

Cheal Petroleum Ltd  
Deep Well Injection  
Monitoring Programme  
Annual Report  
2018-2019

Technical Report 2019-23

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## Executive summary

Cheal Petroleum Ltd (the Company) operate the Cheal wellsites located within their Cheal oil and gas field, south of Stratford. Each wellsite contains varying numbers of producing wells and associated production infrastructure. 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 held four resource consents for DWI activities during the review period, which included a total of 68 conditions setting out the requirements that the Company must satisfy. All four consents were exercised during the period.

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

The Council's monitoring programme for the year under review included 11 site 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 being carried out in compliance with the conditions of the applicable resource consents. There is no evidence of any issues with any injection well currently in use, or the ability of the receiving formation to accept injected fluids. The results of groundwater quality monitoring undertaken show no adverse effects of the activity on local groundwater resources. Inspections undertaken during the monitoring year found sites being operated in a professional manner and there were no Unauthorised Incidents in relation to any of the Company's DWI consents.

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

For reference, in the 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 over the last several years, this report shows that the Company's performance remains at a high level.

This report includes recommendations to be implemented during the 2019–2020 monitoring period.

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# 1 Introduction

## 1.1 Compliance monitoring programme reports and the Resource Management Act 1991

### 1.1.1 Introduction

This report is for the period July 2018 to June 2019 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Cheal Petroleum Limited (the Company) for deep well injection (DWI) activities. During the period under review, the Company held four resource consents for the subsurface injection of fluids by DWI. The consents authorise discharges from three separate wellsites within the Company's Cheal oil and gas field, located south of Stratford.

The resource consents held by the Company permit the discharge of a range of fluids by DWI, including produced water, contaminated stormwater, waste drilling fluids, hydraulic fracturing (HF) fluids, and compatible groundwater abstracted specifically for injection purposes. 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 tenth 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 through 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.<sup>1</sup>

## 1.2 Process description

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

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

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<sup>1</sup> 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

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 Cheal reservoir is depleted, due to production over time, therefore water flooding for enhanced hydrocarbon recovery is the primary purpose of injection at the Cheal wellsites.

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).

### 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. Two of the four consents were varied during the reporting period. Consent 9545-2 was varied to replace prescriptive pressure and volume limits with more appropriate effects based conditions, and to change the monthly data submission timeframe to bring it in line with the Company's other DWI consents. Consent 10354-1.1 was varied to reduce the minimum depth of injection from below 1,665 m TVD to below 1,600 m TVD.

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.

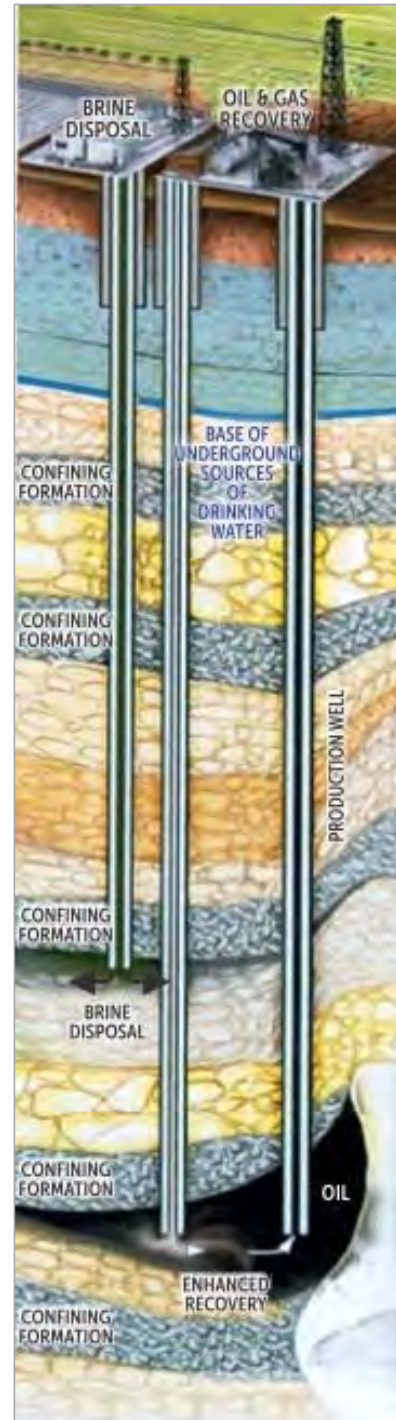


Figure 1 DWI schematic  
([www.epa.gov/uic](http://www.epa.gov/uic))

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

Consent number	Purpose	Granted	Review	Expires
<i>Discharges of waste to land</i>				
<b>9545-2.1</b>	To discharge produced water from hydrocarbon exploration and production operations, reservoir compatible workover fluids and hydraulic fracturing return fluids into the Urenui Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding	28 Aug 2015	June annually	1 June 2035
<b>10254-1</b>	To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-B wellsite.	11 Apr 2016	June annually	1 Jun 2034
<b>10304-1.1</b>	To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-E wellsite for the purpose of water flooding	15 Jun 2016	June annually	1 Jun 2034
<b>10354-1.1</b>	To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding.	8 Nov 2016	June annually	1 Jun 2035

## 1.4 Monitoring programme

### 1.4.1 Introduction

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

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

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

### 1.4.2 Programme liaison and management

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

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

### 1.4.3 Site inspections

The Company's Cheal-A, Cheal-B and Cheal-E wellsites were visited once in relation to the Company's DWI monitoring programme. The main points of interest during routine inspections 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 two visits to the Company's Cheal-A wellsite, by Council Officer's for injectate sampling purposes, and an additional four inspections of the Cheal-A and Cheal-E wellsites in compliance with the Company's Production Station monitoring programme were also undertaken.

### 1.4.4 Injectate sampling

Injectate samples were obtained for analysis on two occasions 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. There are six wells utilised for the injection of fluids for the purpose of water flooding at the Company's DWI wellsites. A summary of the details for each injection well is included in Table 2 and locations are displayed on Figure 3.

Injectate samples were collected from the bulk storage tank at the Cheal-A Production Station identified on-site as tank T-0504 and T-0505 (Figure 3). The injectate samples were analysed by Hill Laboratories Limited (Hills) for the following parameters:

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

**Table 2** Injection well details

Wellsite	Consent	Injection well(s)	TRC bore id.	Formation
Cheal-A	9545-2.1	Cheal-A4	GND2328	Urenui
Cheal-B	10254-1	Cheal-B3	GND2571	Mount Messenger
Cheal-E	10304-1.1	Cheal-E4	GND2714	Mount Messenger
		Cheal-E7	GND2572	Mount Messenger
Cheal-A	10354-1.1	Cheal-A2	GND2570	Mount Messenger
		Cheal-A7	GND2678	Mount Messenger

### 1.4.5 Groundwater sampling

Groundwater samples were obtained on two occasions in the vicinity of the Cheal wellsites during the monitoring period. This sampling is a continuation of the groundwater monitoring component of this programme which was initiated during the 2013-2014 monitoring period.

Four monitoring sites were sampled during the review period, including two dedicated monitoring bores which were installed by the Company under the conditions of consents 10254-1 and 10304-1.1. One in the vicinity of the Cheal-B wellsite (GND2543) and one in the vicinity of the Cheal-E wellsite (GND2592).

Details of the groundwater monitoring sites currently included in the monitoring programme are listed below in Table 3. The location of the groundwater sites in relation to the wellsite being monitored is illustrated in Figure 3.

**Table 3** Groundwater monitoring site details

Site code	Wellsite	Distance from injection well (m)	Cased depth (m)	Screened/open interval (m)	Total depth (m)	Groundwater level (m bmp)	Aquifer
GND1139	Cheal-A	415	0-36.0	36.0-54.0	54.0	6.1	Volcanics
GND0492	Cheal-A	357	0-19.5	19.5- 30.5	30.5	7.0	Volcanics
GND2543	Cheal-B	<50	0-14.1	14.1-32.1	32.1	1.1	Volcanics
GND2592	Cheal-E	<50	0-30.7	18.7-30.7	30.7	0.2	Volcanics

Groundwater samples taken by the Council were sent on behalf of the Company to 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.



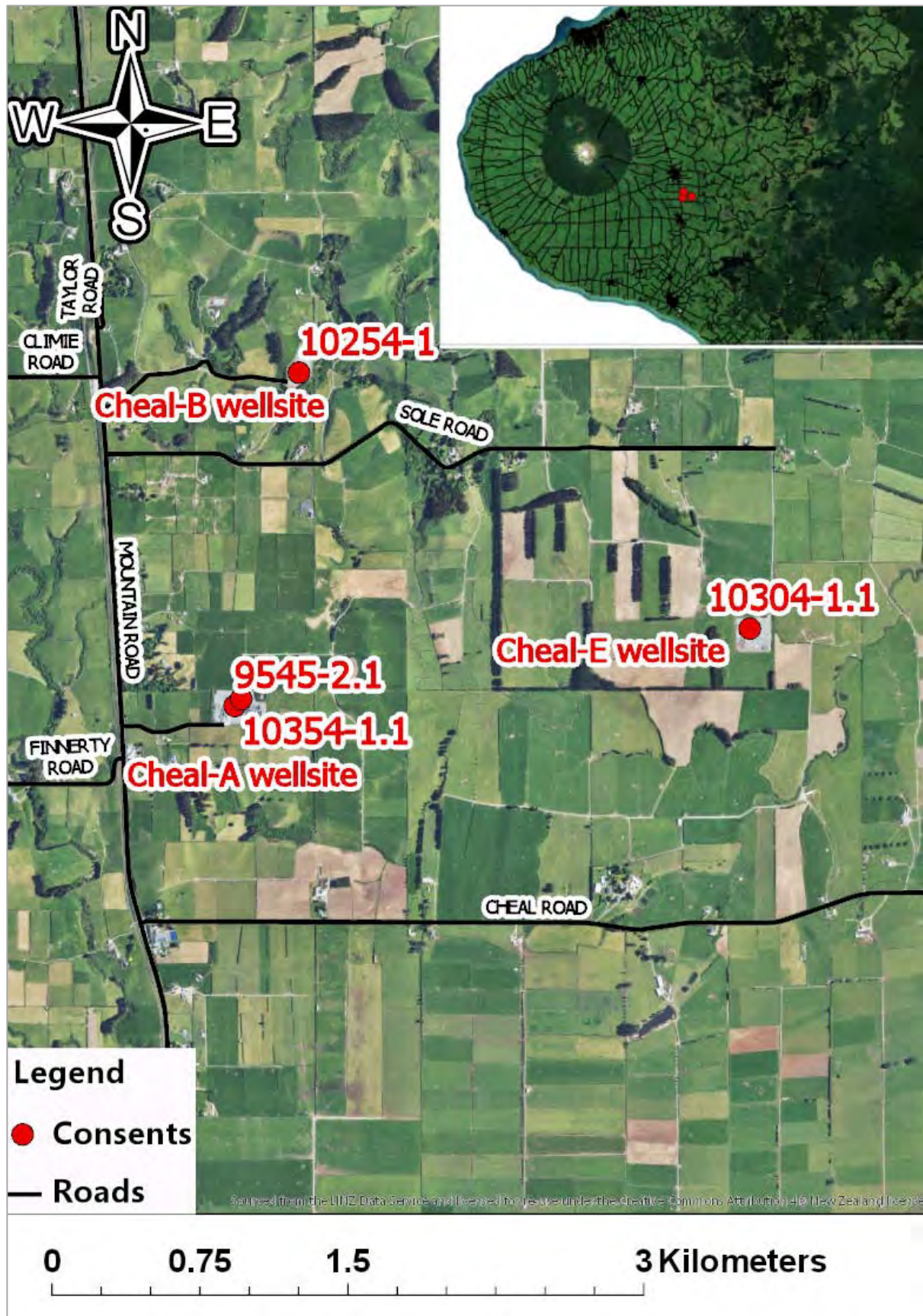


Figure 2 Location of the DWI consents held by the Company during the period under review



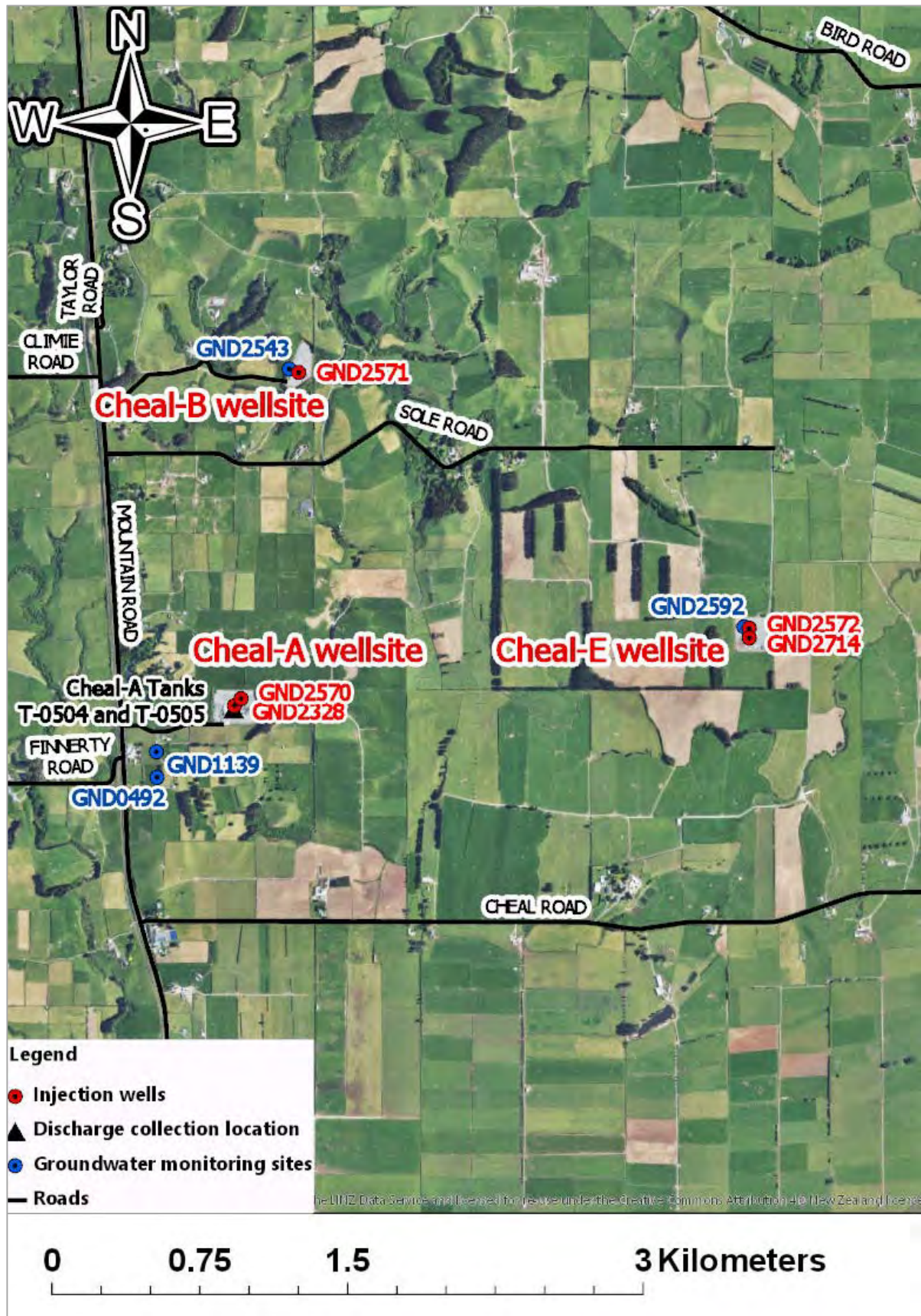


Figure 3 Location of monitoring sites in relation to the Company's DWI wellsites

## 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.

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

### 2.2 Injectate monitoring

Samples of injectate were obtained from the Company's Cheal-A Production Station on 28 November 2018 and 15 May 2019. All fluids for disposal are handled and controlled through the production station. The samples were sent to Hills on the same day for physicochemical analysis.

The results of the sample analyses undertaken by the Council are included below in Table 4. The range of results for each analyte since 2013 are also presented for comparison.

The Company also undertakes analysis of injectate at each well monthly. The range of results provided to the Council for the 2018-2019 monitoring year are presented in Appendix II.

The concentrations of each analyte measured over the 2018-2019 period are within the expected range for injectate samples at these sites.

**Table 4 Results of injectate sampling undertaken by the Council**

Parameter	Unit	Cheal Production Station			
		Minimum	Maximum	Tanks T0504 and T0505	
Date	-	July 2013- to June 2019		28 Nov 2018	15 May 2019
Time	NZST	-	-	13:30	12:30
TRC sample number	-	-	-	TRC184321	TRC191941
pH	pH units	6.0	8.7	8.3	8.7
Conductivity	mS/m	740	4,140	740	998
Suspended solids	g/m <sup>3</sup>	16	1,940	41	-*
Chloride	g/m <sup>3</sup>	1,890	18,300	1,890	2,700
Total petroleum hydrocarbons	g/m <sup>3</sup>	22	520	31	320

*Note - \* due to a lab error suspended solids were not analysed*

### 2.3 Groundwater sampling

Groundwater sampling was undertaken on 28 November 2018 and 15 and 22 May 2019 at four sites.

The results of analyses carried out during the period are set out below in Table 5, Table 6, Table 7 and Table 8. The minimum and maximum range of historical data has also been provided for comparison.

Historically, low level hydrocarbon concentrations, toluene concentrations well below drinking water standards and high concentrations of dissolved methane gas (33-38 mg/L) have been recorded at site GND2592, located at the Cheal-E wellsite. Carbon isotope analysis has shown that the source of this gas is biogenic, meaning it is being generated by the decomposition of organic matter in shallow groundwater zones, as opposed to thermal generation in deep hydrocarbon reservoirs. Given the presence of large amounts of shallow organic matter in locality of the wellsite, including Ngaere swamp deposits, it is possible that trace concentration of hydrocarbons are also present in groundwater as a result of the decomposition



of this material. There are no indications in any of the results received that would indicate that observed concentrations of these analytes are attributable to DWI activities.

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

Table 5 Groundwater monitoring results Cheal-A wellsite GND1139

Sample details	Units	GND1139			
TRC sample number	-	Minimum	Maximum	TRC184287	TRC191937
Sample date	-	July 2012 to June 2019		28 Nov 2018	15 May 2019
Sample time	NZST	-	-	13:00	12:45
pH	pH	6.7	7.1	7.0	7.0
Electrical conductivity	mS/m	14.5	21.4	21.4	21.0
Chloride	g/m <sup>3</sup>	9.4	14.2	11.9	12.4
Total hydrocarbons	g/m <sup>3</sup>	bdl	1.4	<0.7	<0.7

Table 6 Groundwater monitoring results Cheal-A wellsite GND0492

Sample details	Units	GND0492			
TRC sample number	-	Minimum	Maximum	TRC184289	TRC191939
Sample date	-	July 2011 to June 2019		28 Nov 2018	15 May 2019
Sample time	NZST	-	-	14:45	13:35
pH	pH	6.6	8.1	7.1	6.9
Electrical conductivity	mS/m	11.1	21.5	21.5	19.5
Chloride	g/m <sup>3</sup>	10.5	22.3	18.4	16.3
Total hydrocarbons	g/m <sup>3</sup>	bdl	bdl	<0.7	<0.7

Table 7 Groundwater monitoring results Cheal-B wellsite GND2543

Sample details	Units	GND2543			
TRC sample number	-	Minimum	Maximum	TRC184290	TRC191940
Sample date	-	July 2015 to June 2019		28 Nov 2018	22 May 2019
Sample time	NZST	-	-	12:30	10:20
pH	pH	7.1	7.4	7.4	7.3
Electrical conductivity	mS/m	20.9	24	23.2	22.8
Chloride	g/m <sup>3</sup>	14.2	16.9	14.8	14.2
Total hydrocarbons	g/m <sup>3</sup>	bdl	bdl	<0.7	<0.7

Table 8 Groundwater monitoring results Cheal-E wellsite GND2592

Sample details	Units	GND2592			
TRC sample number	-	Minimum	Maximum	TRC184288	TRC191938
Sample date	-	July 2016 to June 2019		28 Nov 2018	22 May 2019
Sample time	NZST	-	-	10:30	11:30
pH	pH	6.9	7.8	7.2	7.2
Electrical conductivity	mS/m	72.5	111.2	108.6	111.2
Chloride	g/m <sup>3</sup>	14.8	21.5	16.1	17.1
Total hydrocarbons	g/m <sup>3</sup>	bdl	1.7	<0.7	<0.7

## 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 and the total annual injection volumes for all sites combined since 2009 are presented in Table 10.

DWI was undertaken by the Company at the Cheal A, Cheal-B and Cheal-E wellsites during the monitoring period.

The greatest volume of discharge during the review period was undertaken at the Cheal-E wellsite with 41% of the total volume of fluids injected via the Cheal-E4 and Cheal-E7 wells under consent 10304-1.1. No discharge was undertaken via the Cheal-A7 well, located at the Cheal-A wellsite.

The volume of fluids discharged has increased significantly during the period under review in comparison to previous years. The observed increase likely the result of greater volumes of water needing disposal and the requirements of the Cheal water flood programme as the reservoir depletes.

**Table 9 Summary of injection activity during the 2017-2018 monitoring year**

Consent	Wellsite	Injection well	Total volume discharged (m <sup>3</sup> ) 01/07/18 – 30/06/19	Discharge period		Well ID
				From	To	
9545-2.1	Cheal-A	Cheal-A4	34,145.16	01/07/2018	30/06/2019	GND2328
10254-1	Cheal-B	Cheal-B3	27,072.60	01/07/2018	30/06/2019	GND2571
10304-1.1	Cheal-E	Cheal-E4	53,870.04	17/08/2018	30/06/2019	GND2714
10304-1.1	Cheal-E	Cheal-E7	29,363.61	01/07/2018	30/06/2019	GND2572
10354-1.1	Cheal-A	Cheal-A2	57,336.58	05/07/2018	30/06/2019	GND2570
10354-1.1	Cheal-A	Cheal-A7	No injection	N/A	N/A	GND2678
Total			201,787.99	-	-	-

**Table 10 Summary of the Company's historical injection activity since 2009**

Period	Total volume discharged (m <sup>3</sup> )	Period	Total volume discharged (m <sup>3</sup> )
2018-2019	201,788	2012-2013	14,660
2017-2018	115,394	2011-2012*	9,793
2016-2017	60,957	2010-2011*	9,792
2015-2016	16,988	2009-2010*	9,792
2014-2015	17,630	2007-2009	No injection
2013-2014	12,880	-	-

*Note \*volume was reported from 2009-2012 (29,377 m<sup>3</sup>) so total has been averaged over the three year period.*

Table 11, Table 12, Table 13 and Table 14 provide a summary of the historical data for each active site. Figure 4 to Figure 18 present the data graphically.

At the Cheal-A wellsite (Cheal-A4 well) the maximum injection pressure of 100.2 bar was recorded on 6 June 2019. The maximum daily volume of 641.37 m<sup>3</sup> and the maximum daily average injection rate of 26.7 m<sup>3</sup>/hr were recorded on 12 May 2019.

At the Cheal-B wellsite the maximum injection pressure of 96.5 bar was recorded on 21 August 2018. The maximum daily volume of 661.00 m<sup>3</sup> was recorded on 28 June 2019 and the maximum daily average injection rate of 60.88 m<sup>3</sup>/hr was recorded on 19 May 2019.

At the Cheal-E wellsite the maximum injection pressure of 100.6 bar was recorded in both the Cheal-E4 and Cheal-E7 wells on 12 February 2019. The maximum cumulative daily volume of 1,298.59 m<sup>3</sup> was recorded on 25 May 2019 and the maximum daily average injection rate of 120 m<sup>3</sup>/hr was recorded in the Cheal-E4 well on 12 May 2019.

At the Cheal-A wellsite (Cheal-A2 well) the maximum injection pressure of 100.3 bar was recorded on 23 June 2019. The maximum daily volume of 862.96 m<sup>3</sup> and the maximum daily average injection rate of 35.96 m<sup>3</sup>/hr were recorded on 12 May 2019.

**Table 11 Summary of injection occurring under consent 9545-2.1 (2013-2019)**

Deep well injection undertaken at Cheal-A wellsite via the Cheal-A4 injection well					
Year	Annual volume (m <sup>3</sup> )	Max. injection volume (m <sup>3</sup> /day)	Maximum injection rate* (m <sup>3</sup> /hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019*	34,145	641	27	100	68
2017-2018	19,217	115	9.7	99	77
2016-2017	20,119	129	13.3	104	74
2015-2016	16,988	123	5.3	104	53
2014-2015	14,705	117	13.4	140	69
2013-2014	12,880	142	12.0	209	58

*Note \* consent limits removed in July 2018*

**Table 12 Summary of injection occurring under consent 10254-1 (2016-2019)**

Deep well injection undertaken at Cheal-B wellsite via the Cheal-B3 injection well					
Year	Annual volume (m <sup>3</sup> )	Max. injection volume (m <sup>3</sup> /day)	Maximum injection rate (m <sup>3</sup> /hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019	27,073	661	60.9	97	65
2017-2018	23,722	589	24.5	96	53
2016-2017	34,006	268	65.6	97	63

Table 13 Summary of injection occurring under consent 10304-1.1 (2016-2019)

Deep well injection undertaken at Cheal-E wellsite via the Cheal-E7 injection well					
Year	Annual volume (m <sup>3</sup> )	Max. injection volume (m <sup>3</sup> /day)	Maximum injection rate* (m <sup>3</sup> /hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019	27,364	746	31.1	100.6	55
2017-2018	32,475	198	8.6	86	60
2016-2017	6,833	198	11.8	81	33
Deep well injection undertaken at Cheal-E wellsite via the Cheal-E4 injection well					
2018-2019	53,870	986	119.9	100.6	50

Table 14 Summary of injection occurring under consent 10354-1.1 (2017-2019)

Deep well injection undertaken at Cheal-A wellsite via the Cheal-A2 injection well					
Year	Annual volume (m <sup>3</sup> )	Max. injection volume (m <sup>3</sup> /day)	Maximum injection rate (m <sup>3</sup> /hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
2018-2019	57,337	863	36.0	100.3	35
2017-2018	39,981	343	14.3	94.3	25

The daily volume, maximum daily injection pressure and a comparison of volume and average daily pressure over the entire data record for consent 9545-2.1 (Cheal-A4 well) is presented in Figure 4, Figure 5 and Figure 6. A visual assessment of the data indicates that:

- The volume of fluid injected via the Cheal-A4 well increased significantly from May to July 2019; and
- Maximum and average pressures have remained relatively stable over the review period.

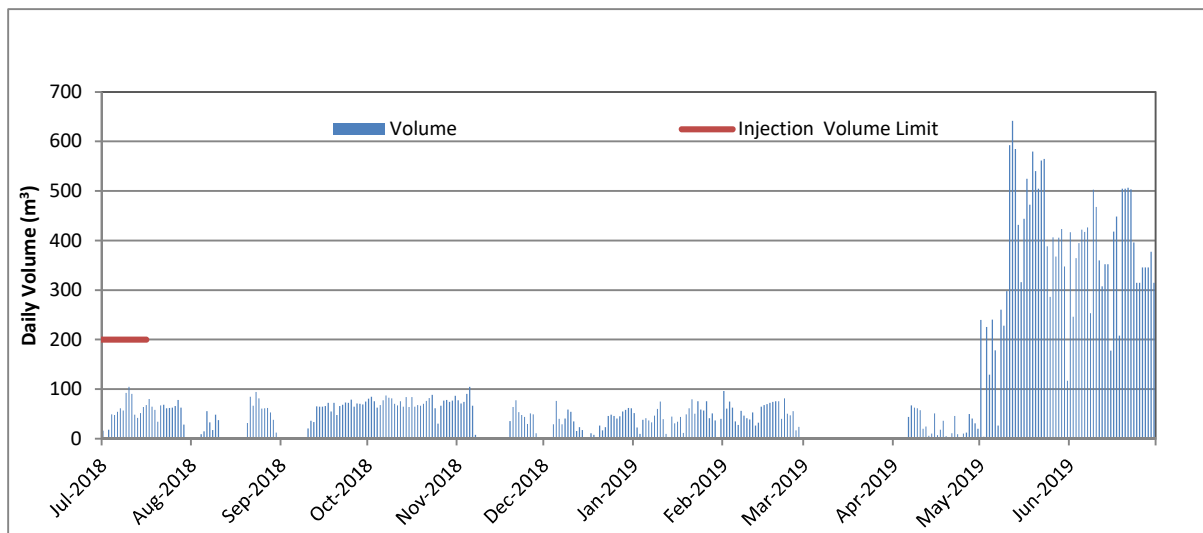


Figure 4 Total daily injection volume consent 9545-2.1 (2018-2019) Cheal-A4 well

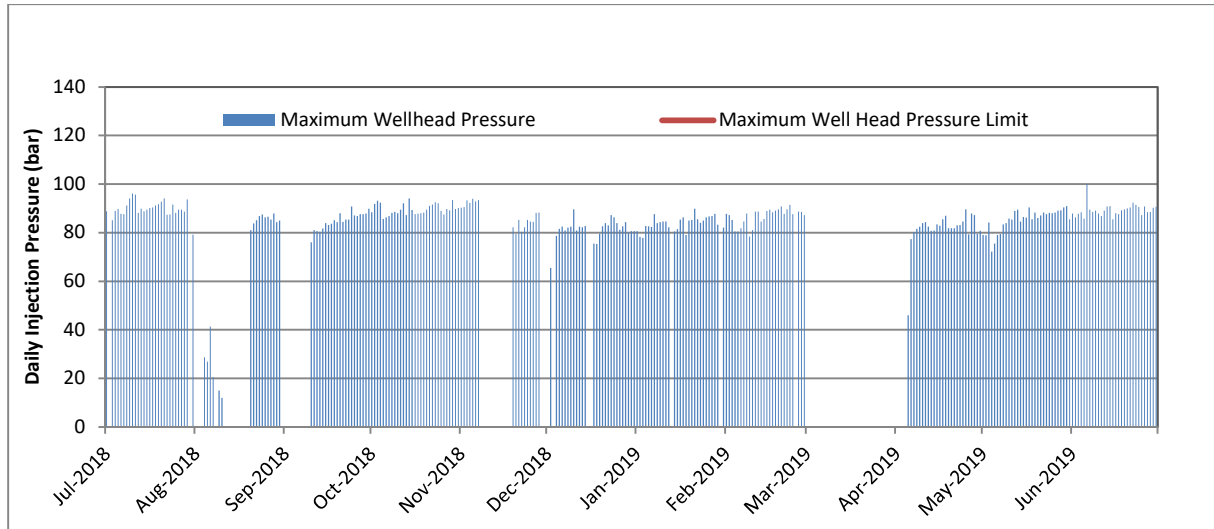


Figure 5 Total daily maximum injection pressure 9545-2.1 (2018-2019) Cheal-A4 well

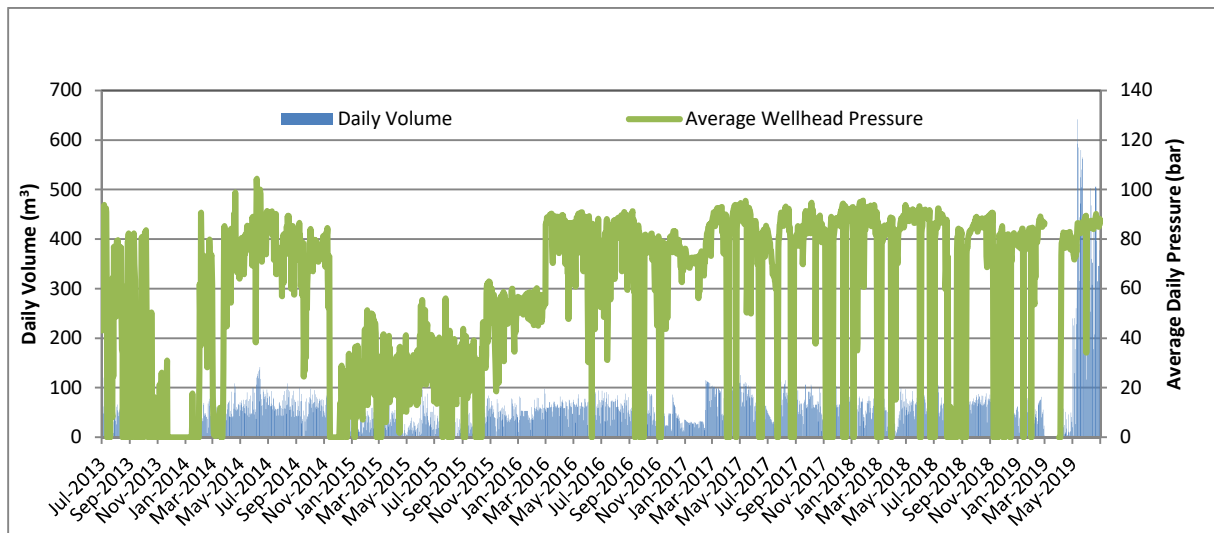


Figure 6 Daily volume and average injection pressure consent 9545-2.1 (2013-2019) Cheal-A4 well

The daily volume, maximum daily injection pressure and a comparison of volume and average daily pressure over the entire data record for consent 10254-1 (Cheal-B3 well) is presented in Figure 7, Figure 8 and Figure 9. A visual assessment of the data indicates that:

- The volume of fluid injected via the Cheal-B4 well increased significantly from May to July 2019; and
- Maximum and average pressures have remained relatively stable over the review period.

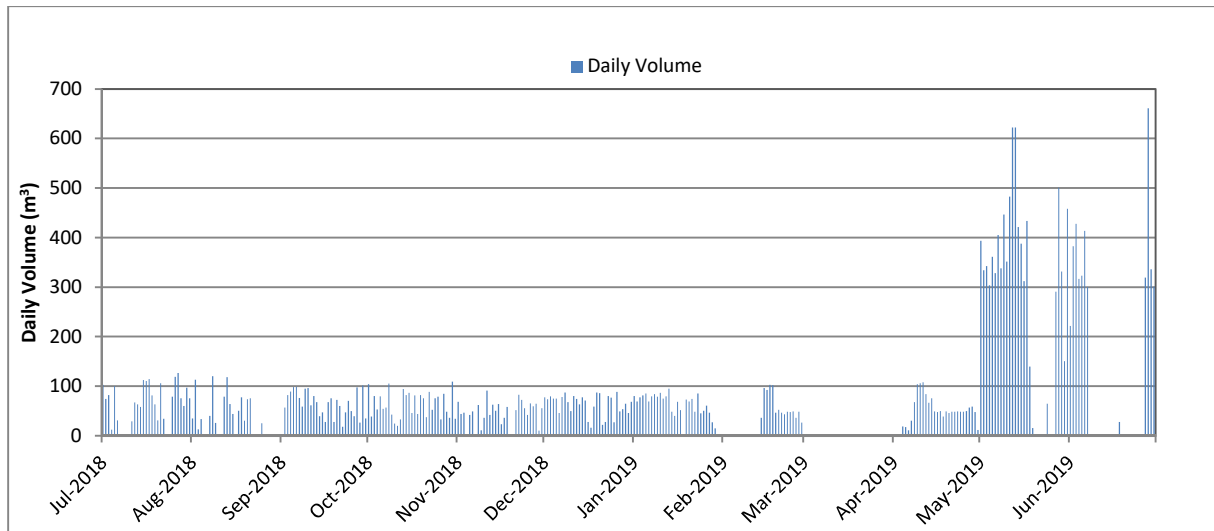


Figure 7 Total daily injection volume consent 10254-1 (2018-2019) Cheal-B3 well

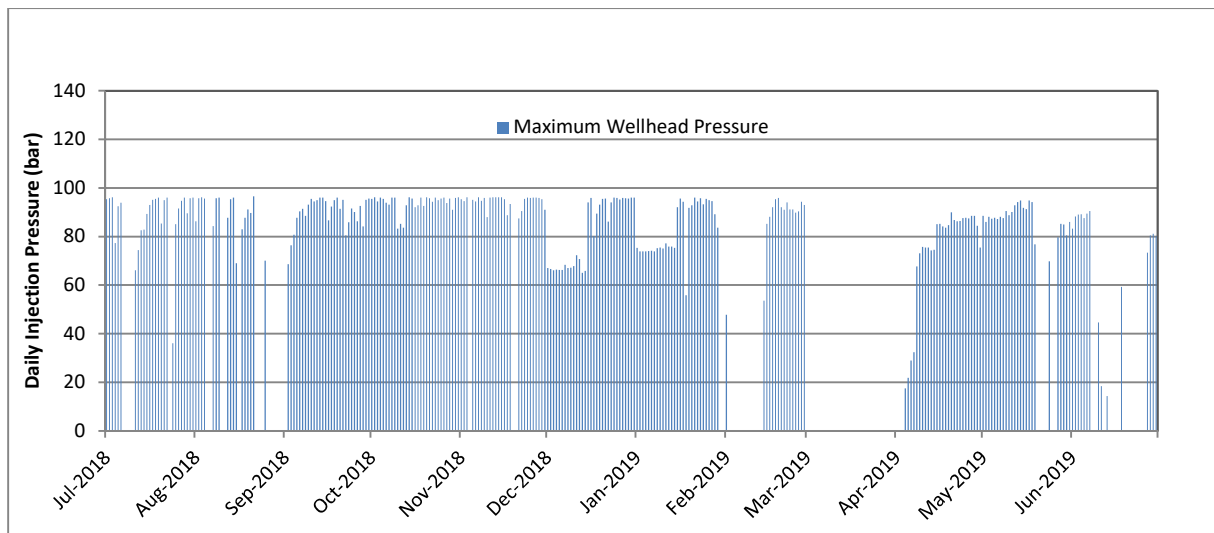


Figure 8 Total daily maximum injection pressure 10254-1 (2018-2019) Cheal-B3 well

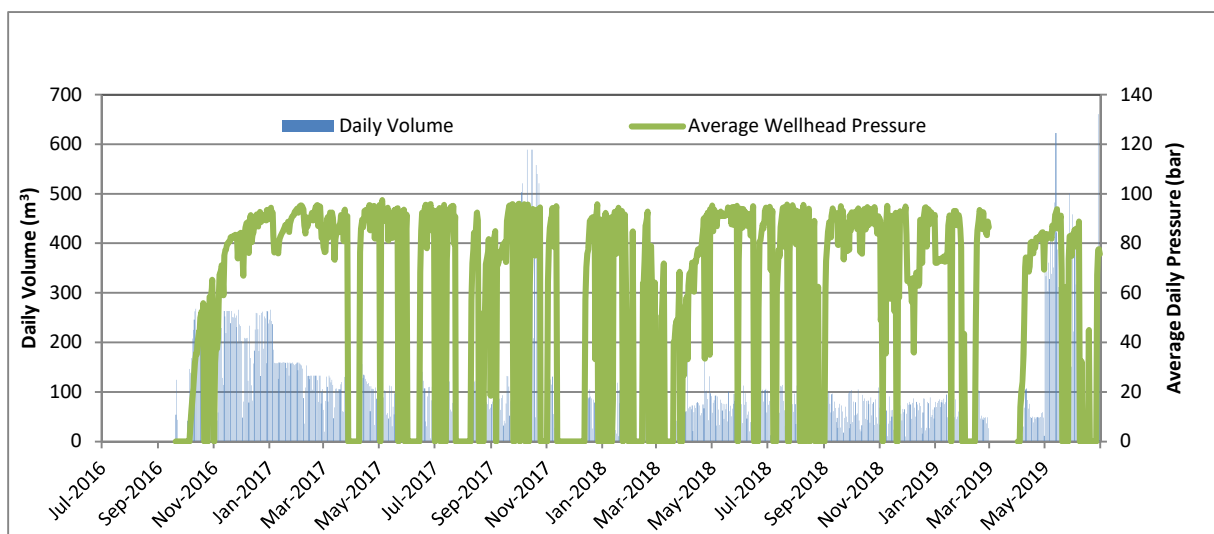


Figure 9 Daily volume and average pressure consent 10254-1 (2012-2019) Cheal-B3 well

The daily volume, maximum daily injection pressure and a comparison of volume and average daily pressure over the entire data record for consent 10304-1.1 is presented in Figure 10, Figure 11 and Figure 12 for the Cheal-E7 well and Figure 13, Figure 14 and Figure 15 for the Cheal-E7 well. A visual assessment of the data indicates that:

- Injection commenced in the Cheal-E4 well on 17 August 2018.
- The volume of fluid injected via the Cheal-E4 and Cheal-E7 wells increased significantly from May to July 2019; and
- Maximum and average pressures fluctuate in response to injection but generally remain relatively stable over the review period.

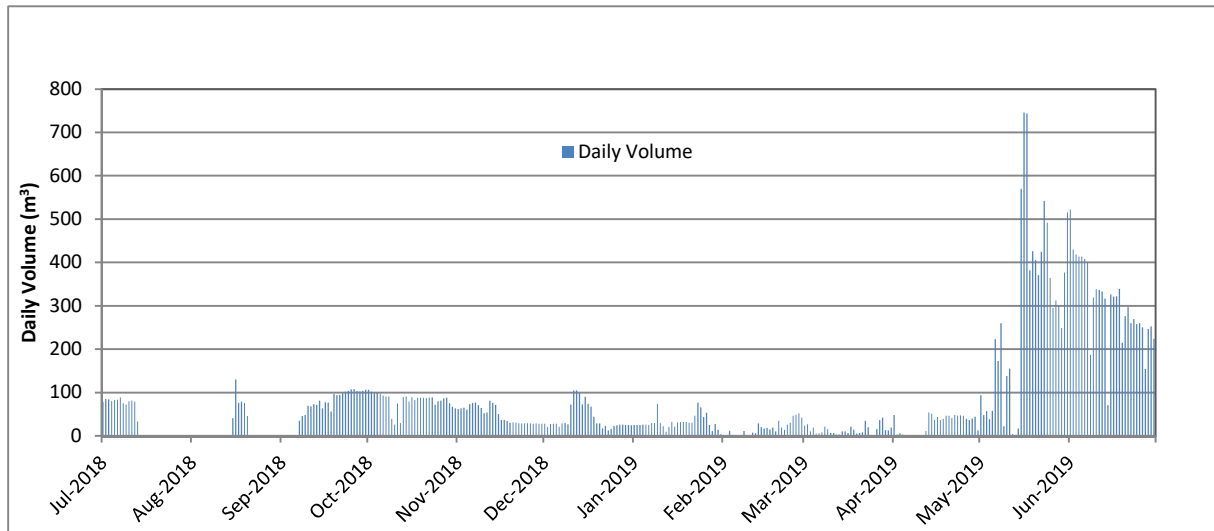


Figure 10 Total daily injection volume consent 10304-1.1 (2018-2019) Cheal-E7 well

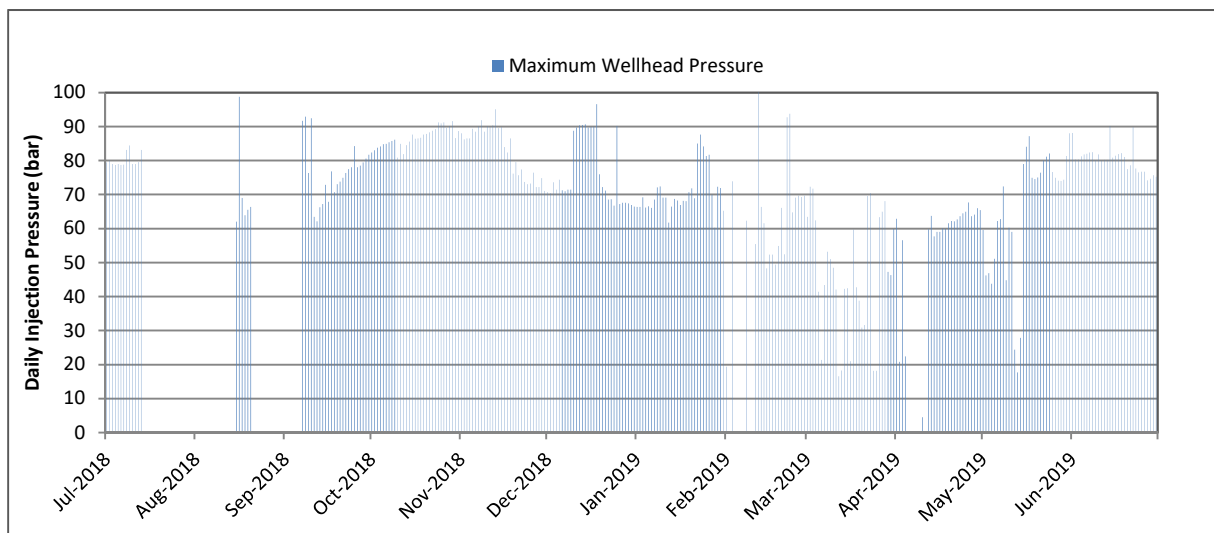


Figure 11 Total daily injection pressure consent 10304-1.1 (2016-2019) Cheal-E7 well

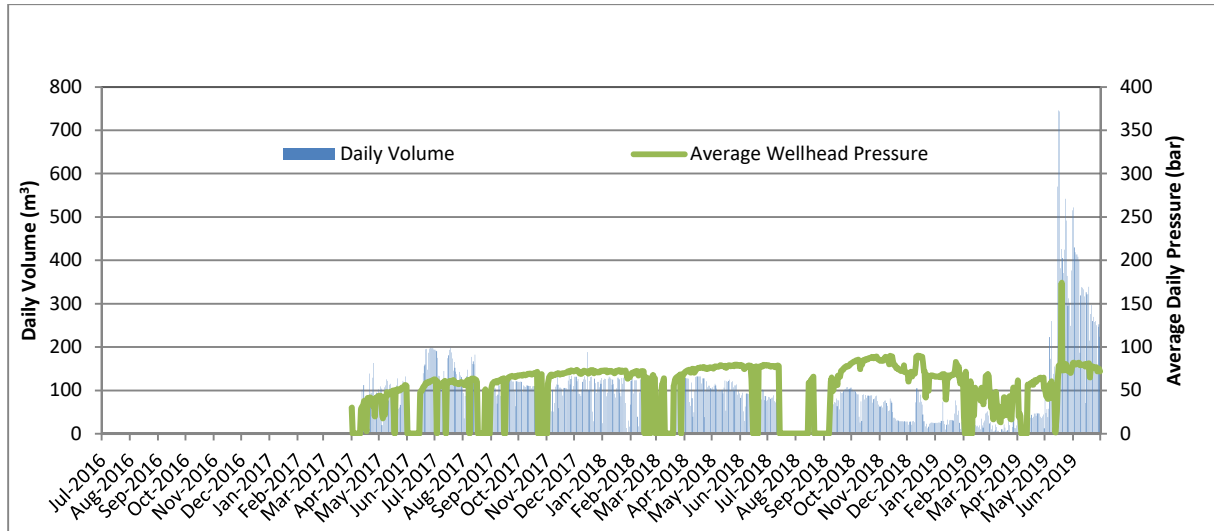


Figure 12 Total daily volume and average pressure consent 10304-1.1 (2016-2019) Cheal-E7 well

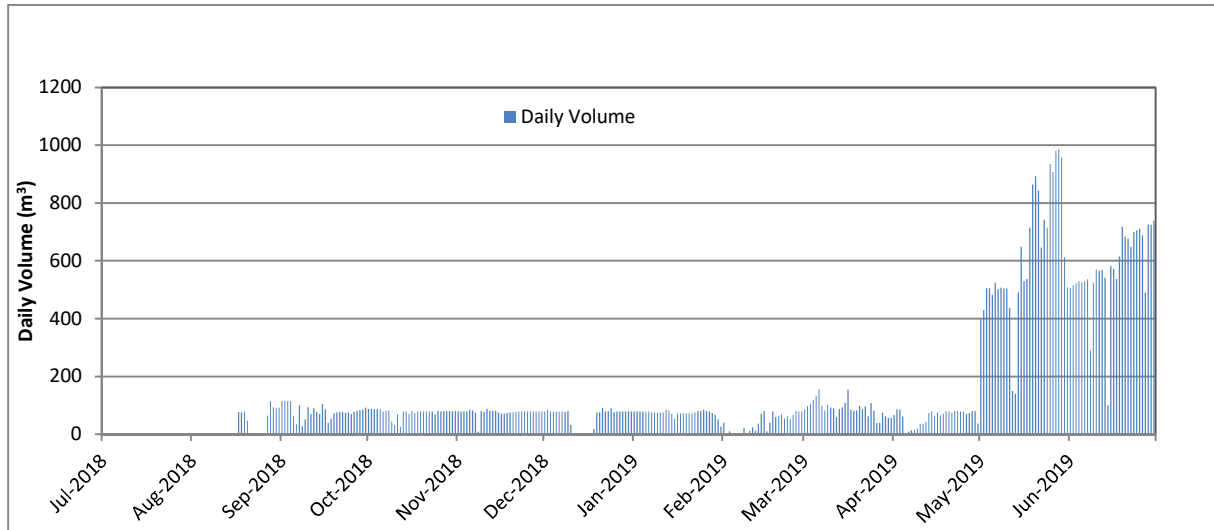


Figure 13 Total daily injection volume consent 10304-1.1 (2018-2019) Cheal-E4 well

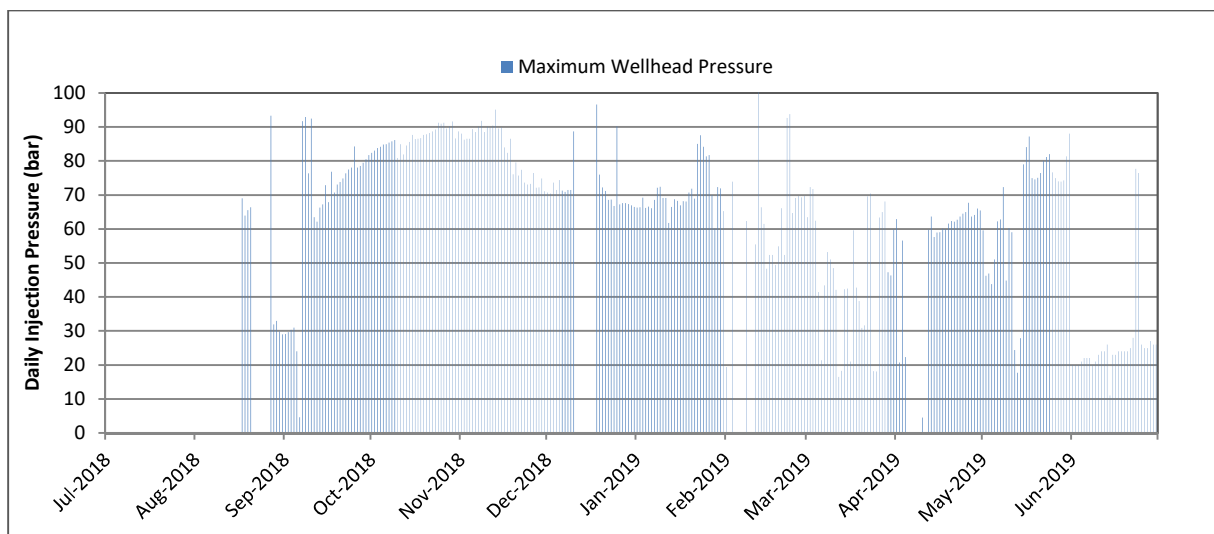


Figure 14 Maximum daily injection pressure consent 10304-1.1 (2018-2019) Cheal-E4 well



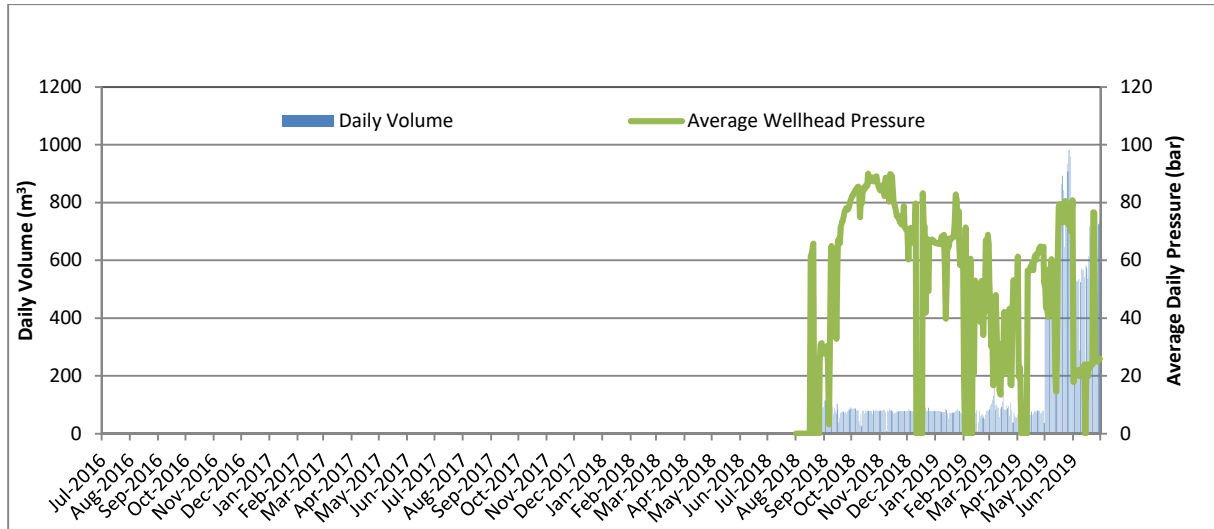


Figure 15 Total daily volume and average pressure consent 10304-1.1 (2018-2019) Cheal-E4 well

The daily volume, maximum daily injection pressure and a comparison of volume and average daily pressure over the entire data record for consent 10354-1.1 (Cheal-A2 well) is presented in Figure 16, Figure 17 and Figure 18. A visual assessment of the data indicates that:

- The volume of fluid injected via the Cheal-A2 well increased significantly from May to July 2019;
- Maximum pressures show occasional peaks and exhibit a slight declining trend over the review period.

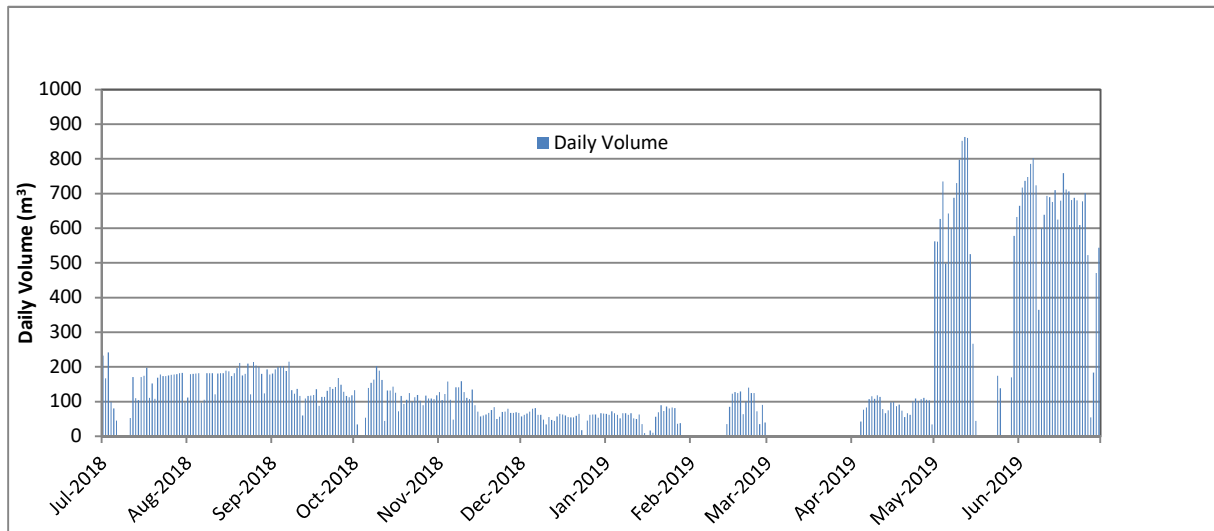


Figure 16 Total daily injection volume consent 10354-1.1 (2018-2019) Cheal-A2 well

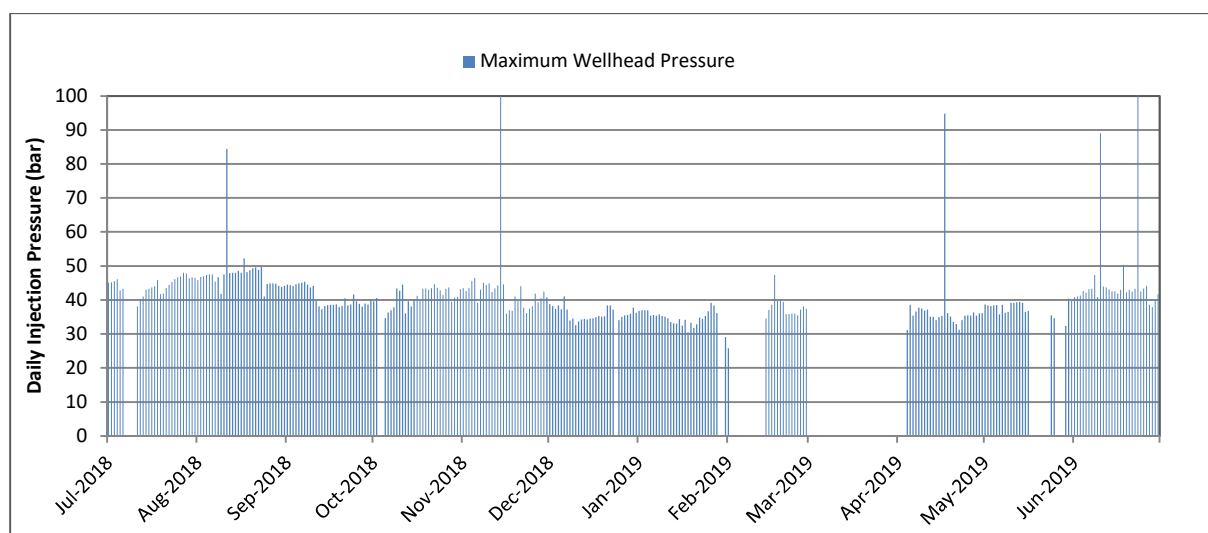


Figure 17 Maximum daily injection pressure consent 10354-1.1 (2018-2019) Cheal-A2 well

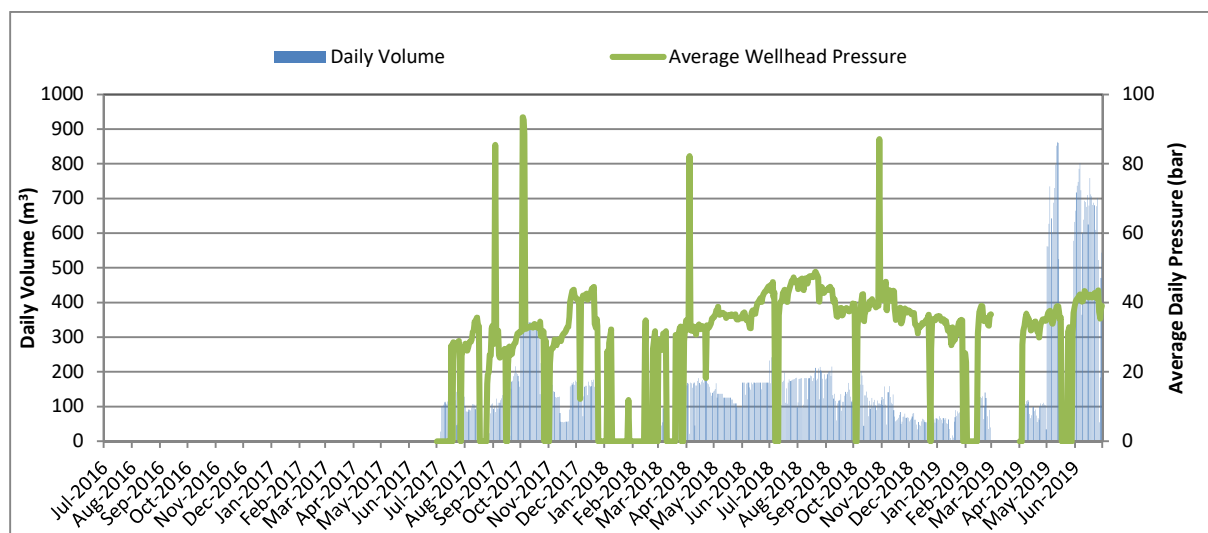


Figure 18 Total daily volume and average pressure consent 10354-1.1 (2018-2019) Cheal-A2 well

## 2.5 Incidents, investigations, and interventions

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

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).

There were no incidents recorded, additional investigations, or interventions required by the Council in relation to the Company's activities during the 2018-2019 period.

## 3 Discussion

### 3.1 Discussion of site performance

During the period under review, the Company exercised four resource consents (9545-2.1, 10254-1, 10304-1.1 and 10354-1.1) for the injection of fluids by DWI. These consents licensed discharges of various forms of fluid into the Mount Messenger Formation, via the Cheal-A2, Cheal-B3, Cheal-E4 and Cheal-E7 injection wells and the Urenui Formation via the Cheal-A4 injection well. The main source of fluids for injection was produced water from the Company's Cheal oil and gas reservoir. Injection at all the Cheal disposal sites is predominantly used for enhanced oil recovery using water flooding techniques.

A review of the 2018-2019 injection data provided by the Company shows that:

- A total of 201,788 m<sup>3</sup> of fluid was injected during the period under review;
- The volume injected during the review period has increased in comparison to previous years;
- An increase in injection volumes can be seen at all three wellsites in all wells from May to July 2019;
- 34,145 m<sup>3</sup> of fluid was injected under consent 9545-2.1;
- 27,073 m<sup>3</sup> of fluid was injected under consent 10254-1 ;
- 83,155 m<sup>3</sup> of fluid was injected under consent 10304-1.1;
- 57,337 m<sup>3</sup> of fluid was injected under consent 10354-1.1; and
- The greatest volume of fluid (41%) was injected under consent 10304-1.1 at the Cheal-E wellsite.

Injection wells are fitted with engineering controls and in built safety systems. Well integrity is constantly assessed by monitoring injection and annular pressures. In the event of any sudden pressure losses or increases, indicating a loss of tubing or annular pressure, safety systems isolate the wellbore and shut down the injectate pumping system. It should also be noted that maximum pressure that can be generated by the injectate pumps is well below the safe operating pressures of the wellhead, casing and tubing.

The operation of the injection well is monitored by Company staff, with automated systems recording the injection data required under the conditions of their consent. Throughout the monitoring period this data was submitted to the Council at the specified frequency. There is no evidence of any issues with any injection well currently in use, or the ability of the receiving formation to accept injected fluids.

Routine inspections of the Company's wellsites conducted during the period under review found them to be in good condition and being well managed. The Council was not required to enter any incidents in relation to the exercising of the Company's DWI consents during the review period, nor were any complaints received from the public in relation to these consents.

Monitoring during the year shows that the Company's DWI activities were being carried out in compliance with the conditions of the applicable resource consents.

### 3.2 Environmental effects of exercise of consents

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

The groundwater monitoring component of this programme continued during the period under review, with eight samples being taken from four 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 15 to Table 18 and an evaluation of the Company's environmental performance in relation to their DWI activities since 2007 is presented in Table 19.

**Table 15** Summary of performance for consent 9545-2.1

<b>Purpose: To discharge produced water from hydrocarbon exploration and production operations, reservoir compatible workover fluids and hydraulic fracturing return fluid into the Urenui Formation by deep well injection at the Cheal-A wellsite.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. By 1 October 2015, the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan," by 1 October 2015.	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 by 1 October 2015.	Yes
3. No injection permitted after 1 June 2030.	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 Urenui Formation, deeper than 1,300 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
6. The consent holder shall ensure that the exercise of this consent does not result in fracturing of geological seals.	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 range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	Yes

**Purpose: To discharge produced water from hydrocarbon exploration and production operations, reservoir compatible workover fluids and hydraulic fracturing return fluid into the Urenui Formation by deep well injection at the Cheal-A 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 not carried out by an IANZ accredited laboratory, analysis shall be carried out in accordance with QA plan which has been certified by the Chief Executive.	Inspection of QA plan.	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 before 1 June 2015.	Yes
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.	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

<b>Purpose: To discharge produced water from hydrocarbon exploration and production operations, reservoir compatible workover fluids and hydraulic fracturing return fluid into the Urenui Formation by deep well injection at the Cheal-A wellsite.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
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.	Yet to be assessed at the time of reporting.
17. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

Table 16 Summary of performance for consent 10254-1

<b>Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-B wellsite.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Before exercising, the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan," before exercising the consent.	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 before exercising the consent.	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 1,600 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
6. The consent holder shall ensure that the exercise of this consent does not result in fracturing of geological seals.	Review and analysis of injection data.	Yes

**Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-B wellsite.**

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	Yes
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. The consent holder will maintain daily injection data records.	Receipt of satisfactory data.	Yes
11. If not carried out by an IANZ accredited laboratory, analysis shall be carried out in accordance with QA plan which has been certified by the Chief Executive.	Inspection of QA plan.	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 before exercising the consent.	Yes

<b>Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-B wellsite.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
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.	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.	Yet to be assessed at the time of reporting.
17. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

Table 17 Summary of performance for consent 10304-1.1

<b>Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-E wellsite for the purpose of water flooding.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Before exercising the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan," before exercising the consent.	Yes



**Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-E wellsite for the purpose of water flooding.**

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 before exercising the consent.	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 1,600 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
6. The consent holder shall ensure that the exercise of this consent does not result in fracturing of geological seals.	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 range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	Yes
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. The consent holder will maintain daily injection data records.	Receipt of satisfactory data.	Yes
11. If not carried out by an IANZ accredited laboratory, analysis shall be carried out in accordance with QA plan which has been certified by the Chief Executive.	Inspection of QA plan.	Yes

**Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-E wellsite for the purpose of water flooding.**

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 before exercising the consent.	Yes
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.	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.	Yet to be assessed at the time of reporting.
17. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

Table 18 Summary of performance for consent 10354-1.1

<b>Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding.</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Before exercising the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan," before exercising the consent.	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 before exercising the consent.	Yes
3. No injection permitted after 1 June 2030.	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 1,600 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
6. The consent holder shall ensure that the exercise of this consent does not result in fracturing of geological seals.	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 range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	
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. The consent holder will maintain daily injection data records.	Receipt of satisfactory data.	Yes

**Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding.**

Condition requirement	Means of monitoring during period under review	Compliance achieved?
11. If not carried out by an IANZ accredited laboratory, analysis shall be carried out in accordance with QA plan which has been certified by the Chief Executive.	Inspection of QA plan.	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 before exercising the consent.	Yes
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.	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.	N/A
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.	Yet to be assessed at the time of reporting.

**Purpose: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding.**

Condition requirement	Means of monitoring during period under review	Compliance achieved?
17. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>
Overall assessment of administrative performance in respect of this consent		<b>High</b>

**Table 19 Evaluation of environmental performance over time**

Year	Consent	High	Good	Improvement	Poor
2017-2018	9545	1	-	-	-
	10254	1	-	-	-
	10304	1	-	-	-
	10354	1	-	-	-
2016-2017	9545	1	-	-	-
	10254	1	-	-	-
	10304	1	-	-	-
	10354	1	-	-	-
2015-2016	4728	Not exercised	-	-	-
	9545	1	-	-	-
	10254	Not exercised	-	-	-
	10304	Not exercised	-	-	-
2014-2015	4728	Not exercised	-	-	-
	9545	1	-	-	-
2013-2014	4728	Not exercised	-	-	-
	9545	1	-	-	-
2012-2013	4728	-	-	1	-
	9545	1	-	-	-
2009-2012	4728	-	-	1	-
2007-2009	4728	1	-	-	-
Totals	-	13	0	2	0

*Note \* not exercised during monitoring period*

During the year, the Company demonstrated a high level of environmental 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 9545-2.1, 10254-1, 10304-1.1 and 10354-1.1 provide for an optional review in June 2020. Condition 17 of all four consents 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 any 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 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.
3. 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.
bdl	Below detection limit.
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 <sup>3</sup> ).
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 earth's 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 <sup>3</sup>	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 <sup>3</sup>	Cubic metre.



pH	Numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are acidic and higher than 7 are alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Produced water	Water associated with oil and gas reservoirs that is produced along with the oil and gas. Typically highly saline with salt concentrations similar to seawater and containing low levels of hydrocarbons.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
UI	Unauthorised Incident.
Water flooding	A method of thermal recovery in which hot water is injected into a reservoir through specially distributed injection wells. Hot water flooding reduces the viscosity of the crude oil, allowing it to move more easily toward production wells.

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

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# Appendix I

## Resource consents held by Cheal Petroleum Limited

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

Consent Number	Wellsite	Status	Formation	Issued	Expiry
9545-2	Cheal-A	Replaced	Urenui	28/08/2015	18/07/2018
9545-2.1	Cheal-A	Active	Urenui	18/07/2018	01/06/2035
10254-1	Cheal-B	Active	Mount Messenger	11/04/2016	01/06/2034
10304-1.0	Cheal-E	Replaced	Mount Messenger	15/06/2016	06/06/2018
10304-1.1	Cheal-E	Active	Mount Messenger	15/06/2016	01/06/2034
10354.1.0	Cheal-A	Replaced	Mount Messenger	08/11/2016	18/07/2018
10354-1.1	Cheal-A	Active	Mount Messenger	08/11/2016	01/06/2035

### 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: Cheal Petroleum Limited  
PO Box 402  
New Plymouth 4340

Decision Date  
(Change): 18 July 2018

Commencement Date  
(Change): 18 July 2018 (Granted Date: 28 August 2015)

**Conditions of Consent**

Consent Granted: To discharge produced water from hydrocarbon exploration and production operations, reservoir compatible workover fluids and hydraulic fracturing return fluids into the Urenui Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding

Expiry Date: 1 June 2035

Review Date(s): June annually

Site Location: Cheal-A wellsite, 4273 Mountain Road, Ngaere  
(Property owners: J & R Lightoller)

Grid Reference (NZTM) 1712361E-5639489N

Catchment: Waingongoro

Tributary: Mangawharawhara

*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. By 1 October 2015, 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. By 1 October 2015, 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 2030.
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 be confined to the Urenui Formation, and be injected at a minimum depth of 1,300 metres true vertical depth below ground level.
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.

## Consent 9545-2.1

8. Only the following types of fluid may be discharged:
  - (a) produced water;
  - (b) well drilling fluids; and
  - (c) well workover fluids, including hydraulic fracturing fluids.
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 Taranaki Regional 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 28<sup>th</sup> 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 (AoR) 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.

The AoR 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 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.

## Consent 9545-2.1

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 18 July 2018

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**



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

Name of  
Consent Holder: Cheal Petroleum Limited  
PO Box 402  
New Plymouth 4340

Decision Date: 11 April 2016

Commencement Date: 11 April 2016

**Conditions of Consent**

Consent Granted: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-B wellsite

Expiry Date: 1 June 2034

Review Date(s): June annually

Site Location: Cheal-B wellsite, Taylor Road, Ngaere  
(Property owner: R & C Taylor)

Grid Reference (NZTM) 1712616E-5640740N

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 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 be confined to the Mount Messenger Formation, and be injected at a minimum depth of 1,600 metres true vertical depth below ground level.
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) compatible groundwater.

*(Note: for the purpose of this condition compatible groundwater means groundwater of a similar salinity to the receiving formation, such that it doesn't cause stratification or fluid migration).*

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 28<sup>th</sup> 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 (AoR) 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.

The AoR 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 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 11 April 2016

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**



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

Name of  
Consent Holder: Cheal Petroleum Limited  
PO Box 402  
New Plymouth 4340

Decision Date  
(Change): 6 June 2018

Commencement Date  
(Change): 6 June 2018 (Granted Date: 15 June 2016)

**Conditions of Consent**

Consent Granted: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-E wellsite for the purpose of water flooding

Expiry Date: 1 June 2034

Review Date(s): June annually

Site Location: Cheal-E wellsite, Sole Road, Ngaere  
(Property Owner: J O'Neill)

Grid Reference (NZTM) 1714369E-5639714N

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 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 be confined to the Mount Messenger Formation, and be injected at a minimum depth of 1,600 metres true vertical depth below ground level.
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.

## Consent 10304-1.1

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) compatible groundwater.

*(Note: for the purpose of this condition compatible groundwater means groundwater of a similar salinity to the receiving formation, such that it doesn't cause stratification or fluid migration).*

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.

## Consent 10304-1.1

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 (AoR) 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.

The AoR 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 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.

## Consent 10304-1.1

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 6 June 2018

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**





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

Name of  
Consent Holder: Cheal Petroleum Limited  
PO Box 402  
New Plymouth 4340

Decision Date  
(Change): 18 July 2018

Commencement Date  
(Change): 18 July 2018 (Granted Date: 8 November 2016)

**Conditions of Consent**

Consent Granted: To discharge produced water, well drilling fluids, well work over fluids and hydraulic fracturing fluids from hydrocarbon exploration and production operations into the Mount Messenger Formation by deep well injection at the Cheal-A wellsite for the purpose of water flooding

Expiry Date: 1 June 2035

Review Date(s): June annually

Site Location: Cheal-A wellsite, 4273 Mountain Road, Ngaere  
(Property owners: J & R Lightoller)

Grid Reference (NZTM) 1712371E-5639468N

Catchment: Waingongoro

Tributary: Mangawharawhara

*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 2030.
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 be confined to the Mount Messenger Formation, and be injected at a minimum depth of 1,600 metres true vertical depth below ground level.
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.

## Consent 10354-1.1

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) compatible groundwater.

*(Note: for the purpose of this condition compatible groundwater means groundwater of a similar salinity to the receiving formation, such that it doesn't cause stratification or fluid migration).*

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 Taranaki Regional 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 28<sup>th</sup> 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 (AoR) 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.

The AoR 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 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.

## Consent 10354-1.1

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 18 July 2018

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**



## Appendix II

The range of injectate results  
provided by the Company 2018-2019





Parameter	Location			Cheal-A2			Cheal-B3			Cheal-E4			Cheal-E7			Cheal-A4		
	Unit	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean		
Date	July 2018- June 2019																	
pH	-	7.5	8.2	7.8	7.5	8.2	7.8	6.8	7.9	7.5	6.8	8.2	7.6	7.5	8.2	7.8		
Conductivity	mho/cm	0.0092	0.0222	0.0146	0.0109	0.0210	0.0145	0.0130	0.0438	0.0220	0.0130	0.0438	0.0218	0.0092	0.1544	0.0278		
Suspended solids	g/m³	7	631	134	7	631	157	15	693	137	15	693	176	7	631	101		
Temperature	Deg°C	11.0	35.6	16.8	5.7	27.0	16.6	13.0	42.0	25.9	9.0	30.0	22.2	14.0	35.0	27.0		
Salinity	TDS g/m³	1,360	3,840	2,682	1,670	3,840	2,646	2,350	9,120	4,565	2,350	9,120	4,445	1,505	5,360	2,786		
Chloride	mg/L	1,940	5,050	3,692	2,200	5,050	3,554	2,940	11,500	5,835	2,940	11,500	5,692	1,880	6,600	3,688		
Total petroleum hydrocarbons	g/m³	8	2,250	864	8	2,250	799	45	830	219	45	830	257	8	2,250	742		