Shell Todd Oil Services Ltd
Maui Production Station
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-117

ISSN: 1178-1467 (Online)
Document: 1699436 (Word)
Document: 1802653 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

March 2017

Executive summary

Shell Todd Oil Services Ltd (STOS) operates the Maui Production Station located on Tai Road, Oaonui, in the Ngapirau catchment. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess STOS's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of STOS's activities.

STOS holds four resource consents, which include a total of 34 conditions setting out the requirements that they must satisfy. STOS holds two consents relating to discharges to water, one consent to discharge emissions to the air, and one to maintain a structure in the coastal marine area. Wood Group M & O also holds one consent relating to the Maui Production Station. The consent is for a discharge to water, and has seven conditions setting out requirements that must be satisfied.

During the monitoring period, Shell Todd Oil Services Ltd demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included six inspections, five water samples collected for physicochemical analysis, one biomonitoring survey of receiving waters, and two ambient air quality analyses.

Receiving water inspections, in conjunction with sampling conducted by both the Council and STOS during the 2015-2016 period, showed that the discharges were not causing any adverse effects on the Ngapirau Stream at the time. This was supported by the findings of the macroinvertebrate survey carried out in the stream.

There were no adverse effects noted on the environment resulting from the exercise of the air discharge consents. The ambient air quality monitoring at the Maui Production Station 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 boundaries during inspections and there were no complaints in relation to air emissions from the sites.

During the period under review, STOS demonstrated an overall high level of both environmental performance and administrative compliance with the resource consents. There were no unauthorised incidents recorded by the Council in relation to STOS's activities. The Maui Production Station was well managed and maintained.

For reference, in the 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

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

This report includes a recommendation for the 2016-2017 year.

Table of contents

List of tables

List of figures

List of photos

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Shell Todd Oil Services Ltd (STOS). STOS operates the Maui Production Station situated on Tai Road, Oaonui.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by STOS that relate to abstractions and discharges of water within the Ngapirau and Oaonui catchments, and structures in the coastal marine area, and 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 STOS's use of water, land and air, and is the 26th combined annual report by the Council for the Maui Production Station.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by STOS in the Ngapirau and Oaonui catchments;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at the Maui 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 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

(a) the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
(d) natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and
(e) risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. **Administrative performance** is concerned with STOS'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 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process description

Photo 1 Maui Production Station

The onshore Maui Production Station at Oaonui was built to process gas and condensate from the offshore Maui Field. Exploration of the Maui field began in 1969, and production commenced in 1979 from the Maui-A platform. Gas and condensate is transported 33 km from the offshore Maui-A platform to the onshore Maui Production Station via submarine pipelines. Another platform, Maui-B, was installed in 1992. Gas and condensate from Maui-B is piped 15 km to Maui-A for initial separation, and then to the production station.

The Maui Production Station separates the various hydrocarbon components, mainly by distillation. The production station supplies natural gas to the national grid and liquefied petroleum gas (LPG) is transported off-site by road tankers. Condensate is piped to storage tanks at Omata.

Facilities at the Maui Production Station include: an administration building and workshop which accommodates the control room on the upper floor; glycol trains and oil heaters located in the north west portion of the site; fractionation trains, gas trains and compressor houses; condensate storage, LPG storage and LPG load out facilities; and a flare compound that contains a 55 metre high flare stack, a radio tower, and a flare seal recovery system, located in the south western corner of the site.

The plant formerly used two flares as essential plant safety features designed to combust excess gas during planned maintenance activities, and emergency situations. A change to plant management has seen this reduced to one flare. The flare continuously burns fuel gas as a purge to prevent air ingress to the flare system (thus avoiding an explosion risk) and to maintain a pilot flame at the flare tip.
The Council is responsible for monitoring the onshore production station and pipelines within the coastal marine area (to 12 nautical miles). Monitoring of the offshore Maui-A and B platforms does not come under the jurisdiction of the Council as they are situated outside the coastal marine area.

1.3 Resource consents

1.3.1 Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

STOS holds water discharge permit **0245-3** to discharge treated stormwater from the Maui Production Station to the Ngapirau Stream. The permit was first granted in 1975. The latest renewal was issued by the Council on 11 October 2000 under Section 87(e) of the RMA. A variation to the special conditions was approved on 4 September 2013 to align the limit on suspended solids in the discharge with modern consent conditions and standards in the Council's Regional Fresh Water Plan. The consent is due to expire on 1 June 2018.

There are 6 special conditions attached to this consent.

Condition 1 requires an oily water separator and stormwater oil trap.

Conditions 2 and 3 impose limits on contaminants (hydrocarbons and suspended solids) in the discharge, and stipulate effects the discharge shall not give rise to in the Ngapirau Stream.

Condition 4 requires a contingency plan to be maintained.

Conditions 5 and 6 are review provisions.

STOS also holds water discharge permit **0246-3** to discharge treated domestic effluent from the oxidation ponds at the Maui Production Station to the Ngapirau Stream. The permit was first granted in 1975. The latest renewal was issued by the Council on 11 October 2000 under Section 87(e) of the RMA. It is due to expire on 1 June 2018.

There are 6 special conditions attached to this consent.

Condition 1 requires the oxidation ponds to be properly and efficiently maintained to ensure consent conditions are met.

Condition 2 stipulates effects the discharge shall not give rise to in the Ngapirau Stream.

Condition 3 required the treatment system to be upgraded by 30 November 2000.

Conditions 4, 5, and 6 are review provisions.

Wood Group M & O holds water discharge permit **1228-4** to discharge treated stormwater and wastewater from fire fighting at the Fire Training Centre at the Maui Production Station to the Oaonui Stream. The permit was first granted in 1975. The latest renewal was issued by the Council on 11 October 2000 under Section 87(e) of the RMA. It is due to expire on 1 June 2018. STOS previously held this discharge permit. As the consent relates to the Maui site it is commented upon as part of this report.

There are 7 special conditions attached to this consent.

Condition 1 requires the settling ponds to be operated and maintained to meet the conditions of this consent.

Conditions 2 to 4 impose limits on contaminants, and stipulate effects the discharge shall not give rise to in the receiving water.

Condition 5 requires a contingency plan to be maintained.

Conditions 6 and 7 are review provisions.

The permits are attached to this report in Appendix I.

1.3.2 Air discharge pemit

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.

STOS holds air discharge permit **4052-4** to discharge emissions into the air from the refining and distribution of hydrocarbons and associated processes at the Maui Production Station site. The current permit was issued by the Council on 9 January 2003 under Section 87(e) of the RMA. It was subsequently amended on 7 April 2005 to remove reference to carbon dioxide emissions in condition 5 after an amendment to the RMA. It was subsequently amended on 26 August 2005 through insertion of a new condition 10, along with amendments to conditions 5 and 18 (previously condition 17),

to include emissions from a carbon dioxide removal plant. A change to special condition 5 was requested by STOS and made on 9 August 2013 to move the due date for annual reporting from May to August. The consent is due to expire on 1 June 2024.

There are 18 special conditions attached to this consent.

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 states that the consent holder shall minimise emissions to air by ensuring the proper and effective operation of equipment and processes.

Condition 3 requires the use of equipment to avoid, remedy or mitigate any effect on the environment.

Condition 4 requires the consent holder to undertake effective liquid separation and recovery.

Condition 5 states that the consent holder must provide the Council with a report, in August each year detailing measures to reduce emissions, gas combustion, plant efficiency, etc.

Condition 6 states that there shall be no offensive or objectionable odour beyond the boundary of the site.

Condition 7 requires the consent holder to control all emissions of sulphur dioxide to the atmosphere.

Condition 8 requires the consent holder to control all emissions of nitrogen oxides to the atmosphere.

Condition 9 requires the consent holder to control all emissions of carbon monoxide to the atmosphere.

Condition 10 states that the consent holder shall control all emissions of benzene to the atmosphere.

Condition 11 requires that the consent holder shall control all other emissions to the air from the site.

Condition 12 requires the consent holder to obtain approval from the Council prior to undertaking any significant alterations to the plant or equipment.

Condition 13 requires the consent holder to notify the Council whenever flaring is expected to occur for more than five minutes.

Condition 14 requires notification of any incident that has an impact or a potential impact, within one week of the incident.

Conditions 15 and 16 require the consent holder to keep records of all smoke emitting incidents and continuous flaring incidents.

Condition 17 states that depressurisation of the plant shall be undertaken so that emissions of smoke are minimised.

Condition 18 is a review provision.

The permit is attached to this report in Appendix I.

1.3.3 Coastal permit

Section 12(1)(b) of the RMA stipulates that no person may, in the coastal marine area, erect, reconstruct, place, alter, extent, remove, or demolish any structure or any part of a structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

STOS holds coastal permit **5224-2** to place and maintain two pipelines in, under and over the foreshore and seabed in the coastal marine area between mean high water spring and the outer limit of the territorial sea. The current permit was granted by the Council on 10 March 1998 under Section 87(c) of the RMA. It is due to expire on 1 June 2025.

There are 4 special conditions attached to this consent.

Condition 1 requires STOS to notify the Council prior to maintenance works.

Condition 2 stipulates that during maintenance works STOS must minimise disturbance, and prevent the discharge of silt, debris, and contaminants to the coastal marine area.

Condition 3 requires the structures to be removed (where practicable) and the area reinstated if and when the structures are no longer required.

Condition 4 is a review provision.

The permit is attached to this report in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the Maui Production Station site consisted of four primary components.

1.4.2 Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any 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 Maui Production Station site was visited 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 STOS 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 Production Station discharge was sampled once, and the sample analysed for ammoniacal nitrogen, conductivity, chlorides, enterococci bacteria, faecal coliforms, hydrocarbons, pH, suspended solids and turbidity. The Ngapirau Stream was sampled concurrently, and the samples analysed for the same constituents as the discharges.

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 each 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. STOS supplied data on flaring causes and flare volumes throughout the period.

1.4.5 Biomonitoring surveys

A biological survey was performed once in the Ngapirau Stream to determine whether or not the discharge of stormwater from the site has had a detrimental effect upon the communities of the stream.

2. Results

2.1 Water

2.1.1 Inspections

Six inspections were carried out at the Maui Production Station during the 2015-2016 period. The following was found during the inspections:

30 July 2015
The site was observed to be neat and tidy with ring drains and bunds secure. The discharge point into the Ngapirau Stream did not give rise to any concerns. The water was clear and aquatic life was evident. The fire water pond was clear. Minimal flaring was being undertaken and no smoke or odours were noted.

11 August 2015
A site inspection was undertaken in response to self notification from STOS regarding extreme rainfall that occurred at the site. The stormwater system had 'overtopped' due to the excess rainfall. At the time of the inspection (a few days later) the stream had reverted to its normal flow and no downstream effects were noted. Ring drains and bunds were clear and the site was neat and tidy. Minimal flaring was being undertaken at the time of the inspection with no odours or smoke.

11 November 2015
The site was inspected during a period of fine weather. Despite very little flow through the stormwater system, this was clear of any contaminants or algal growth. All ring drains and bunds were clean and the oily water separator was operating effectively. The fire water pond system was clean and aquatic life was noted indicating good water quality. Minimal flaring was observed, with the pilot flare operating normally.

29 February 2016
The site inspection was undertaken during a prolonged period of stable weather. The stormwater separator system at the discharge point to the Ngapirau Stream was clear of all contaminants. The fire water ponds were clean. The sewage discharge point assimilation area did not give rise to any concerns. Minimal flaring was being undertaken at the time of the inspection, with no smoke or odours noted.

30 May 2016
The ring drains, bunds, and separator systems were all clear of contaminants. Minimal flaring was being undertaken at the time of the inspection with no off-site effects noted.

23 June 2016
An inspection of receiving water quality in the Ngapirau Stream was undertaken during a period of heavy rainfall. The discharge area on the foreshore did not give rise to any visual effects with the stormwater visually clear despite the rainfall, providing evidence that onsite silt control measures and separator systems were operating effectively. No off-site odours were noted in relation to air discharges.

2.1.2 Results of discharge monitoring

2.1.2.1 Site stormwater

The stormwater network at the Maui Production Station consists of open stormwater drains around the site perimeter and stormwater pipelines from the process areas. The perimeter drains also accept stormwater runoff from Tai Road and a number of adjoining farms. The main internal discharges are into the open stormwater drains at several separate points. Stormwater from the internal catchment passes through the oily water separator before moving on to the secondary oil trap located at the south-west corner of the site.

The stormwater from inside the bunded areas does not enter into the stormwater drains and is directed straight to the oily waste separator. The stormwater in the perimeter drains goes directly to the secondary oil trap. The treated stormwater then flows to a tributary drain which discharges to the Ngapirau Stream.

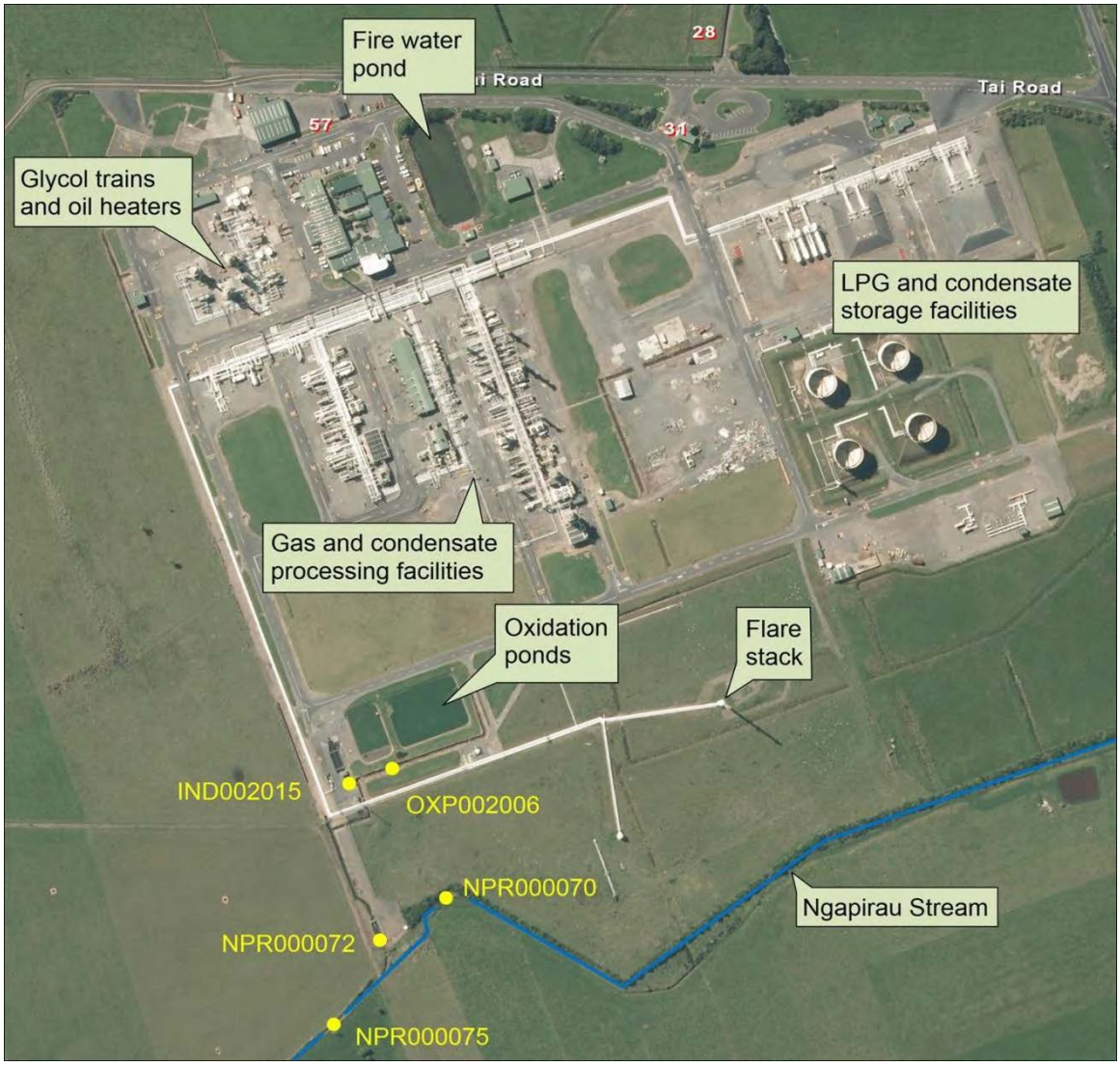

Figure 1 Maui Production Station and associated sampling sites

Chemical water quality sampling of the treated stormwater discharge from the production station was undertaken once during the 2015-2016 period. The location of

the sampling site (IND002015) is shown in Figure 1. Table 1 presents the results of this sampling.

Table 1 Results of stormwater discharge monitoring from Maui Production Station

Parameter	Units	23 May 2016	Consent limits
Chloride	g/m^3	33.8	-
Conductivity	mS/m	18.7	-
Hydrocarbons	g/m^3	< 0.5	15
Suspended solids	g/m^3	6	100
pH		7.0	-
Turbidity	NTU	6.6	-

All measured parameters were within the limits stipulated by consent 0245-3 and were indicative of a clean discharge.

2.1.2.2 Domestic wastewater

STOS have treated their domestic sewage on site since 1979 using a two-pond aerobic oxidation system. The discharge is to a perimeter drain, which flows to an oily water separator where it combines with the site stormwater before being discharged to the Ngapirau Stream. The discharge to the perimeter drain was sampled once during the monitoring period. The results are presented in Table 2 and the sampling site (OXP002006) is shown in Figure 1.

Table 2 Results of oxidation pond discharge monitoring at Maui Production Station

Parameter	Units	23 May 2016	Site median	Site maximum
Conductivity	mS/m	15.3	25.8	46.2
Enterococci bacteria	/100 ml	1,700	265	10,000
Faecal coliforms	/100 ml	560	540	7,100
Ammoniacal nitrogen	g/m^3 N	0.044	2.02	14.6
Suspended solids	g/m^3	4	25	150
pH		7.0	7.2	10.0
Turbidity	NTU	4.4	13	57.0

Consent 0246-3, which authorises the oxidation pond discharge, does not specify any numerical limits on its constituents. However, it does require that adverse effects be prevented. The results for the period under review were typical of well-treated oxidation pond effluent which would not be expected to cause more than minor off site effects. There is also significant on site dilution of the discharge, provided by combination with the site stormwater discharge prior to reaching the Ngapirau Stream.

2.1.2.3 Combined discharge

The combined discharge from the site includes the treated stormwater discharge from process areas, the oxidation pond discharge and runoff collected in perimeter drains. It passes through a separator before entering the Ngapirau Stream. The sampling point is in the tributary between the production station site boundary and the Ngapirau Stream (site NPR000072, Figure 1). It was sampled once during the period under review. The results of this sampling are presented in Table 3.

Table 3 Results of combined discharge monitoring from Maui Production Station

Parameter	Units	23 May 2016	Site median	Site maximum
Temperature	Deg.C	11.5	15.1	20.8
Conductivity	mS/m	13.1	23.6	30.6
Enterococci bacteria	/100 ml	1,600	100	7,700
Faecal coliforms	/100 ml	760	120	12,000
Hydrocarbons	g/m^3	< 0.5	<0.5	5.2
Ammoniacal nitrogen	g/m^3 N	0.037	0.119	0.584
Suspended solids	g/m^3	3	4	19
pH		7.1	7.2	7.9
Chloride	g/m^3	25.5	34	34
Turbidity	NTU	3.4	4.2	9.7

The results comply with all applicable consent conditions and indicate a reasonably clean discharge with low suspended solids and no detectable hydrocarbons. This is complemented by the results of the concurrent receiving water sampling shown in Table 6.

Every month, STOS provided the Council with the results for daily composite samples of the combined stormwater and oxidation ponds discharge, sampled downstream of the final separator. The results are summarised in Table 4.

Table 4 STOS Maui Production Station combined discharge results summary for 2015-2016

Month	Hydrocarbons (g/m^3)		Suspended solids (g/m^3)		Glycol (g/m^3)	
Consent 0245-3 limits	*15*		*100*		-	
	Max	Average	Max	Average	Max	Average
July 2015	0.7	< 0.5	21	7	0	0
August 2015	<0.5	< 0.5	36	10	0	0
September 2015	<0.5	< 0.5	19	5	0	0
October 2015	<0.5	< 0.5	50	8	0	0
November 2015	< 0.5	< 0.5	40	12	<1	0
December 2015	< 0.5	< 0.5	29	13	0	0

Month	Hydrocarbons (g/m^3)		Suspended solids (g/m^3)		Glycol (g/m^3)	
Consent 0245-3 limits	*15*		*100*		-	
	Max	Average	Max	Average	Max	Average
January 2016	< 0.5	< 0.5	44	10	0	0
February 2016	< 0.5	< 0.5	47	10	0	0
March 2016	<0.5	< 0.5	14	4	0	0
April 2016	< 0.5	< 0.5	14	6	0	0
May 2016	< 0.5	< 0.5	35	9	0	0
June 2016	< 0.5	< 0.5	42	5	0	0
Days limit exceeded	0		0		No limit. Total of 1 detection.	

Both hydrocarbon and suspended solid results were low on average and below the limit stipulated by consent 0245-3 throughout the monitoring period.

Glycol was detected in just one sample during the year, and this was below the reporting limit of 1 g/m^3.

Photo 2 Silt cloth installed in a perimeter stormwater drain at the Maui Production Station, April 2013

2.1.2.4 Fire fighting, stormwater and wastewater discharge

Wood Group M & O operates a Fire Training Centre adjacent to the production station, to train personnel for fire and helicopter crash response in accordance with STOS's response plan. Fire training exercises are carried out approximately 25 times per year. Hydrocarbons (mainly LPG) are used as accelerants in training exercises. The residues

accumulate in the first holding and settling pond, along with the wastewater used during exercises and stormwater.

The discharge is taken from the second pond from below the surface (to prevent entrainment of any hydrocarbon sheen) and flows to the Oaonui Stream. The wastewater and stormwater is held in the ponds for a varying amount of time depending on rainfall. Discharge only occurs when the ponds are full, which is usually only six or seven times per year due to low inflow volumes and evaporation.

The facility is inspected regularly as part of the Council's monitoring programme for the Maui Production Station. The ponds are also checked for any discharges in conjunction with sampling at the production station. No samples were collected in the 2015-2016 period, as there were no discharges sighted during inspections.

STOS samples the water in the ponds for hydrocarbon and suspended solids analyses prior to discharge. The results are provided to the Council and are presented in Table 5.

Table 5 Safety Training Centre stormwater discharge results 2015-2016

Date	Hydrocarbons (g/m^3)	Suspended solids (g/m^3)
Consent 1228-4 limits	*15*	*50*
8 July 2015	< 0.5	13
4 August 2015	< 0.5	30
6 August 2015	< 0.5	13
10 August 2015	< 0.5	**66**
26 August 2015	< 0.5	**93**
1 September 2016	< 0.5	**57**
8 September 2016	< 0.5	11
23 September 2016	< 0.5	6
28 October 2015	< 0.5	32
16 November 2015	< 0.5	25
2 December 2015	< 0.5	23
11 January 2016	< 0.5	30
23 February 2016	< 0.5	**91**
6 April 2016	< 0.5	**65**
2 May 2016	< 0.5	6
24 May 2016	< 0.5	12
8 June 2016	< 0.5	16
15 June 2016	< 0.5	37
Median (and maximum) values	< 0.5	27 (93)

The STOS monitoring results show that the discharge was usually in compliance with consent conditions. Although the suspended solids concentration exceeded the 50 g/m^3 consent limit in five of the samples, the results were all under 100 g/m^3 which is the limit set on new consents and for permitted activities under the Council's current Regional Fresh Water Plan. Discharges from the Fire Training Centre were unlikely to have caused any adverse effects in the Oaonui Stream.

2.1.3 Results of receiving environment monitoring

2.1.3.1 Chemical

The receiving stream for the treated stormwater and oxidation pond discharge, the Ngapirau Stream, arises from springs approximately four kilometres above the production station and meets the coast between the Okaweu and Oaonui Streams approximately two kilometres from the production station.

Receiving water quality sampling was undertaken in conjunction with discharge sampling at points upstream (NPR000070) and downstream (NPR000075) of the discharge. The results are shown in Table 6, and the sampling sites are shown in Figure 1.

Table 6 Receiving environment results for the Maui Production Station 2015-2016

Parameter	Units	23 May 2016	
		Upstream	Downstream
Temperature	Deg.C	11.2	11.6
Conductivity	mS/m	70.8	22.3
Enterococci	/100mL	2,900	1,600
Faecal coliforms	/100mL	1,100	650
Hydrocarbons	g/m^3	< 0.5	< 0.5
Ammoniacal Nitrogen	g/m^3 N	0.559	0.102
Turbidity	NTU	3.8	3.5
pH		6.9	7.1
Chloride	g/m^3	70.6	31.1
Suspended solids	g/m^3	6	2

As has been found on previous occasions, the Maui Production Station discharge was actually improving the water quality of the Ngapirau Stream in many respects at the time of sampling. The poor water quality of the stream above the production station discharge is most likely related to dominant effects from surrounding dairy farming activities within a small catchment area.

2.1.3.2 Biomonitoring

The Council's standard 'streambed-kick' technique was used at two established sites (NPR000100 and NPR000190, Figure 2) to collect streambed macroinvertebrates from

an unnamed coastal stream on 7 December 2015. Samples were sorted and identified to provide number of taxa (richness) and MCI and $SQMCI_s$ scores for each site.
The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to pollution and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

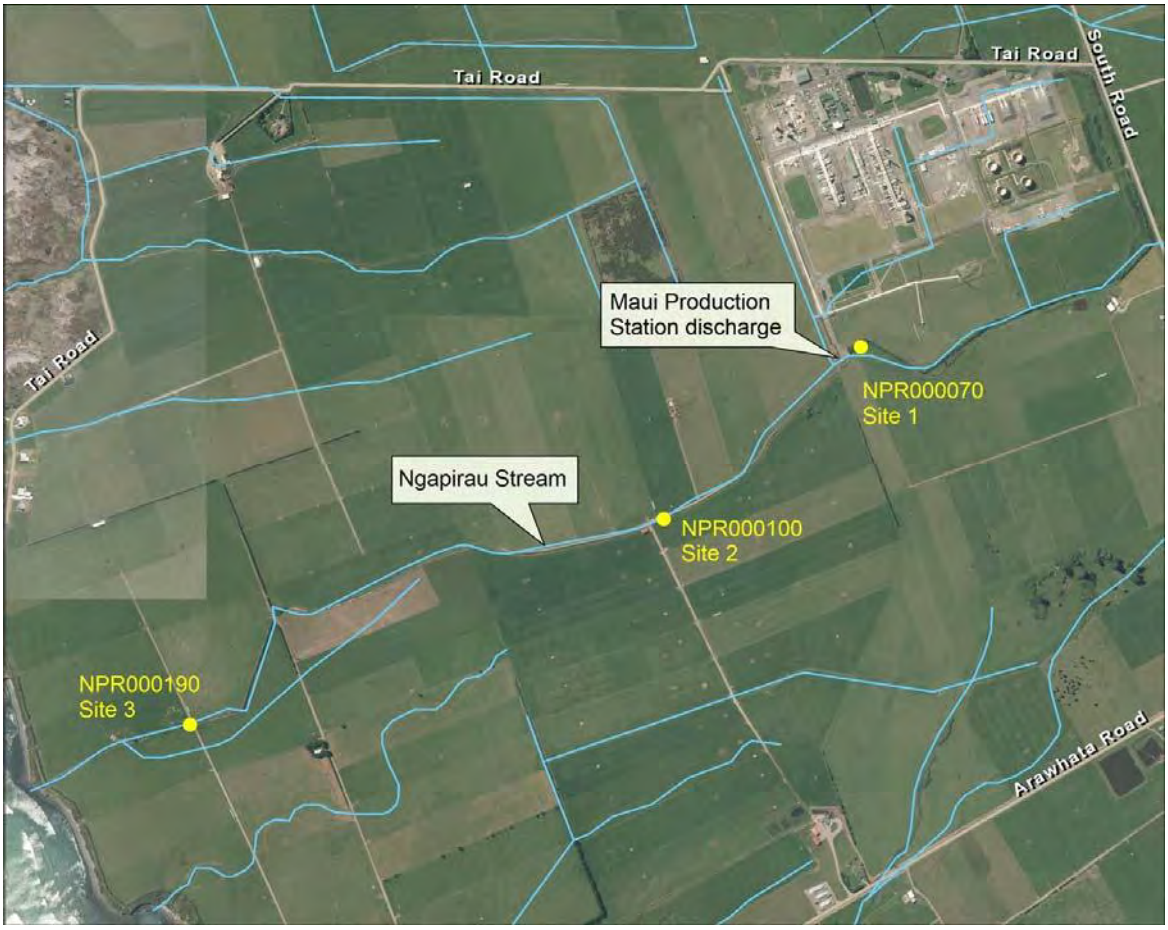

Figure 2 Biomonitoring sites in the Ngapirau Stream adjacent to the Maui Production Station

Significant differences in either the MCI or the SQMCI between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The early summer macroinvertebrate survey indicated that the discharge of treated wastes from the Maui Production Station site had not had any significant detrimental effect on the macroinvertebrate communities of the stream in comparison with the historical condition of these communities to date. The macroinvertebrate communities found at two sites downstream of the site discharge reflected the poor habitat present during a period of low flow conditions in summer, but also indicated that the water quality that preceded this survey was well above average.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa. However, two 'sensitive' taxa were found in abundance at both sites, as were two 'tolerant' taxa. At both sites, taxonomic richness (number of taxa) was equal to the long-term median, while the MCI scores were amongst the highest recorded at these sites. Similarly, the $SQMCI_S$ scores recorded at both sites were also amongst the highest

recorded to date for these sites, with most of these high results recorded in recent surveys. This indicates ongoing improvement in water quality and/or instream habitat.

The MCI and $SQMCI_S$ scores indicated that the stream communities were of well above average but still poor to fair 'health', although probably typical of communities in drain-like habitats in early summer.

The full biomonitoring report is attached to this report in Appendix II.

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. Air discharges were all found to be satisfactory, and no offensive, obnoxious or objectionable odours were noted during the inspections.

Photo 3 Emissions sources at the Maui Production Station

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 45 hours, with the instrument placed in a downwind 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 3.

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 3 Air monitoring sites at Maui Production Station for 2015-2016

The details of the sample run are summarised in Table 7 and the data from the sample run are presented graphically in Figure 4.

Table 7 Results of carbon monoxide and LEL monitoring at Maui Production Station

	Period	14 to 16 September 2015 (45 hours)
Max	CO(ppm)	6.80
	LEL(%)	0.10
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/m3
(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.

The consent covering air discharges from the Maui Production Station has specific limits related to particular gases. Special condition 9 of consent 4052-4 sets a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m^3 for an eight hour average or 30 mg/m^3 for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 7.79 mg/m^3 while the average concentration for the entire dataset was 0.2 mg/m^3 which comply with consent conditions. This is in line with the pattern found in previous years.

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 Maui Production Station reach any more than a trivial level.

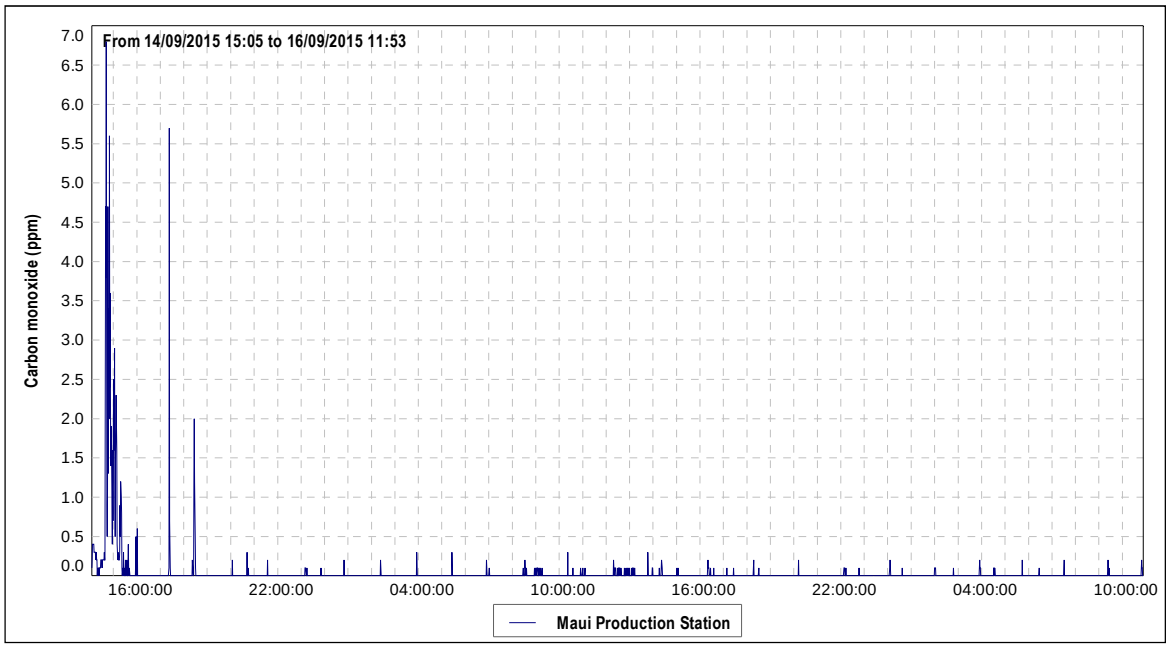

Figure 4 Ambient carbon monoxide levels in the vicinity of Maui Production Station

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 µg/m³ (24-hour average).

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 Maui Production Station. The deployment lasted approximately 45 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 3. The results of the sample run are presented in Table 8 and Figure 5.

Table 8 Daily averages of PM10 results from monitoring at Maui Production Station

	14 to 16 September 2015 (45 hours)	
24 hr. set	Day 1	Day 2
Daily average	16.3 µg/m³	19.9 µg/m³
NES limit (24 hour average)	50 µg/m³	

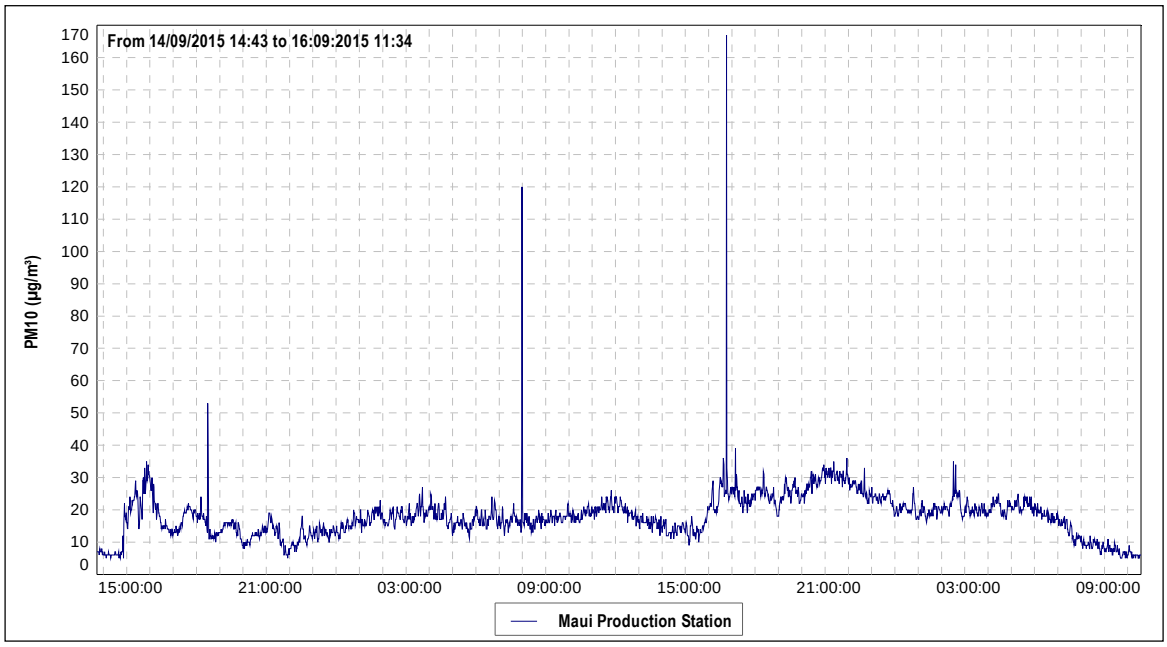

Figure 5 PM10 concentrations (µg/m³) at Maui Production Station

During the 45 hour run, from 14 to 16 September 2015, the average recorded PM10 concentration was 16.3 µg/m³ for the first 24 hour period and 19.9 µg/m³ for the second 24 hour period. These daily averages equate to 32.6% and 39.8%, respectively, of the 50 µg/m³ value that is set by the NES. Background levels of PM10 in the region have been found to be typically around 11 µg/m³.

2.2.2.3 Nitrogen oxides

From 2014 onwards, the Council implemented a coordinated region-wide compliance monitoring programme to measure nitrogen oxides (NOx). The programme involves deploying measuring devices at 28 NOx monitoring sites (including two sites in the vicinity of Maui 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 Maui Production Station has specific limits related to particular gases. Special condition 8 of consent 4052-4 sets a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 200 µg/m³ for a 1-hour average or 100 µg/m³ for a 24-hour average exposure.

NOx passive adsorption discs were placed at two locations in the vicinity of the Maui 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 and 24-hour theoretical maximum NOx concentrations found at Maui Production Station during the year under review equate to 6.36 µg/m³ and 3.37 µg/m³, respectively. The results show that the ambient ground level concentration of NOx is well below the limits set out by consent 4052-4.

The full air monitoring report is attached to this report in Appendix III.

2.2.3 Summary of flaring volumes reported by STOS

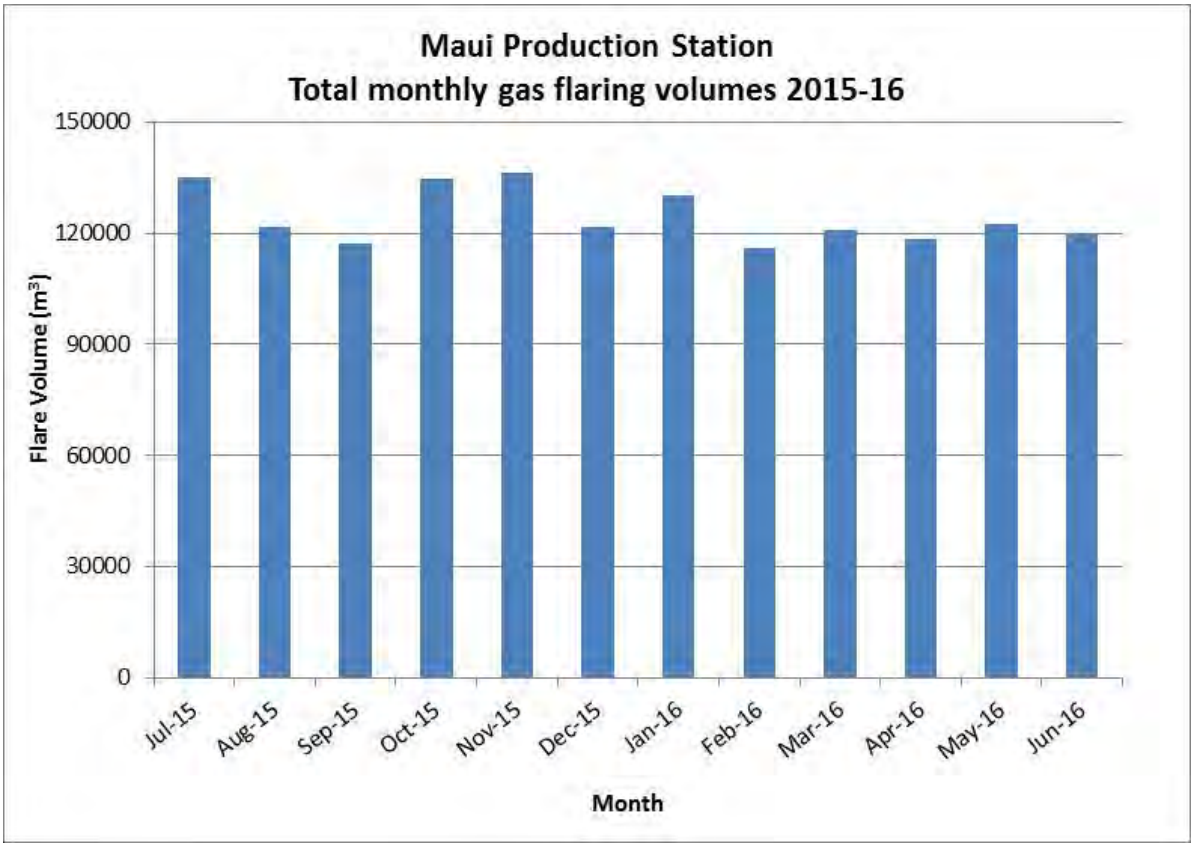

Figure 6 Monthly gas flaring for Maui Production Station under consent 4052-4

STOS provided the Council with an annual report on flaring and emissions during the 2015-2016 period, as required by consent 4052-4. A summary of flaring volumes at Maui Production Station is provided in Figure 6. The total volume flared in the 2015-2016 year was 1,500,000 m³ of gas, similar to the previous monitoring period.

Flaring was relatively consistent through the period (around 120,000 m³/month), with slight increases in July and October 2015, due to planned depressurisation for maintenance purposes, and a planned emergency shut down in November 2015. In January 2016 two unplanned events including a depressurisation of the recompressor and the fractionation train resulted in additional gas being flared.

Of the 38 flaring events in the period, 32 generated light smoke which was localised and dissipated quickly. The majority of events related to process upsets, depressurisation, plant repairs and ongoing maintenance. The median duration of these events was 180 minutes. No complaints were received from the public regarding flaring at the production station.

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 causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

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

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

In the 2015-2016 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with STOS's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Discussion of site performance

Monitoring of the Maui Production Station during the 2015-2016 year found that the site was well managed. All consent conditions relating to site operations and management were complied with.

3.2 Environmental effects of exercise of consents

Receiving water inspections, in conjunction with sampling conducted by both the Council and STOS during the 2015-2016 period, indicated that the discharges were not causing any adverse effects on the Ngapirau Stream at the time. This was supported by the findings of the macroinvertebrate survey carried out in the stream.

There were no adverse effects noted on the environment resulting from the exercise of the air discharge consent. The ambient air quality monitoring at the site indicated 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 9-13.

Table 9 Summary of performance for Consent 0245-3

Purpose: ***To discharge treated stormwater from the Maui Production Station to the Ngapirau Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Oily water separator and stormwater oil trap operated and maintained correctly	Inspections and sampling	Yes
2. Limits on contaminants in the discharge	Council and Company sampling	Yes
3. No effects in receiving water	Site inspections, sampling and biomonitoring	Yes
4. Contingency plan	Plan approved	Yes
5. Review/change of consent to take account of operational requirements	Not required	N/A
6. Review of consent	No further option for review	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 10 Summary of performance for Consent 0246-3

Purpose: ***To discharge treated domestic effluent from the oxidation ponds at the Maui Production Station to the Ngapirau Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Oxidation ponds maintained in aerobic condition to meet conditions	Inspections and sampling	Yes
2. No effects in receiving water	Site inspections, sampling and biomonitoring	Yes
3. Upgrade treatment system by November 2000	Upgrade completed	Yes
4. Option to review consent in 2001 to assess effectiveness of upgrade	Not exercised	N/A
5. Review/change of consent to take account of operational requirements	Not required	N/A
6. Review of consent	No further option for review	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 11 Summary of performance for Consent 1228-4

Purpose: ***To discharge treated stormwater and wastewater from fire fighting at the Fire Training Centre at the Maui Production Station to the Oaonui Stream*** **(held by Wood Group M & O)**		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Settling pond operated and regularly maintained to meet conditions	Site inspections	Yes
2. Limits on contaminants in the discharge	Discharge results provided by consent holder	No. 5 exceedances of suspended solids limit, but all were below the current 100 g/m^3 standard.
3. No chemicals or agents to be discharged without approval	Site inspections and liaison with consent holder	Yes
4. No effects in receiving water	Site inspections	Yes
5. Contingency plan	Plan approved	Yes
6. Review/change of consent to take account of operational requirements	Not required	N/A
7. Review of consent	No further option for review	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**Good** **High**

Table 12 Summary of performance for Consent 4052-4

Purpose: ***To discharge emissions into the air from the refining and distribution of hydrocarbons and associated processes at the Maui Production Station site***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adoption of best practicable option to minimise adverse effects	Site inspections and liaison with consent holder	Yes
2. Minimise emissions by appropriate selection, operation, supervision, control and maintenance of equipment	Site inspections and liaison with consent holder	Yes
3. Appropriate maintenance and operation of equipment	Site inspections	Yes
4. Treatment of flaring gas by effective liquid separation and recovery	Site inspections	Yes
5. Provision of annual report on flaring to council	Report received	Yes
6. No offensive, obnoxious or objectionable odours beyond site boundary	Site inspections	Yes
7. Limit on maximum ground level concentration of sulphur dioxide	Not measured, sampling in previous years	N/A
8. Limit on maximum ground level concentration of nitrogen oxides	Air quality monitoring	Yes
9. Limit on maximum ground level concentration of carbon monoxide	Air quality monitoring	Yes
10. Limit on maximum ground level concentration of benzene	Not monitored during period under review	N/A
11. Limit on maximum ground level concentration for other contaminants	Air quality monitoring	Yes
12. Consultation with Council prior to significant alterations to plant, processes, or operations	Site inspections and liaison with consent holder	Yes
13. Notification of flaring more than five minutes in duration	Flaring notifications received	Yes
14. Notification to Council of incidents or hazardous situations	No incidents or hazardous situations to notify this period	Yes
15. Record of smoke emitting events	Site inspections, records kept by consent holder, and liaison with consent holder	Yes
16. Maintenance of log of continuous flaring incidents	Site inspections, records kept by consent holder, and liaison with consent holder	Yes
17. Depressurisation of plant to prevent dense black smoke being discharged from the flare	Site inspections, records kept by consent holder, and liaison with consent holder	Yes

Purpose: *To discharge emissions into the air from the refining and distribution of hydrocarbons and associated processes at the Maui Production Station site*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
18. Optional review provision	Next option for review in June 2018	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 13 Summary of performance for Consent 5224-2

Purpose: *To place and maintain two pipelines in, under and over the foreshore and seabed in the coastal marine area between mean high water spring and the outer limit of the territorial sea*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notify Council before undertaking major maintenance works	No maintenance works undertaken	N/A
2. During maintenance works observe measures to prevent discharge and minimise disturbance	No maintenance works undertaken	N/A
3. Structures to be removed and area reinstated when no longer required	Currently operational	N/A
4. Review of consent	No further option for review	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

During the period under review, STOS demonstrated an overall high level of both environmental performance and administrative compliance with the resource consents as defined in Section 1.1.4. There were no unauthorised incidents recorded by the Council in relation to STOS's activities. The Maui Production Station was well managed and maintained.

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

> THAT monitoring of consented activities at the Maui Production Station in the 2015-2016 year continues at the same level as in 2014-2015.

This recommendation was implemented.

3.5 Alterations to monitoring programmes for 2016-2017

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
- to 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 2016-2017 the monitoring of consented activities at the Maui Production Station continue at the same level as in 2015-2016.

4. Recommendations

1. THAT monitoring of consented activities at the Maui Production Station in the 2016-2017 year continues at the same level as in 2015-2016.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
Bund	A wall around a tank to contain its contents in the case of a leak.
CO	Carbon monoxide.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
g/m^3	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.
Incident Register	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.
LEL	Lower Explosive Limit (LEL) gives the percentage of the lower explosive limit, expressed as methane, that is detected in the air sampled.
m^2	Square Metres.
mg/m^3	Milligrams per cubic metre.
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.
NOx	Nitrogen oxides.
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).
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_{10}	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	*Resource Management Act 1991* and including all subsequent amendments.
Separator	A device designed to separate oil and suspended solids from wastewater and stormwater.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
$\mu g/m^3$	Micrograms per cubic metre of air.

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

Bibliography and references

Taranaki Regional Council (2016): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2014-2015. Technical Report 2015-103

Taranaki Regional Council (2015): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Biennial Report 2012-2014. Technical Report 2014-41

Taranaki Regional Council (2012): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2011-2012. Technical Report 2012-35

Taranaki Regional Council (2011): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2010-2011. Technical Report 2011-74

Taranaki Regional Council (2010): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2009-2010. Technical Report 2010-98

Taranaki Regional Council (2009): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2008-2009. Technical Report 2009-28

Taranaki Regional Council (2008): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2007-2008. Technical Report 2008-14

Taranaki Regional Council (2007): Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2006-2007. Technical Report 2007-72

Taranaki Regional Council (2007): Shell Todd Oil Services Maui and Kapuni Monitoring Programme Annual Report 2005-2006. Technical Report 2006-51

Taranaki Regional Council (2005): Shell Todd Oil Services Maui and Kapuni Monitoring Programme Annual Report 2004/2005. Technical Report 2005-66

Taranaki Regional Council (2004): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 2003/2004. Technical Report 2004-31

Taranaki Regional Council (2003): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 2002/2003. Technical Report 2003-63

Taranaki Regional Council (2002): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 2001/2002. Technical Report 2002-62

Taranaki Regional Council (2001): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 2000/2001. Technical Report 2001-90

Taranaki Regional Council (2000): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1999/2000. Technical Report 00-12

Taranaki Regional Council (1999): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1998/1999. Technical Report 99-50

Taranaki Regional Council (1998): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1997/1998. Technical Report 98-35

Taranaki Regional Council (1997): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1996/1997. Technical Report 97-30

Taranaki Regional Council (1996): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1995/1996. Technical Report 96-59

Taranaki Regional Council (1995): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1994/1995. Technical Report 95-35

Taranaki Regional Council (1994): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1993/1994. Technical Report 94-46

Taranaki Regional Council (1993): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1992/1993. Technical Report 92-31

Taranaki Regional Council (1992): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1991/1992. Technical Report 92-31A

Taranaki Regional Council (1991): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1990/1991. Technical Report 91-31

Taranaki Regional Council (1990): Shell Todd Oil Services Ltd Compliance Monitoring Programme Annual Report 1989/1990. Technical Report 90-9

Appendix I

Resource consents held by
Shell Todd Oil Services Ltd
and
Wood Group M & O

(For a copy of the signed 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:	Shell Todd Oil Services Ltd Private Bag 2035 NEW PLYMOUTH 4342
Decision Date (Change):	4 September 2013
Commencement Date (Change):	4 September 2013 (Granted: 11 October 2000)

Conditions of Consent

Consent Granted:	To discharge treated stormwater from the Maui Production Station to the Ngapirau Stream
Expiry Date:	1 June 2018
Site Location:	Maui Production Station, Tai Road, Oaonui
Legal Description:	Lot 1 DP 11402 Ngatitara 7C Blk XV Opunake SD (Discharge source & site)
Grid Reference (NZTM)	1669907E-56379680N
Catchment:	Ngapirau

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

General condition

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

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

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

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

Special conditions

1. The oily water separator and the stormwater oil trap shall be operated and regularly maintained to ensure that the conditions of this consent are met.

2. The discharge shall not exceed the following concentrations:

Contaminant	Concentration
Total recoverable hydrocarbons	15 gm^{-3}
Suspended solids	100 gm^{-3}

3. After allowing for reasonable mixing, within a mixing zone extending 20 metres downstream of the discharge point, the discharge [in conjunction with any other discharge pertaining to the same property] 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 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, habitats or ecology.

4. The consent holder shall maintain, and regularly update, a contingency plan, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

5. The resource consent holder may apply to the Taranaki Regional Council for a change or cancellation of any of the conditions of this resource consent in accordance with section 127(1)(a) of the Resource Management Act 1991 to take account of operation requirements or the results of monitoring.

6. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2006 and/or June 2012, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this consent, which either were 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 4 September 2013

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Biomonitoring report

To Callum McKenzie; Job Manager
From Bart Jansma; Scientific Officer
Report No BJ284
Doc No 1704384
Date 24 June 2016

Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, December 2015

Introduction

This early summer biological survey of an unnamed coastal stream receiving wastewater from the Maui gas treatment plant at Oaonui was the only survey scheduled for the 2015-2016 monitoring year. The results from surveys performed since the 2001-2002 monitoring year are discussed in reports referenced later in this report.

Methods

Macroinvertebrates were collected from sites 2 and 3, in an unnamed coastal stream (Table 1, Figure 1), on 7 December 2015 by the Taranaki Regional Council. The sampling method employed was the 'streambed-kick' sampling technique, which is very similar to Protocol C1 (hard-bottomed, semi-quantitative), of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). Site 1 was removed from the monitoring programme in the 2001-2002 monitoring year due to fluctuating flows (a tendency to dry up in summer), which influenced the results obtained from this site.

Table 1 Biomonitoring sites in an unnamed coastal stream related to the Oaonui Production Station

Site No.	Site Code	GPS Reference (NZTM)	Location
2	NPR 000100	E1669554 N5637641	Approximately 500 m downstream of discharges
3	NPR 000190	E1668603 N5637217	Approximately 1600 m downstream of discharges

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology, which is very similar to protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity

scores for certain taxa have been modified in accordance with Taranaki experience. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways.

A semi-quantitative MCI value ($SQMCI_s$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

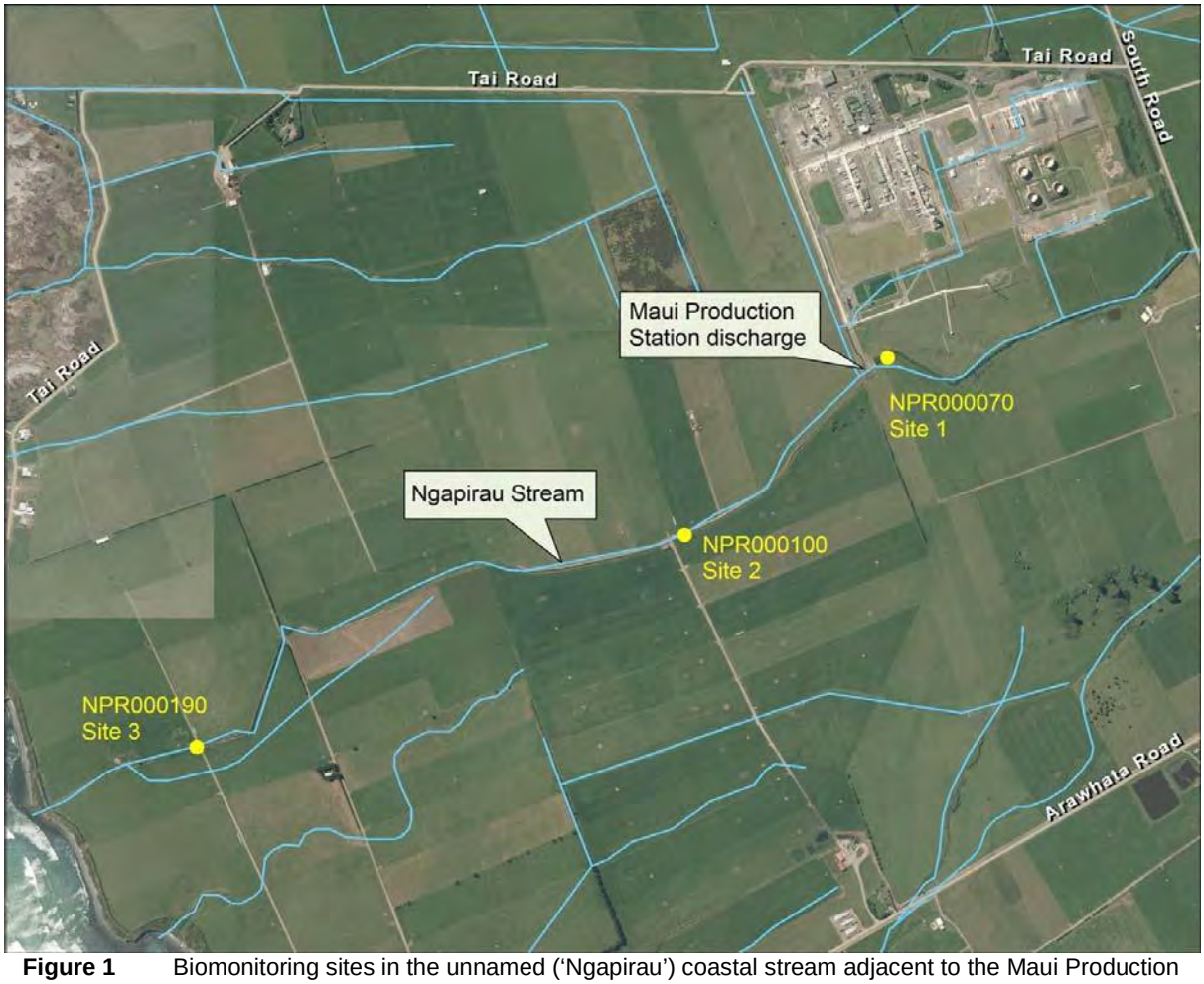

Figure 1 Biomonitoring sites in the unnamed ('Ngapirau') coastal stream adjacent to the Maui Production Station

Results and discussion

At the time of this midday survey, the water temperatures in the stream were 18.7°C at site 2, approximately 500m downstream of the production station and 20.1°C at site 3,

approximately 1,600m downstream of the production station. The moderate and steady stream flow was uncoloured and clear at both sites and followed a short recession period, 9 days after the most recent fresh (above 3 times median flow) in the nearby Punehu Stream.

The streambed was comprised mainly of hard clay and gravels at site 2, with the addition of some silt and sand. The substrate at site 3 was relatively soft, and was dominated by sand, silt and gravels, although there was also a fair proportion as hard clay. Site 2 had a similar degree of algal growth as that noted in the previous survey, with slippery films and patches of filamentous growth observed. This compares well with the extensive patchy algal mats (some in floating mats) and widespread filamentous algae observed in December 2013. Site 3 had a similar algal biomass as site 2, with a slippery film and patches of filamentous growth also observed here. Site 2 was completely unshaded whereas site 3 was partially shaded. Site 2 supported some macrophyte growth, but only on the edges, while no macrophytes were present in the sampled reach at site 3. Discolouration caused by an unauthorised dairy effluent discharge to the stream upstream of the Maui Production Station discharge had been noted on some previous survey occasions but has not been seen to be occurring for at least the last eight surveys. Due to slightly improved flow conditions compared with the previous survey, habitat in the stream was less limited and a moderately sized sample was collected.

Microscopic analysis revealed that there were no 'undesirable heterotrophic growths' at either site consistent with the visual absence of such growths, at the time of this early summer survey.

Macroinvertebrate communities

This drain-like stream typically supports macroinvertebrate communities of limited taxonomic richness, with relatively low proportions of 'sensitive' taxa, as reflected by the MCI values. Results from previous surveys are summarised in Table 2, together with current results which are also illustrated in Figure 2.

Table 2 Numbers of taxa and MCI values recorded in previous surveys performed since June 1988 in the unnamed coastal stream receiving wastes from the Maui Production Station at Oaonui, together with current results

Site	N	Numbers of taxa			MCI values			$SQMCI_S$ (N=24)		
		Range	Median	Current survey	Range	Median	Current survey	Range	Median	Current survey
2	45	8-21	15	15	44-75	63	69	1.1-4.2	2.4	4.4
3	34	9-26	16	16	58-75	66	71	1.3-4.7	2.6	4.4

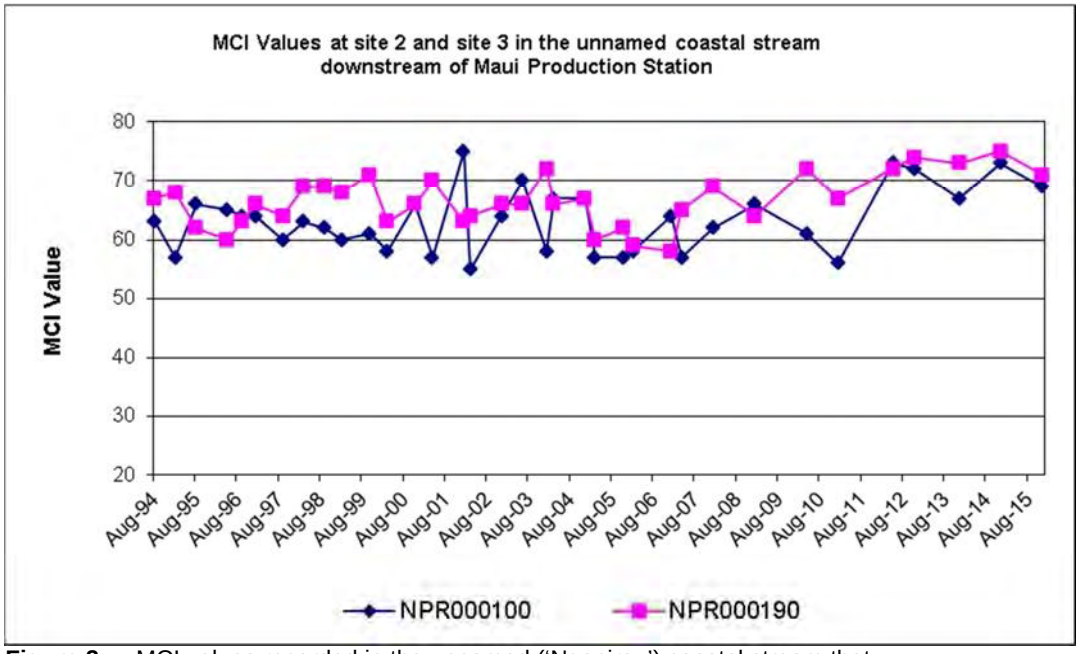

Figure 2 MCI values recorded in the unnamed ('Ngapirau') coastal stream that receives discharges from the Maui Production Station since August 1994

Table 3 Macroinvertebrate fauna of an unnamed coastal stream ('Ngapirau' Stream) in relation to the Maui Production Station, sampled on 7 December 2015

Taxa List	Site Number	MCI score	2	3
	Site Code		NPR000100	NPR000190
	Sample Number		FWB15357	FWB15358
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	C	-
ANNELIDA (WORMS)	Oligochaeta	1	A	A
	Lumbricidae	5	C	A
MOLLUSCA	*Physa*	3	C	R
	Potamopyrgus	4	XA	XA
CRUSTACEA	Ostracoda	1	R	R
	Isopoda	5	R	R
	Paracalliope	5	XA	XA
COLEOPTERA (BEETLES)	Elmidae	6	-	R
	Dytiscidae	5	R	-
TRICHOPTERA (CADDISFLIES)	*Hydrobiosis*	5	A	A
	Oxyethira	2	R	C
DIPTERA (TRUE FLIES)	Hexatomini	5	R	-
	Chironomus	1	R	-
	Maoridiamesa	3	-	C
	Orthocladiinae	2	R	C
	Tanytarsini	3	-	R
	Ephydridae	4	-	R
	Muscidae	3	-	R
ACARINA (MITES)	Acarina	5	C	R
		No of taxa	15	16
		MCI	69	71
		SQMCIs	4.4	4.4
		EPT (taxa)	1	1
		%EPT (taxa)	7	6

'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 2

A moderate richness of fifteen taxa was found at site 2, which was equal to the median of previous values recorded at this site (Table 2) and similar to that recorded in the previous survey. The community was dominated by two 'tolerant' taxa, [oligochaete worms and extremely abundant snail (*Potamopyrgus*)] and two 'moderately sensitive' taxa (extremely abundant *Paracalliope* amphipods and abundant *Hydrobiosis* caddisfly).

This site's habitat supported a predominance of 'tolerant' taxa (53% of taxa number), resulting in the 'poor' MCI score of 69 units. This score was six units higher than the median of all previous scores, and only four units less than that recorded in the previous survey(Table 2, Figure 2). The extreme abundance of the 'tolerant' snail *Potamopyrgus* was tempered by the extreme abundance of the 'moderately sensitive' amphipod *Paracalliope* resulting in an $SQMCI_S$ score of 4.4 units. Although this indicates that only fair water quality preceded this survey, this score is significantly higher than the median $SQMCI_S$ score for this site (by 1.8 units), and is the highest $SQMCI_S$ score recorded at this site to date, indicating better than average water quality. In general, the current results are well above average for this site, and not reflective of any impacts caused by the Maui Production Station discharge.

Site 3

An improved community richness of sixteen taxa was found at site 3 (when compared with the previous survey), equal to the median richness for this site, and one more than that recorded upstream (Table 2). The community was dominated by 'tolerant' taxa [oligochaete worms and extremely abundant snail (*Potamopyrgus*)], and three 'moderately sensitive' taxa [lumbricid worms, extremely abundant amphipods (*Paracalliope*) and *Hydrobiosis* caddisfly].

This softer-bottomed, nutrient enriched habitat supported a community dominated by 'tolerant' taxa (63% of taxa number), resulting in the MCI score of 71 units. Although this score was not significantly different to the median MCI score for this site, it was amongst the highest MCI scores recorded at this site to date, and two units higher than recorded at site 2 upstream (Figure 2, Table 2). As with site 2, the extreme abundance of the 'tolerant' snail *Potamopyrgus* was tempered by the extreme abundance of 'moderately sensitive' amphipod *Paracalliope*. This resulted in a equivalent $SQMCI_S$ score (4.4 units), which is significantly higher than the median for this site, and continues the above average trend observed in the previous four surveys. Community compositions were relatively dissimilar at the two sites with only 50% of the total taxa (20) found in the reach of the stream surveyed, present at both sites.

Conclusions

This early summer 2015 biomonitoring survey of a small coastal stream that receives wastewater (including treated sewage) from the Oaonui Production Station was undertaken during a relatively normal early summer period, with the stream being in recession for 9 days prior to this survey. Results indicated that the wastewater discharge had not had an impact on the macroinvertebrate communities of the stream, although the poor physical habitat conditions of this drain-like watercourse are not suitable for most 'sensitive' invertebrate taxa, and this may often limit the degree of impact of the discharges on the biological communities. The absence of 'heterotrophic growths' at both sites also indicated a lack of impacts of the discharge on the stream, with no clear improvement in the quality of the macroinvertebrate communities with distance downstream. The MCI values were very similar at sites 2 and 3, despite the slightly improved habitat at site 3, primarily through improved shading and reduced algal growth. Overall, the scores at both sites were reflective

of the poor habitats over the summer period. In general, the current results are well above average for this site, and not reflective of any impacts caused by the Maui Production Station discharge.

Summary

The Council's standard 'streambed-kick' technique was used at two established sites to collect streambed macroinvertebrates from an unnamed coastal stream on 7 December 2015. Samples were sorted and identified to provide number of taxa (richness) and MCI and $SQMCI_s$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either the MCI or the SQMCI between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This early summer macroinvertebrate survey indicated that the discharge of treated wastes from the Maui Production Station site had not had any significant detrimental effect on the macroinvertebrate communities of the stream in comparison with the historical condition of these communities to date. The macroinvertebrate communities found at two sites downstream of the site discharge reflected the poor habitat present during a period of low flow conditions in summer, but also indicated that the water quality that preceded this survey was well above average.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa. However, two 'sensitive' taxa were found in abundance at both sites, as were two 'tolerant' taxa. At both sites, taxonomic richness (number of taxa) was equal to the long-term median, while the MCI scores were amongst the highest recorded at these sites. Similarly, the $SQMCI_S$ scores recorded at both sites were the also amongst the highest recorded to date for these sites, with most of these high results recorded in recent surveys. This indicates ongoing improvement in water quality and/or instream habitat.

The MCI and $SQMCI_S$ scores indicated that the stream communities were of well above average but still poor to fair 'health', although probably typical of communities in drain-like habitats in early summer.

References

Colgan, B, 2003: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, June 2003. TRC report BC003.

Dunning KJ, 2002a: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2002. TRC report KD99.

Dunning KJ, 2002b: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, March 2002. TRC report KD111.

Dunning KJ & CR Fowles, 2002c: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, December 2002. TRC report CF279.

Fowles CR, 2004: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, March 2004. TRC report CF319.

Fowles CR & Hope KJ, 2005: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, March 2005. TRC report CF384.

Fowles CR & Jansma B, 2007: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2007. TRC report CF425.

Fowles CR & Jansma B, 2007: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, April 2007. TRC report CF426.

Fowles CR & Jansma B, 2008: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2008. TRC report CF457.

Hope KJ, 2006: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, November 2005. TRC report KH081.

Hope KJ, 2006: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, February 2006. TRC report KH082.

Jansma B, 2009: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2009. TRC report BJ067.

Jansma B, 2011: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, April 2010. TRC report BJ131.

Jansma B, 2011: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2011. TRC report BJ159.

Jansma B, 2012: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, May 2012. TRC Report BJ176.

Jansma B, 2013: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, November 2012. TRC Report BJ194.

Jansma B, 2014: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, December 2014. TRC Report BJ257.

Moore SC & Colgan BC, 2004: Biomonitoring of an unnamed coastal stream in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, January 2004. TRC report SM587

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. *Water and Soil* Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. *New Zealand Journal of Marine and Freshwater Research 32(1*): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate

Thomas B & Jansma B, 2014: Biomonitoring of an unnamed coastal stream (Ngapirau Stream) in relation to waste discharges from the Shell Todd Oil Services Ltd Maui Production Station, December 2013. TRC report BT022.

Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

Appendix III

Air monitoring reports

Memorandum

To Job Manager, Callum MacKenzie
From Scientific Officer - Air Quality, Brian Cheyne
File 1778698
Date November 23, 2016

Ambient Gas (PM10, NOx, CO and LEL) Monitoring at Maui Production Stations during 2015-2016 monitoring year

Introduction

In September 2015 and January 2016 as part of the compliance monitoring programme for the Maui 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 45 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.

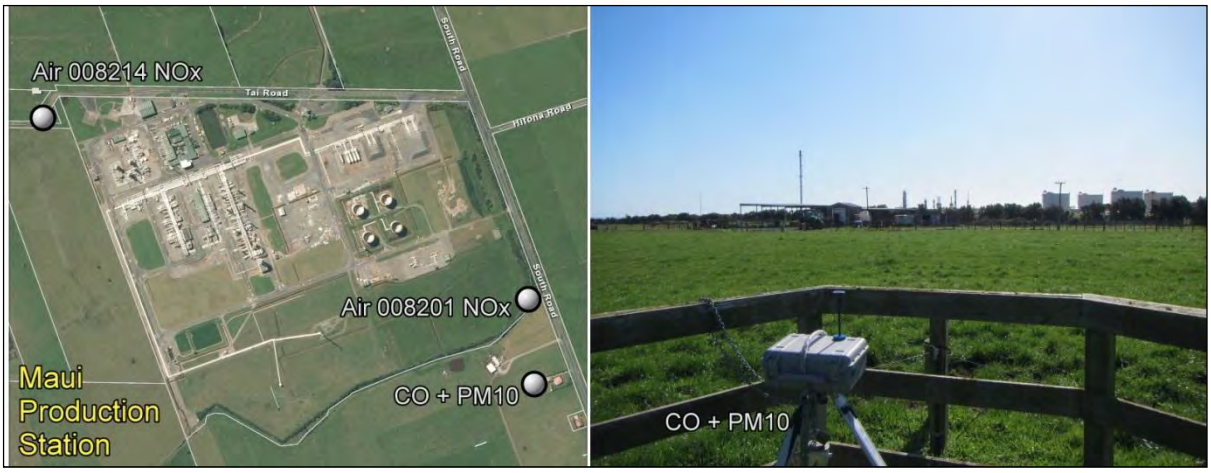

Figure 1 Air monitoring sites at Maui production station (2015-2016)

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 Maui production station have specific limits related to particular gases. Special condition 9 of consent 4052-4set a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m³ for an eight hour average or 30 mg/m³ for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 7.79 mg/m³ with average concentration for the entire dataset was only 0.2 mg/m³ 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 Maui production station (2015-16)

Period (from-to)		14/09/2015 15:05 to 16/09/2015
Max	CO(ppm)	6.80
	LEL(%)	0.10
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^3

(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 Maui production station reach any more than a trivial level.

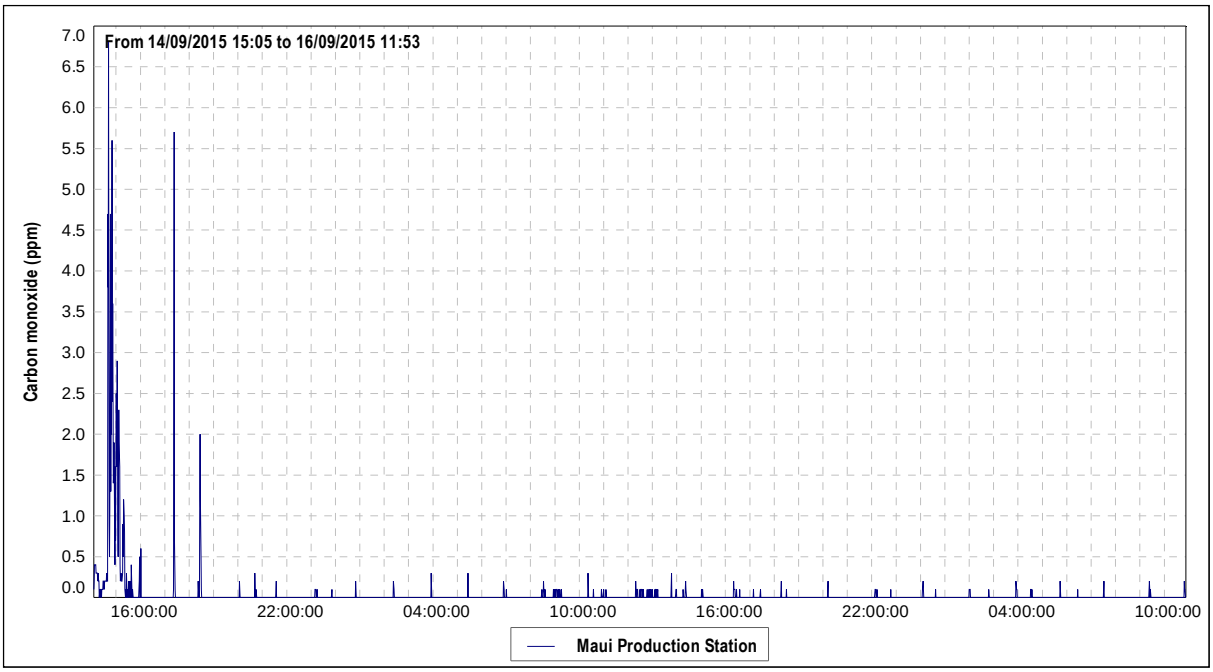

Figure 2 Graph of ambient CO levels in the vicinity of the Maui Production Station (2015-16)

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 µg/m^3 (24-hour average).

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 Maui production station. The deployment lasted approximately 45 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.

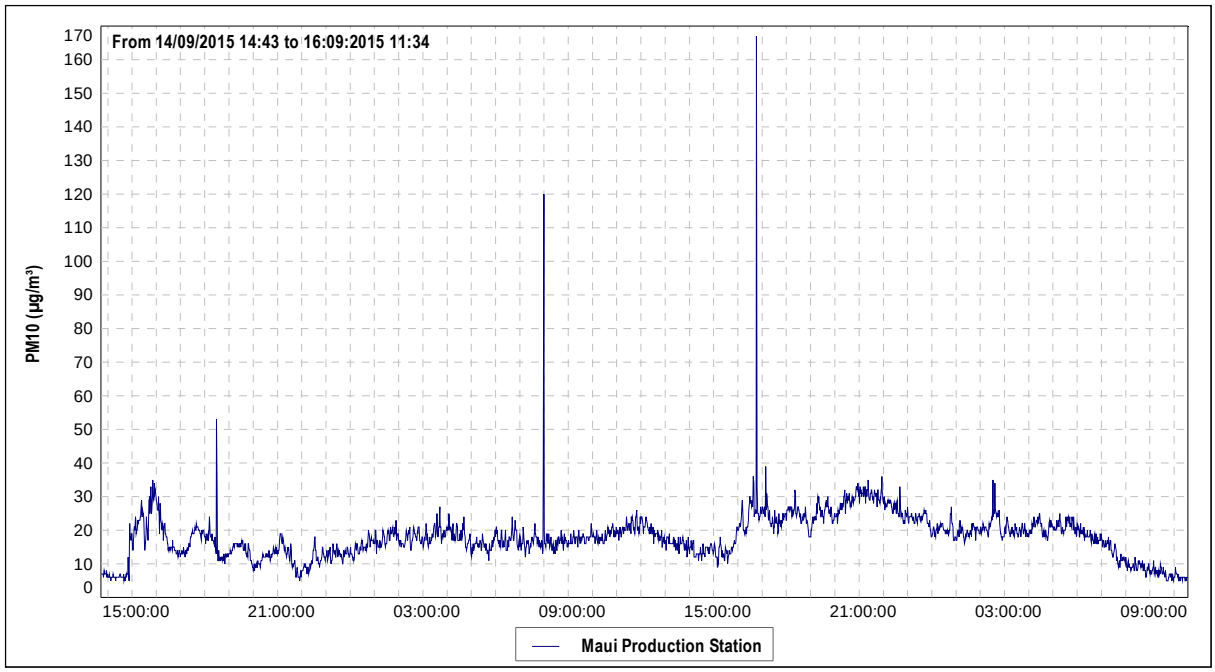

Figure 2 PM10 concentrations (µg/m³) at the Maui production station (2015-16)

	(45 hours) (14-16/09/2015)	
24 hr. set	Day 1	Day 2
Daily average	16.3 µg/m³	19.9 µg/m³
NES	50µg/m³	

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

During the 45-hour run, from 14th to 16th of September 2015, the average recorded PM_{10} concentration for the first 24 hour period was 16.3µg/m³ and 19.9µg/m³ for the second 24 hour period. These daily means equate to 32.6% and 39.8%, respectively, of the 50 µg/m³ value that is set by the National Environmental Standard.

Background levels of PM_{10} in the region have been found to be typically around 11 µg/m³.

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 Maui 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 to this memorandum.

The consents covering air discharges from the Maui production station have specific limits related to particular gases. Special condition 8 of consent 4052-4 set a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 100 µg/m³ for a 24 hour average or 200 µg/m³ for a one hour average exposure.

NOx passive adsorption discs were place at two locations in the vicinity of the Maui 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 and 24-hour theoretical maximum NOx concentrations found at the Maui production station during the year under review equates to 6.36µg/m³ and 3.37 µg/m³ respectively. The results show that the ambient ground level concentration of NO_x is well below the limits set out by consent 4052-4.

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 # 1718841
Date	22 July 2016

Monitoring of nitrogen oxides (NOx) levels in Taranaki near the NOx emitting sites, year 2015-2016

From 2014 onwards, the Taranaki Regional Council (TRC) has implemented a coordinated region-wide monitoring programme to measure NOx, not only at individual compliance monitoring sites near industries that emit NOx, but simultaneously at the urban sites (the Council regional state of the environment programme) to determine exposure levels for the general population. 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 (NOx), a mixture of nitrous oxide (N2O), nitric oxide (NO) and nitrogen dioxide (NO2), 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 NO2 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 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 (NO2) 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/m³.

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 (NO2) 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/m³.

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 (NOx) 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 more then 660 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 2015-16 year, passive absorption discs were placed on one occasion at twenty four sites, staked about two metres off the ground for a period of 21 days, for the purpose of Compliance Monitoring.

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 NOx 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_2 given a measured concentration for time period t_1). 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 NOx monitoring sites are shown in Figure 1 and the details of the NOx results are presented in Table 1 and Figure 2.

Table 1 Actual (laboratory) and recalculated ambient NOx results, NES and MfE guideline.

	Survey at	Site code	NOx(µg/m³) Lab. results	NOx 1/hr (µg/m³) Theoretical max.	NOx 24/hr (µg/m³) Theoretical max.
Petrochemical	McKee PS	AIR007901	1.9	6.5	3.5
		AIR007902	8.1	27.8	14.8
	Turangi PS	AIR007922	3.8	13.1	6.9
		AIR007824	3.3	11.3	6.0
	Kaimiro PS	AIR007817	1.2	4.1	2.2
		AIR007818	4.0	13.8	7.3
	Sidewinder PS	AIR007831	0.8	2.8	1.5
		AIR007832	0.8	2.8	1.5
	Maui PS	AIR008201	1.3	4.5	2.4
		AIR008214	2.4	8.3	4.4
	Kupe PS	AIR007827	2.1	7.2	3.8
		AIR007830	1.4	4.9	2.6
	Kapuni PS	AIR003410	5.9	20.3	10.7
		AIR003411	7.0	24.1	12.7
	Cheal PS	AIR007841	1.5	5.2	2.7
		AIR007842	2.0	6.9	3.6
	Waihapa PS	AIR007815	1.5	5.2	2.7
		AIR007816	2.6	8.9	4.7
	Ballance AUP	AIR003401	4.2	14.4	7.7
		AIR003404	6.9	23.8	12.6
Dairy factory	Fonterra	AIR002410	3.4	11.7	6.2
		AIR002711	4.8	16.5	8.7
		AIR002412	4.3	14.8	7.8
		AIR002413	4.1	14.1	7.5
National Environmental Standard (NES) and MfE guideline				**200 (NES)**	**100 (guideline)**

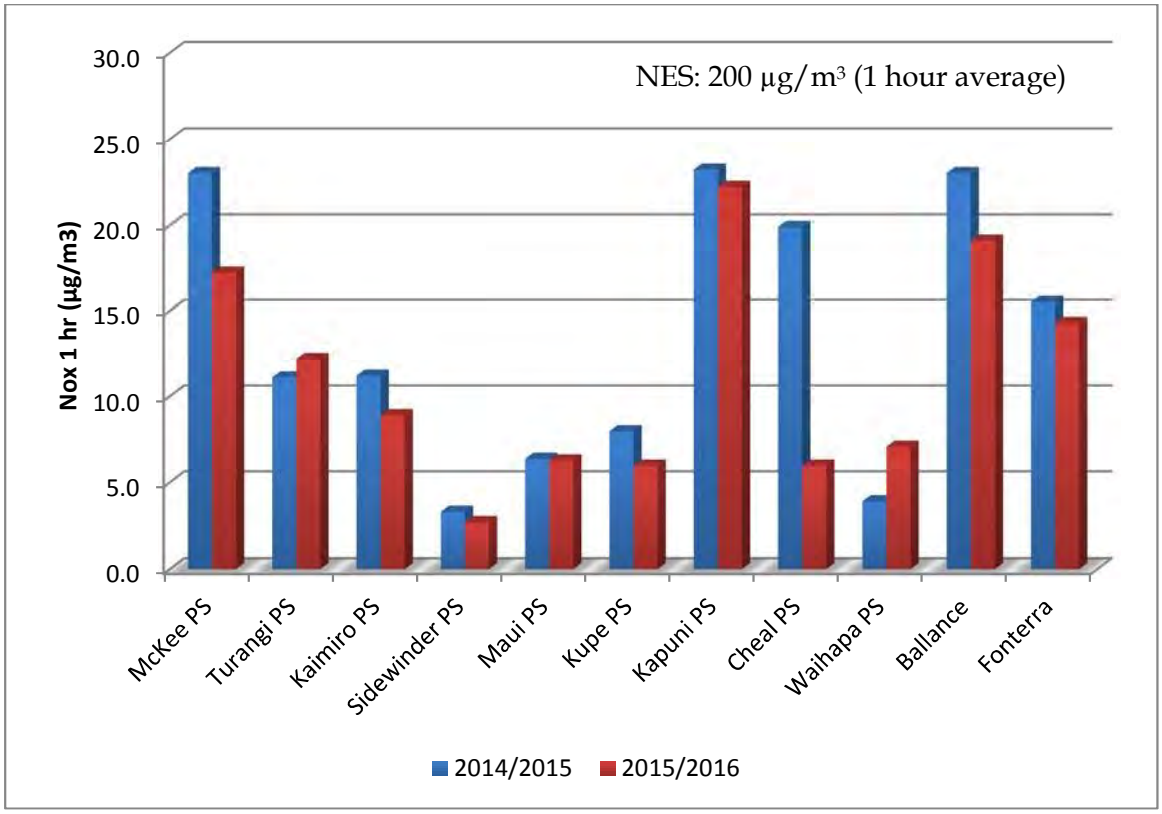

Figure 2 Average NOx levels at 11 surveyed locations throughout the region (year 2014-2016).

Discussion

The calculated 1-hour and 24-hour theoretical maximum concentrations (using a power law exponent of 0.2) ranged from 2.8 µg/m³ to 27.8 µg/m³ and 1.5 µg/m³ to 14.8 µg/m³ respectively. The highest results in 2015-16 monitoring year were obtained from the NOx emitting sites at four different locations:

1. Around the Fonterra's Whareroa co-generation plant.
2. In Kapuni heavy industrial area around the STOS production station and
3. 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.

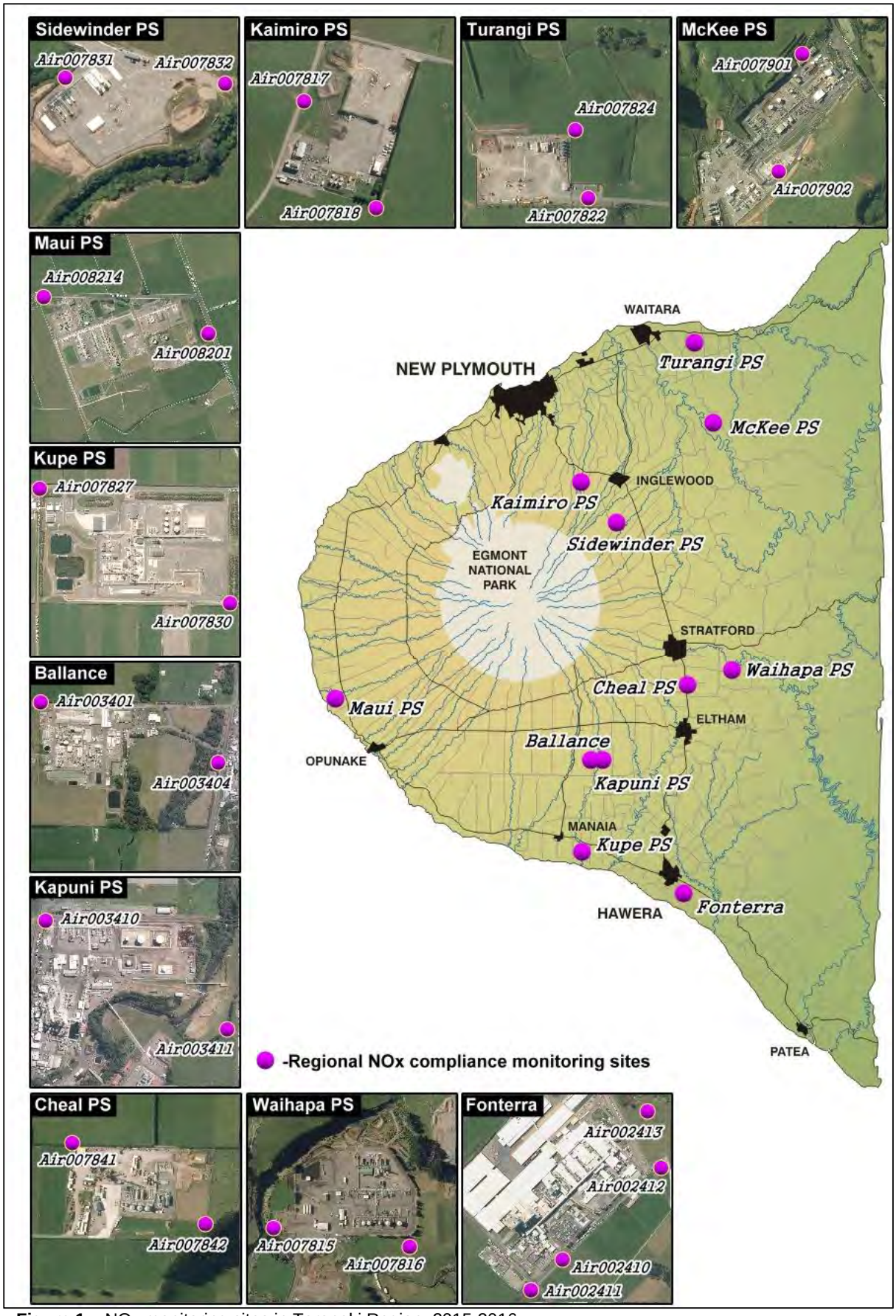

Figure 1 NOx monitoring sites in Taranaki Region, 2015-2016

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 NOx 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	*excellent*	*good*	*acceptable*	*alert*	*action*

Table 3 Categorisation of results (2015-16 monitoring year)

National Environmental Standard for NO2 = 200 µg/m³- 1 hour average.		
Category	**Measured values**	
Excellent	<10% of the NES, (0-20µg/m³)	**20** (83%)
Good	10-33% of the NES, (20-66µg/m³)	**4** (17 %)
Acceptable	33-66% of the NES, (66-132 µg/m³)	**0** (0%)
Alert	66-100% of the NES, (132-200 µg/m³)	**0** (0%)
Total number of samples		**24** (100%)

Conclusion

The monitoring showed that 83% of the 1-hour average results fell into Ministry's 'excellent' categories and 17% 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/m³.

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.