

Cheal Petroleum Limited  
Cheal Production Station  
Monitoring Programme  
Annual Report  
2014-2015

Technical Report 2015-89

ISSN: 1178-1467 (Online)  
Document: 1639663 (Word)  
Document: 1659728 (Pdf)

Taranaki Regional Council  
Private Bag 713  
STRATFORD

May 2016



## Executive summary

Cheal Petroleum Limited (the Company), a subsidiary of TAG Oil New Zealand Limited, operates a petrochemical production station located on Mountain Road at Ngaere, in the Waingongoro catchment. The Cheal Production Station processes oil and gas from the Cheal group of wellsites. This report for the period July 2014–June 2015 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds a total of three resource consents in relation to the Cheal Production Station, which include a total of 32 conditions setting out the requirements that the Company must satisfy. The Company holds one consent to discharge stormwater and treated waste water onto land in circumstances where it may subsequently enter an unnamed tributary of the Mangawharawhara Stream, one consent to abstract groundwater, and one consent to discharge emissions related to production activities into the air at the site.

**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 six inspections, three water samples collected for physicochemical analysis, and two ambient air quality surveys.

Stormwater system inspections showed that discharges from the sites complied with consent conditions. Receiving water inspections and sampling showed that the discharges were not causing any adverse effects on the tributary of the Mangawharawhara Stream.

There were no adverse effects on the environment resulting from the exercise of the air discharge consent. The ambient air quality monitoring at the site showed that levels of carbon monoxide, combustible gases, PM10 particulates and nitrogen oxides were all below levels of concern at the time of sampling. No offensive or objectionable odours were detected beyond the boundary during inspections and there were no complaints in relation to air emissions from the site.

During the period under review, the Company demonstrated an overall high level of both environmental performance and administrative compliance with the resource consents. The single spill incident recorded by the Council in relation to the Company's activities was quickly resolved in accordance with contingency procedures and did not result in any unauthorised discharges. The Cheal Production Station and associated wellsites were well managed and maintained.

For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.



## Table of contents

	<b>Page</b>
1. Introduction	1
1.1 Compliance monitoring programme reports and the Resource Management Act 1991	1
1.1.1 Introduction	1
1.1.2 Structure of this report	1
1.1.3 The Resource Management Act 1991 and monitoring	2
1.1.4 Evaluation of environmental and administrative performance	2
1.2 Process description	4
1.3 Resource consents	5
1.3.1 Water abstraction permit	5
1.3.2 Water discharge permit	6
1.3.3 Air discharge permit	7
1.3.4 Wellsite consents	8
1.4 Monitoring programme	9
1.4.1 Introduction	9
1.4.2 Programme liaison and management	9
1.4.3 Site inspections	9
1.4.4 Chemical sampling	9
2. Results	11
2.1 Water	11
2.1.1 Inspections	11
2.1.2 Results of discharge monitoring	12
2.1.3 Results of receiving environment monitoring	13
2.1.4 Summary of consented water abstractions reported by Cheal Petroleum	13
2.2 Air	13
2.2.1 Inspections	13
2.2.2 Results of receiving environment monitoring	13
2.2.3 Summary of flaring volumes reported by Cheal Petroleum	17
2.3 Investigations, interventions, and incidents	17
3. Discussion	19
3.1 Discussion of site performance	19
3.2 Environmental effects of exercise of consents	19
3.3 Evaluation of performance	19
3.4 Recommendations from the 2013-2014 Annual Report	22
3.5 Alterations to monitoring programmes for 2015-2016	22
3.6 Exercise of optional review of consent	22
4. Recommendations	23

Glossary of common terms and abbreviations	24
Bibliography and references	27
Appendix I Resource consents held by Cheal Petroleum Limited	
Appendix II Air monitoring reports	

## List of tables

<b>Table 1</b>	Consents for production activities at wellsites associated with Cheal Production Station	8
<b>Table 2</b>	Results for discharge monitoring from the Cheal Production Station (TRC site IND001056)	12
<b>Table 3</b>	Results of receiving environment monitoring in relation to the Cheal Production Station	13
<b>Table 4</b>	Results of carbon monoxide and LEL monitoring at Cheal Production Station	14
<b>Table 5</b>	Daily averages of PM10 results from monitoring at Cheal Production Station	16
<b>Table 6</b>	Summary of performance for Consent 4727-2	19
<b>Table 7</b>	Summary of performance for Consent 7906-1	20
<b>Table 8</b>	Summary of performance for Consent 9211-1	21

## List of figures

<b>Figure 1</b>	Location of the Cheal Production Station and associated sampling sites	12
<b>Figure 2</b>	Air monitoring sites at Cheal Production Station for 2014-2015	14
<b>Figure 3</b>	Ambient CO levels in the vicinity of the Cheal Production Station	15
<b>Figure 4</b>	PM10 concentrations ( $\mu\text{g}/\text{m}^3$ ) at the Cheal Production Station	16
<b>Figure 5</b>	Summary of monthly gas flaring volumes at Cheal Production Station	17

## List of photos

<b>Photo 1</b>	Cheal Production Station	5
----------------	--------------------------	---





# **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 2014-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Cheal Petroleum Limited (the Company), a subsidiary of TAG Oil New Zealand Limited. The Company operates a petrochemical production station situated on Mountain Road at Ngaere, in the Waingongoro catchment.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to abstractions and discharges of water within the Waingongoro catchment, and the air discharge permit to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the sixth combined annual report by the Council for the Cheal Production Station.

### **1.1.2 Structure of this report**

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Cheal Petroleum in the Waingongoro catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at the Cheal Production Station.

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 2015-2016 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);
- (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 consent holder during the period under review, this report also assigns a rating as to the Company's environmental and administrative performance.

**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 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2 Process description

The Cheal-A wellsite was first established on Mountain Road at Ngaere by NZOG Services Ltd in 1995. Austral Pacific developed the neighbouring Cheal-B wellsite in July 2006 and started construction of the Cheal Production Station adjacent to the Cheal-A wellsite in late 2006. The production station was commissioned in August 2007 and the tie-in to the Cheal-B pipeline was complete in December 2007.

The owners of the Cheal facilities, including Austral Pacific Energy (NZ) Ltd, were placed in receivership in April 2009. The consents were transferred to Cheal Petroleum Limited in October 2009 and the site is now operated by TAG Oil. The production station continued to operate during this transition. Consents for Austral Pacific's Cardiff wellsite on Brookes Road were transferred to Cheal Petroleum in December 2010. This site is now known as Cheal-C and is operated by TAG Oil as part of the Cheal group.

Consents were granted to Cheal Petroleum for construction of three additional exploration wellsites in the area, being Cheal-D, Cheal-E and Cheal-G. Construction and commissioning of a multiphase pipeline from Cheal-E to the Cheal Production Station was undertaken in the 2014-2015 year.

The production station processes oil and gas from the Cheal wellsites. Some gas is used to power the site and to generate electricity for supply. Construction of a new gas processing plant and pipelines were completed in the 2012-2013 year to process raw inlet gas to New Zealand gas specifications for delivery on the Vector system for domestic use. Stormwater from the Cheal-A wellsite and Production Station is collected in a large skimmer pit in the northwest corner of the site prior to discharge.



**Photo 1** Cheal Production Station

## **1.3 Resource consents**

### **1.3.1 Water abstraction permit**

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.

TAG Oil (NZ) Ltd holds water permit **9211-1** to take saline groundwater from the Lower Mateamateonga Formation for use in water flooding activities. This permit was issued by the Council on 25 February 2012 under Section 87(d) of the RMA. It is due to expire on 1 June 2017.

There are seven special conditions attached to this consent.

Condition 1 required submission of details of the Cheal A4 well workover prior to exercise of the consent.

Condition 2 places a limit on the maximum daily abstraction volume.

Conditions 3 to 5 require installation of an accurate water meter, access for inspection by the Council and provision of monthly abstraction volume records.

Condition 6 requires the adoption of the best practicable option to minimise adverse environmental effects.

Condition 7 is a review provision.

The permit is attached to this report in Appendix I.

### 1.3.2 Water discharge permit

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.

Cheal Petroleum Ltd holds water discharge permit **4727-2** to discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Cheal-A wellsite and Cheal Production Station, onto and into land in circumstances where it may enter an unnamed tributary of the Mangawharawhara Stream. This permit was issued by the Council on 10 November 2011 under Section 87(e) of the RMA. Changes to the conditions were made on 29 April 2013 upon application by Cheal Petroleum to allow for an increased stormwater catchment area. It is due to expire on 1 June 2029.

There are 13 special conditions attached to this consent.

Condition 1 requires the consent holder to exercise the best practicable option to prevent or minimise effects.

Condition 2 states the size limit of the catchment from which stormwater may be discharged.

Condition 3 requires the consent holder to advise the Council seven working days prior to commencement of any site works or drilling operation.

Condition 4 requires the consent holder to maintain a contingency plan to the satisfaction of the Council, detailing measures and procedures to prevent, remedy and mitigate environmental effects of spillage or discharge.

Condition 5 requires management and maintenance of the stormwater system in accordance with information submitted in support of the consent.

Condition 6 requires all stormwater and produced water to be directed for treatment through the stormwater treatment system before being discharged.

Conditions 7 and 8 set requirements on the minimum size and design of the skimmer pits.

Condition 9 outlines standards that the constituents in the discharge shall meet.

Condition 10 states that the discharge shall not give rise to an increase in temperature of more than two degrees Celsius after allowing for a mixing zone of 25 metres.

Condition 11 states the effects that shall not occur in the receiving water as a result from the discharge, after allowing for a 25 metre mixing zone.

Condition 12 requires the consent holder to advise the Council in writing at least 24 hours prior to the reinstatement if the site, which shall be carried out so as to minimise adverse effects on stormwater quality.

Condition 13 provides for review of the consent.

The permit is attached to this report in Appendix I.

### **1.3.3 Air discharge permit**

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.

Cheal Petroleum Ltd holds air discharge permit **7906-1** to discharge emissions into the air during flaring and to discharge miscellaneous emissions from tank vents and generators arising from hydrocarbon production activities including emergency situations and well workovers at the Cheal-A wellsite and Cheal Production Station. This permit was issued by the Council on 10 November 2011 under Section 87(e) of the RMA and is due to expire on 1 June 2029.

There are 12 special conditions attached to this consent.

Condition 1 requires the consent holder to adopt the best practicable option to prevent or minimise effects.

Condition 2 and 3 require the consent holder to keep logs of flaring and to submit a monthly flaring report to the Council.

Condition 4 requires provision to the Council of an annual report detailing activities and measures undertaken relating to flaring.

Condition 5 requires the consent holder to keep, and make available to the Council, a record of all smoke-emitting incidents.

Condition 6 states that the consent holder shall make available upon request an analysis of a typical gas and crude oil stream from the wells.

Condition 7 stated that there shall be no alterations to plant equipment or processes which may alter the nature of the flare without consulting the Council.

Condition 8 requires the Council to be notified if a flaring event is expected to exceed five minutes duration.

Condition 9 requires the consent holder to control all emissions of the specified contaminants in order that the maximum ground level concentration at the site boundary measured under ambient conditions does not exceed relevant ambient air quality standards.

Condition 10 states that the consent holder shall control emissions to the atmosphere, other than those specified in condition 9, in order that they do not cause hazardous, noxious, dangerous, offensive or objectionable effect at or beyond the wellsite boundary.

Condition 11 requires all permanent tanks used as hydrocarbon storage tanks to be fitted with vapour recovery systems.

Condition 12 is a review provision.

The permit is attached to this report in Appendix I.

### 1.3.4 Wellsite consents

The Company also holds consents for production activities at wellsites associated with the Cheal Production Station. A summary of these consents is provided in Table 1. Production activities at Cheal-A are covered under the production station consents. The Cheal-D wellsite has not yet been constructed.

**Table 1** Consents for production activities at wellsites associated with Cheal Production Station

Wellsite	Consent number	Purpose	Issue date	Expiry
Cheal-B	6814-1	To discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Cheal-B wellsite	23/3/2006	2022
	6815-1	To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Cheal-B wellsite onto and into land in the vicinity of the Ngaere Stream in the Patea catchment	23/3/2006	2022
Cheal-C	6403-1	To discharge treated stormwater, treated produced water and treated wastewater at the Cheal-C wellsite onto and into land in the vicinity of an unnamed tributary of the Mangawharawhara Stream in the Waingongoro catchment	22/7/2004	2023
	7780-2	To take and use water from an unnamed tributary of the Mangawharawhara Stream for hydrocarbon exploration activities at the Cheal-C wellsite	22/7/2014	2029
	9262-1	To discharge emissions to air associated with production activities from up to 10 wells at the Cheal-C wellsite, including: flaring associated with emergencies (including operational emergencies) and maintenance; emissions from gas treatment or production plants; and minor emissions from other miscellaneous activities	11/6/2012	2029
Cheal-D	9534-1	To discharge emissions to air associated with hydrocarbon producing wells at the Cheal-D wellsite	5/6/2013	2028
	9535-1	To discharge treated stormwater, treated surplus drilling water and treated produced water from hydrocarbon exploration and production operations at the Cheal-D wellsite, onto land and into an unnamed tributary of the Kahikatea Stream	2/4/2013	2028
Cheal-E	9549-1	To discharge emissions to air associated with hydrocarbon producing wells at the Cheal-E wellsite	1/11/2013	2028
	9550-1	To discharge treated stormwater, treated surplus drilling water and treated produced water from hydrocarbon exploration and production operations at the Cheal-E wellsite, onto land and into an unnamed tributary of the Ngaere Stream	6/5/2013	2028
Cheal-G	9614-1	To discharge emissions to air associated with hydrocarbon producing wells at the Cheal-G wellsite	5/2/2014	2029
	9615-1	To discharge treated stormwater, treated surplus drilling water and treated produced water from hydrocarbon exploration and production operations at the Cheal-G wellsite, onto land where it may enter the Tuikonga Stream	23/8/2013	2029



## **1.4 Monitoring programme**

### **1.4.1 Introduction**

Section 35 of the RMA sets out obligations upon the Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

The 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 Cheal Production Station consisted of three primary components: management, inspections and chemical sampling.

Biomonitoring of the tributary of the Mangawharawhara Stream is not undertaken in relation to activities at the production station due to the lack of a suitable upstream control site. The point of entry for any discharge that reaches the tributary is immediately below the ponds at Ngaere Gardens. Sampling and visual inspection of the stream are the main means of receiving environment monitoring.

### **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 reviews;
- renewals;
- new consents;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

### **1.4.3 Site inspections**

The Cheal Production Station was inspected six times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

### **1.4.4 Chemical sampling**

The Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge point and mixing zone.

The combined Cheal Production Station/Cheal-A wellsite discharge was sampled on one occasion, and the sample analysed for chloride, hydrocarbons, suspended solids, temperature and pH. The unnamed tributary of the Mangawharawhara Stream was sampled concurrently, and the samples analysed for biochemical oxygen demand, chloride, hydrocarbons, suspended solids, temperature and pH.

The Council also undertook sampling of the ambient air quality outside the boundary of the site. A multi-gas meter was deployed on one occasion in the vicinity of the plant, with monitoring consisting of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). A PM10 particulate monitor was deployed concurrently with the multi-gas meter. Two nitrogen oxide measuring devices were also deployed in the vicinity of the plant on one occasion during the year under review. The Company supplied data on flaring causes and flare and fuel gas volumes throughout the period.

## **2. Results**

### **2.1 Water**

#### **2.1.1 Inspections**

Six inspections were carried out at the Cheal Production Station and associated facilities in the 2014-2015 year. The following was found during the inspections:

##### **7 August 2014**

All sites were neat, tidy and well managed. Ring drains and bunds were secure. No flaring was evident and there were no odours noted off site. The rig at Cheal-B was to be moved to Gisborne.

##### **23 October 2014**

The Cheal Production Station and wellsite were neat and tidy. All contingency measures were in place. Some production flaring was being undertaken with no smoke or odours resulting. The skimmer pits were clear and not discharging. There was little activity at Cheal-B and C and no flaring. Cheal-E had been prepared for the arrival of the drilling rig. Ring drains and bunds were all secure. All sites were tidy and well managed.

##### **16 January 2015**

A perimeter inspection was undertaken. Flaring was occurring through thermal oxidisers with no smoke or odours evident. Ring drains and bunds were secure. The skimmer pits were not discharging and hadn't done so for some time. The receiving water downstream of the Cheal-E site showed no instream effects from any previous stormwater discharges. The sites were neat and tidy. Everything was satisfactory.

##### **11 February 2015**

The Cheal Production Station was operating normally at the time of inspection. The truck load out area was being utilised with no signs of any mishaps. The skimmer pits and separators were all operating as per design. Frogs resident in the main stormwater skimmer pits were indicative of good water quality. There were no signs of any flaring activity and no odours or smoke were evident. The site was tidy and obviously well managed. Everything was satisfactory.

##### **30 April 2015**

The Cheal sites were checked as part of routine monitoring. At all sites the ring drains and bunds, along with skimmer pits and stormwater discharges, were found to be operating in accordance with management plans. Flaring was being carried out at Cheal-A with no smoke or odours evident off site. The thermal oxidiser was being used at Cheal-E with nothing untoward noted. The pipeline between Cheal-E and the production station had been completed without any issues. Re-fencing of the pipeline corridor was underway.

All sites were well managed and tidy. Any stormwater discharges to adjacent streams had not given rise to any adverse effects. Everything was satisfactory.

##### **29 June 2015**

The Cheal sites were inspected following an extreme rainfall event the previous weekend. The design and management of the stormwater systems, ring drains,

skimmer pits and bunds had ensured that all stormwater from the sites had been directed to the skimmer pits for treatment prior to discharge into the adjacent water bodies. No adverse effects were noted from these discharges. Minimal flaring was being undertaken and no effects, odours or smoke were noted.

### 2.1.2 Results of discharge monitoring

Chemical water quality sampling of the combined discharge from the Cheal Production Station/Cheal-A wellsite was undertaken on one occasion during the 2014-2015 year. The sample was collected on 4 June 2015. Table 2 below presents the results. The location of the sampling site (IND001056) is shown in Figure 1.



**Figure 1** Location of the Cheal Production Station and associated sampling sites

**Table 2** Results for discharge monitoring from the Cheal Production Station (TRC site IND001056)

Parameter	Units	4 June 2015	Consent limits
Chloride	g/m <sup>3</sup>	6.9	50
Hydrocarbons	g/m <sup>3</sup>	< 0.5	15
Suspended solids	g/m <sup>3</sup>	24	100
Temperature	Deg. C	10.7	-
pH		6.9	6.0 – 9.0

The results show that the discharge was in compliance with the resource consent limits at the time of sampling.

### 2.1.3 Results of receiving environment monitoring

Chemical water quality sampling of the receiving environment was undertaken in conjunction with discharge monitoring on 4 June 2015. The results are presented in Table 3 and the sampling sites are shown in Figure 1.

**Table 3** Results of receiving environment monitoring in relation to the Cheal Production Station

Parameter	Units	4 June 2015	
		Upstream [site MWW000237]	Downstream [site MHWW000238]
BOD*	g/m <sup>3</sup>	1.9	5.8
Chloride	mS/m	14.8	12.2
Hydrocarbons	g/m <sup>3</sup>	< 0.5	< 0.5
pH		6.6	6.6
Temperature	Deg.C	10.5	10.8
Suspended solids	g/m <sup>3</sup>	6	19

\*Biochemical oxygen demand

The results indicate that the discharge was having negligible effect on the water quality of the tributary of the Mangawharawhara Stream and was in compliance with all applicable consent conditions at the times of sampling. The elevated suspended solids and BOD values at the downstream site was most likely due to iron oxide sediment suspended in the flow which could not be avoided during the sampling process.

### 2.1.4 Summary of consented water abstractions reported by Cheal Petroleum

Neither the Cheal-A groundwater take under consent 9211-1, nor the Cheal-C surface water take under consent 7780-2 were exercised during the year under review.

## 2.2 Air

### 2.2.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in Section 2.1.1 above. No issues regarding air quality were noted during the monitoring year.

### 2.2.2 Results of receiving environment monitoring

#### 2.2.2.1 Carbon monoxide and combustible gases

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately nine hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The monitoring sites used in the year under review are shown in Figure 2.

Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the

average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.



**Figure 2** Air monitoring sites at Cheal Production Station for 2014-2015

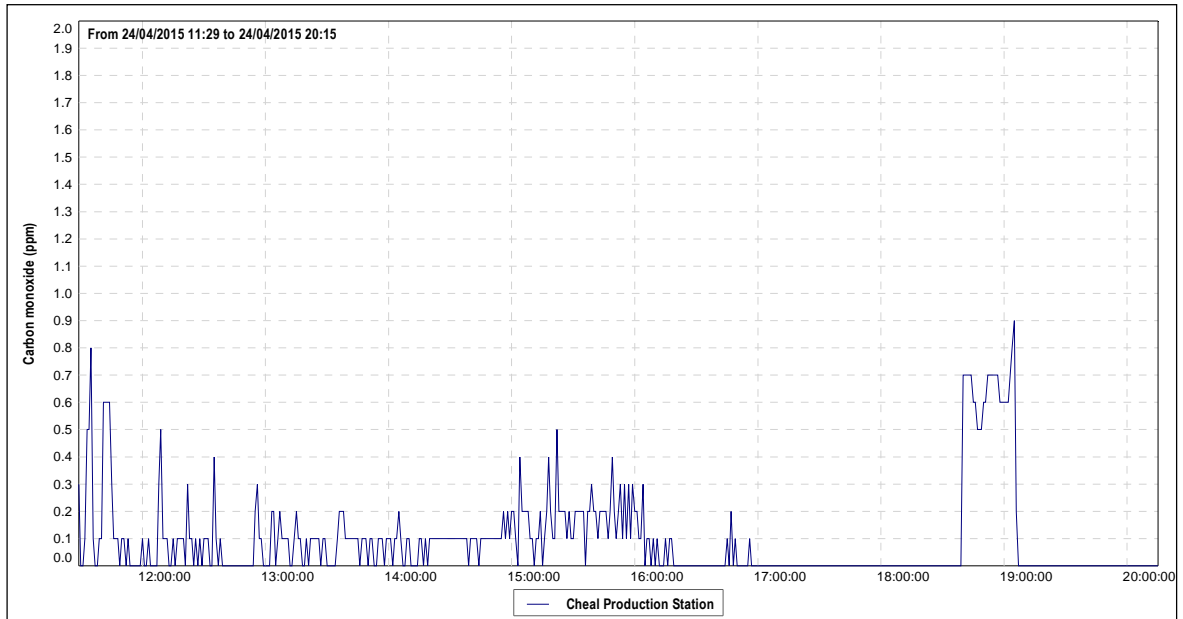
The details of the sample run are summarised in Table 4 and the data from the sample run are presented graphically in Figure 3.

The consents covering air discharges from the Cheal Production Station have specific limits related to particular gases. Special condition 9 of consent 7906-1 sets limits on the carbon monoxide, nitrogen dioxide and fine particle (PM10) concentrations at or beyond the production station's boundary. The limit on the carbon monoxide is expressed as 10 mg/m<sup>3</sup> for an eight hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 1.03 mg/m<sup>3</sup> while the average concentration for the entire dataset was only 0.15 mg/m<sup>3</sup> which comply with consent conditions. This is in line with the pattern found in previous years.

**Table 4** Results of carbon monoxide and LEL monitoring at Cheal Production Station

Period		24/04/2015 11:29 to 24/04/2015 20:15
Max	CO (ppm)	0.90
	LEL (%)	0.30
Mean	CO (ppm)	0.10
	LEL (%)	0.00
Min	CO (ppm)	0.00
	LEL (%)	0.00

Notes: (1) the instrument records in units of ppm. At 25°C and 1 atm, 1ppm CO = 1.145 mg/m<sup>3</sup>  
 (2) because the LEL of methane is equivalent to a mixture of approximately 5% methane in air, then the actual concentration of methane in air can be obtained by dividing the percentage LEL by 20.



**Figure 3** Ambient CO levels in the vicinity of the Cheal Production Station

Lower Explosive Limit (LEL) gives the percentage of the lower explosive limit, expressed as methane that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Cheal Production Station reach any more than a trivial level.

### 2.2.2.2 PM10 particulates

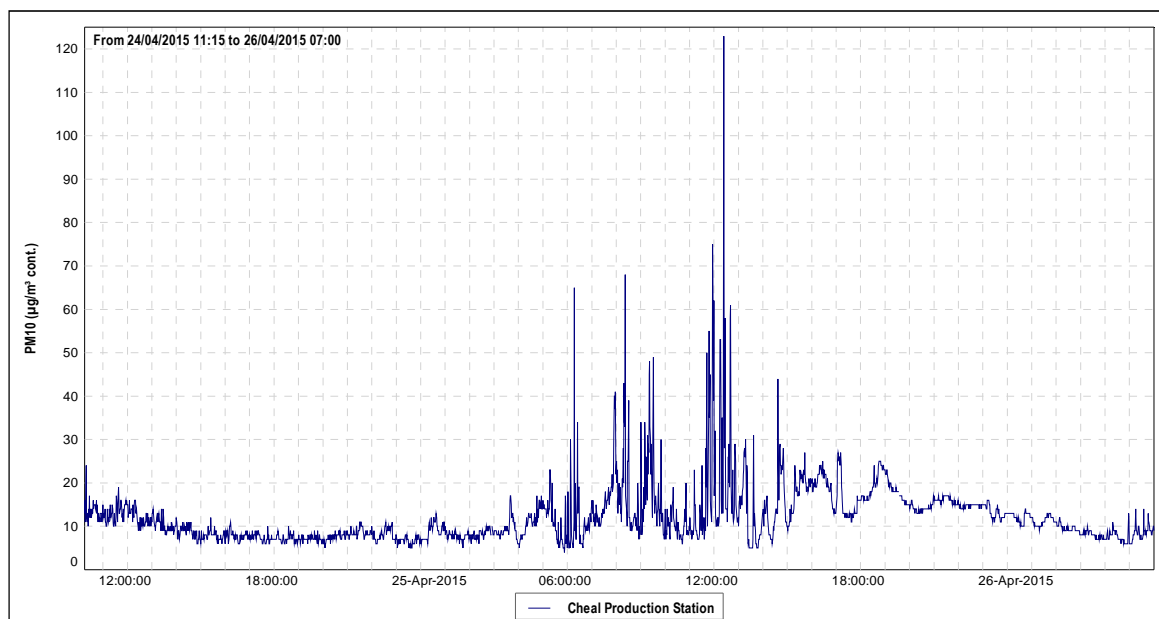
In September 2004 the Ministry for the Environment enacted National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 particulates is  $50 \mu\text{g}/\text{m}^3$  (24-hour average). The same limit is imposed on consent 7906-1, in condition 9, which provides for the discharge of emissions to air from Cheal Production Station.

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs, significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a DustTrak PM10 monitor was deployed on one occasion in the vicinity of the Cheal Production Station. The deployment lasted approximately 44 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations.

The location of the DustTrak monitor during the sampling run is shown in Figure 2. The results of the sample run are presented in Figure 4 and Table 5.



**Figure 4** PM10 concentrations ( $\mu\text{g}/\text{m}^3$ ) at the Cheal Production Station

**Table 5** Daily averages of PM10 results from monitoring at Cheal Production Station

	44 hours 24-26/04/2015	
24 hr. set	Day 1	Day 2
Daily average	10.2 $\mu\text{g}/\text{m}^3$	14.5 $\mu\text{g}/\text{m}^3$
NES limit (24 hour average)	50 $\mu\text{g}/\text{m}^3$	

During the 44 hour run, from 24 April to 26 April 2014, the average recorded PM10 concentration was 10.2  $\mu\text{g}/\text{m}^3$  for the first 24 hour period and 14.5  $\mu\text{g}/\text{m}^3$  for the second 24 hour period. These daily averages equate to 20.4% and 29%, respectively, of the 50  $\mu\text{g}/\text{m}^3$  value that is set by the NES and consent 7906-1. Background levels of PM10 in the region have been found to be typically around 11  $\mu\text{g}/\text{m}^3$ .

### 2.2.2.3 Nitrogen oxides

From 2014 onwards, the Council implemented a coordinated region-wide compliance monitoring programme to measure nitrogen oxides (NO<sub>x</sub>). The programme involves deploying measuring devices at 28 NO<sub>x</sub> monitoring sites (including two sites in the vicinity of Cheal Production Station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The consent covering air discharges from the Cheal Production Station has specific limits related to particular gases. Special condition 9 of consent 7906-1 sets a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 200  $\mu\text{g}/\text{m}^3$  for a 1-hour average exposure.

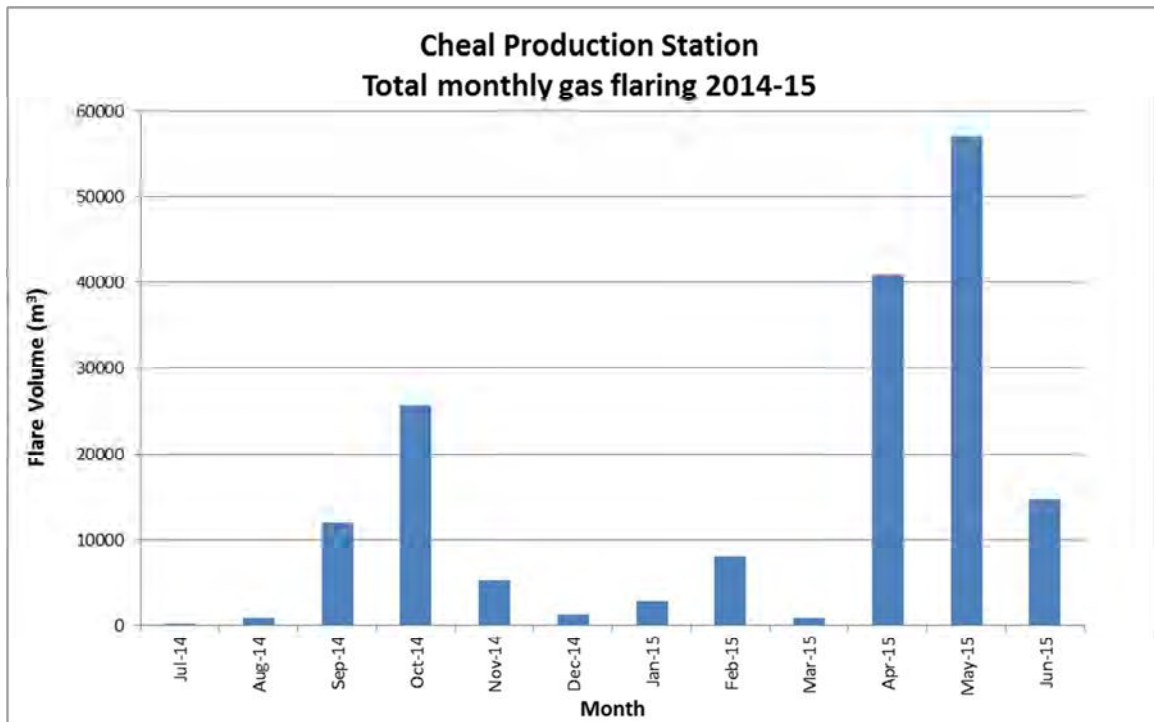


NOx passive adsorption discs were placed at two locations in the vicinity of the Cheal Production Station on one occasion during the year under review. The discs were left in place for a period of 21 days. The calculated 1-hour theoretical maximum NOx concentration found at Cheal Production Station during the year under review equates to 5.75 µg/m<sup>3</sup>. The results show that the ambient ground level concentration of NOx is well below the limits set out by consent 7906-1.

The full air monitoring reports are attached to this report in Appendix II.

### 2.2.3 Summary of flaring volumes reported by Cheal Petroleum

A summary of flaring volumes at Cheal Production Station is provided in Figure 5.



**Figure 5** Summary of monthly gas flaring volumes at Cheal Production Station

During the period under review, Cheal Petroleum kept the Council informed of all non-routine flaring at the production station. The majority of this flaring related to plant start ups and shutdowns, process upsets and mechanical failures. At most, light smoke was generated by these flaring events with no offsite effects. No complaints were received by the Company or the Council during the year under review.

### 2.3 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Incident Register (IR) includes events where the Company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2014-2015 period, the Council was required to investigate one incident in association with the activities at the Cheal Production Station and wellsite.

Notification was received from the Company on 23 September 2014 of a spill from the Cheal-A12 wellhead the preceding weekend. Approximately 1-2 m<sup>3</sup> of power fluid from the centripetal pump had discharged from the well's B annulus. Inspection showed that the majority of the discharge had been contained in the well cellar. There was no visible staining of the surrounding pad material. Site clean up had been quickly undertaken according to spill contingency procedures and the fluid had been removed from the cellar for deep well injection via the A4 well. Inspection of the stormwater discharge receiving environment showed no visual impacts.

Self-monitoring of the skimmer pit water quality by the Company showed no changes in pH or chloride concentrations following the spill. Analysis of a sample of stormwater from the skimmer pit by the Council did not show any signs of contaminants.

Wireline analysis of the A12 well was undertaken to determine the cause of the discharge and the wellhead area was monitored during the next rainfall to ensure no residual power fluid was released from the pad.

### 3. Discussion

#### 3.1 Discussion of site performance

Monitoring of the Cheal Production Station during the 2014-2015 year found that the site was well managed. All consent conditions relating to site operations and management were complied with. Any issues identified during inspections were quickly resolved.

#### 3.2 Environmental effects of exercise of consents

Stormwater system inspections showed that discharges from the sites complied with consent conditions. Receiving water inspections and sampling showed that the discharges were not causing any adverse effects on the tributary of the Mangawharawhara Stream.

There were no adverse effects on the environment resulting from the exercise of the air discharge consent. The ambient air quality monitoring at the site showed that levels of carbon monoxide, combustible gases, PM10 particulates and nitrogen oxides were all below levels of concern at the time of sampling. No offensive or objectionable odours were detected beyond the boundary during inspections and there were no complaints in relation to air emissions from the site.

#### 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 6-8.

**Table 6** Summary of performance for Consent 4727-2

<b>Purpose: To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Cheal-A wellsite and Cheal Production Station, onto and into land in circumstances where it may enter an unnamed tributary of the Mangawharawhara Stream</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Adopt best practicable option	Inspections and review of records	Yes
2. Stormwater collection from catchment area no larger than 3 ha	Inspections	Yes
3. Advise Council at least 7 days before site works commence	Notifications received	Yes
4. A contingency plan be maintained detailing measures to avoid, remedy and mitigate spillage or discharge	Contingency plan received	Yes
5. Management and maintenance of stormwater system	Inspections	Yes
6. Stormwater and produced water treated through stormwater system before discharged	Inspections	Yes

<b>Purpose: To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Cheal-A wellsite and Cheal Production Station, onto and into land in circumstances where it may enter an unnamed tributary of the Mangawharawhara Stream</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
7. Design of skimmer pits to meet minimum size and hydrocarbon capture requirements	Inspections and sampling	Yes
8. Stormwater retention areas to be lined	Inspections	Yes
9. Constituents meet specified standards	Sampling	Yes
10. Temperature increase less than 2 Degrees Celsius after 25 metre mixing zone	Sampling	Yes
11. No effects to receiving waters after 25 metre mixing zone	Inspections and sampling	Yes
12. Advise Council prior to reinstatement of site	Site not reinstated	N/A
13. Review provision	Next option for review in June 2017	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>

N/A = not applicable

**Table 7** Summary of performance for Consent 7906-1

<b>Purpose: To discharge emissions into the air during flaring and to discharge miscellaneous emissions from tank vents and generators arising from hydrocarbon production activities including emergency situations and well workovers at the Cheal-A wellsite and Cheal Production Station</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Adopt the best practicable option	Inspections and review of records	Yes
2. Maintain a flaring log	Review of records	Yes
3. Provide monthly flaring data	Records received	Yes
4. Provide an annual air emission report	Report received	Yes
5. Keep a record of all smoke emitting incidents and complaints	Review of records	Yes
6. Provide analysis of typical gas and crude oil stream from the wells	Analysis not requested	N/A
7. No alterations to plant, equipment or processes without prior consultation	Inspections and liaison with consent holder	Yes
8. Notification of flaring events longer than 5 minutes duration	Notifications received	Yes

<b>Purpose: To discharge emissions into the air during flaring and to discharge miscellaneous emissions from tank vents and generators arising from hydrocarbon production activities including emergency situations and well workovers at the Cheal-A wellsite and Cheal Production Station</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
9. Emissions are controlled in order to meet requirements of the ambient air quality standards	Air monitoring	Yes
10. All emissions to the atmosphere are controlled	Inspections and air monitoring	Yes
11. Tanks used as hydrocarbon storage vessels are fitted with vapour recovery systems	Inspections	Yes
12. Review provision	Next option for review in June 2017	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 8** Summary of performance for Consent 9211-1

<b>Purpose: To take saline groundwater from the Lower Mateamateonga Formation for use in water flooding activities</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Submit A4 well workover details	Information received	Yes
2. Limit on daily abstraction volume	Review of records	Yes
3. Install and maintain water meter	Inspection	Yes
4. Allow for Council inspection	Inspection	Yes
5. Submit monthly records of volumes abstract by 31 July	No abstraction in year under review	N/A
6. Adopt the best practicable option	No abstraction in year under review	N/A
7. Review provision	Next option for review in June 2016	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>

During the period under review, the Company demonstrated an overall high level of both environmental performance and administrative compliance with the resource consents as defined in Section 1.1.4. The single spill incident recorded by the Council in relation to the Company's activities was quickly resolved in accordance with contingency procedures and did not result in any unauthorised discharges. The Cheal Production Station and associated wellsites were well managed and maintained.

### **3.4 Recommendations from the 2013-2014 Annual Report**

In the 2013-2014 Annual Report, it was recommended:

1. THAT monitoring of consented activities at the Cheal Production Station in the 2014-2015 year continues at the same level as in 2013-2014.

Subsequent to this recommendation being made, there were significant alterations made to the majority of the Council's compliance monitoring programmes, mostly to allow for revised health and safety requirements. However, the level of monitoring at the Cheal Production Station was largely unchanged.

### **3.5 Alterations to monitoring programmes for 2015-2016**

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, its obligations to monitor emissions/discharges and effects under the RMA, and report 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 emitting to the atmosphere/discharging to the environment.

It is proposed that for 2015-2016 the monitoring of consented activities at the Cheal Production Station and associated facilities continue at the same level as in 2014-2015. A recommendation to this effect is attached to this report.

### **3.6 Exercise of optional review of consent**

Resource consent 9211-1 provides for an optional review of the consent in June each year. Condition 7 allows the Council to review the consent for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Based on the results of monitoring 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.

A recommendation to this effect is presented in Section 4 of this report.

#### **4. Recommendations**

1. THAT monitoring of consented activities at the Cheal Production Station and associated facilities in the 2015-2016 year continue at the same level as in 2014-2015.
2. THAT the option for a review of resource consent 9211-1 in June 2016, as set out in condition 7, not be exercised on the grounds that the current conditions are considered adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent.

## Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m <sup>3</sup> s <sup>-1</sup> ).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m <sup>2</sup> /day	grams/metre <sup>2</sup> /day.
g/m <sup>3</sup>	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.



Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
IR	The 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 <sup>2</sup>	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM <sub>10</sub>	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act</i> 1991 and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

Zn\*

Zinc.

\*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

For further information on analytical methods, contact the Council's laboratory.

## **Bibliography and references**

- Taranaki Regional Council (2014): Cheal Petroleum Limited Cheal Production Station Monitoring Programme Annual Report 2013-2014, Technical Report 2014-29
- Taranaki Regional Council (2014): Cheal Petroleum Limited Cheal Production Station Monitoring Programme Annual Report 2012-2013, Technical Report 2013-88
- Taranaki Regional Council (2013): Cheal Petroleum Limited Cheal Production Station Monitoring Programme Biennial Report 2010-2012, Technical Report 2012-74
- Taranaki Regional Council (2010): Austral Pacific Energy (NZ) Limited Cheal Production Station Monitoring Programme Annual Report 2009-2010, Technical Report 2010-88
- Taranaki Regional Council (2010): Austral Pacific Energy (NZ) Limited Cheal Production Station Monitoring Programme Biennial Report 2007-2009, Technical Report 2009-78
- Taranaki Regional Council (2009): Austral Pacific Energy (NZ) Limited Cheal A 6 & 7 Wellsite Monitoring Programme Annual Report 2007-2008, Technical Report 2008-49
- Taranaki Regional Council (2006): Rata Energy NZ Ltd & Austral Pacific Energy (NZ) Limited Cheal Production Wells Monitoring Programme Annual Report 2005-2006, Technical Report 2006-29
- Taranaki Regional Council (2005): Rata Energy NZ Ltd & Austral Pacific Energy (NZ) Limited Cheal Production Wells Monitoring Programme Annual Report 2004-2005, Technical Report 2005-16



## **Appendix I**

**Resource consents held by  
Cheal Petroleum Limited**  
(For a copy of the resource consent  
please contact the TRC consent department)



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

Name of  
Consent Holder:                      Cheal Petroleum Limited  
    P O Box 402  
    NEW PLYMOUTH 4340

Decision Date (Change):            29 April 2013

Commencement Date                29 April 2013      (Granted: 10 November 2011)  
(Change):

**Conditions of Consent**

Consent Granted:                      To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Cheal-A wellsite and Cheal Production Station, onto and into land in circumstances where it may enter an unnamed tributary of the Mangawharawhara Stream

Expiry Date:                            1 June 2029

Review Date(s):                        June 2017, June 2023

Site Location:                            Cheal-A wellsite and Cheal Production Station,  
    4723 Mountain Road, Ngaere  
    (Property owners: JR & RP Lightoller)

Legal Description:                      Pt Sec 24 Blk VI Ngaere SD (Discharge source & site)

Grid Reference (NZTM)                1712269E-5639504N

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. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.
2. Stormwater discharged shall be collected from a catchment area of no more than 3 hectares.
3. At least 7 working days prior the consent holder shall advise the Chief Executive, Taranaki Regional Council of the date of each of the following events:
  - a) commencement of any site works, and
  - b) commencement of any well drilling operation.

If either of these events is rescheduled or delayed after advice is given, the consent holder shall immediately provide further notice advising of the new date.

Any advice given in accordance with this condition shall include the consent number and a brief description of the activity consented and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).

4. The consent holder shall maintain a contingency plan that, to the satisfaction of the Chief Executive, Taranaki Regional Council, details measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. The contingency plan shall be provided to the Council prior to discharging from the site.
5. The design, management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the consent application 5603 in particular sections 7.2 and 8.1, and consent application 7378.
6. All discharges from the site, including from any containment pit or hydrocarbon combustion facility (e.g. flare pit, thermal oxidiser), shall flow to a perimeter drain and skimmer pit. Perimeter drains shall be designed, including by having a positive grade and low permeability, to ensure that runoff flows directly to a skimmer pit without ponding.
7. Skimmer pits shall have a combined capacity of no less than 250 m<sup>3</sup>, and be designed to retain any hydrocarbons that enter them.
8. All skimmer pits and any other stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls, and all skimmer pits shall have a valve that can be shut off to prevent any discharge from the site.



9. Constituents in the discharge shall meet the standards shown in the following table.

<b>Constituent</b>	<b>Standard</b>
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm <sup>-3</sup>
total recoverable hydrocarbons	Concentration not greater than 15 gm <sup>-3</sup> [as determined by infrared spectroscopic technique]
chloride	Concentration not greater than 50 gm <sup>-3</sup>

10. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to an increase in temperature of more than 2 degrees Celsius.
11. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to any of the following effects in the receiving water:
- a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.
12. The consent holder shall advise the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise adverse effects on stormwater quality. Notification shall include the consent number and a brief description of the activity consented and be emailed to [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz).
13. 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 2017 and/or June 2023, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 29 April 2013

For and on behalf of  
Taranaki Regional Council

---

**Chief Executive**



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

Name of  
Consent Holder: Cheal Petroleum Limited  
P O Box 402  
NEW PLYMOUTH 4340

Decision Date: 10 November 2011

Commencement  
Date: 10 November 2011

**Conditions of Consent**

Consent Granted: To discharge emissions into the air during flaring and to discharge miscellaneous emissions from tank vents and generators arising from hydrocarbon production activities including emergency situations and well workovers at the Cheal-A wellsite and Cheal Production Station at or about (NZTM) 1712310E-5639497N

Expiry Date: 1 June 2029

Review Date(s): June 2017, June 2023

Site Location: Cheal-A wellsite and Cheal Production Station, Mountain Road, Ngaere [Property owners: JR & RP Lightoller]

Legal Description: Pt Sec 24 Blk VI Ngaere SD [site of discharge]

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

### **General condition**

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

### **Special conditions**

#### **Exercise of consent**

1. The consent holder shall at all times adopt the best practicable option [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or likely adverse effects on the environment associated with the discharge of contaminants into the environment arising from the emissions to air from the flare.

#### **Recording and submitting information**

2. The consent holder shall keep and maintain a log of all continuous flaring incidents lasting longer than 5 minutes and any intermittent flaring lasting for an aggregate of 10 minutes or longer in any 60-minute period. The log shall contain the date, the start and finish times, the quantity and type of material flared, and the reason for flaring. The log shall be made available to the Chief Executive, Taranaki Regional Council, upon request, and summarised annually in the report required under condition 4. Flaring, under normal operation in the low pressure flare, of rich mono-ethylene glycol degasser vapour, condensate tank vapours, non-condensibles from tri-ethylene glycol/mono-ethylene glycol regeneration and purge gas shall be excluded from this requirement.
3. The consent holder shall supply to the Taranaki Regional Council each month a copy of flaring information comprising: the type and amount of material flared [including any gas used to maintain a pilot flame], the date this was flared, the reason why flaring was undertaken, and an indication of whether smoke was produced from such flaring events.
4. The consent holder shall provide to the Taranaki Regional Council during May of each year, for the duration of this consent, a report:
  - a) detailing gas combustion at the production station flare, including but not restricted to routine operational flaring and flaring logged in accordance with condition 2;
  - b) detailing any measures that have been undertaken by the consent holder to improve the energy efficiency of the production station;
  - c) detailing any measures to reduce smoke emissions;
  - d) detailing any measures to reduce flaring;
  - e) addressing any other issue relevant to the minimisation or mitigation of emissions from the production station flare; and
  - f) detailing any complaints received and any measures undertaken to address complaints.

5. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, a record of all smoke emitting incidents, noting time, duration and cause. The consent holder shall also keep, and make available to the Chief Executive, upon request, a record of all complaints received as a result of the exercise of this consent.

### **Information and notification**

6. The consent holder shall make available to the Chief Executive, Taranaki Regional Council upon request, an analysis of a typical gas and/or condensate stream from the Mt Messenger Formation and Urenui Formation, covering sulphur compound content and the content of compounds containing six or more carbon atoms in their molecular structure.
7. Prior to undertaking any alterations to the plant equipment, processes or operations, which may substantially alter the nature or quantity of flare emissions other than as described in the consent application, the consent holder shall first consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.
8. The consent holder shall notify the Chief Executive, Taranaki Regional Council, as soon as practicable, whenever the continuous flaring of hydrocarbons [other than the flaring of rich mono-ethylene glycol degasser vapour, condensate tank vapours, non-condensibles from tri-ethylene glycol/mono-ethylene glycol regeneration and purge gas] is expected to occur for more than five minutes in duration.

### **Preventing and minimising emissions**

9. The consent holder shall control all emissions of carbon monoxide, nitrogen dioxide, fine particles [PM<sub>10</sub>] and sulphur dioxide to the atmosphere from the site, in order that the maximum ground level concentration of any of these contaminants arising from the exercise of this consent measured under ambient conditions does not exceed the relevant ambient air quality standard as set out in the Resource Management [National Environmental Standards for Air Quality Regulations, 2004] at or beyond the boundary of the property on which the site is located.
10. The consent holder shall control all emissions to the atmosphere from the site of contaminants other than those expressly provided for under special condition 7, in order that they do not individually or in combination with other contaminants cause a hazardous, noxious, dangerous, offensive or objectionable effect at or beyond the boundary of the property on which the site is located.
11. All permanent tanks used as hydrocarbon storage vessels, shall be fitted with vapour recovery systems.

**Review**

12. 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 2017 and/or June 2023, for the purposes of:

- a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
- b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
- c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant or contaminants.

Signed at Stratford on 10 November 2011

For and on behalf of  
Taranaki Regional Council

---

**Director-Resource Management**

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

Name of  
Consent Holder: TAG Oil (NZ) Limited  
P O Box 402  
NEW PLYMOUTH 4340

Decision Date: 25 May 2012

Commencement  
Date: 25 May 2012

**Conditions of Consent**

Consent Granted: To take saline groundwater from the Lower  
Mateamateanga Formation for use in water flooding  
activities at or about (NZTM) 1712361E-5639489N

Expiry Date: 1 June 2017

Review Date(s): June 2013, June 2014, June 2015, June 2016

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

Legal Description: Pt Sec 24 Blk VI Ngaere SD (Site of take)

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 this consent, the consent holder shall submit to the Taranaki Regional Council details of the workover carried out on the Cheal-A4 including a revised well construction log.
2. The volume of saline groundwater taken shall not exceed 800 cubic metres per day.
3. Before exercising this consent, the consent holder shall install, and thereafter maintain a water meter at the bore. The water meter shall be tamper-proof and shall measure and record the rate and volume of water taken to an accuracy of  $\pm 5\%$ .
4. The water meter shall be accessible to Taranaki Regional Council officer's at all reasonable times for inspection.
5. The consent holder shall maintain monthly records of the volume abstracted and supply these records to the Chief Executive, Taranaki Regional Council, no later than 31 July of each year, or earlier upon request.
6. At all times the consent holder shall adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment associated with the abstraction of groundwater, including, but not limited to, the efficient and conservative use of water.
7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month 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 25 May 2012

For and on behalf of  
Taranaki Regional Council

---

**Director-Resource Management**



## **Appendix II**

### **Air monitoring reports**



## Memorandum

**To** Job Manager, Callum MacKenzie  
**From** Scientific Officer - Air Quality, Brian Cheyne  
**File** 1656560  
**Date** March 17, 2016

### **Ambient Gas (PM10, NOx, CO and LEL) Monitoring at Cheal Production Stations during 2014-2015 monitoring year**

#### **Introduction**

In January 2015 and April 2015 as part of the compliance monitoring programme for the Cheal production station, a survey of ambient air quality sampling was carried out by the Taranaki Regional Council (the Council) in the vicinity of the plant. The main objectives were to measure:

- The concentrations of PM10 using a portable data logging TSI 'DustTrak';
- To measure the concentrations of the nitrogen oxides (NOx) using a passive sampling method, that gives a result for average exposure;
- And to measure carbon monoxide (CO) using a portable multi gas meter that provides instantaneous data throughout the monitoring period.

The findings of this study are presented in this memorandum, together with the locations of the monitoring sites which are provided in Figure 1.

#### **Carbon monoxide (CO) and Lower explosive limit (LEL)**

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately nine hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases).

Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.



**Figure 1** Air monitoring sites at Cheal production station (2014-2015)

The details of the sample run are summarised in Table 1 and the data from the sample run are presented graphically in Figure 2.

The consents covering air discharges from the Cheal production station have specific limits related to particular gases. Special condition 9 of consent 7906-1 set limits on the carbon monoxide, nitrogen dioxide and fine particles [PM10] concentrations at or beyond the production station's boundary. The limit on the carbon monoxide is expressed as 10 mg/m<sup>3</sup> for an eight hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 1.03 mg/m<sup>3</sup> with average concentration for the entire dataset was only 0.15 mg/m<sup>3</sup> which comply with consent conditions. This is in line with the pattern found in previous years.

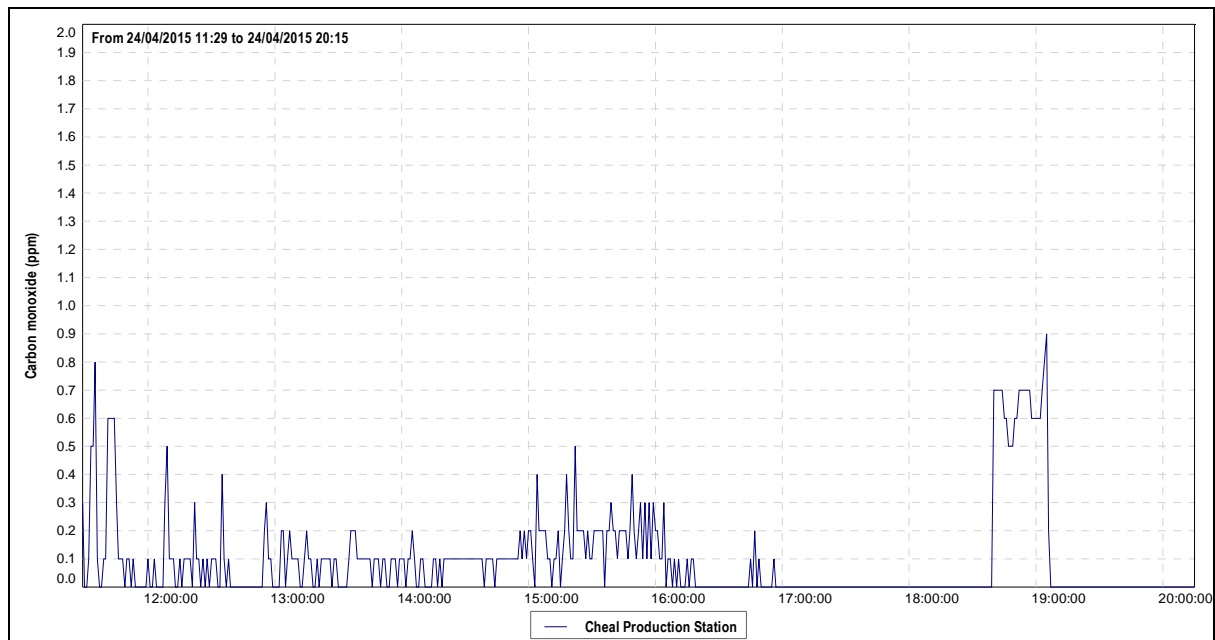
**Table 1** Results of carbon monoxide and LEL monitoring at Cheal production station

Period (from-to)		24/04/2015 11:29 to 24/04/2015 20:15
Max	CO(ppm)	0.90
	LEL(%)	0.30
Mean	CO(ppm)	0.10
	LEL(%)	0.00
Min	CO(ppm)	0.00
	LEL(%)	0.00

Note: (1) the instrument records in units of ppm. At 25°C, 1 atm.  
 1ppm CO = 1.145 mg/m<sup>3</sup>

(2) See text for explanation of LEL. Because the LEL of methane is equivalent to a mixture of approximately 5% methane in air, then the actual concentration of methane in air can be obtained by dividing the percentage LEL by 20.

LEL gives the percentage of the lower explosive limit, expressed as methane that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Cheal production station reach any more than a trivial level.



**Figure 2** Graph of ambient CO levels in the vicinity of the Cheal Production Station

## PM10

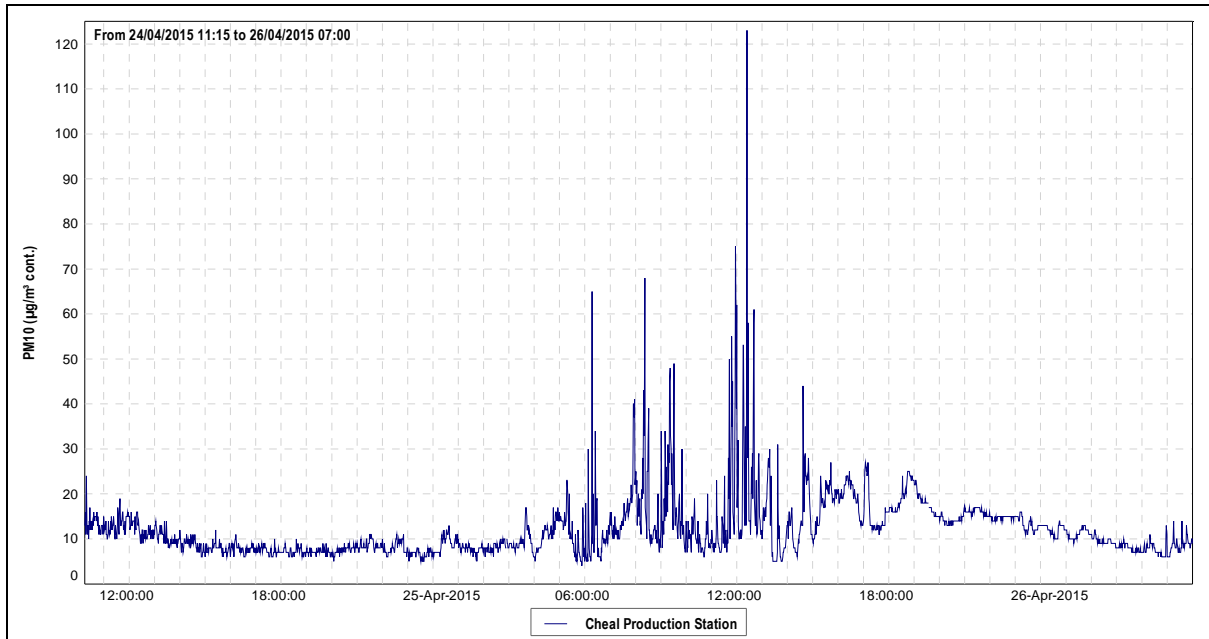
In September 2004 the Ministry for the Environment made public National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 is  $50 \mu\text{g}/\text{m}^3$  (24-hour average). The same limit is imposed on consent 7906-1, in condition 9, that provides for the discharge of emissions to air from Cheal production station.

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a “DustTrak” PM10 monitor was deployed on one occasion in the vicinity of the Cheal production station. The deployment lasted approximately 44 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations. The location of the “DustTrak” monitor during the sampling run is shown in Figure 1.

The details of the sample run are presented in Figure 3 and Table 2.



**Figure 2** PM10 concentrations ( $\mu\text{g}/\text{m}^3$ ) at the Cheal production station (2014-15)

	(44 hours) (24-26/04/2015)	
24 hr. set	Day 1	Day 2
Daily average	10.2 $\mu\text{g}/\text{m}^3$	14.5 $\mu\text{g}/\text{m}^3$
NES	50 $\mu\text{g}/\text{m}^3$	

**Table 1** Daily mean of PM10 results during two days' monitoring at Cheal production station

During the 44-hour run, from 24<sup>th</sup> of April to 26<sup>th</sup> of April 2015, the average recorded PM<sub>10</sub> concentration for the first 24 hour period was 10.2  $\mu\text{g}/\text{m}^3$  and 14.5  $\mu\text{g}/\text{m}^3$  for the second 24 hour period. These daily means equate to 20.4% and 29%, respectively, of the 50  $\mu\text{g}/\text{m}^3$  value that is set by the National Environmental Standard and consent 7906-1.

Background levels of PM<sub>10</sub> in the region have been found to be typically around 11  $\mu\text{g}/\text{m}^3$ .

## Nitrogen oxides (NOx)

From 2014 onwards, the Council has implemented a coordinated region-wide compliance monitoring programme to measure NOx. The programme involves deploying all measuring devices at 28 NOx monitoring sites (including two sites in the vicinity of the Cheal production station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The complete report covering region-wide NOx monitoring is attached in the Appendix to this memorandum and can also be found at the following link:

<http://www.trc.govt.nz/assets/Publications/state-of-the-environment-monitoring/environmental-monitoring-technical-reports/1541533.pdf>

The consents covering air discharges from the Cheal production station have specific limits related to particular gases. Special condition 9 of consent 7906-1 set a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 200  $\mu\text{g}/\text{m}^3$  for a one hour average exposure.

NO<sub>x</sub> passive adsorption discs were placed at two locations in the vicinity of the Cheal production station on one occasion during the year under review. The discs were left in place for a period of 21 days.

The calculated 1-hour theoretical maximum NO<sub>x</sub> concentration found at the Cheal production station during the year under review equates to 5.75µg/m<sup>3</sup>. The results show that the ambient ground level concentration of NO<sub>x</sub> is well below the limits set out by consent 7906-1.





## Memorandum

**To** Fiza Hafiz, Scientific Officer – State of the Environment  
Job Managers - Callum MacKenzie, Emily Roberts, James Kitto  
**From** Brian Cheyne, Scientific Officer – Air Quality  
**File** Frodo # 1545133  
**Date** 29 July 2015

### **Monitoring of nitrogen oxides (NO<sub>x</sub>) levels in Taranaki near the NO<sub>x</sub> emitting sites, year 2014-2015**

From 2014 onwards, the Taranaki Regional Council (TRC) has implemented a coordinated region-wide monitoring programme to measure NO<sub>x</sub>, not only at individual compliance monitoring sites near industries that emit NO<sub>x</sub>, but simultaneously at the urban sites (the Council regional state of the environment programme). The programme involves deploying all measuring devices on the same day, with retrieval three weeks later. This approach will assist the Council to further evaluate the effects of local and regional emission sources and ambient air quality in the region.

#### **Nitrogen oxides**

Nitrogen oxides (NO<sub>x</sub>), a mixture of nitrous oxide (N<sub>2</sub>O), nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>), are produced from natural sources, motor vehicles and other fuel combustion processes. Indoor domestic appliances (gas stoves, gas or wood heaters) can also be significant sources of nitrogen oxides, particularly in areas that are poorly ventilated. NO and NO<sub>2</sub> are of interest because of potential effects on human health.

Nitric oxide is colourless and odourless and is oxidised in the atmosphere to form nitrogen dioxide. Nitrogen dioxide is an odorous, brown, acidic, highly corrosive gas that can affect our health and environment. Nitrogen oxides are critical components of photochemical smog – nitrogen dioxide produces the yellowish-brown colour of the smog.

#### **Environmental and health effects of nitrogen oxides**

Nitrogen dioxide is harmful to vegetation, can fade and discolour fabrics, reduce visibility, and react with surfaces and furnishings. Vegetation exposure to high levels of nitrogen dioxide can be identified by damage to foliage, decreased growth or reduced crop yield.

Nitric oxide does not significantly affect human health. On the other hand, elevated levels of nitrogen dioxide cause damage to the mechanisms that protect the human respiratory tract and can increase a person's susceptibility to, and the severity of, respiratory infections and asthma. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease. It may also affect sensory perception, for example, by reducing a person's ability to smell an odour.

#### **National environmental standards and guidelines**

In 2004, national environmental standards (NES) for ambient (outdoor) air quality were introduced in New Zealand to provide a guaranteed level of protection for the health of New Zealanders. The national standard for nitrogen dioxide (NO<sub>2</sub>) is set out below.

In any 1-hour period, the average concentration of nitrogen dioxide in the air should not be more than 200 µg/m<sup>3</sup>.

Before the introduction of the national environmental standards, air quality was measured against the national air quality guidelines. The national guidelines were developed in 1994 and revised in 2002 following a comprehensive review of international and national research and remain relevant. The national guideline for nitrogen dioxide (NO<sub>2</sub>) is set out below.

In any 24-hour period, the average concentration of nitrogen dioxide in the air should not be more than 100 µg/m<sup>3</sup>.

Nitrogen dioxide limits are also set in the special conditions of the resource consents. The consents limits are the same as those imposed under the NES and MfE's guideline.

### **Measurement of nitrogen oxides**

The Taranaki Regional Council has been monitoring nitrogen oxides (NO<sub>x</sub>) in the Taranaki region since 1993 using passive absorption discs. Research to date indicates that this is an accurate method, with benefits of simplicity of use and relatively low cost. To date 527 samplers of nitrogen oxides have been collected in Taranaki region. Discs are sent to EUROFINs ELS Ltd. Lower Hutt for analysis. Passive absorption discs are placed at the nominated sites. The gases diffuse into the discs and any target gases (nitrogen dioxide or others) are captured.

In the 2014-15 year, passive absorption discs were placed on one occasion at twenty eight sites, staked about two metres off the ground for a period of 21 days, for the purpose of Compliance Monitoring and SEM studies.

### **Conversion of exposure result to standardised exposure time period**

From the average concentration measured, it is possible to calculate a theoretical maximum daily or one hour concentrations that may have occurred during the exposure period. Council data on NO<sub>x</sub> is gathered over a time period other than exactly 24 hours or one hour. There are mathematical equations used by air quality scientists to predict the maximum concentrations over varying time periods. These are somewhat empirical, in that they take little account of local topography, micro-climates, diurnal variation, etc. Nevertheless, they are applied conservatively and have some recognition of validity.

One formula in general use is of the form:

$$C(t_2) = C(t_1) \times \left(\frac{t_1}{t_2}\right)^p$$

where C(t) = the average concentration during the time interval t, and p = a factor lying between 0.17 and 0.20. When converting from longer time periods to shorter time periods, using p = 0.20 gives the most conservative estimate (i.e. the highest calculated result for time period t<sub>2</sub> given a measured concentration for time period t<sub>1</sub>). Using the 'worst case' factor of p = 0.20, the monitoring data reported above has been converted to equivalent 'maximum' 1-hour and 'maximum' 24-hour exposure levels.

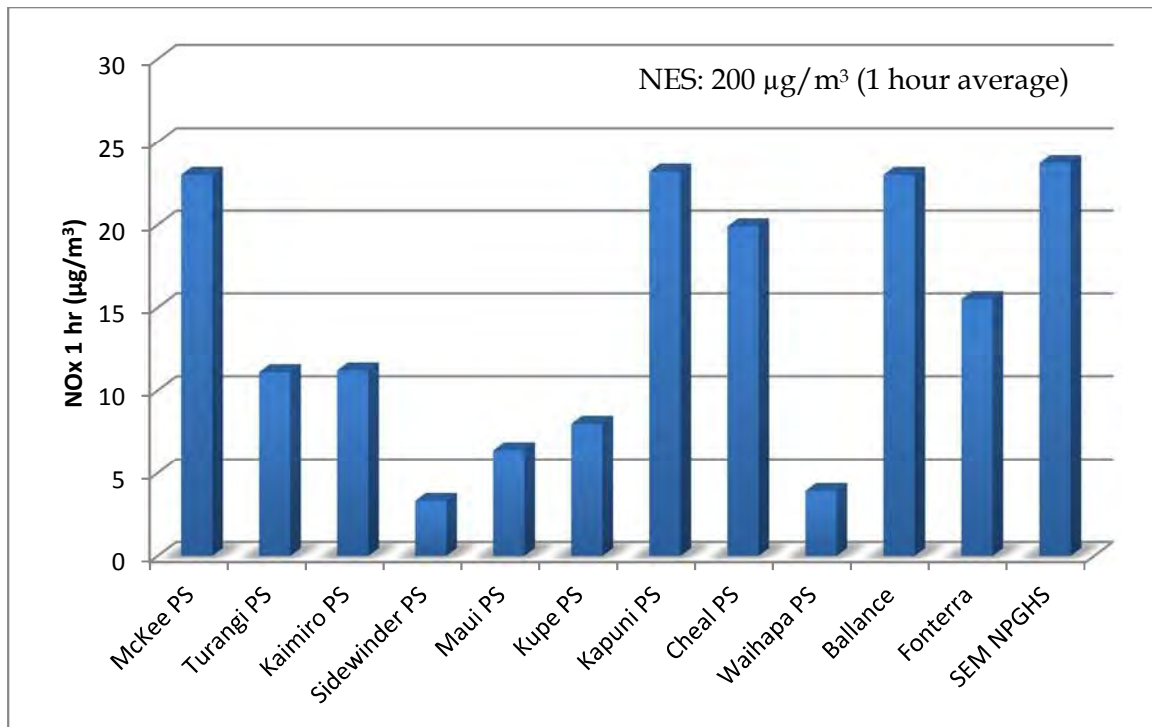
## Results

The location of the NO<sub>x</sub> monitoring sites are shown in Figure 1 and the details of the NO<sub>x</sub> results are presented in Table 1 and Figure 2.

**Table 1** Actual (laboratory) and recalculated ambient NO<sub>x</sub> results, NES and MfE guideline.

	Survey at	Site code	NO <sub>x</sub> (µg/m <sup>3</sup> ) Lab. results	NO <sub>x</sub> 1/hr (µg/m <sup>3</sup> ) Theoretical max.	NO <sub>x</sub> 24/hr (µg/m <sup>3</sup> ) Theoretical max.
Petrochemical	McKee PS	AIR007901	4.5	15.6	8.3
		AIR007902	8.8	30.5	16.2
	Turangi PS	AIR007922	2.9	10.1	5.3
		AIR007824	3.5	12.1	6.4
	Kaimiro PS	AIR007817	1.8	6.2	3.3
		AIR007818	4.7	16.3	8.6
	Sidewinder PS	AIR007831	1.1	3.8	2.0
		AIR007832	0.8	2.8	1.2
	Maui PS	AIR008201	1.6	5.6	2.9
		AIR008214	2.1	7.3	3.9
	Kupe PS	AIR007827	Lost	N/A*	N/A*
		AIR007830	2.3	8.0	4.2
	Kapuni PS	AIR003410	5.5	19.1	10.1
		AIR003411	7.9	27.4	14.5
	Cheal PS	AIR007841	5.7	19.8	10.5
		AIR007842	5.8	20.1	10.7
Waihapa PS	AIR007815	1.8	6.2	3.3	
	AIR007816	0.5	1.7	0.9	
Ballance AUP	AIR003401	7.2	25.0	13.2	
	AIR003404	6.0	21.0	11.0	
Dairy factory	Fonterra	AIR002410	3.2	11.1	5.9
		AIR002711	6.8	23.6	12.5
		AIR002412	4.7	16.3	8.6
		AIR002413	3.2	11.1	5.9
SEM	NPGHS	AIR000012(NW)	7.5	26.0	13.8
		AIR000012(NE)	5.4	18.7	9.9
		AIR000012(SW)	6.2	21.5	11.4
		AIR000012(SE)	8.2	28.5	15.1
<b>National Environmental Standard (NES) and MfE guideline</b>				<b>200 (NES)</b>	<b>100 (guideline)</b>

\*no results



**Figure 2** Average NOx levels at 12 surveyed locations throughout the region (year 2014-2015).

## Discussion

The calculated 1-hour and 24-hour theoretical maximum concentrations (using a power law exponent of 0.2) ranged from 1.7 µg/m<sup>3</sup> to 30.5 µg/m<sup>3</sup> and 0.9 µg/m<sup>3</sup> to 16.2 µg/m<sup>3</sup> respectively. The highest results were obtained from the NOx emitting sites at four different locations:

1. In New Plymouth's urban area near a busy traffic intersection and next to the heavy road realignment works.
2. Around the Fonterra's Whareroa co-generation plant.
3. In Kapuni heavy industrial area around the STOS production station and Ballance ammonia/urea plant.
4. And from the sites at McKee production station and power generation plant.

All values were within the National Environmental Standards, Ministry for the Environment Ambient Air Quality Guidelines and the respective resource consents limits. This continues the pattern found in previous years.

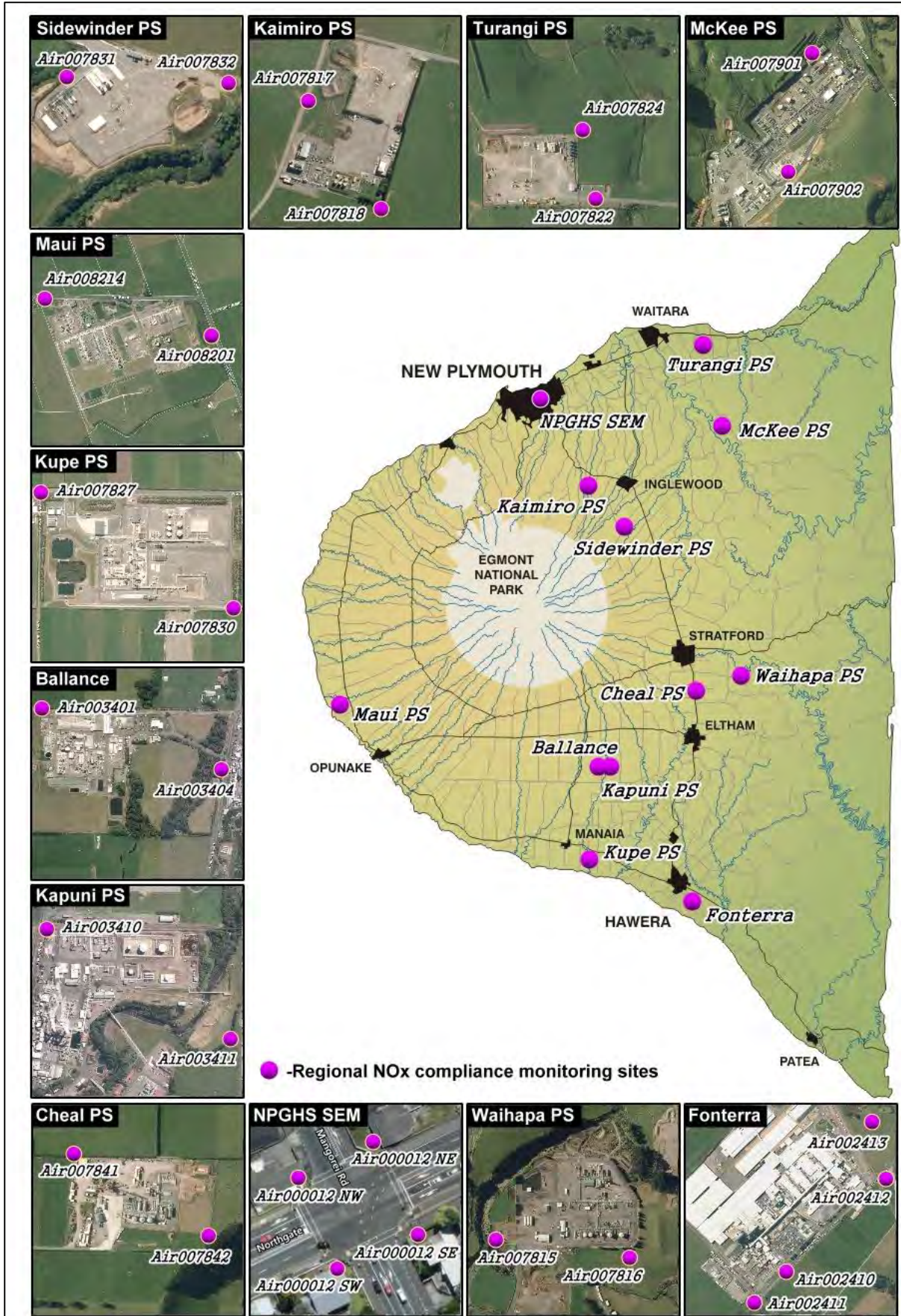


Figure 1 NOx monitoring sites in Taranaki Region, 2014-2015

## Ministry for the Environment environmental performance indicator

Ministry for the Environment uses an environmental performance indicator to categorise air quality. These categories are set out in Table 2 and further details of the entire NO<sub>x</sub> results are set out in Table 3.

**Table 2** Environmental Performance Indicator air quality categories

Measured value	Less than 10% of NES	10-33% of NES	33-66% of NES	66-100% of NES	More than 100% of NES
Category	<i>excellent</i>	<i>good</i>	<i>acceptable</i>	<i>alert</i>	<i>action</i>

**Table 3** Categorisation of results

National Environmental Standard for NO <sub>2</sub> = 200 µg/m <sup>3</sup> - 1 hour average.		
Category	Measured values	
Excellent	<10% of the NES, (0-20µg/m <sup>3</sup> )	<b>18</b> (67%)
Good	10-33% of the NES, (20-66µg/m <sup>3</sup> )	<b>9</b> (33 %)
Acceptable	33-66% of the NES, (66-132 µg/m <sup>3</sup> )	<b>0</b> (0%)
Alert	66-100% of the NES, (132-200 µg/m <sup>3</sup> )	<b>0</b> (0%)
<b>Total number of samples</b>		<b>27</b> (100%)

## Conclusion

The monitoring showed that 67% of the 1-hour average results fell into Ministry's 'excellent' categories and 33% of the results lay within Ministry's 'good' category. No results ever entered the 'acceptable' or 'alert' categories, i.e., no results ever exceeded the National Environmental Standard of 200µg/m<sup>3</sup>.

These results, and all regional monitoring to date, have shown that Taranaki has very clean air, and on a regional basis there are no significant pressures upon the quality of the air resource.