New Zealand Energy Corporation (NZEC)
Deep Well Injection
Monitoring Programme
Annual Report
2017-2018

Technical Report 2018-78

ISSN: 1178-1467 (Online)
Document: 2114356 (Word)
Document: 2139479 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD
November 2018

Executive summary

NZEC Waihapa Limited and Taranaki Ventures Limited subsidiaries of New Zealand Energy Corporation (the Company) operate a number of wellsites within the Taranaki Region, including the Waihapa-D, Waihapa-F and Waitapu wellsites. The Waihapa-F wellsite is located on Bird Road, Stratford. The Waihapa-D and Waitapu wellsites are located on Cheal Road, Stratford. This report for the period July 2017 to June 2018 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) in relation to the Company's deep well injection (DWI) activities. The report details the results of the monitoring undertaken, assesses the Company's environmental performance during the period under review and the environmental effects of their DWI activities.

The Company holds three resource consents, which include a total of 31 conditions setting out the requirements that the Company must satisfy. Only two of the consents were exercised during the period being reported.

During the monitoring period, the Company demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included eight site inspections, two injectate samples and four groundwater samples collected for physicochemical analysis. The monitoring programme also included a significant data review component, with all injection data submitted by the Company assessed for compliance on receipt.

The monitoring showed that the Company's DWI activities were being carried out in compliance with the conditions of the applicable resource consents. There was no evidence of any issues with any injection well or the ability of the receiving formation to accept injected fluids, during the period under review. The results of groundwater quality monitoring undertaken show no adverse effects of the activity at monitored locations. Inspections undertaken during the monitoring year found sites being operated in a professional manner and there were no Unauthorised Incidents in relation to any of the Company's DWI consents.

During the year, the Company demonstrated a high level of environmental and administrative performance with the resource consents.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the Company over the last several years, this report shows that the Company's performance remains at a generally high level.

This report includes recommendations to be implemented during the 2018–2019 monitoring period.

Table of contents

List of tables

List of figures

1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2017 to June 2018 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by NZEC Waihapa Limited and Taranaki Ventures Limited (the Company) for deep well injection (DWI) activities. During the period under review, the Company held three resource consents for the subsurface injection of fluids by DWI. The consents authorise discharges from three separate wellsites within the Company's oil and gas fields. The Waihapa-F wellsite, located near Bird Road, 6 kilometres (km) south east of Stratford and the Waihapa-D and Waitapu wellsites located on Cheal Road, Ngaere, approximately 5 km north east of Eltham.

The resource consents held by the Company permit the discharge of a range of fluids by DWI, including produced water, contaminated stormwater, drilling fluids, hydraulic fracturing (HF) fluids and production sludges. The consents include a number of special conditions which set out specific requirements the Company must satisfy.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the DWI consents held by the Company. This is the sixth report to be prepared by the Council to cover the Company's DWI discharges and their effects.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the Company for DWI activities;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted by the Company.

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

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

Section 4 presents recommendations to be implemented in the 2018-2019 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and
e. risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self-reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;

- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self-reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self-reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

1.2 Process description

The process of DWI involves injecting fluids deep underground into geological formations which are confined from overlying groundwater aquifers by low permeability strata. Injection wells are also designed and constructed to provide multi barrier protection against contaminant migration to groundwater systems.

The subsurface injection of fluids by DWI is often used as a method for disposing of waste fluids generated during oil and gas exploration and production activities. The greatest volume of waste fluids generated through these activities is saline water (brine) that is drawn to the surface with hydrocarbons through producing wells ('produced water'). The DWI consents currently held by the Company also authorise the injection of fluid types other than produced water. The range of fluid types authorised for injection varies by consent, but includes contaminated stormwater, well drilling fluids, HF fluids and HF return fluids.

In addition to providing a means to dispose of waste fluids, the subsurface injection of fluids by DWI is also an established oilfield technique for regulating reservoir pressure as a means of enhancing the rate of hydrocarbon recovery from a reservoir. This process, commonly referred to as water flooding, is often implemented when natural reservoir pressures become reduced due to ongoing production. Fluids can also be heated prior to injection to reduce the viscosity of the oil being produced, improving its flow toward a producing well and upward through the wellbore itself.

The Company has one water flooding programme, undertaken at the Waitapu wellsite under consent 10086-1 to enhance oil production from its Copper Moki wellsite, also located on Cheal Road.

A schematic representation of injection wells for both waste discharge and enhanced oil recovery is presented in Figure 1.

Further details regarding hydrocarbon exploration and production in Taranaki, the DWI process and its history within region can be found in previous compliance reports published by the Council (see Bibliography).

Figure 1 DWI schematic (www.epa.gov/uic)

1.3 Resource consents

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

The Company held three discharge consents, summarised in the table below, covering their DWI activities during the review period. Two of the three consents were exercised during the 2017-2018 monitoring year (Table 1).

Table 1 Consents held by the Company during the review period

Consent Number	Wellsite	Status	Injection Well(s)	TRC bore id.	Formation	Issued	Expiry
3688-2	Waihapa-D	Not active	Waihapa-5	GND1752	Tikorangi	03/09/2013	01/06/2034
4094-2	Waihapa-F	Active	Waihapa-7A	GND1634	Matemateaonga	03/09/2013	01/06/2028
10086-1	Waitapu	Active	Waitapu-2	GND2529	Mt Messenger	31/03/2015	01/06/2034

Consent **3688-2** was issued to the Company by the Council on 3 September 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2034. The consent authorises the discharge of waste fluids by DWI at the Waihapa-D wellsite, Cheal Road, Stratford (Figure 2).

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

- Conditions 1, 3 and 4 refer to the Company's process monitoring and data submission requirements;
- Condition 2 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Condition 5 limits injection pressures to those which do not fracture the injection formation;
- Condition 6 is a lapse clause; and
- Condition 7 is a consent review provision.

Consent **4094-2** was issued to the Company by the Council on 3 September 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2028. The consent authorises the discharge of waste fluids via the Waihapa-7A well at the Waihapa-F wellsite, Bird Road, Stratford (Figure 2).

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

- Condition 1 states that the well shall operate in accordance with the "Origin Energy Resource NZ Limited – Deep Well Injection Management Plan;
- Condition 2 sets a maximum allowable injection pressure of 85 bar (1,232 psi);
- Condition 3 requires the Company adopt the best practicable option as defined in Section 2 of the RMA;
- Conditions 4 and 5 refer to the Company's process monitoring and data submission requirements; and
- Condition 6 is a review provision.

Consent **10086-1** was issued by the Council on 31 March 2015 under Section 87(e) of the RMA. It is due to expire on 1 June 2034. The consent authorises the discharge of waste fluids via the Waitapu-2 well at the Waitapu wellsite on Cheal Road, Stratford, for water flooding purposes (Figure 2).

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

- Condition 1 requires the consent holder to submit a "Injection Operation Management Plan" prior to exercising the consent;
- Condition 2 refers to injection well and subsurface information required for submission;
- Condition 3 limits the injection pressure to below 689 psi;
- Condition 4 stipulates that there shall be no injection after 1 June 2029;
- Condition 5 requires the best practicable option to be adopted for fluid injection;
- Condition 6 limits the injection of fluids to the Mount Messenger Formation, below 1,800 m TVD;
- Condition 7 prohibits the discharge resulting in fracturing of the geological seals confining the injection zone;

- Condition 8 prohibits the discharge from resulting in any contaminants reaching any useable freshwater resources;
- Conditions 9, 10, 11 and 12 refer to process monitoring and data submission requirements;
- Conditions 13, 14 and 15 refer to local groundwater quality monitoring requirements;
- Condition 16 stipulates the annual reporting requirements;
- Condition 17 is a lapse provision; and
- Condition 18 is a review condition.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which are appended to this report (Appendix I).

Figure 2 shows the location of the DWI consents held by the Company during the period under review.

Figure 2 Location of the DWI consents held by the Company during the period under review

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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

The monitoring programme for the Company's DWI sites consisted of five primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The Company's Waihapa-D and Waitapu wellsites were visited once and the Company's Waihapa-F wellsite, located adjacent to the Waihapa Production Station (WPS), was visited six times during the monitoring period. With regard to consents for DWI activities, the main points of interest are general housekeeping and any processes with potential or actual discharges, including any surface water runoff, and their receiving environments.

An additional two visits to the Company's WPS and one visit to Waitapu wellsite were undertaken by Council Officers for injectate sampling purposes, as outlined in Section 1.4.4.

1.4.4 Injectate sampling

Injectate samples were obtained for analysis in the Council's IANZ accredited laboratory on two occasions from the WPS and on one occasion from the Waitapu wellsite during the monitoring period. 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.

Injectate samples were collected from the bulk storage tanks at the WPS, identified on-site as tank T206A and T206B, and produced water storage tank at the Waitapu wellsite (Figure 3). The injectate samples were analysed for the following parameters:

- pH;
- conductivity;
- suspended solids;
- chlorides; and
- total petroleum hydrocarbons.

1.4.5 Groundwater sampling

Groundwater samples were obtained on two occasions during the monitoring period. This sampling is a continuation of the groundwater monitoring component of this programme which was initiated during the 2012-2013 monitoring period, when consent 4094-2 was still held by Origin Energy New Zealand (TAWN) Limited.

The programme consists of sampling one groundwater monitoring bore in the vicinity of the Waihapa-F wellsite and one groundwater bore, specifically installed by the Company, in the vicinity of the Waitapu wellsite.

Details of the groundwater monitoring sites included in the current monitoring programme are listed below in Table 2. The location of the groundwater sites in relation to the injection well being monitored are illustrated in Figure 3.

Table 2 Location of groundwater monitoring sites

Site code	Wellsite	Type	Distance from wellsite (m)	Screened/open depth (m)	Drilled depth (m)	Groundwater level (m bmp)	Aquifer	Sample method
GND1031	Waihapa-F	Bore	748	220-303	303.8	26.0	Matemateaonga	Tap
GND2528	Waitapu	Bore	41	38-50	50.3	5.8	Volcanics	Bladder

Note: m bmp- metres below measuring point

Groundwater samples taken by the Council were sent on behalf of the Company to Hill Laboratories Limited (Hills) and analysed for a range of parameters including the following:

- pH;
- conductivity;
- chlorides; and
- total petroleum hydrocarbons.

The parameters above are deemed sufficient to enable identification of any significant changes in groundwater quality related to DWI activities.

In addition, baseline samples have been collected from all monitored sites and analysed by Hills for general ion chemistry, BTEX and dissolved gas concentrations. These more detailed analyses will allow a more in depth assessment of variations in groundwater composition should the need arise in the future.

Figure 3 Location of monitoring sites in relation to the Company's DWI wellsites

1.4.6 Assessment of data submitted by the Company

A significant component of the monitoring programme is the assessment of consent holder submitted data. The Company is required to submit a wide range of data under the conditions of their DWI consents.

As required by the conditions of each consent, the Company has submitted an Injection Operation Management Plan for each active injection well. The plans are 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 Company was also required to submit well construction details, an assessment of the local geological environment, results of well integrity testing and details of the proposed monitoring plan for the injection well.

The Company is also required to maintain continuous records of injection volumes and average and maximum injection pressures, and to characterise the chemical characteristics of all waste types being discharged. This data is submitted to the Council on a monthly basis where it is assessed for compliance against the relevant consent conditions.

2 Results

2.1 Inspections

The routine inspections undertaken at each active wellsite during the monitoring year, included undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment. The inspecting officer concluded that the wellsites were in good condition and being well managed.

Additional inspections were also undertaken during the monitoring year, for the purpose of injectate sampling. No issues were noted by staff during these visits.

2.2 Injectate monitoring

Samples of injectate were obtained from the Company's storage tanks at the WPS on 9 October 2017 and 27 April 2018. A sample was also obtained from the produced water storage tank at the Waitapu wellsite on 27 April 2018. The samples were submitted to the Council's laboratory on the same day for physicochemical analysis. Injectate samples are generally a composite of waste water from the Company's wellsites, third party wellsites and other production facilities.

During the 2017-2018 monitoring period injectate stored in the WPS bulk storage tanks was made up of a mixture of NZEC and third party produced fluids. Sources included the Waihapa, Rimu, Kupe, Cheal and Kapuni production stations, the STOS Omata Tank Farm and the Ahuroa Gas Storage Facility.

Injectate trucked to the Waitapu wellsite at the time of sampling contained produced water sourced from the WPS and Copper Moki Reservoir.

The results of the sample analyses undertaken by the Council are included below in Table 3 and Table 4. The range of results for each analyte since sampling commenced is also presented for comparison. The Company is required by consent conditions to undertake additional injectate sampling on each waste stream arriving on site for discharge. A range of the results from the Company's sampling programme are presented in Table 5.

The concentrations of each analyte measured over the 2017-2018 period are within the expected range for injectate samples at these sites.

Table 3 Results of injectate sampling undertaken by the Council at the WPS

Parameter	Unit	Waihapa Production Station (WPS)			
		Minimum	Maximum	Tanks T206A and T206B	
Date		2004 - 2018		09-Oct-17	27-Apr-18
Time	NZST	-	-	12:45	1:45
TRC sample number	-	-	-	TRC173478	TRC182054
pH	pH Units	6.0	9.0	9.0	7.0
Alkalinity	g/m^3 $CaCO_3$	162	5,580	-	4,540
Conductivity	mS/m @ 20^0C	1,560	4,050	3,800	3,820
Chloride	g/m^3	5,900	69,200	14,200	13,600
Total petroleum hydrocarbons	g/m^3	11	4,600	1,700	84
Suspended solids	g/m^3	24	360	-	56

Table 4 Results of the injectate sampling undertaken by the Council at the Waitapu wellsite

Parameter	Unit	Waitapu wellsite		
		Waitapu tank		
Date		22-Jun-07	30-Jun-08	27-Apr-18
Time	NZST	-	13:30	14:15
TRC sample number	-	-	-	TRC182055
pH	pH units	7.7	7.3	7.5
Alkalinity	g/m^3 $CaCO_3$	3,720	4,210	2,500
Conductivity	mS/m @ 20^0C	3,560	3,280	3,660
Chloride	g/m^3	14,600	14,200	1,520
Total petroleum hydrocarbons	g/m^3	900	160	23
Suspended Solids	g/m^3	-	37	24

Table 5 Results of the Company's monthly injectate sampling (2017-2018)

Parameter	Location	Waihapa and Waitapu injectate samples	
		Minimum	Maximum
Date	Unit	July 2017-June 2018	
pH	pH units	5.9	7.5
Conductivity	mS/m	24	5,570
Salinity	ppt	6.7	28.3
Chloride	g/m^3	5,500	21,000
Total petroleum hydrocarbons	ppm	25	2,075
Suspended solids	g/m^3	12	682

2.3 Groundwater sampling

Groundwater samples were obtained from one site located in the vicinity of the Waihapa-F wellsite (GND1031) and one site in the vicinity if the Waitapu wellsite (GND2528) on 9 October 2017 and 27 April 2018.

All groundwater samples were collected following standard groundwater sampling methodologies and generally in accordance with the National Protocol for State of the Environment Groundwater Sampling in New Zealand (2006). The samples from GND2528 were taken using a low flow bladder pump and the samples from GND1031 were taken from an outlet tap, as this bore is pumped and there is no direct access to the well head.

The results of analyses carried out during the monitoring period compared to historical concentrations are set out below in Tables 6 and 7.

The results show there have been no significant changes in groundwater composition at either site. This is demonstrated by the relatively narrow ranges between minimum and maximum analyte concentrations recorded since monitoring commenced. The subtle variation in analyte concentrations at each site are a result of natural seasonal fluctuation and sampling variability.

Table 6 Results of groundwater sampling undertaken in relation to the Waihapa-F wellsite

Sample details	Units	GND1031			
TRC sample number	-	Minimum	Maximum	TRC173479	TRC182058
Sample date	-	July 2012-June 2018		09-Oct-17	27-Apr-18
Sample time	NZST	-	-	13:10	13:38
pH	pH units	7.8	8.1	8.0	8.1
Electrical conductivity	mS/m@20°C	33.2	39.0	34.0	34.0
Chloride	g/m^3	10.8	13.1	11.4	11.6
Total hydrocarbons	g/m^3	<0.5	<0.7	<0.5	<0.5

Table 7 Results of groundwater sampling undertaken in relation to the Waitapu wellsite

Sample details	Units	GND2528			
TRC sample number	-	Minimum	Maximum	TRC173945	TRC182059
Sample date	-	July 2015-June 2018		07-Nov-17	27-Apr-18
Sample time	NZST	-	-	9:15	14:45
pH	pH units	7.0	7.3	7.0	7.3
Electrical conductivity	mS/m@20°C	42.9	47.4	42.9	43
Chloride	g/m^3	12.6	14.2	13.8	14.2
Total hydrocarbons	g/m^3	<0.7	<0.5	<0.5	<0.5

2.3.1 Provision of consent holder data

The Company provided records of their injection activities during the 2017-2018 monitoring period, including daily injection volumes, pumping duration and maximum and average injection pressures. All data was provided within the consented timeframes, with the exception of the annual report required for consent 10086-1, due for submission by 31 August, which was provided late.

Table 8 provides an overview of the Company's injection activities across all consents during the monitoring period. Figure 4 to Figure 7 present the data graphically.

Table 9 provides an overview of the Company's injection activities across all consents since 2013 and Table 10 and Table 11 provide a summary of the historical data for each active consent. The Company's historical data is also presented graphically in Figure 8 to Figure 11.

The majority of discharge during the review period was undertaken at the Waihapa-F wellsite via the Waihapa-7A well under consent 4094-2. Waihapa-F is utilised for the disposal of waste fluids from both the Company's production facilities and those of other third party sites. Injection at the Waitapu wellsite is undertaken to enhance hydrocarbon production within the Copper Moki Formation, therefore discharge volumes are dictated by the requirements of the water flood programme. No discharge was undertaken via the Waihapa-5 well located at the Waihapa-D wellsite.

All injection remained within consented limits with one exception. Pressure within the Waitapu-2 well exceeded the limit of 689 psi slightly, on 1 August 2017. When the exceedance was recorded, the operations team were immediately contacted, and a number of operational changes were made to bring the pressure down including:

- Adjusting the relief valve (it was set a little high);
- Reducing the injection rate; and
- Changing to a (generally) 24 hour operation.

The actions undertaken enabled injection of the same or similar volumes to continue, at a lower rate over a slightly longer time period and resulted in a more uniform injection pressure within the well.

Overall, more fluids have been injected by the Company over the monitoring period than in previous years.

A visual assessment of the data presented indicates that the volume of fluid being injected under consent 4094-2 increased during the summer months and decreased during the winter months. In contrast, injection at Waitapu under consent 10086-1 was lower during the summer months, with no injection undertaken during December 2017.

The data also suggests that maximum well head pressures at both wellsites fluctuate with higher pressures correlating with more sustained periods of injection.

Table 8 Summary of injection activity during the 2017-2018 monitoring year

Consent	Wellsite	Injection well	Total volume discharged (m3) 01/07/17 – 30/06/18	Discharge period		Well ID
				From	To	
3688-1	Waihapa-D	Waihapa-5	No injection	-	-	GND1752
4094-1	Waihapa-F	Waihapa-7A	342,804.03	01/07/2017	30/06/2018	GND1684
10086-1	Waitapu	Waitapu-2	8,711.83	01/07/2017	30/06/2018	GND2529
Total			**351,515.85**	-	-	-

Table 9 Summary of the Company's historical injection activity since 2013

Period	Total volume discharged (m^3)	Period	Total volume discharged (m^3)
2017-2018	351,516	2014-2015	208,077
2016-2017	349,661	2013-2014	104,967
2015-2016	205,245	-	-

*Note *prior to 2013 consents (3688 and 4094) were held by Origin Energy Resources*

Table 10 Summary of injection occurring under consent 4094-2 (2013-2018)

Waihapa-F Consent 4094-2					
Period	Annual volume (m3)	Max. injection volume (m3/day)	Max. injection rate* (m3/hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
Consent limit	-	-	-	85.0	-
2017-2018	342,804	1,549	89	81.3	50
2016-2017	329,395	2,199	92	84.0	64
2015-2016	194,609	1,049	93	73.0	55
2014-2015	208,077	1,770	82	85.5	43
2013-2014*	104,967	1,632	97	82.0	44

*Note *the 2013-2014 period consisted of 8 months and the maximum injection rate is the maximum average rate per hour.*

Table 11 Summary of injection occurring under consent 10086-1 (2016-2018)

Waitapu Consent 10086-1					
Period	Annual volume (m^3)	Max. injection volume (m^3/day)	Max. injection rate (m^3/hr)	Max. injection pressure (psi/bar)	Avg. injection pressure (bar)
Consent limit	-	-	-	689	-
2017-2018	8,712	63	-	696	11.3
2016-2017	20,266	104	-	653	16.2
2015-2016	10,636	105	-	218	7.3

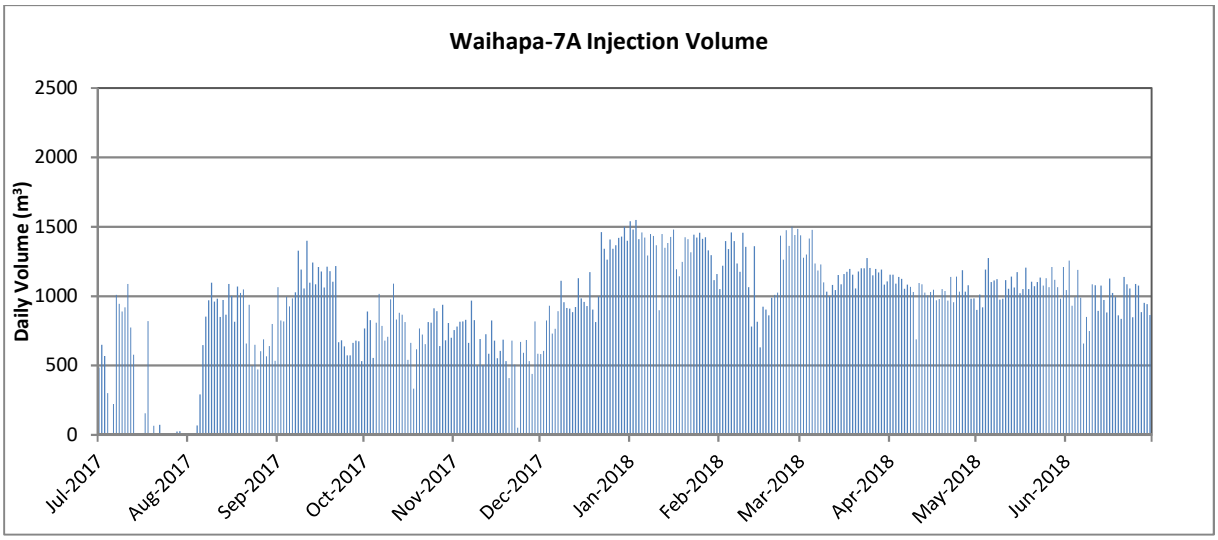

Figure 4 Daily injection volume consent 4904-2 (2017-2018)

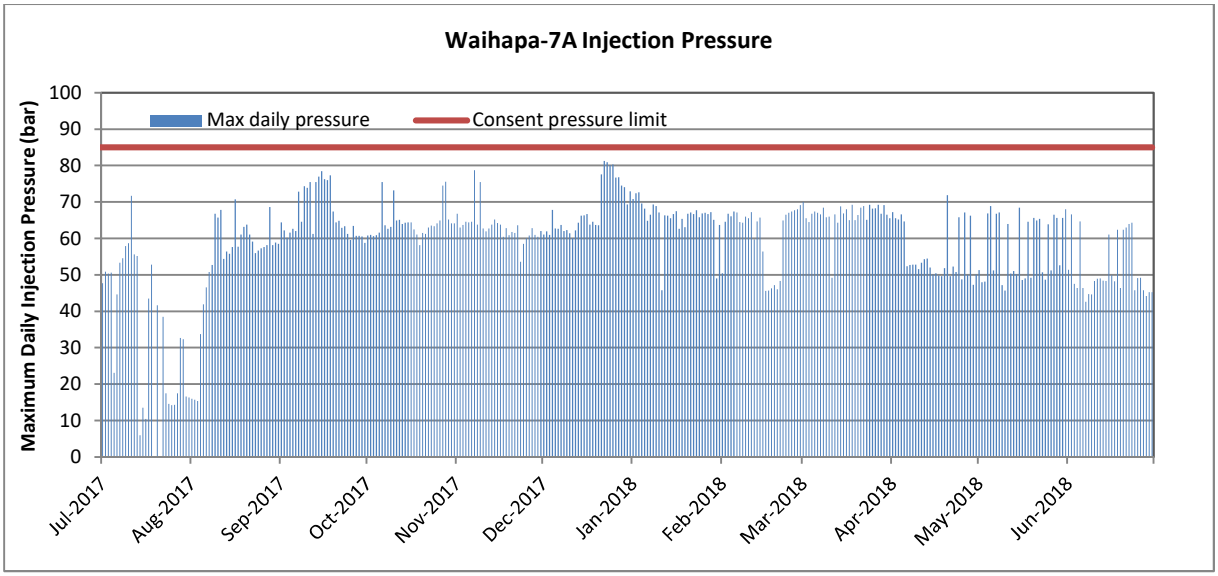

Figure 5 Daily maximum injection pressure 4094-2 (2017-2018)

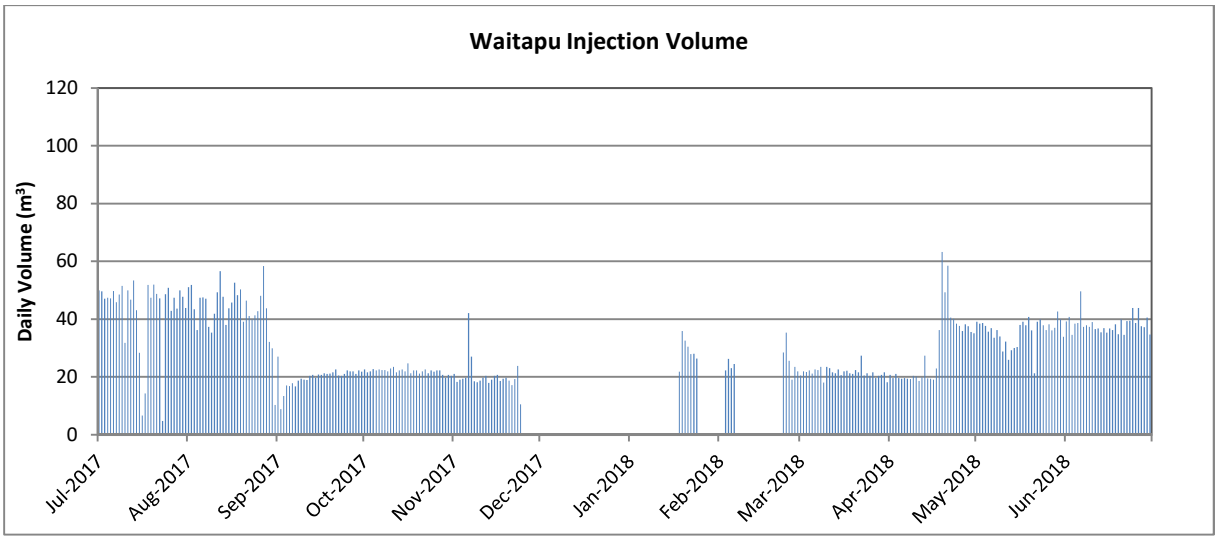

Figure 6 Daily injection volume consent 10086-1 (2017-2018)

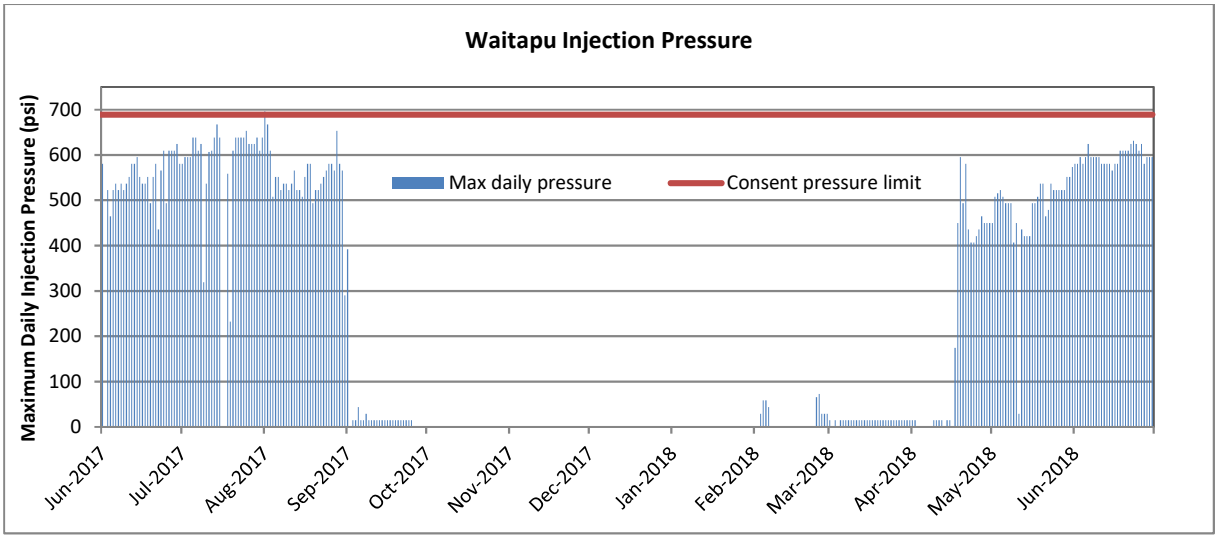

Figure 7 Daily maximum injection pressure 10086-1 (2017-2018)

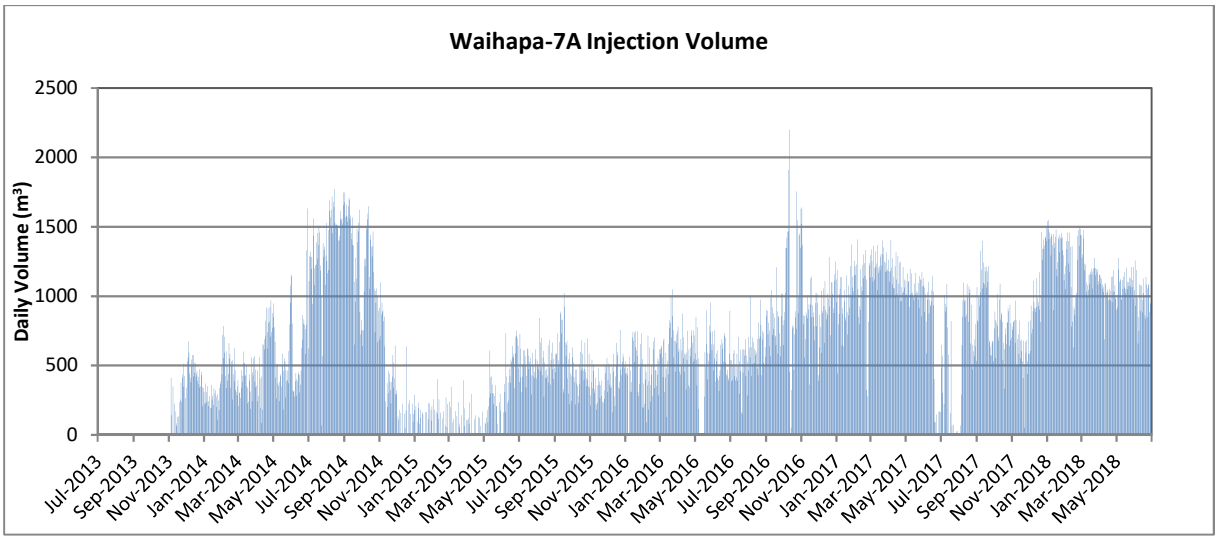

Figure 8 Daily injection volume consent 4094-2 (2013-2018)

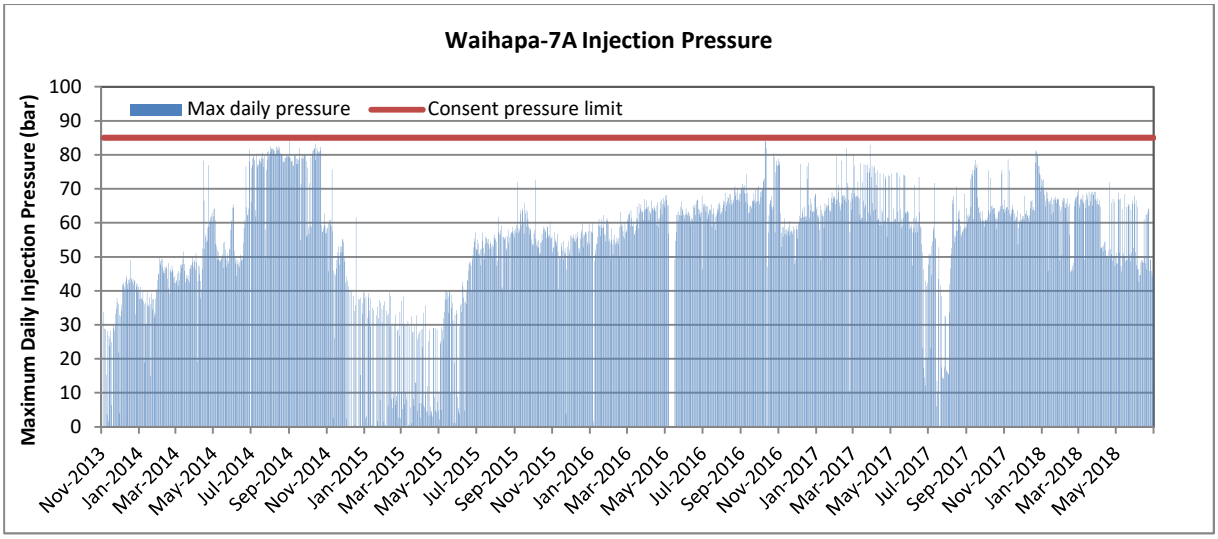

Figure 9 Daily maximum injection pressure consent 4094-2 (2013-2018)

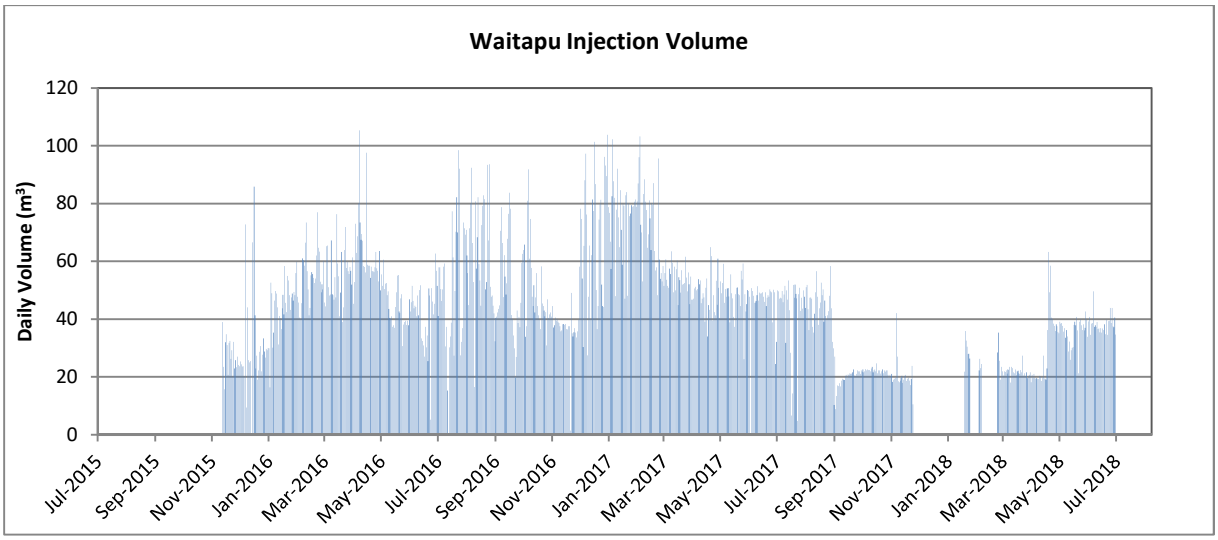

Figure 10 Daily injection volume consent 10086-1 (2015-2018)

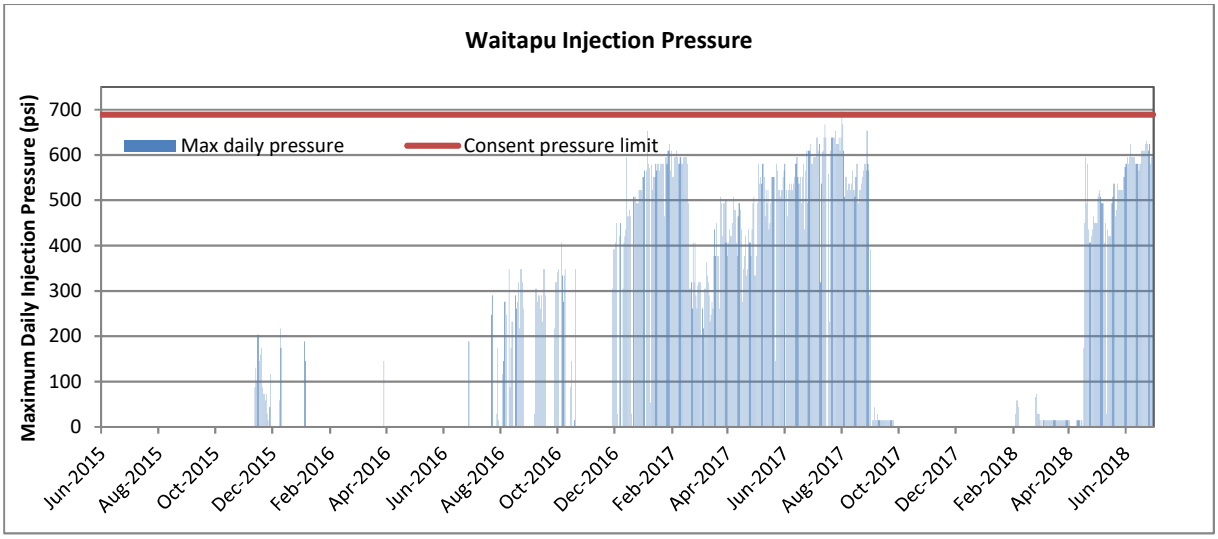

Figure 11 Daily maximum injection pressure consent 10086-1 (2015-2018)

2.4 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the 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 2017-2018 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3 Discussion

3.1 Discussion of site performance

During the period under review, the Company exercised two resource consents for the injection of fluids by DWI (4094-2 and 10086-1). Consent 4094-2 authorises the injection of fluids into the Matemateaonga Formation and consent 10086-1 authorises injection of fluids into the Mt Messenger Formation below 1,800 m TVD. No injection was undertaken at the Waihapa-D wellsite under consent 3688-2 during the period under review.

The Waihapa-F and Waitapu injection wells are fitted with engineering controls and in built safety systems to protect the wellbore against any process or subsurface related failures. In the event of any sudden pressure losses or increases, safety systems isolate the wellbore and shut down the injectate pumping system.

The operation of the injection well is monitored by Company staff, with automated systems recording the injection data required under the conditions of their consent. Throughout the monitoring period this data was submitted to the Council at the specified frequency.

A review of the 2017-2018 injection data provided by the Company shows a total of:

- No fluid was injected under consent 3688-2.;
- 342,804 m3 of fluid was injected under 4094-2; and
- 8,712 m3 of fluid was injected under 10354-1.

The overall volume injected increased slightly since last year. The data also shows that the maximum daily volume injected was 1,549 m^3 for consent 4094-2 and 63.3 m^3 for consent 10086-1. These occurred on 3 January 2018 and 19 April 2018 respectively. The maximum daily injection pressure recorded during the period under consent 4094-2 was 81 bar on 22 December 2017 and under 10086-1 was 696 psi (48 bar) on 1 August 2017. The maximum injection pressures recorded under consent 10086-1 exceeded the limit of 689 psi slightly. The operational changes undertaken quickly rectified the problem and no further actions were deemed necessary.

An assessment of the injection data record over the lifetime of consent 4094-2 (2013-2018) shows that the daily volumes of fluid being injected under consent 4094-2 appear to increase during the winter months and decrease during the summer months and that higher injection pressures correlate to increases in the injection. Volumes and pressure at the Waitapu wellsite (10086-1) fluctuate in response to the requirements of the water flooding programme which is designed to enhance production at the Copper Moki wellsite.

Routine inspections of the Company's wellsites conducted during the period under review found them to be in good condition and being well managed. No complaints were received from the public in relation to these consents.

3.2 Environmental effects of exercise of consents

To date, no adverse environmental effects have been recorded by the Council in relation to any DWI consent exercised by the Company.

The groundwater monitoring component of this programme continued during the period under review, with two samples being taken from monitoring sites in the vicinity of the Company's active injection wells. The results of the monitoring carried out show that the groundwater composition at each site has remained stable since the commencement of monitoring. Some very minor fluctuations in analyte concentrations are attributable to seasonal variations in water composition and standard sampling variability. There is no

evidence to suggest that injection activities undertaken by the Company during the review period have had any adverse effect on local groundwater quality.

All results are within the ranges expected for shallow Taranaki groundwater and indicate that there has been no contamination by DWI fluids.

Compliance with the conditions of the Company's DWI consents exercised during the 2017-2018 monitoring period is summarised below in Section 3.3.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 12 to 14 and an evaluation of the Company's environmental performance in relation to their DWI activities since 2009 is presented in Table 15.

Table 12 Summary of performance for consent 3688-2

Purpose: ***To discharge produced water, contaminated stormwater, water based drilling fluids and hydraulic fracturing fluids, including return fluids, by deep well injection into the Matemateaonga Formation***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder must operate in accordance in Injection Operation Management Plan.	Receipt of satisfactory information	Yes
2. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh groundwater.	Assessment of injection records and results of groundwater sampling and analysis programme.	N/A
3. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
4. Chemical analysis of discharge and submission to the Council	Receipt of discharge analysis results	Yes
5. The injection of fluids shall not fracture any overlying geological seal.	Review and analysis of injection data.	N/A
6. Lapse condition	Consent exercised	Yes
7. Review provision	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Not exercised**
Overall assessment of administrative performance in respect of this consent		**Not exercised**

Table 13 Summary of performance for consent 4094-2

Purpose: ***To discharge produced water, contaminated stormwater, water based drilling fluids and hydraulic fracturing fluids, including return fluids, by deep well injection into the Matemateaonga Formation***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder must operate in accordance in Injection Operation Management Plan.	Receipt of satisfactory information	Yes
2. Injection pressure must not exceed 85 Bar (1232 PSI)	Assessment of consent holder records	Yes
3. Consent holder shall at all times adopt best practicable option (BPO to prevent and/or minimise environmental impact)	Assessment of consent holder records and site inspection results	Yes
4. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
5. Chemical analysis of discharge and submission to the Council	Receipt of discharge analysis results	Yes
6. Review provision	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 14 Summary of performance for consent 10086-1

Purpose: ***To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Before exercising the consent the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan".	Yes
2. Injection well, geological and operational data submission requirements. This information can be included in the "Injection Operation Management Plan."	Receipt of satisfactory information.	Yes
3. The injection pressure at the wellhead shall not exceed 689 psi.	Review and analysis of injection data.	No (exceedance 1 August 2017)

Purpose: *To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
4. No injection permitted after 1 June 2029.	Assessment of injection records and site inspection notices.	N/A
5. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
6. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1,800 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
7. The injection of fluids shall not fracture any overlying geological seal.	Review and analysis of injection data.	Yes
8. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water).	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
9. Maintain full records of injection data.	Receipt and assessment of injection data.	Yes
10. Maintain records and undertake analysis to characterise each type of waste arriving on-site for discharge.	Receipt and assessment of injection data.	Yes
11. If the analysis required by condition 10c is not carried out in a accredited laboratory sampling shall be undertaken in accordance with a certified Quality Assurance Plan.	Sampling undertaken by the Council, and submitted to an accredited laboratory.	Yes
12. The data required by conditions 9 & 10 above, for each calendar month, is required to be submitted by the 28th day of the following month.	Receipt of satisfactory data by the date specified.	Yes
13. The consent holder shall undertake a programme of sampling and testing (the 'Monitoring Programme') that monitors the effects of the exercise of this consent on fresh water resources.	Monitoring Programme submitted to the Chief Executive, Taranaki Regional Council, for certification.	Yes

Purpose: *To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
14. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for: • pH • conductivity • chloride; and • total petroleum hydrocarbons	Implementation of Groundwater Monitoring Programme and assessment of results.	Yes
15. All groundwater sampling and analysis shall be undertaken in accordance with a Sampling and Analysis Plan, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken.	Receipt of Sampling and Analysis Plan prior to first round of sampling being undertaken.	Yes
16. The consent holder shall provide to the Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period.	Receipt of satisfactory report by 31 August each year.	No (report was provided late)
17. The consent will lapse on 31 March 2020 unless the consent is exercised before that date	Consent exercised.	Yes
18. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**Good**

During the year, the Company demonstrated a high level of environmental and good- high level of administrative performance with the resource consents as defined in Section 1.1.4.

Table 15 Evaluation of environmental performance over time

Year	Consent number	High	Good	Improvement required	Poor
2016-2017	3688*				
	4094	1			
	10086	1			
2015-2016	3688*				
	4094	1			
	10086	1			
2014-2015	3688*				
	4094	1			
2013-2014	3688*				
	4094	1			
Totals		4			

*Note * not exercised during monitoring period*

3.4 Recommendations from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

1. THAT monitoring of consented activities in the 2017-2018 year continues at the same level as in the 2016-2017 monitoring period.
2. THAT there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

The recommendations above were implemented during the period under review

3.5 Alterations to monitoring programmes for 2018-2019

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed the range of monitoring carried out during the 2017-2018 period be continued during the 2018-2019 monitoring period. Recommendations to this effect are included in Section 4 of this report.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme

from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

3.6 Exercise of optional review of consent

Resource consent 10086-1 provides for an optional review in June 2019. Condition 18 allows the Council to review the consent, if there are grounds that "the conditions are not adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were either not foreseen at the time the application was considered or which was not appropriate to deal with at the time".

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

4 Recommendations

1. THAT in the first instance, monitoring of consented activities in the 2018-2019 year continue at the same level as in 2017-2018.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
3. THAT the option for a review of resource consents in June 2019, as set out in the respective consent conditions not be exercised.

Glossary of common terms and abbreviations

The following abbreviations and terms may be 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.
BPO	Best practicable option
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/m3).
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.
Fracture gradient	A measure of how the pressure required to fracture rock in the earths crust changes with depth. It is usually measured in units of "pounds per square inch per foot" (psi/ft) and varies with the type of rock and the strain of the rock.
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).
Hydraulic fracturing (HF)	The process of increasing reservoir permeability by injecting fluids at pressures sufficient to fracture rock within the reservoir (“fracking”).
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.
IR	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.
L/s	Litres per second.
m bgl	Metres below ground level.
M bmp	Metres below measuring point.
mS/m	Millisiemens per metre.
m TVD	Metres true vertical depth
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).
UI	Unauthorised Incident.
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.

For further information on analytical methods, contact a Scientific Services Manager.

Bibliography and references

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 (2017). NZEC Waihapa Limited Deep Well Injection Monitoring Programme Annual Report 2016-2017. Technical report 2017-25. Document number 1854235.

Taranaki Regional Council (2016). NZEC Waihapa Limited Deep Well Injection Monitoring Programme Annual Report 2015-2016. Technical report 2016-59. Document number 1767625.

Taranaki Regional Council (2015). NZEC Waihapa Limited Deep Well Injection Monitoring Programme 2014-2015 Technical report 2015-12. Document number 1545855.

Taranaki Regional Council (2015). NZEC Waihapa Limited Deep Well Injection Monitoring Programme Annual Report 2013-2014. Technical report 2014-96. Document number 1468314.

Taranaki Regional Council (2012). Origin Energy Resources New Zealand Limited Deep Well Injection Monitoring Programme Triennial Report (2009-2012). Technical report 2011-85. Document number 1114242.

Appendix I

Resource consents held by NZEC Waihapa Ltd and Taranaki Ventures Ltd

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

Discharge Permit

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

Name of Consent Holder:	NZEC Waihapa Limited P O Box 8440 NEW PLYMOUTH 4342
Decision Date (Change):	3 September 2013
Commencement Date (Change):	3 September 2013 (Granted: 23 June 2003)

Conditions of Consent

Consent Granted:	To discharge waste drilling fluids, produced water, hydraulic fracturing fluids, including return fluids, and stormwater from hydrocarbon exploration and production operations by deepwell injection at the Waihapa-D wellsite
Expiry Date:	1 June 2034
Review Date(s):	June 2016, June 2022, June 2028
Site Location:	Waihapa-D wellsite, Cheal Road, Ngaere, Stratford (Property owner: A & J Moore)
Legal Description:	Lot 1 DP 17294 Blk VII Ngaere SD (Discharge source & site)
Grid Reference (NZTM)	1718010E-5638199N
Catchment:	Patea

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

General conditions

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

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

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

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

Special conditions

1. 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 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, and total hydrocarbons;
   c) demonstrate the integrity of well casing; and
   d) outline design and operational procedure to isolate the zone.

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

3. The consent holder shall keep daily records of the amounts of all material injected, including injection pressure and rate, and shall make the records available to the Taranaki Regional Council on a 12 monthly basis, and when there has been a significant pressure change event.

4. The consent holder shall monitor the injected material monthly, and upon the request of the Taranaki Regional Council. Concentrations of suspended solids, total dissolved solids, salinity, chlorides, total hydrocarbons, and pH shall be monitored and the records made available to the Taranaki Regional Council on a 12 monthly basis.

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

6. 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.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent, by giving notice of review during the month following receipt of information required under special conditions 3 and 4 above, and the month of June 2010 and/or June 2016 and/or June 2022 and/or June 2028 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 1 November 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	NZEC Waihapa Limited P O Box 8440 NEW PLYMOUTH 4342
Decision Date (Change):	3 September 2013
Commencement Date (Change):	3 September 2013 (Granted: 10 September 2010)

Conditions of Consent

Consent Granted:	To discharge produced water, contaminated stormwater, water based drilling fluids and hydraulic fracturing fluids, including return fluids, by deepwell injection into the Matemateaonga Formation
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Waihapa-F wellsite, 7 Bird Road, Stratford
Legal Description:	Sec 10 Blk III Ngaere SD (Discharge source & site)
Grid Reference (NZTM)	1717193E-5642014N
Catchment:	Patea
Tributary:	Ngaere

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall operate the well in accordance with the "Origin Energy Resources NZ Limited - Deep Well Injection Management Plan" dated June 2010. In particular, Section 7 of the plan (page 11) which identifies the conditions that would trigger concerns about the integrity of the well, or the injection zone, and the action to be taken by the consent holder if trigger conditions are reached.

2. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 85 bars (1,232 PSI).

3. 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; in particular, ensuring that the injection material is contained within the injection zone.

4. The consent holder shall keep daily records of:

   a) maximum injection pressure;
   b) maximum and average rate of injection; and
   c) volume of fluid injected;

   during operation of the well. These records shall be provided to the Taranaki Regional Council at the end of each month.

5. The consent holder shall measure and record the following constituents of the discharge at the end of each month:

   a) pH;
   b) suspended solids concentration;
   c) temperature;
   d) salinity;
   e) chloride concentration; and
   f) total hydrocarbon concentration.

   The consent holder shall provide to Taranaki Regional Council, during the month of May of every year, a summary of all records collected in accordance with this condition. The consent holder must also provide any details on the major changes in characteristics or sources of injected fluid.

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 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.

Signed at Stratford on 1 November 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Taranaki Ventures Limited PO Box 8440 New Plymouth 4342
Decision Date:	31 March 2015
Commencement Date:	31 March 2015

Conditions of Consent

Consent Granted:	To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for waterflooding purposes at the Waitapu wellsite
Expiry Date:	1 June 2034
Review Date(s):	June annually
Site Location:	Waitapu wellsite, 326 Cheal Road, Ngaere (Property owner: WK Slattery)
Legal Description:	Secs 49, 73, 75, 80, 81 Blk VI Ngaere SD (Discharge source & site)
Grid Reference (NZTM)	1715783E-5637623N
Catchment:	Patea
Tributary:	Ngaere

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. Before exercising this consent, the consent holder shall submit an "Injection Operation Management Plan." The plan shall include the operational details of the injection activities and identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plan shall also detail the action(s) to be taken by the consent holder if trigger conditions are reached.

2. Before exercising this consent, the consent holder shall provide to the Chief Executive, Taranaki Regional Council:

   a) a geological assessment of the environment in which the well is located, including the injection zone, the geological seals confining the injection zone and any associated faulting;
   b) details of the injection well design and its structural integrity;
   c) an assessment of the suitability of the injection well for the proposed activity;
   d) details of how the integrity of the injection well will be monitored and maintained;
   e) confirmation of the depth to which fresh water resources, as defined in condition 8, are encountered below the site; and
   f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids concentration, and also demonstrates that the mixing of formation and injection fluids will not result in any adverse effects on the receiving formation or the injection well.

   (Note: The information required by condition 2 may be included within the "Injection Operation Management Plan" required by condition 1).

3. The injection pressure at the wellhead shall not exceed 689 psi.

4. There shall be no injection of any fluids after 1 June 2029.

5. 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.

6. The injection of fluids shall be confined to the Mount Messenger Formation, and be injected at a minimum depth of 1,800 metres true vertical depth below ground level.

7. The consent holder shall ensure that the discharge authorised by this consent does not result in the fracturing of the geological seals confining the injection zone.

8. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Useable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.

9. Once the consent is exercised, the consent holder shall keep daily records of the:

    a) injection hours;
    b) volume of fluid discharged; and
    c) maximum and average injection pressure.

10. For each waste stream arriving on site for discharge, the consent holder shall characterise the fluids by recording the following information:

    a) type of fluid;
    b) source of fluid (site name and company);
    c) an analysis of a representative sample of the fluid for:
        i. pH;
        ii. conductivity;
        iii. suspended solids concentration;
        iv. temperature;
        v. salinity;
        vi. chloride concentration; and
        vii. total hydrocarbon concentration.

    The analysis required by condition 10(c) above is not necessary if a sample of the same type of fluid, from the same source, has been taken, analysed and provided to the Chief Executive, Taranaki Regional Council within the previous 6 months.

11. If the analysis required by condition 10(c) above is not carried out in an International Accreditation New Zealand accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 10. The Council may also, at its discretion, carry out an audit of the consent holder's sampling and analysis regime to assess adherence to the Quality Assurance plan.

12. The information required by conditions 9 and 10 above, for each calendar month, shall be provided to the Chief Executive, Taranaki Regional Council before the 28th day of the following month.

13. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources within an Area of Review to assess compliance with condition 8 (the 'Monitoring Programme'). The Monitoring Programme shall be designed to characterise local groundwater quality, and be submitted to the Chief Executive, Taranaki Regional Council, for certification before the exercising of this consent, and shall include:

    a) the location of sampling sites;
    b) well/bore construction details; and
    c) sampling frequency.

The Area of Review shall extend 1,000 metres from the point of injection. It is a requirement that at least one suitable monitoring bore be located within 500 metres of the well head. If no suitable existing bores are available, it will be necessary for the Monitoring Programme to include installation of, and sampling from, a suitable bore. The bore would be of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.

14. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:

    a) pH;
    b) conductivity;
    c) chloride; and
    d) total petroleum hydrocarbons.

    Note: The samples required, under conditions 13 and 14, could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.

15. All groundwater sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken. This Plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive, Taranaki Regional Council within 30 days of sampling and shall include supporting quality control and assurance information.

    Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 13.

16. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period. Based on the data provided, the report shall also provide:

    a) an assessment of injection well performance;
    b) an assessment of the on-going integrity and isolation of the wellbore;
    c) an assessment of the on-going integrity and isolation of the receiving formation; and
    d) an updated injection modeling report, demonstrating the ability of the receiving formation to continue to accept additional waste fluids and an estimation of remaining storage capacity.

17. This consent shall lapse on 31 March 2020, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

18. 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 each year, 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 31 March 2015

For and on behalf of
Taranaki Regional Council

_____

B G Chamberlain
Chief Executive