	3,320	3,460
Chloride	g/m^3	5,690	6,950
Total petroleum hydrocarbons	g/m^3	220	12

2.2 Assessment of data provided by the consent holder

The Company provided a record of injection data for the 2012-2013 monitoring period, including the injection volumes, rates and pressure data. Table 4 outlines the Company's injection activities during the period under review.

The injection data provided by the Company is summarised in Table 5.

Table 4 Summary of DWI activities during the period under review (2012-2013)

Consent	Wellsite	Injection wells	Total volume discharged (m^3) 01/07/12 – 30/06/13	Discharge period		TRC well ID
				From	To	
1315-1	Tuhua-B	McKee Disposal-1	83,546	01/07/2012	30/06/2013	GND1749
3895-2	Tuhua-B	Other wells	-	-	-	-
4182-2	McKee-A	McKee-1	8,373	01/07/2012	30/06/2013	GND0443
5052-1	McKee-B	McKee-4	-	-	-	-
Total			91,919	01/07/12	30/06/13	-

Table 5 Summary of the Company's 2012-2013 injection data

	1315-1 - McKee Disposal-1 injection well		
	Volume Injected (m^3)	Pressure (Bar)	Injection Rate (m^3/hr)
Total	83,546	N/A	N/A
Max/day	353	36	34
Average (day)	229	28	11
	4182-2 - McKee-1 injection well		
	Volume Injected (m^3)	Pressure (Bar)*	Injection Rate (m^3/hr)
Total	8,373	N/A	N/A
Max/day	277	0	81
Average (day)	23	0	7

* Well is in vacuum – no pressure required to inject waste.

The injection volume and pressure data provided by the Company for injection carried out under consent 1315-1 is presented graphically in Figures 3 and 4. The injection data for consent 4182-2 is presented in Figures 5.

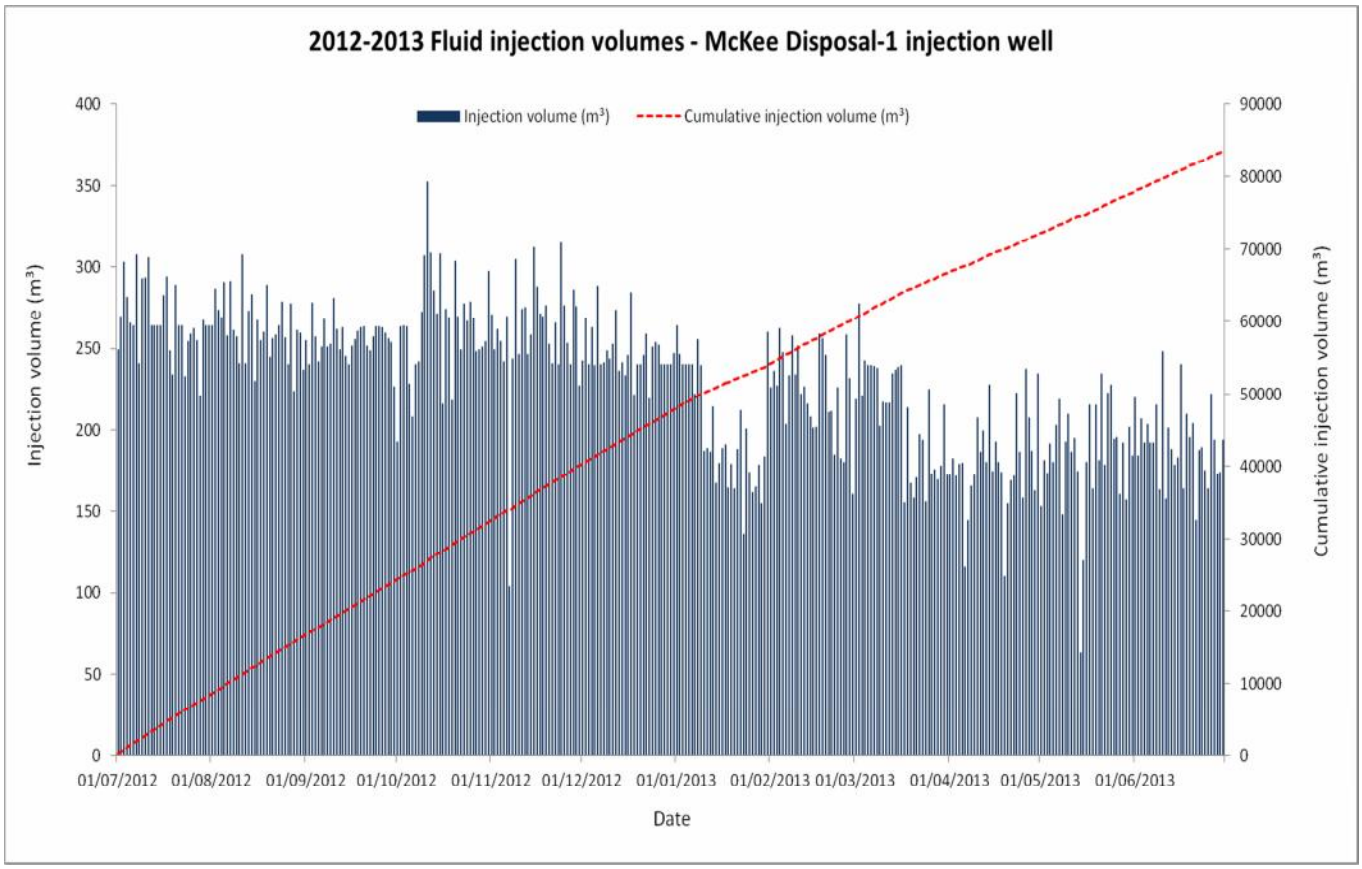


Figure 3 2012-2013 Fluid injection volumes - McKee Disposal-1 well (1315-1)

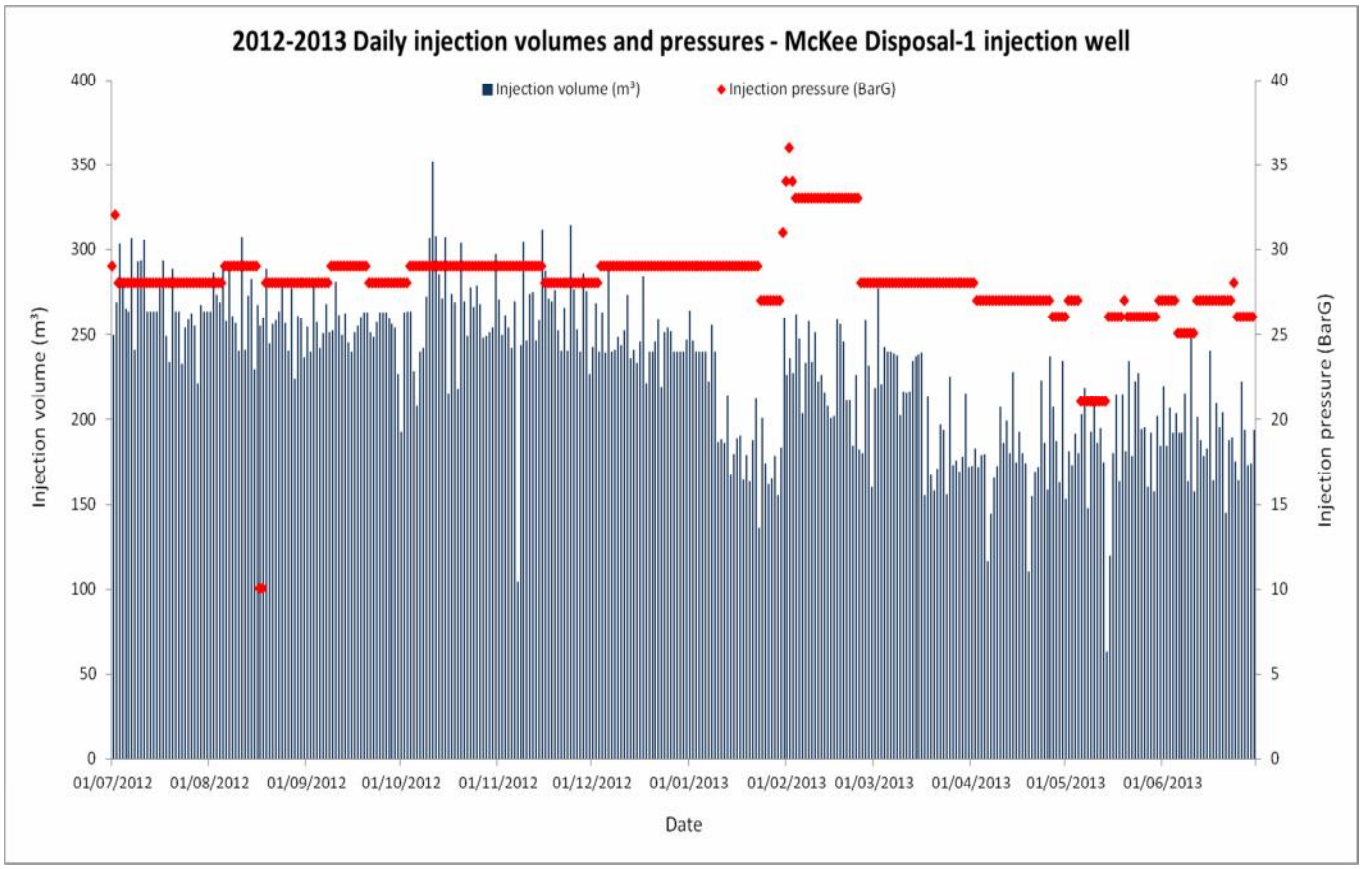


Figure 4 2012-2013 Daily injection volumes and pressures- McKee Disposal-1 well (1315-1)

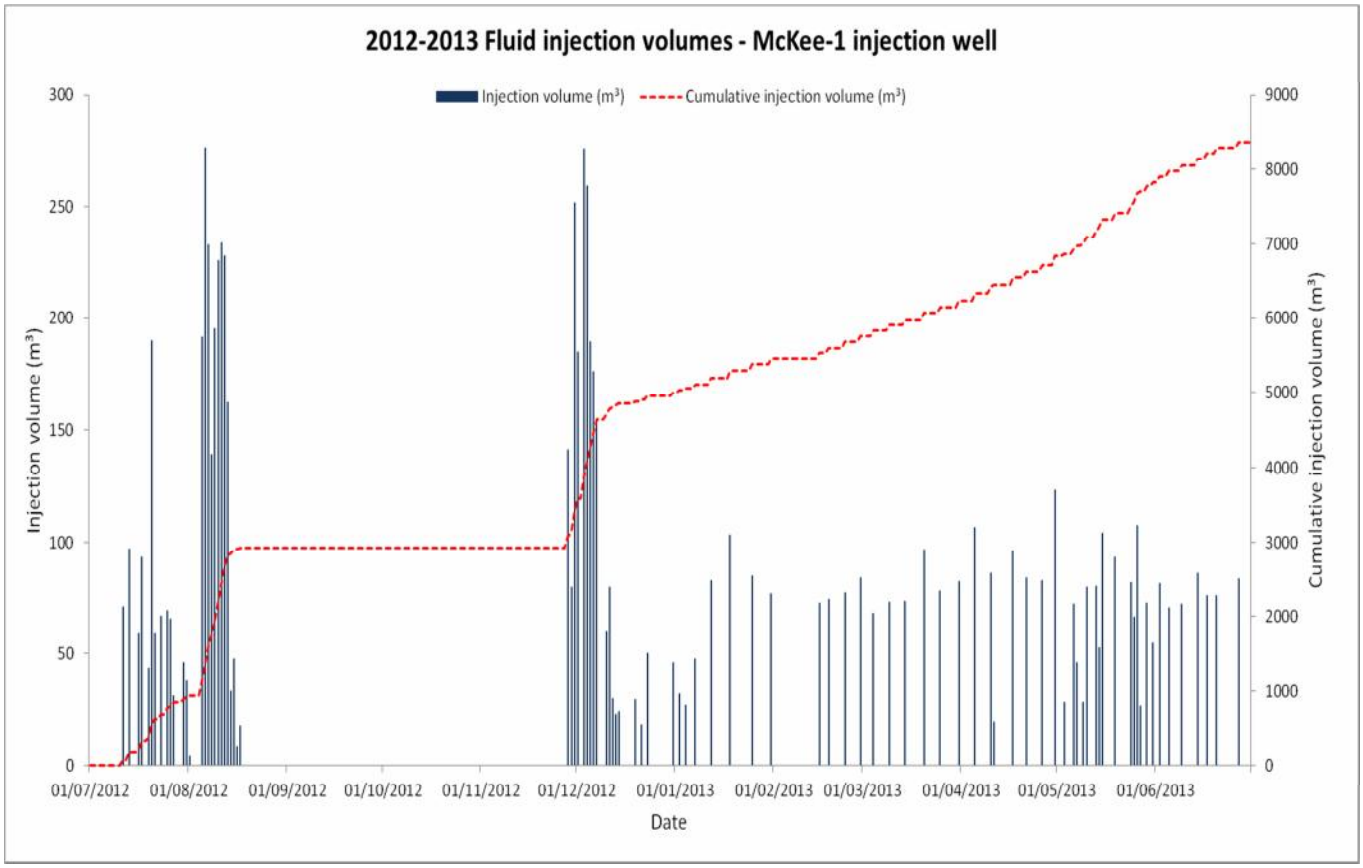


Figure 5 2012-2013 Fluid injection volumes - McKee-1 injection well (4182-2)

In addition to the Council's injectate sampling (Section 2.1), the Company also provided analytical results for samples of produced water injected via the McKee Disposal-1 and McKee-1 injection wells.

As presented in Table 6 and Table 7 below, the maximum and mean values associated with the results of these analyses illustrate the variability in the composition of injectate across the monitoring period.

The composition of the injectate varies depending on the origin and volume of fluids transferred from each individual source at the time of injection.

Table 6 Range of contaminants in McKee disposal-1 injectate samples (2012-2013)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Mean value
pH	pH units	4	7.8	7.6	7.7
Chloride	g/m³	3	6,700	5,900	6,434
Alkalinity	g/m³	3	3,500	3,200	3,367
Suspended solids	g/m³	4	34	11	17.3
Total dissolved solids	g/m³	3	15,300	14,000	14,634
Total petroleum hydrocarbons	ppm	1	1	1	1

Table 7 Range of contaminants McKee-1 injectate samples (2012-2013)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Mean value
pH	pH units	5	7.5	6.7	7
Chloride	g/m³	5	14,200	10,900	12,060
Alkalinity	g/m³	5	2,100	1,280	1,542
Suspended solids	g/m³	5	250	22	75.6
Total dissolved solids	g/m³	5	37,000	21,000	24,800
Total petroleum hydrocarbons	ppm	-	-	-	-

3. Investigations, interventions and incidents

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

The Council operates and maintains a register of all complaints and reported or discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken. Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2012-2013 monitoring period, there were no incidents recorded by the Council associated with any of the Company's DWI consents.

4. Discussion

During the period under review, the Company exercised two resource consents for the injection of fluids by DWI. These consents licensed discharges of various forms of fluid into the Mount Messenger and McKee Formations, via the McKee Disposal-1 and McKee-1 injection wells. The main source of fluids for injection was produced water from the Company's Mangahewa and McKee fields.

The Company exercised consent 1315-1 for the entire course of the 2012-2013 monitoring period. During the period under review, a total of 83,546 m^3 of fluid was injected under the consent, at an average of 229 m^3/day. The average injection pressure was 28 bar, with a maximum pressure of 36 bar. The fluids were injected into the Mount Messenger Formation, via the McKee Disposal-1 injection well, at a depth between 1,267 mbgl and 1,350 mbgl.

Consent 1315-1 does not specify any limits on injection pressure, but does limit the discharge volume to 1,000 m^3/day. Based on the data provided, the maximum daily volume injected occurred on 11 October 2012 when a total of 353 m^3 of fluid was injected. The daily injection volumes are far the below the maximum daily discharge volume limit stipulated in the consent.

During the 2012-2013 monitoring period, the Company also utilised consent 4182-2 for the disposal of fluid by DWI. The consent was exercised on an intermittent basis only. The fluids were injected into the McKee Formation, via the McKee-1 injection well, at a depth between 2,305 mbgl and 2,392 mbgl. During the period under review, a total of 8,373 m^3 of fluid was injected under the consent, at an average of 23 m^3/day. No pump pressure was required to inject fluids in into the McKee Formation, as the Mckee-1 well is in a state of vacuum which creates a suction effect.

Consent 4182-2 does not specify any limit for discharge volume. Special condition 5 specifies that injection pressure must remain below the pressure that would fracture the receiving formation. Since no pump pressure is required to inject waste via the Mckee-1 well, it is very unlikely that fracturing would occur.

During the 2012-2013 period, consent holder performance was assessed on compliance with consent conditions, with a particular emphasis on record keeping requirements and information provision, and the analysis of the information and data provided. Compliance with the conditions of the DWI consents exercised during the 2012-2013 is summarised below in Section 4.1.

For each of the wells used for DWI during the monitoring period, the consent holder has provided sufficient information regarding well construction and the injection zone to satisfy the relevant consent and monitoring programme information requirements.

Based on the assessment of the injection data submitted by the consent holder, there is no evidence to suggest that DWI activities at either of the Company's active injection sites has resulted in the vertical migration of contaminants outside of the intended injection interval.

If deemed necessary, the Council may request further information from the consent holder that illustrates that the wells being used for the injection of waste and the receiving formation remain secure.

The Council was unable to obtain any samples of groundwater in the vicinity of the Company's active DWI sites due to the lack of suitable existing sampling sites in their locality. The Council is currently in discussions with the Company regarding the installation of suitable monitoring wells in the vicinity active injection wells.

No complaints were received from the public with regard to any of the Company's DWI activities during the period under review, and no incidents were recorded by the Council.

4.1 Discussion of site performance

During the period under review, the Company exercised DWI consents, 1315-1 and 4182-2. A summary of the Company's level of compliance with the special conditions attached to consent 1315-1 is provided in Table 8, and consent 4182-2 in Table 9.

Table 8 Summary of Company performance with regard to consent 1315-1 (2012-2013)

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Provision of well and injection zone information	Receipt of satisfactory information	Yes
2. No contamination of freshwater aquifers	Assessment of consent holder records	Yes*
3. Provision of records for discharge volumes, rates and pressures.	Receipt of well discharge data	Yes
4. Provision of records of chemical analysis of discharge	Receipt of discharge analytical results	Yes**
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**

* No evidence to suggest any contamination of freshwater aquifers has occurred in the period under review
** Samples were not analysed for the full range of parameters stipulated in the consent

Table 9 Summary of Company performance with regard to consent 4182-2 (2012-2013)

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Provision of well and injection zone information	Receipt of satisfactory information	Yes
2. No contamination of freshwater aquifers	Assessment of consent holder records	Yes*
3. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
4. Provision of records of chemical analysis of discharge	Receipt of discharge analytical results	Yes**

Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Provision of records of any production sludges discharged including volumes, injection rate, pressure, density, viscosity and solids content of sludge	Receipt of satisfactory information	N/A***
6. Fracturing of stratigraphic seals of injection formation	Assessment of consent holder records	No indication
7. Provision of annual report on deep well injection activities	Receipt of annual report from consent holder	Yes
8. Lapse clause	Receive notice of exercise of consent	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**

* No evidence to suggest any contamination of freshwater aquifers has occurred in the period under review

** Samples were not analysed for the full range of parameters stipulated in the consent or at the required intervals

*** No record of any discharge of production sludges in the period under review

Overall in 2012-2013, the Company achieved a '**high**' standard of environmental performance with respect to consents 1315-1 and 4182-2. The criteria associated with a 'high' level of environmental performance are outlined in Section 1.1.4 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."

4.2 Environmental effects of exercise of discharge permit

The most significant potential adverse environment effect arising as a result of fluid injection is the contamination of freshwater aquifers. The protection of groundwater is fundamental to the protection of surface water and consequently, groundwater should be protected to the greatest extent practicable from serious or irreversible damage arising from human activity.

Well engineering technology, regional and local geologic characterisation, and site specific mathematical modelling are typically combined at the planning stage of a injection well to ensure that injected fluids are contained within the intended disposal interval. This information is typically supplied to the Council when an application for consent to discharge fluids by DWI is lodged, and used to assess the potential for adverse environmental effects resulting from the proposed activity.

The DWI consents exercised during the period under review permit discharges into the Mount Messenger Formation via the McKee Disposal-1 well, and into the McKee Formation via the McKee-1 injection well.

Discharges to the Mount Messenger Formation via the McKee Disposal-1 well occur at depths in excess of 1,267 mbgl. The receiving formation is overlain by several hundred metres of low permeability strata, including the Urenui Formation.

The Urenui Formation, comprised of impermeable siltstones and mudstones, forms an extensive aquitard (Stevens, 2001). The geological formations overlying the receiving formation provide extensive vertical isolation from shallow freshwater aquifers, and ensure that the injected fluids remain within the intended zone. At present all produced water from the McKee & Mangahewa Production Station is injected via the McKee Disposal-1 well.

Testing of McKee Disposal-1 well was carried out by the Company in April 2011. During the test, the tubing head pressure dropped below zero (negative pressure) indicating that the injection interval has not become over-pressured (no pressure increase), and remains suitable for continued injection via the well.

Discharges to the McKee Formation via the McKee-1 well occur at depths in excess of 2,305 mbgl. The McKee Formation is also overlain by a number of low permeability confining geological units, including, the Turi, Otaraoa, and Urenui Formations. These formations, due to their low permeability, act as confining layers and prevent the vertical migration of injected fluids from the injection zone.

Discharges from both injection wells occur at depths well below the freshwater/saltwater interface. The interface depth, based on logging information from McKee Formation wells, is estimated to occur within the Matemateaonga Formation, at a depth of approximately 250 m below sea-level.

The natural geological characteristics of the strata overlying the injection intervals, the engineering of the injection wells, the planning and monitoring of injection activities, and their regulation, all contribute to minimise the potential for any adverse environmental effect resulting from DWI activities.

4.3 Recommendations from the previous monitoring report

In the 2009-2012 Triennial Report, it was recommended:

1. THAT all monitoring of the Company's DWI activities carried out during the 2009-2012 period be continued during the 2012-2013 monitoring period.

   The recommendation was implemented in the 2012-2013 period. This report is the first annual report produced under the new reporting frequency adopted.

2. THAT biannual sampling of shallow groundwater in the vicinity of active injection wells be included in the monitoring programme for the forthcoming period.

   The implementation of this recommendation commenced in the 2012-2013 period. However, the Council was unable to obtain any samples of groundwater in the vicinity of active injection wells, as currently there are no suitable existing sampling points in their locality. The Council is currently in discussions with the Company regarding the installation of suitable monitoring wells in the vicinity of active injection wells. Sampling of groundwater will be carried out in the forthcoming monitoring period once the monitoring wells are installed. A recommendation to this effect is attached to this report.

3. THAT the Company maintain full records of all injection data, as required by the relevant resource consents, including injection volumes, pressures, hours and rates.

   The recommendation was implemented and achieved by the Company in the 2012-2013 period.

4. THAT the Company provides the Council, in May of each year, an annual DWI report detailing all activities authorised by the consents held by the company for these activities.

   The recommendation was implemented and achieved by the Company in the 2012-2013 period.

4.4 Alterations to the monitoring programme for 2013-2014

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

It is proposed that the range of monitoring carried out in the 2012-2013 period be continued in the 2013-2014 period. As discussed previously, groundwater sampling in the vicinity of the Tuhua-B and McKee-A wellsites will be carried out once suitable monitoring wells are installed during the forthcoming monitoring period. Groundwater samples will then be obtained on a biannual basis. Recommendations to this effect are attached to this report.

4.5 Exercise of optional review of consents

There is no further provision for the review of consent 1315-1 before its expiry in June 2023, or consent 5052 before its expiry in June 2015. An optional review of consents 3895-2 and 4182-2 is next provided for in June 2015.

The Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent. A review may be required 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.

Based on the results of monitoring carried out in the period under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are no grounds to require a consent review to be pursued or grounds to exercise the review options.

A recommendation to this effect is included in Section 5 of this report.

5. Recommendations

1. THAT the range of monitoring carried out during the 2012-2013 period in relation to the Company's DWI activities be continued during the 2013-2014 monitoring period.

2. THAT the Company ensures that injectate analysis is carried out for the full range of parameters, and at the required frequencies, as stipulated in the resource consents for active injection sites.

3. THAT the Company installs a suitable groundwater monitoring well in the vicinity of active injection wells where there are no suitable existing groundwater monitoring sites available.

4. THAT sampling of shallow groundwater in the vicinity of active injection wells be carried out on a biannual basis.

5. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Aquifer (freshwater)	A formation, or group or part of a formation that contains sufficient saturated permeable media to yield exploitable quantities of fresh water.
Bcf	Billion cubic feet.
Conductivity	A measure of the level of dissolved salts in a sample. Usually measured at 20°C and expressed as millisiemens per metre (mS/m) or as Total Dissolved Solids (g/m^3).
Confining layer	A geological layer or rock unit that is impermeable to fluids.
Deep well injection (DWI)	Injection of fluids at depth for disposal or enhanced recovery.
Freshwater-saltwater interface	The depth in a well at which fresh water becomes saline. The interface may be a gradational or sharp transition, depending on geology. The FW-SW transition is demonstrated by down-hole geophysical logging.
g/m^3	Grams per cubic metre. A measure of concentration which is equivalent to milligrams per litre (mg/l), or parts per million (ppm).
Hyraulic fracturing (HF)	The process of increasing reservoir permeability by injecting fluids at pressures sufficient to fracture rock within the reservoir ("fraccing").
injectate	Fluid disposed of by deep well injection.
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.
mbgl	Metres below ground level.
m^3	Cubic metre.
pH	Numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are acidic and higher than 7 are 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.
Produced water	Water associated with oil and gas reservoirs that is produced along with the oil and gas. Typically highly saline with salt concentrations similar to seawater and containing low levels of hydrocarbons.

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).
The Act	Resource Management Act 1991 and subsequent amendments.
TRC	Taranaki Regional Council (the Council).
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
Water flooding	A method of thermal recovery in which hot water is injected into a reservoir through specially distributed injection wells. Hot water flooding reduces the viscosity of the crude oil, allowing it to move more easily toward production wells.

Bibliography and references

Environmental Protection Agency, United States. An introduction to the technology of subsurface wastewater injection. Environmental Protection Technology Series (EPA-600/2-77-240).

Ministry for the Environment (2006). A National Protocol for State of the Environment Groundwater Sampling in New Zealand. Ref. ME781.

Stevens G. 2001. Taranaki : *In*: Groundwaters of New Zealand, M.R, Rosen and P.A. White (*eds*). New Zealand Hydrological Society Inc., Wellington. P381-386.

Taranaki Regional Council. Disposal of contaminants by deep well injection; A guide to applicants seeking resource consent to discharge contaminants by deep well injection in Taranaki. Unpublished memorandum September 2005; 12pp. Document number 100856.

Taranaki Regional Council. 2011. Todd Taranaki Limited Deep Well Injection Monitoring Programme, Triennial Report, 2009-2012. Technical Report 2011-86. Document number 1108053.

Todd Taranaki Limited. Injection records. July 2012 to July 2013. Electronic data file provided to TRC by Todd Taranaki Limited, July 2012. Document number 1229251.

Appendix I

DWI consents exercised in 2012-2013 period

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

Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Todd Taranaki Limited P O Box 802 NEW PLYMOUTH
Change To Conditions Date:	8 February 1999 [Granted: 8 August 1984]

Conditions of Consent

Consent Granted:	To discharge up to 1,000 cubic metres/day of waste drilling fluids from hydrocarbon exploration and production operations by deepwell injection via the Mckee disposal-1 well at the Tuhua-B wellsite into the Mount Messenger Formation at or about GR: Q19:270-370
Expiry Date:	1 June 2023
Review Date(s):	June 2003, June 2009
Site Location:	Tuhua-B-wellsite, Otaraoa Road, Tikorangi
Legal Description:	Lot 3 DP 15159 Blk XI Waitara SD

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. That the results of geological sampling, well logging and injectivity testing undertaken for well evaluation and maintenance, be forwarded to the Chief Executive, Taranaki Regional Council, upon request.

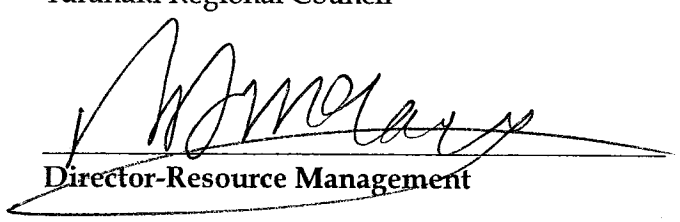
2. That the consent holder shall ensure that injection will not contaminate or endanger any actual or potential useable freshwater aquifer.

3. That the consent holder shall keep daily records of volumes injected, including injection pressure and rate, and shall monitor for pH, salinity, and hydrocarbon content of the discharge on a six-monthly basis, and shall make such records available to the Chief Executive, Taranaki Regional Council, upon request.

4. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2003 and/or June 2009, 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 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 31 May 2006

For and on behalf of
Taranaki Regional Council



Director-Resource Management

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

Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Todd Taranaki Limited P O Box 802 NEW PLYMOUTH
Consent Granted Date:	20 November 2003

Conditions of Consent

Consent Granted:	To discharge waste drilling fluids, water, produced water and stormwater from hydrocarbon exploration and production operations by deepwell injection at the Tuhua-B Wellsite at or about GR: Q19:271-369
Expiry Date:	1 June 2033
Review Date(s):	June 2009, June 2015, June 2021, June 2027
Site Location:	Tuhua-B wellsite, Foreman Road, Tikorangi [Property owner: Tikorangi Hills Trust]
Legal Description:	Lot 3 DP 15159 Pt Ngatirahiri 11A Block Blk XI Waitara SD
Catchment:	Onaero
Tributary:	Pouri

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. Prior to the exercise of this consent for each individual well to be used for deep well injection, the consent holder shall submit, to the written satisfaction of the Chief Executive, a summary geological log of the injection well, and an injection well operation management plan, to demonstrate that special condition 2 of this consent can be met. The report shall:

   a) identify the injection zone[s] using validated geological and geophysical logs;
   b) demonstrate the depth of the freshwater-saline water interface in the disposal well.
   c) provide analytical results to adequately characterise the chemistry of the connate groundwater in the injection zone and the proposed waste products to be injected, and shall include pH and concentrations of suspended solids, total dissolved solids, salinity, chlorides, and total hydrocarbons;
   d) list all system additives including biocides, fungicides, anti corrosion agents, etc, with reference to relevant Materials Safety Data Sheet or Chemwatch number.
   e) demonstrate the structural integrity of disposal well and provide a Well Engineering Completion Report Summary and;
   f) outline design and operational procedure to isolate the injection zone[s].

2. The consent holder shall ensure that the deep well injection will not contaminate or endanger any actual or potential useable freshwater aquifer.

3. The consent holder shall keep daily records of the source and volumes of all material injected and shall make these records available to the Taranaki Regional Council on request.

4. The consent holder shall monitor the injected wastes daily for pH and maximum and mean concentrations of suspended solids, total dissolved solids, salinity, chlorides and total hydrocarbons, and shall make these records available to the Taranaki Regional Council on request.

5. The consent holder shall monitor injection pressures and rates daily and shall make the records available to the Taranaki Regional Council on request, and immediately following any significant pressure change event that cannot be explained at surface, which could indicate structural failure of the integrity of the injection well and/or injection zone[s].

6. The consent holder shall at all times operate the injection regime at pressures which will not cause fracturing of the confining lithologies of the injection zone.

7. The consent holder shall provide to the Taranaki Regional Council during the month of May of each year, for the duration of the consent, a written report on all matters required under special conditions 1, 2, 3, 4 and 5 above.

8. This consent shall lapse on the expiry of five years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(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 following receipt of information required under special condition 7 above, and the month of June 2009 and/or June 2015 and/or June 2021 and/or June 2027 required 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 31 May 2006

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Consent 4182-2

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder: Todd Taranaki Limited
P O Box 802
Taranaki Mail Centre
NEW PLYMOUTH 4340

Change To Conditions Date: 22 June 2009 [Granted: 24 June 2003]

Conditions of Consent

Consent Granted: To discharge waste drilling fluids, fraccing fluids, water, produced water, stormwater and production sludges from hydrocarbon exploration and production operations by deepwell injection at the McKee-A wellsite via McKee-1 wellsite at or about (NZTM) 1715113E-5670963N

Expiry Date: 1 June 2033

Review Date(s): June 2015, June 2021, June 2027 and/or receiving notification under special condition 7

Site Location: McKee-A wellsite, Otaraoa Road, Tikorangi
[Property owner: MF & JF Osborne]

Legal Description: Pt Lot 6 DP 658 Blk XIV Waitara SD

Catchment: Waitara

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

Conditions 1 to 3 [unchanged]

1. Prior to the exercise of this consent for each individual well to be used for deepwell injection, the consent holder shall submit, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a log of the injection well, and an injection well operation management plan, to demonstrate that special condition 2 of this consent can be met. The report shall:

a) identify the injection zone, including a validated bore log and geophysical log;

b) detail the results of fluid sampled from the injection zone, and the proposed wastes to be injected for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides, composition of fraccing fluids and total hydrocarbons;

c) demonstrate the integrity of well casing;

d) outline design and operational procedure to isolate the zone; and

e) demonstrate that the integrity of the re-injection zone will be maintained.

Condition 2

2. The consent holder shall ensure that injection will not contaminate or endanger any actual or potential usable freshwater aquifer.

Condition 3

3. The consent holder shall keep records of injection activities, including injection volumes, pressure and rate, and shall make the records available to the Taranaki Regional Council on a 3 monthly basis, and when there has been a significant pressure change event.

Condition 4 [changed]

4. The consent holder shall monitor the injected wastes for the composition of fraccing fluids and for maximum and mean concentrations of pH, suspended solids, total dissolved solids, salinity, chlorides and total hydrocarbons, and shall make the records available to the Taranaki Regional Council every two months or upon request.

Condition 5 [new]

5. In the event that that production sludges are disposed of via the McKee-1 well, the discharge shall take place in general accordance with application 6271. The consent holder shall monitor the injection pressure; rate, volume, density, viscosity and solids content of the slurry; and shall make the records available to the Taranaki Regional Council every two months or upon request.

Condition 6 [previously condition 5 - changed]

6. The consent holder shall inject fluids at pressures below the pressure that would not cause the propagation of vertical fractures in the injection formation that may extend into the upper confining layers.

Condition 7 [previously condition 6 - changed]

7. The consent holder shall provide to the Taranaki Regional Council during the month of May of each year, for the duration of the consent, a written report on all matters required under special conditions 1, 2, 3, 4, 5 and 6 above.

Condition 8 [previously condition 7- unchanged]

8. This consent shall lapse on 30 June 2014, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(b) of the Resource Management Act 1991.

Condition 9 [previously condition 8- changed]

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 following receipt of information required under special condition 7 above, and the month of June 2015 and/or June 2021 and/or June 2027 required for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 22 June 2009

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Consent 5052-1

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

Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	Todd Taranaki Limited P O Box 802 NEW PLYMOUTH
Change To Conditions Date:	17 May 2007 [Granted: 13 November 1996]

Conditions of Consent

Consent Granted:	To discharge waste drilling and fraccing fluids and/or up to 3,000 cubic metres/day of produced water from hydrocarbon exploration and production operations by deepwell injection into the Matemateaonga formation via the McKee-4 well at the McKee-B wellsite at or about GR: Q19:253-335
Expiry Date:	1 June 2015
Review Date(s):	June 2003, June 2009
Site Location:	Mckee-B Wellsite, Via Otaraoa Road, Tikorangi
Legal Description:	Lot 1 DP 14374 Blk X Waitara SD
Catchment:	Onaero
Tributary:	Mangahewa

For General, Standard and Special conditions pertaining to this consent please see reverse side of this document
www.trc.govt.nz

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

Condition 1 [changed]

1. Prior to the exercise of this consent for each individual well to be used for deepwell injection, the consent holder shall submit, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a log of the injection well, and an injection well operation management plan, to demonstrate that special condition 2 of this consent can be met. The report shall:

a) identify the injection zone, including a validated bore log and geophysical log;
b) detail the results of fluid sampled from the injection zone, and the proposed wastes to be injected for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides, composition of fraccing fluids and total hydrocarbons;
c) demonstrate the integrity of well casing; and
d) outline design and operational procedure to isolate the zone
e) demonstrate that the integrity of the re-injection zone will be maintained

Condition 2 [unchanged]

2. The consent holder shall ensure that injection will not contaminate or endanger any actual or potential usable freshwater aquifer.

Condition 3 [changed]

3. The consent holder shall keep records of injection activities, including injection volumes, pressure and rate, and shall make the records available to the Taranaki Regional Council on a 3 monthly basis, and when there has been a significant pressure change event.

Conditions 4 to 7 [new]

4. The consent holder shall monitor the injected wastes daily for composition of fraccing fluids and for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides and total hydrocarbons and shall make the records available to the Taranaki Regional Council every two months.

5. The consent holder shall inject fluids at pressures below the pressure that would be required to fracture the injection formation.

6. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4624. In the case of any contradiction between the documentation submitted in support of application 4624 and the conditions of this consent, the conditions of this consent shall prevail.

7. This consent shall lapse on the expiry of five years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Condition 8 [unchanged - old condition 4]

8. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2003 and/or June 2009, 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 consent which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 17 May 2007

For and on behalf of
Taranaki Regional Council

Director-Resource Management