New Zealand Energy Corporation (NZEC)
Deep Well Injection
Monitoring Programme
Annual Report
2018-2019

Technical Report 2019-32

ISSN: 1178-1467 (Online)
Document: 2279237 (Word)
Document: 2300991 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

November 2019

Executive summary

NZEC Waihapa Ltd and Taranaki Ventures Ltd operate the Waihapa-D, Waihapa-F, Waitapu and Toko-E wellsites, located in the vicinity of Stratford. Both companies are subsidiaries of New Zealand Energy Corporation (the Company). This report for the period July 2018 to June 2019 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 four resource consents, which include a total of 48 conditions setting out the requirements that the Company must satisfy. All four consents were exercised during the period being reported.

During the monitoring period, the Company demonstrated a level of environmental performance that required improvement.

The Council's monitoring programme for the year under review included eight inspections, two injectate samples and eight 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 predominantly carried out in compliance with the conditions of the applicable resource consents. Inspections undertaken in relation to the activity during the monitoring year found sites being operated in a professional manner.

There was one Unauthorised Incident reported in relation to the Company's DWI consents during the period under review. On 1 August 2018, the Company notified the Council that they had discovered a produced water leak at their Waihapa Production Station (WPS), located on Bird Road, Stratford. Produced water was found to be discharging and ponding at the surface. The Company undertook immediate works to confine the leak and investigate the source, and began pumping fluids from the leak site for storage and removal from the site. The investigations concluded that the discharge was a result of the failure of the cement seal surrounding the Waihapa-7A injection well, which is located at the Waihapa-F wellsite, immediately adjacent to the WPS.

The Council served two abatement notices to the Company on 7 August 2018 in relation to the incident. One required injection from the Waihapa-7A well to cease immediately, while the other required the Company to undertake works to locate the origin of the discharge, prevent any further discharge, and to mitigate any effects on the environment that may have occurred as a result of the discharge. The abatement notices were complied with.

The loss of fluids to surface from the Waihapa-7A well was confined to two small areas within the boundary of the WPS itself. The Company is currently developing plans for the abandonment of the well. Overall, the incident resulted in only minor adverse effects on the environment, which were isolated to small areas within the Company's site.

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

For reference, in the 2018-2019 year, consent holders were found to achieve a high level of environmental performance and compliance for 83% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 13% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the Company this report shows that the Company's performance although generally at a high level over the last several years, required some improvement during the year under review.

This report includes recommendations to be implemented during the 2019-2020 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 2018 to June 2019 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by NZEC Waihapa Ltd and Taranaki Ventures Ltd for deep well injection (DWI) activities. Both companies are subsidiaries of New Zealand Energy Corporation (the Company).

During the period under review, the Company held four resource consents for the subsurface injection of fluids by DWI. The consents authorise discharges from four separate wellsites within the Company's oil and gas fields. These include the Waihapa-F wellsite, located near Bird Road, 6 km south-east of Stratford, the Waihapa-D and Waitapu wellsites located on Cheal Road, Ngaere, 5 km north-east of Eltham and the Toko-E wellsite located near Standish Road, 5 km east of Stratford.

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 seventh 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 Resource Management Act 1991 (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 2019-2020 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 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 2018-2019 year, consent holders were found to achieve a high level of environmental performance and compliance for 83% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 13% of the consents, a good level of environmental performance and compliance was achieved.[1]

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.

[1] The Council has used these compliance grading criteria for 15 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

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, well workover 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. All other consents are utilised for the disposal of the various forms of wastewater they authorise.

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).

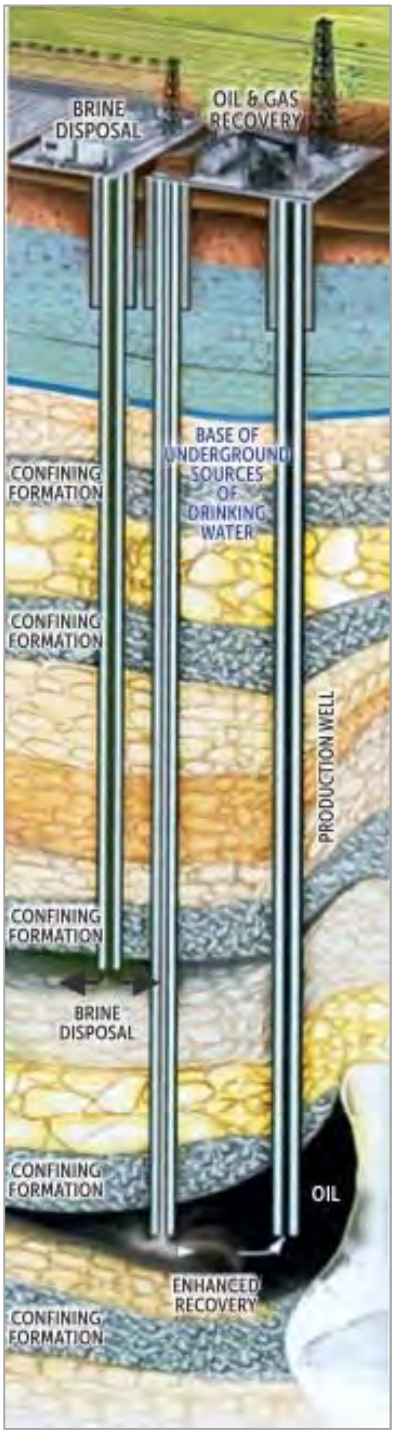

Figure 1 DWI schematic (www.epa.gov/uic)

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 holds four resource consents the details of which are summarised in Table 1 below. Summaries of the conditions attached to each permit are set out in Section 3 of this report.

A summary of the various consent types issued by the Council is included in Appendix I, as are copies of all permits held by the Company during the period under review.

Figure 2 shows the 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.

Table 1 Resource consents held by the Company during the 2018-2019 monitoring year

Consent number	Purpose	Granted	Review	Expires
Discharges of waste to land				
3688-2	To discharge waste drilling fluids, produced water, hydraulic fracturing fluids, including return fluids, and stormwater from hydrocarbon exploration and production operations by deep well injection at the Waihapa-D wellsite.	23 Jun 2003	June 2022	01 Jun 2034
4094-2	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.	10 Sep 2010	June 2022	01 Jun 2028
10086-1	To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite.	31 Mar 2015	June annually	01 Jun 2034
10708-1	To discharge produced water, well drilling fluids, well work over fluids, hydraulic fracturing fluids, and contaminated stormwater from hydrocarbon exploration and production operations into the Tikorangi Limestone by deep well injection at the Toko-E wellsite.	29 Jan 2019	June annually	01 Jun 2034

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, Waihapa-F, Waitapu and Toko-E wellsites were visited once in relation to the Company's DWI monitoring programme. The main points of interest with regard to DWI consents are general housekeeping and any processes with potential or actual discharges, including any surface water runoff, and their receiving environments.

An additional six visits to the Company's Waihapa Production Station (WPS), located adjacent to the Waihapa-F wellsite, were also undertaken by Council Officers. These included two visits for injectate sampling purposes and a further four inspection visits undertaken as part of the Company's production station monitoring programme.

In addition to the scheduled inspections and sampling discussed above, the Waihapa-F wellsite was also visited on several occasions by Council Officers following Incident IN/36683. The inspections related to the Incident are documented separately and a brief description of the Incident and investigation undertaken, are summarised below in Section 2.5.

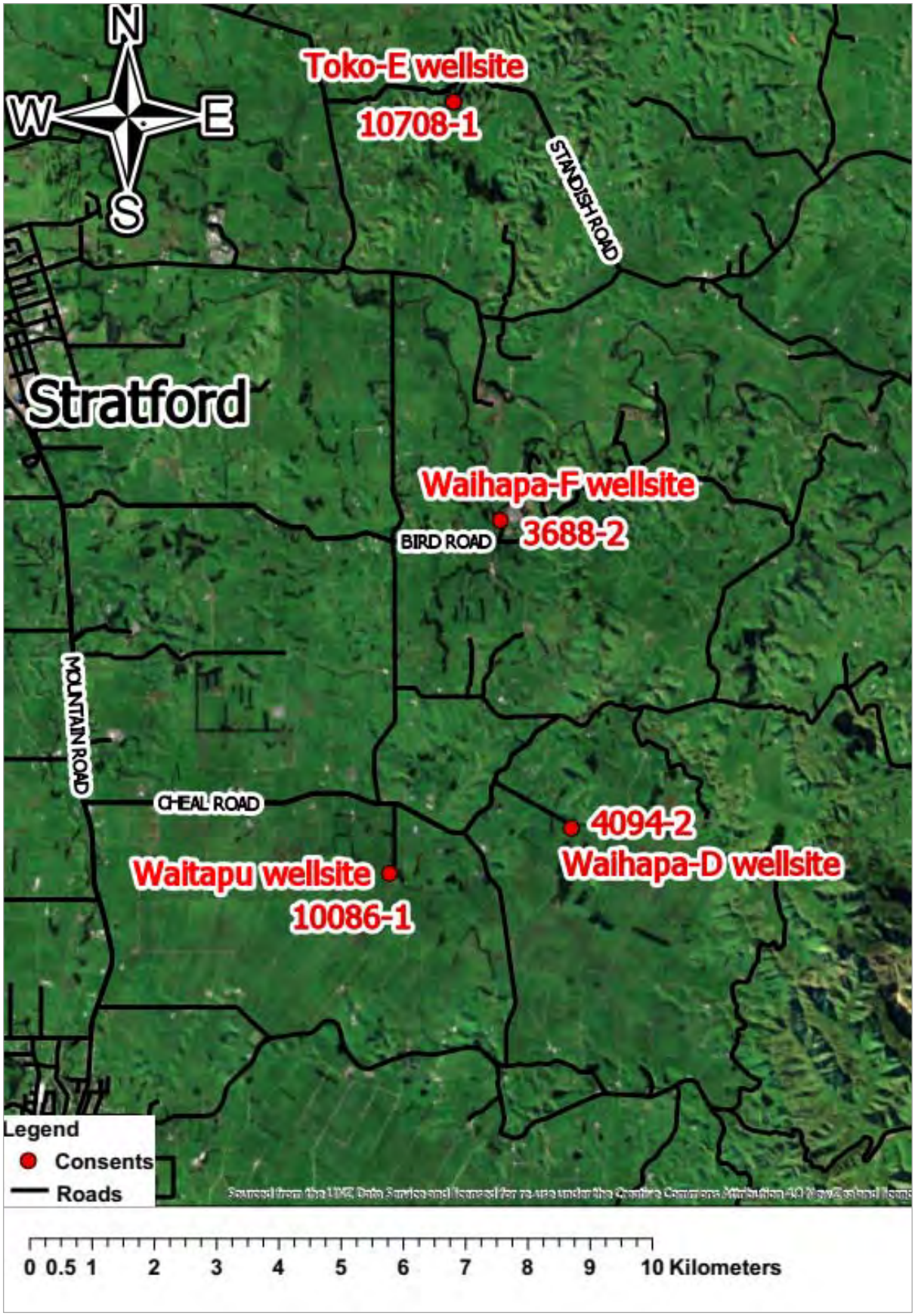

Figure 2 Location of the DWI consents held by the Company during the period under review

1.4.4 Injectate sampling

Injectate samples were obtained for analysis on two occasions from the WPS 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 (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 in relation to the DWI monitoring programme 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) Ltd.

The programme consists of sampling two groundwater monitoring bores in the vicinity of the Waihapa-F wellsite and one groundwater bore, specifically installed by the Company, in the vicinity of the Waitapu wellsite. An additional bore GND3055 was added to the programme in June 2019, prior to injection commencing at the Toko-E wellsite, and was sampled for a more extensive baseline suite of parameters.

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
GND0431	Waihapa-F	Bore	120	unknown	96.3	11.0	Matemateaonga	Bladder
GND2528	Waitapu	Bore	<50	38-50	50.3	5.8	Volcanics	Bladder
GND3055	Toko-E	Bore	<50	9.7-18.7	18.7	artesian	Volcanics	Peri

Groundwater samples taken by the Council were sent on behalf of the Company to Hill Laboratories Ltd (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 to the routine sampling, 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.

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 their consents, 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.

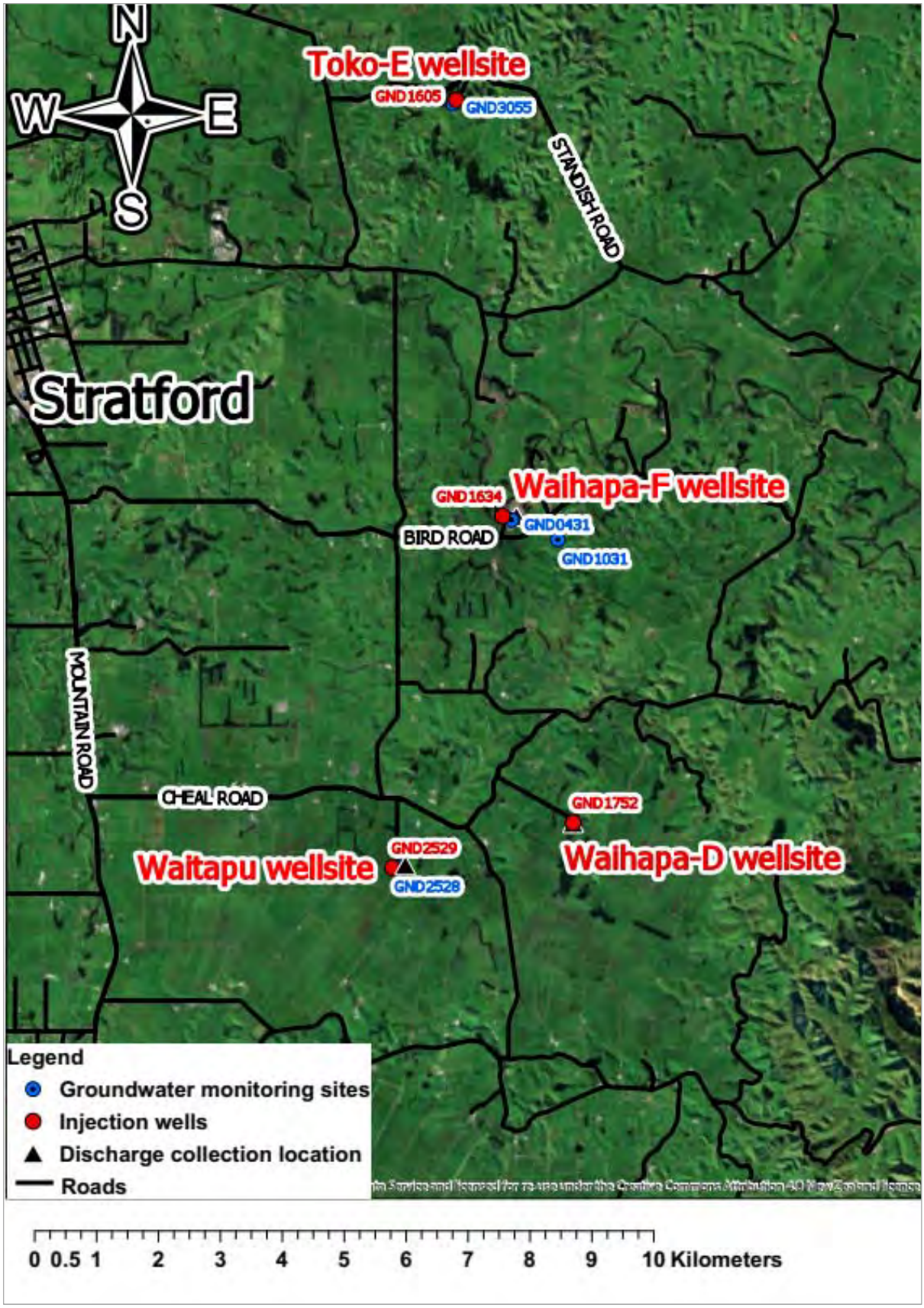

Figure 3 Location of monitoring sites in relation to the Company's DWI wellsites

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.

No issues were identified by staff during any additional inspections undertaken for the purpose of injectate sampling.

2.2 Injectate monitoring

Samples of injectate were obtained from the Company's storage tanks at the WPS on 19 November 2018 and 14 March 2019. The samples were sent to Hills on the same day for physicochemical analysis. Injectate samples are generally a composite of wastewater from the Company's wellsites, third party wellsites and other production facilities.

During the 2018-2019 monitoring period injectate stored in the WPS bulk storage tanks was made up of a mixture of the Company's produced fluids, and those sourced from third parties. These third party sources included the Waihapa, Kupe and Copper Moki Production Stations, the STOS Omata Tank Farm and the Ahuroa Gas Storage Facility. The results of the sample analyses undertaken by the Council are included below in Table 3. The range of results for each analyte since sampling commenced is also presented for comparison.

The Company is also required by consent conditions to undertake additional injectate sampling on each waste stream arriving on-site for discharge. A summary of the results from the Company's sampling programme are presented in Table 4. The summary information includes data from samples taken at both WPS and the Waitapu wellsite. The concentrations of each analyte measured over the 2018-2019 period are within the typical range for injectate samples at these sites.

Table 3 Results of injectate sampling undertaken by the Council

Parameter	Unit	Minimum	Maximum	TRC184324	TRC191973
Date	-	2004 - 2019		19-Nov-18	14-Mar-19
Time	NZST	-	-	13:00	12:40
pH	pH units	6.0	9.0	7.3	7.7
Alkalinity	g/m^3 $CaCO_3$	162	5,600	4,600	5,600
Electrical conductivity	mS/m	1,560	4,190	4,190	3,960
Chloride	g/m^3	1,520	69,200	13,800	11,400
Total petroleum hydrocarbons	g/m^3	11	4,600	42	57
Suspended Solids	g/m^3	3	360	3	45
Temperature	^0C	-	-	-	39.4

Table 4 Results of the Company's monthly injectate sampling (2018-2019)

Parameter	Unit	Minimum	Maximum	Average
pH	pH units	6.9	7.2	7.1
Conductivity	mS/m	4,134	4,431	4,273
Suspended Solids	g/m^3	27	213	72
Salinity	ppt	26.3	28.4	27.5

Parameter	Unit	Minimum	Maximum	Average
Chloride	mg/L	9,200	14,300	12,022
Hydrocarbons	ppm	115	825	300

2.3 Groundwater sampling

Groundwater samples were obtained from two sites located in the vicinity of the Waihapa-F wellsite (GND1031 and GND0431) and one site in the vicinity of the Waitapu wellsite (GND2528) on 21 November 2018 and 14 May 2019. An additional sample was obtained from GND0431, located down gradient of the WPS, on 8 August 2018 following the incident detailed in Section 2.5. A baseline sample was also collected from a purpose built monitoring bore at the Toko-E wellsite (GND3055) on 29 May 2019, prior to the commencement of injection at the site.

No groundwater sampling was undertaken in relation to consent 3688-2, as there are no suitable sites for sampling. The Waihapa-D wellsite operates under a consent that does not include the requirement to install a monitoring bore if there are no suitable existing bores in close proximity to the wellsite. Injection commenced at the wellsite during the period under review following the cessation of injection at the Waihapa-F wellsite. Injection via the well ceased on 6 June 2019. Discussions between the Council and the Company have taken place regarding the need to install a site specific monitoring bore should injection from the well recommence in the future.

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 results of analyses carried out during the monitoring period compared to historical concentrations are set out below in Table 5, Table 6 and Table 7. The results of the baseline groundwater sampling undertaken at GND3055 are included in Table 8.

The results show there have been no significant changes in groundwater composition in the vicinity of either the Waihapa-F or Waitapu wellsites. 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.

The results of the baseline groundwater sampling undertaken at the Toko-E wellsite indicate water quality beneath the wellsite is similar to that recorded in other bores within the region, which intercept similar sediments at a similar depth. Methane was reported in the baseline sample, which is common across Taranaki. A sample was sent to Geological and Nuclear Sciences (GNS) for further analysis of the methane composition. The results of the isotopic analysis undertaken indicate that the methane is biogenic in nature, as opposed to being potentially sourced from an underlying hydrocarbon reservoir (thermogenic methane).

Table 5 Results of Waitapu wellsite groundwater sampling at GND2528 (consent 10086-1)

Parameter	Units	Minimum	Maximum	TRC183176	TRC191956
Sample date	-	July 2015-June 2019		21-Nov-18	14-May-19
Sample time	NZST	-	-	9:15	16:00
pH	pH units	7.0	7.5	7.2	7.5
Temperature	°C	13.3	15.1	13.6	14.1
Dissolved oxygen	g/m^3	0.10	1.35	0.14	0.34
Electrical conductivity	mS/m	42.9	47.4	47.4	46.0
Chloride	g/m^3	11.5	14.2	11.5	13.5
Total hydrocarbons	g/m^3	<0.7	<0.5	<0.7	<0.7

Table 6 Results of Waihapa-F wellsite groundwater sampling at GND1031 (consent 4094-2)

Parameter	Units	Minimum	Maximum	TRC184295	TRC191957
Sample date	-	July 2012-June 2019		21-Nov-19	14-May-19
Sample time	NZST	-	-	10:10	12:25
pH	pH units	7.8	8.2	8.2	8.1
Temperature	°C	15.1	18.4	15.3	15.6
Dissolved oxygen	g/m^3	0.17	4.56	0.17	4.56
Electrical conductivity	mS/m	33.2	43.3	37.6	43.3
Chloride	g/m^3	10.8	13.1	11.3	11.3
Total hydrocarbons	g/m^3	<0.7	<0.5	<0.7	<0.7

Table 7 Results of Waihapa-F wellsite groundwater sampling at GND0431 (consent 4094-2)

Parameter	Units	Minimum	Maximum	TRC183176	TRC184296	TRC191958
Sample date	-	July 2018-June 2019		06-Aug-18	19-Nov-18	14-May-19
Sample time	NZST	-	-	16:00	14:15	13:50
pH	pH units	6.6	7.1	7.1	6.6	6.6
Temperature	°C	15.1	15.9	15.2	15.1	15.9
Dissolved oxygen	g/m^3	0.23	6.69	0.23	6.69	1.65
Electrical conductivity	mS/m	16.5	22.0	22.0	16.6	16.5
Chloride	g/m^3	13.3	14.6	14.3	14.6	13.3
Total hydrocarbons	g/m^3	<0.7	<0.7	< 0.7	< 0.7	< 0.7

Table 8 Results of Toko-E wellsite groundwater sampling at GND3055 (consent 10708-1)

Parameter	Units	Result	Parameter	Units	Result
TRC sample number	-	TRC192153	Dissolved copper	g/m^3	< 0.0005
Sample date	-	29-May-19	Dissolved Iron	g/m^3	< 0.02
Sample time	NZST	13:55	Dissolved Manganese	g/m^3	0.063
pH	pH units	8.0	Dissolved Mercury	g/m^3	< 0.00008
Sample temperature	°C	14.7	Dissolved nickel	g/m^3	< 0.0005
Electrical conductivity	mS/m	30.3	Dissolved zinc	g/m^3	0.0016
Total alkalinity	g/m^3 as $CaCO_3$	148	Benzene	g/m^3	< 0.0010
Bicarbonate	g/m^3 at 25°C	179	Ethane	g/m^3	< 0.003
Total hardness	g/m^3 as $CaCO_3$	126	Methane	g/m^3	3.9
Bromide	g/m^3	< 0.05	Ethylbenzene	g/m^3	< 0.0010
Dissolved calcium	g/m^3	39	Ethylene	g/m^3	< 0.003
Chloride	g/m^3	9.1	Toluene	g/m^3	< 0.0010
Dissolved magnesium	g/m^3	6.9	o-Xylene	g/m^3	< 0.0010
Nitrate-N	g/m^3	0.004	m&p-Xylene	g/m^3	< 0.002
Nitrate-N + nitrite-N	g/m^3	0.004	C10 - C14	g/m^3	< 0.2
Nitrite-N	g/m^3	< 0.002	C15 - C36	g/m^3	< 0.4
Dissolved potassium	g/m^3	1.83	C7 - C9	g/m^3	< 0.06
Dissolved sodium	g/m^3	16.9	Total hydrocarbons (C7 - C36)	g/m^3	< 0.7
Sulphate	g/m^3	< 0.5	Carbon 13	‰	69.6
Dissolved barium	g/m^3	0.009	-	-	-

2.4 Provision of consent holder data

The Company provided records of their injection activities during the 2018-2019 monitoring period, including daily injection volumes, pumping duration and maximum and average injection pressures. All data was provided within the consented timeframes. Table 9 provides an overview of the Company's injection activities across all consents during the monitoring period. The total volume of fluid injected by the Company over the monitoring period was lower than that recorded during each of the two previous two monitoring years (Table 10). The higher volumes of fluids injected in previous years were as a result of field management programmes being trialled by the Company.

Table 9 Summary of injection activity during the 2018-2019 monitoring year

Consent	Wellsite	Injection well	Total volume discharged (m^3) 01/07/18-30/06/19	Discharge period		Well ID
				From	To	
3688-2	Waihapa-D	Waihapa-5	208,767.87	7/08/2018	04/06/2019	GND1752
4094-2	Waihapa-F	Waihapa-7A	26,366.07	01/07/2018	6/08/2018	GND1684
10086-1	Waitapu	Waitapu-2	9,468.20	01/07/2018	30/06/2019	GND2529
10708-1	Toko-E	Toko-2B	28,120.09	05/06/2019	30/06/2019	GND1605
Total			272,722.23	-	-	-

Table 10 Summary of the Company's historical injection activity by year

Period	Total volume discharged (m^3)	Period	Total volume discharged (m^3)
2018-2019	272,722	2015-2016	205,245
2017-2018	351,516	2014-2015	208,077
2016-2017	349,661	2013-2014	104,967

2.4.1 Summary of injection at the Waihapa-D wellsite (consent 3688-2)

The majority of discharge during the review period was undertaken at the Waihapa-D wellsite, via the Waihapa-5 well, under consent 3688-2. The Waihapa-5 well was brought into operation following the cessation of DWI activities at the Waihapa-F wellsite. Prior to coming into operation during the reported period, no injection had occurred via the Waihapa-5 injection well since 2010. A summary of the injection undertaken via the well during the period under review is presented in Table 11. Figure 4 plots the daily injection volumes and corresponding injection pressures recorded over the same period.

Table 11 Summary of injection via the Waihapa-5 well (2018-2019)

Period	Annual volume (m^3)	Max. injection volume (m^3/day)	Max. injection rate* (m^3/hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019	208,768	1,549	67	85	30

*Note * calculated using daily volume and hours*

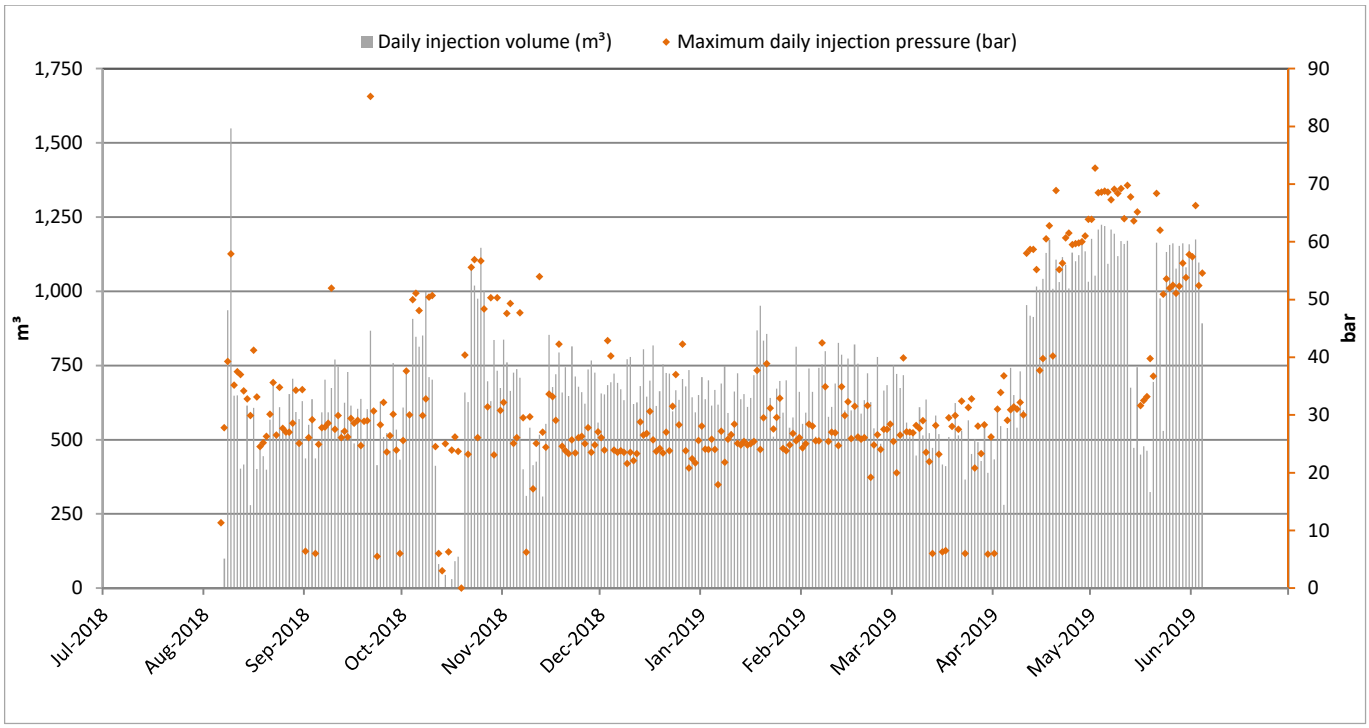

Figure 4 Waihapa-5: Daily injection volumes and injection pressures (2018-2019)

2.4.2 Summary of injection activities at the Waihapa-F wellsite (consent 4094-2)

Historically, the majority of injection within the Waihapa field has been undertaken from the Waihapa-F wellsite, via the Waihapa-7A well. The volumes of fluids injected via the well had generally increased over recent years, peaking at 342,804 m^3 over the 2017-2018 monitoring year (Table 12). Historical injection volume and pressure data is presented in Figure 5. Injection via the Waihapa-7A well ceased on 6 August 2018 following the incident discussed further in Section 2.5. No further injection took place via the well during the reported period (Figure 6). The well is currently shut-in awaiting plugging and abandonment.

Table 12 Summary of injection via the Waihapa-7A well (2013-2019)

Period	Annual volume (m^3)	Max. injection volume (m^3/day)	Max. injection rate* (m^3/hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
Consent limit	-	-	-	85.0	-
2018-2019	26,366	1,154	55	64.0	48
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 *calculated using daily volume and hours.*

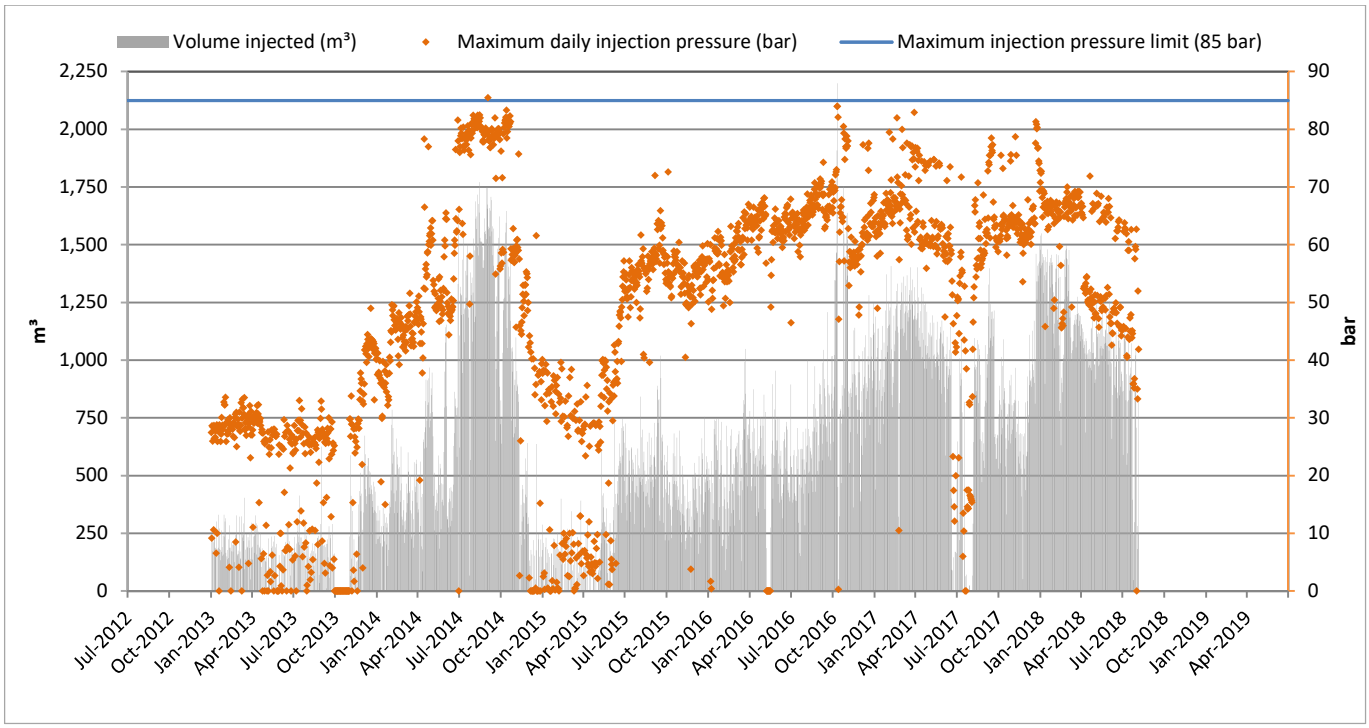

Figure 5 Waihapa-7A: Daily injection volumes and injection pressures (2012-2019)

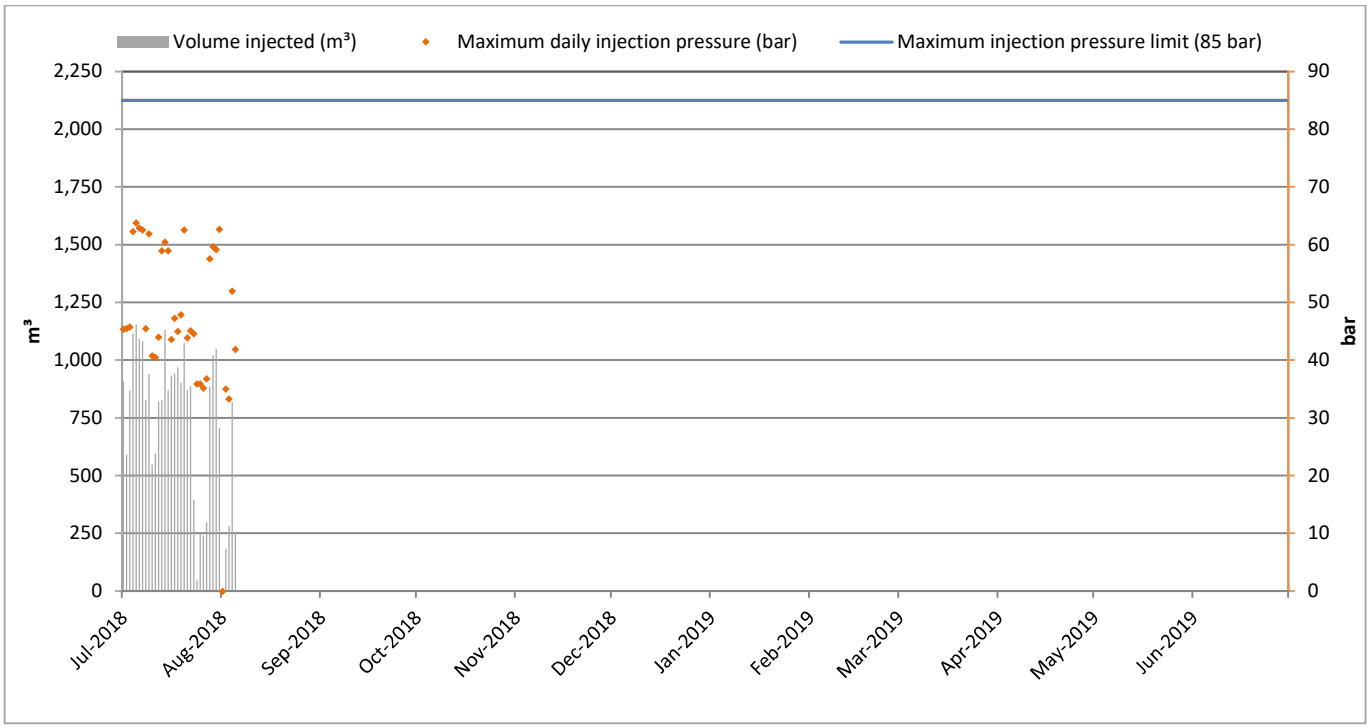

Figure 6 Waihapa-7A: Daily injection volumes and injection pressures (2018-2019)

2.4.3 Summary of injection at the Waitapu wellsite (consent 10086-1)

The injection of fluids at the Waitapu wellsite is via the Waitapu-2 well. Injection via the well commenced during the 2015-2016 monitoring period. The injection of fluids from the Waitapu-2 well is designed to regulate pressure within the target formation as part of the Copper Moki water flooding programme. Since injection commenced from the wellsite, the volumes of fluid discharged have fluctuated in response to the requirements of the water flooding programme (Table 13 and Figure 7).

During the period under review, relatively consistent volumes of fluid were discharged via the well when it was being utilised for injection. Analysis of the injection pressure data for the 2018-2019 period found that minor exceedances of the injection pressure limit of 689 psi had occurred (Figure 8). The reasons behind these exceedances and the Council's response is discussed further in Section 2.5. The data presented also indicates that the Waitapu-2 well sporadically operates under a vacuum, meaning little or no pressure is required to inject fluids into the receiving formation. This scenario is common where injection occurs into a formation that has been depressurised through hydrocarbon production activities. To clean out the Waitapu-2 well perforations, an acid/solvent wash was undertaken on 19 June 2019. Following the treatment injectivity under a vacuum can be seen in the well (Figure 8). This indicates that the high pressures seen during the monitoring period were likely a result of blockages caused by mineral scale formation, rather than an increase in pressure within the receiving formation.

Table 13 Summary of injection occurring at the Waitapu wellsite under consent 10086-1 (2016-2019)

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	-
2018-2019	9,468	63	5	696	34.8
2017-2018	8,712	63	-	696	11.3
2016-2017	20,266	104	-	653	16.2
2015-2016	10,636	105	-	218	7.3

*Note * calculated using daily volume and hours*

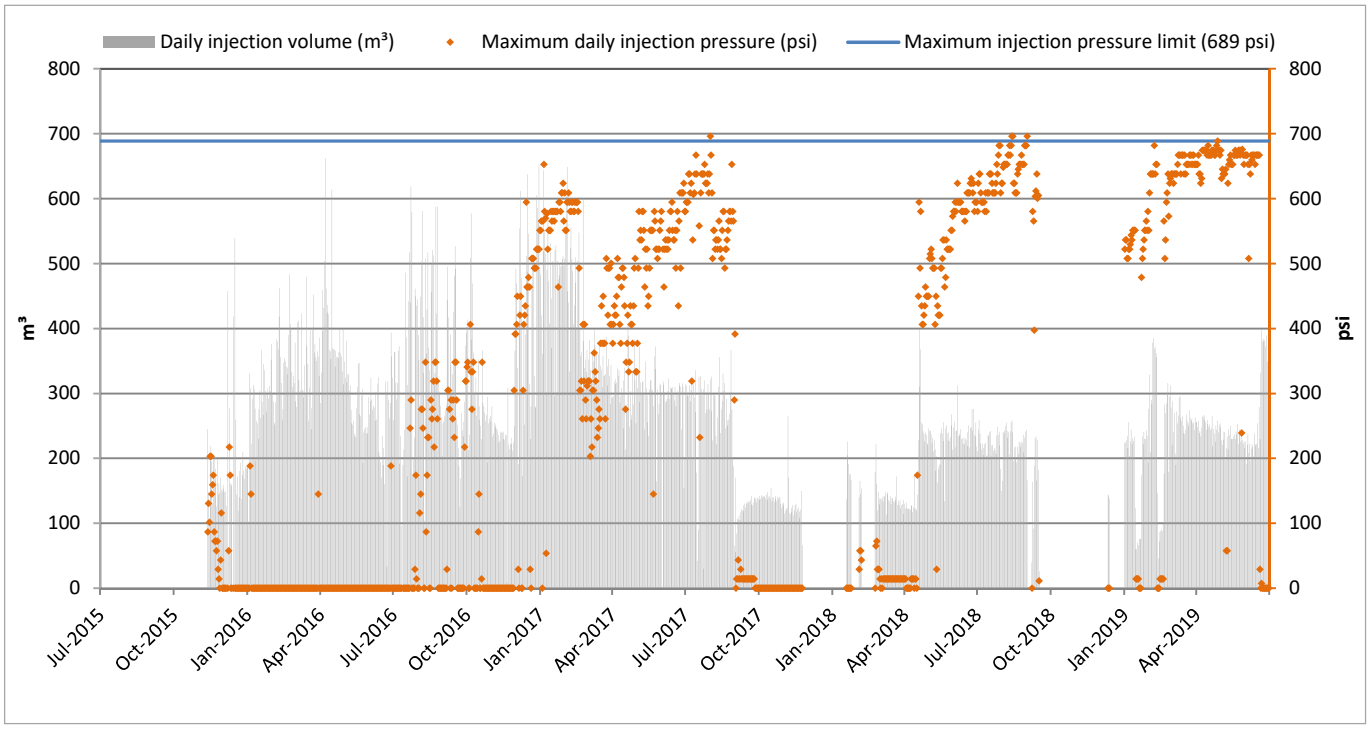

Figure 7 Waitapu-2: Daily injection volumes and injection pressures (2015-2019)

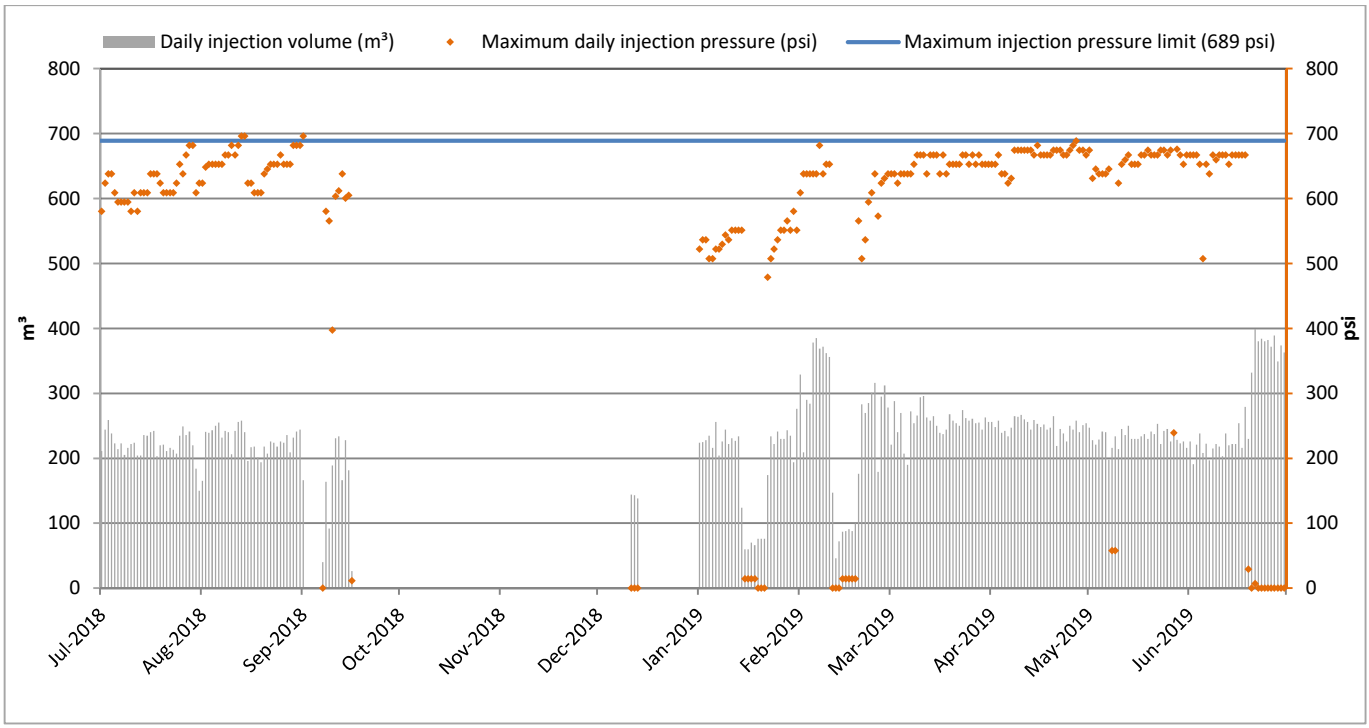

Figure 8 Waitapu-2: Daily injection volumes and injection pressures (2018-2019)

2.4.4 Summary of injection at the Toko-E wellsite (consent 10708-1)

The Toko-2B well, at the Toko-E wellsite, was brought into operation on 5 June 2019 and injection continued through the remainder of the monitored period (Figure 9 and Table 14). The Toko-2B well has now replaced Waihapa-5 as the Company's primary injection well.

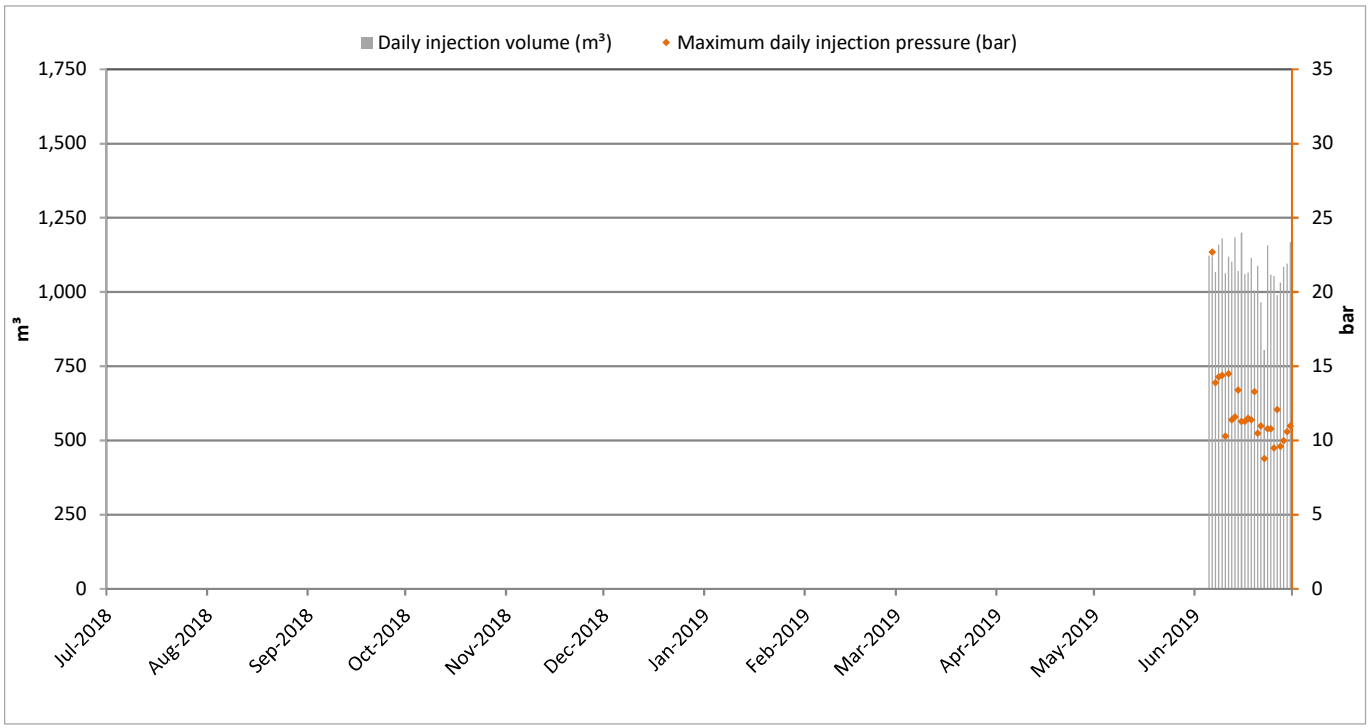

Figure 9 Toko-2B: Daily injection volumes and injection pressures (2018-2019)

Table 14 Summary of injection occurring at the Toko-E wellsite under consent 10708-1 (2018-2019)

Period	Annual volume (m^3)	Max. injection volume (m^3/day)	Max. injection rate (m^3/hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019	28,120	1,200	50	23	12

2.5 Incidents, investigations, and interventions

The monitoring programme initiated 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.

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

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 individual/organisation is indeed the source of the incident (or that the allegation cannot be proven).

Table 15 below sets out details of any incidents recorded, additional investigations, or interventions required by the Council in relation to the Company's activities during the 2018-2019 period. This table presents details of all events that required further investigation or intervention regardless of whether these were found to be compliant or not.

For the vast majority of the reported period, injection was undertaken by the Company within consented discharge limits. The exception to this were exceedances of the maximum injection pressure authorised under consent 10086-1 at the Waitapu wellsite. Three separate exceedances were recorded during August and September 2018. The exceedances were extremely minor, with injection pressure exceeding the limit of 689 psi by approximately 1%. When contacted by the Council, the Company explained that the injection pressure measurements are manually read from a pressure gauge to the nearest bar. These pressure measurements are then converted from bar to psi. The Company attributed the minor exceedances to errors resulting from the rounding of manually read pressure measurements. The explanation was accepted by the Council and no further action was deemed necessary.

An incident was also recorded in relation to consent 4094-2 during the period under review (IN/36683). On 31 July 2018, Company staff discovered a flow of groundwater to surface within the WPS. A spill response was initiated by the Company to contain the flow of fluids. A sample of fluids discharging was obtained and the results of laboratory analyses, received on 1 August 2018, confirmed the fluid composition was typical of produced water. On receipt of the results, the Company notified the Council that they had discovered a produced water leak at the WPS.

Investigations to locate the likely source of the leak commenced immediately and identified the discharge was likely to be a result of a loss of integrity within the Waihapa-7A injection well, which is located at the Waihapa-F wellsite, immediately adjacent to the WPS. The Company ceased injection via the well on 5 August.

The Council served two abatement notices to the Company on 7 August 2018. One required injection from the Waihapa-7A well to cease immediately, while the other required the Company to undertake works to locate the origin of the discharge, prevent any further discharge, and to mitigate any effects on the environment that may have occurred as a result of the discharge.

The ongoing investigations by the Company concluded that the most likely cause of the fluid loss was a breach of the outer cement seal surrounding the Waihapa-7A injection well. Following the incident the well was depressurised and shut-in. Diagnostic logging of the well indicates that there is no on-going loss of fluids occurring via the leak pathway. At the end of the period under review the Company was working through the process of developing plugging and abandonment plans for the well, prior to seeking the required approvals to commence this work.

The loss of fluids to surface from the Waihapa-7A well was confined to two small discharge areas within the boundary of the WPS itself. No wider contaminant plumes within the WPS, or any off-site impacts, were detected during an intensive follow-up investigation, which included aerial surveys of the surrounding area, surface and groundwater sampling and subsurface geophysical surveys. Overall, the incident resulted in only minor adverse effects on the environment, which were mitigated by the removal of contaminated soil and water from the discharge locations.

Table 15 Incidents, investigations, and interventions summary table

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
13/08/2018 14/08/2018 01/09/2018	Minor exceedances in maximum pressure recorded	N	Consent holder was contacted to provide an explanation	Explanation received and accepted. No further exceedances occurred.
31/7/2018	Produced water flow to the surface at the WPS (IN/36683)	N	Abatement notices EAC-22109 and EAC-22123 issued	Investigations determined that the Waihapa-7A well as the likely source of the leak. Injection ceased as soon as the well was identified as the likely source, and it remains shut-in awaiting abandonment. An extensive programme of water quality sampling and subsurface investigations found no significant adverse environmental effects had occurred as a results of the fluid loss and no impacts were detected off-site.

3 Discussion

3.1 Discussion of site performance

During the period under review, the Company exercised four resource consents for the injection of fluids by DWI (3688-2, 4094-2, 10086-1 and 10708-1). Routine inspections of the Company's sites found them to be in good condition and being well managed. No complaints were received from the public in relation to these consents.

The operation of the injection wells is monitored by Company staff, and key injection data is recorded as 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 injection data provided by the Company shows that a total of 272,722 m^3 of fluid was injected over the 2018-2019 monitoring period. The vast majority of this fluid was discharged via the Waihapa-5 well, under consent 3688-2. The total volume of fluids injected was less than that injected over the two previous monitoring periods. The higher volumes of fluids injected in previous years were as a result of field management programmes being trialled by the Company.

A visual assessment of the Company's injection data indicates that injection pressures generally fluctuate in response to injection volumes, with higher maximum pressures corresponding with higher daily injection volumes. There is no evidence of any sustained increases in injection pressures over time at any injection site.

For the vast majority of the reported period, injection was undertaken within consented discharge limits. The exception to this were reported exceedances of the authorised maximum injection pressure limit at the Waitapu wellsite. The exceedances were minor in degree and the explanation provided by the Company in relation to them was accepted by the Council (see Section 2.5).

As also discussed in Section 2.5, the Council was notified by the Company on 1 August 2018 that produced water was discharging to the surface within the WPS. Subsequent Investigations attributed the discharge to a loss of integrity in the cement seal surrounding the Waihapa-7A injection well.

In terms of the Company's response to the incident, they acted quickly to contain and manage the flow of fluids and undertook works to identify the source of the fluid and cease its flow. The Company also undertook a significant volume of monitoring work to determine the extent of the area impacted by the discharge and assess its environmental effects (see Section 3.2). The work undertaken was effective in determining the environmental significance of the discharges and minimising any adverse effects.

Throughout the incident the Company were proactive in their communication with the Council. They submitted regular updates of works undertaken and provided comprehensive summaries of information collected through update reports. Both abatement notices served on the Company were complied with.

The Waihapa-7A well is shut-in and plans are being developed for its plugging and abandonment.

Over the course of the period under review, the Company was found to be operating the Waihapa-7A in line with the Injection Operation Management Plan for the well. All required injection data was collected as planned and gave no indication of any potential issues with the well prior to the incident occurring.

3.2 Environmental effects of exercise of consents

The investigation undertaken in relation to IN/36683 indicated that any effects on the environment relating to the unauthorised discharge were minor. Effects were limited to the areas within the WPS where discharges were found to be occurring. Small volumes of contaminated water and soil were removed from these areas for discharge at the appropriate facilities. There were no adverse effects detected elsewhere

within the WPS, or outside the boundaries of the site, during intensive monitoring carried out at the time of the event or through on-going monitoring work undertaken.

No adverse environmental effects were recorded by the Council in relation to any other DWI consent exercised by the Company.

The groundwater monitoring component of the compliance programme continued during the period under review, with eight 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.

Compliance with the conditions of the Company's DWI consents exercised during the 2018-2019 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 16 to 19 and an evaluation of the Company's environmental performance in relation to their DWI activities since 2009 is presented in Table 20.

Table 16 Summary of performance for consent 3688-2

Purpose: ***To discharge waste drilling fluids, produced water, hydraulic fracturing fluids, including return fluids, and stormwater from hydrocarbon exploration and production operations by deep well injection at the Waihapa-D wellsite***		
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	Yes (Ltd data for assessment)
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	Yes
6. Lapse condition	Consent exercised	Yes
7. Review provision	N/A	N/A

Purpose: *To discharge waste drilling fluids, produced water, hydraulic fracturing fluids, including return fluids, and stormwater from hydrocarbon exploration and production operations by deep well injection at the Waihapa-D wellsite*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
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 17 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	No Loss of well confinement resulting in the discharge of produced water to surface
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		**Improvement required**
Overall assessment of administrative performance in respect of this consent		**High**

Table 18 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

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?**
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 Some minor exceedances reported
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

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?**
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
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	Yes
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

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?**
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**

Table 19 Summary of performance for consent 10708-1

Purpose: *To discharge produced water, well drilling fluids, hydraulic fracturing fluids and contaminated stormwater from hydrocarbon exploration and production operations into the Tikorangi Limestone by deep well injection at the Toko-E 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. No injection permitted after 1 June 2029	Assessment of injection records and site inspection notices	N/A
4. The consent holder shall at all times adopt the best practicable option	Assessment of consent holder records and site inspection notices	Yes
5. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 2,000 metres true vertical depth	Review of "Water Flooding Operation Management Plan," well construction log and injection data	Yes
6. The injection of fluids shall not fracture any overlying geological seal	Review and analysis of injection data	Yes
7. 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
8. Limits the types of fluids to be discharged	Receipt and assessment of injection data	Yes

Purpose: *To discharge produced water, well drilling fluids, hydraulic fracturing fluids and contaminated stormwater from hydrocarbon exploration and production operations into the Tikorangi Limestone by deep well injection at the Toko-E wellsite*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
9. Maintain records and undertake analysis to characterise each type of waste arriving on-site for discharge	Receipt and assessment of injection data	Yes
10. Maintain full records of injection data	Receipt and assessment of injection data	Yes
11. If the analysis required by condition 9c is not carried out in an 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
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

Purpose: *To discharge produced water, well drilling fluids, hydraulic fracturing fluids and contaminated stormwater from hydrocarbon exploration and production operations into the Tikorangi Limestone by deep well injection at the Toko-E wellsite*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
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	Yes
17. 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		**High**

Table 20 Evaluation of environmental performance over time

Year	Consent number	High	Good	Improvement required	Poor
2017-2018	3688	Not exercised			
	4094	1	-	-	-
	10086	1	-	-	-
2016-2017	3688	Not exercised			
	4094	1	-	-	-
	10086	1	-	-	-
2015-2016	3688	Not exercised			
	4094	1	-	-	-
	10086	1	-	-	-
2014-2015	3688	Not exercised			
	4094	1	-	-	-
2013-2014	3688	Not exercised			
	4094	1	-	-	-
Totals	-	8	-	-	-

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

3.4 Recommendations from the 2017-2018 Annual Report

In the 2017-2018 Annual Report, it was recommended:

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.

The recommendations above were implemented during the period under review.

3.5 Alterations to monitoring programmes for 2019-2020

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 2018-2019 period be continued during the 2019-2020 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 2019-2020.

3.6 Exercise of optional review of consent

Resource consent 10086-1 and 10708-1 provide for an optional review in June 2020. Condition 18 of consent 10086-1 and condition 17 of consent 10708-1 allow 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 on either consent.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities in the 2019-2020 year continue at the same level as in 2018-2019.
2. THAT the Company expedites the plugging and abandonment of the Waihapa-7A well.
3. THAT as injection has commenced in the vicinity of the Waihapa-D wellsite that a groundwater bore be installed to monitor groundwater quality.
4. THAT should there be issues with environmental or administrative performance in 2019-2020, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
5. THAT the option for a review of resource consents in June 2020, 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 25°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.
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.
N/A	Not applicable.

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.
Plug and abandon	To prepare a wellbore to be shut in and permanently isolated.
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.
WPS	Waihapa Production Station.

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

Bibliography and references

Ministry for the Environment 2018: Best Practice Guidelines for Compliance, Monitoring and Enforcement under the Resource Management Act 1991. Wellington: Ministry for the Environment.

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

New Zealand Energy Corporation (NZEC) 2019: Produced water leak event, Waihapa Production Station, Bird Road Update Report 3. Response to abatement notice IN/36683. Document number 2219036.

New Zealand Energy Corporation (NZEC) 2018: Produced water leak event, Waihapa Production Station, Bird Road Update Report 2. Response to abatement notice IN/36683. Document number 2287948.

New Zealand Energy Corporation (NZEC) 2018: Produced water leak event, Waihapa Production Station, Bird Road Update Report 1. Response to abatement notice IN/36683. Document number 2145814.

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 2018: NZEC Waihapa Ltd Abatement Notice No. EAC-22109. Document number 2102226.

Taranaki Regional Council 2018: NZEC Waihapa Ltd Deep Well Injection Monitoring Programme Annual Report 2017-2018. Technical report 2018-78. Document number 2114356.

Taranaki Regional Council 2017: NZEC Waihapa Ltd Deep Well Injection Monitoring Programme Annual Report 2016-2017. Technical report 2017-25. Document number 1854235.

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

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

Taranaki Regional Council 2015: NZEC Waihapa Ltd 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 Ltd Deep Well Injection Monitoring Programme Triennial Report (2009-2012). Technical report 2011-85. Document number 1114242.

Appendix I

Resource consents held by New Zealand Energy Corporation

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

Consent Number	Wellsite	Status	Injection Well(s)	TRC bore id.	Granted	Issued	Expiry
3688-2	Waihapa-D	Not active	Waihapa-5	GND1752	23/06/2003	03/09/2013	01/06/2034
4094-2	Waihapa-F	Not active	Waihapa-7A	GND1634	10/09/2010	03/09/2013	01/06/2028
10086-1	Waitapu	Active	Waitapu-2	GND2529	31/03/2015	31/03/2015	01/06/2034
10708-1	Toko-E	Active	Toko-2B	GND1605	29/01/2019	29/01/2019	01/06/2034

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

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. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

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

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 PO Box 8440 New Plymouth 4342
Decision Date	29 January 2019
Commencement Date	29 January 2019

Conditions of Consent

Consent Granted:	To discharge produced water, well drilling fluids, well work over fluids, hydraulic fracturing fluids and contaminated stormwater from hydrocarbon exploration and production operations into the Tikorangi Limestone by deep well injection at the Toko-E wellsite
Expiry Date:	1 June 2034
Review Date(s):	June annually
Site Location:	Toko-E wellsite, Standish Road, Toko
Grid Reference (NZTM)	1716683E-5647191N
Catchment:	Patea
Tributary:	Manawawiri

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 the 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 the 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 7, are encountered below the site; and
   (f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids (TDS) 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. There shall be no injection of any fluids after 1 June 2029.

4. 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.

5. The injection of fluids shall only be injected to the Tikorangi Limestone formation, at a minimum depth of 2000 metres true vertical depth sub-sea.

6. 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.

7. 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 TDS concentration of less than 1,000 mg/L.

8. Only the following types of fluid may be discharged:

   (a) produced water;
   (b) well drilling fluids;
   (c) well workover fluids, including hydraulic fracturing fluids; and
   (d) contaminated stormwater.

9. 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 (as listed in condition 8);
   (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 9(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.

10. 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.

11. If the analysis required by condition 9(c) above is not carried out in an International Accreditation New Zealand (IANZ) accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 9. 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 QA 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 to assess compliance with condition 7 (the 'Monitoring Programme'). The Monitoring Programme shall be submitted to the Chief Executive, Taranaki Regional Council, for certification before exercising the consent, and shall include:

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

    It is a minimum 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 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 IANZ 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. 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 29 January 2019

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management