

Shell Todd Oil Services Limited
Maui and Kapuni Production Stations
Monitoring Programmes
Biennial Report
2012-2014

Technical Report 2014-41

ISSN: 0144-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1381218 (Word)
Document: 1452511 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

February 2015

Executive summary

Shell Todd Oil Services Ltd operates the Maui Production Station located on Tai Road, Oaonui, in the Ngapirau catchment, and the Kapuni Production Station located on Palmer Road in the Kapuni catchment. The Company holds resource consents to allow it to discharge into the Ngapirau and Kapuni Streams, to discharge emissions into the air, and to erect and maintain various structures associated with the production stations.

This report for the period July 2012-June 2014 describes the monitoring programmes implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

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

For the Maui Production Station, the Company holds a total of four resource consents; two relating to discharges to water, one consent to discharge emissions to the air, and one to maintain a structure in the coastal marine area. The consents include a total of 34 conditions setting out the requirements that the Company must satisfy. M & O Pacific Limited 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.

For the Kapuni Production Station, the Company holds a total of three resource consents; one relating to discharges to water, one to discharge emissions to the air, and one relating to structures in the Kapuni Stream. The consents include a total of 28 conditions setting out the requirements that the Company must satisfy. The Company also holds a further 31 resource consents for production activities at wellsites associated with the Kapuni Production Station. These include 3 consents in respect of discharges to land for three blowdown pits at wellheads within the Kapuni field. The 3 consents include a total of 37 conditions setting out the requirements that the Company must satisfy.

The Council's monitoring programmes for the period under review included: 12 inspections and 15 water samples collected for physicochemical analysis at the Maui Production Station; 13 inspections and 12 water samples collected at the Kapuni Production Station; two biomonitoring surveys of receiving waters at each of the production stations; and two ambient air quality surveys at each production station. An extended biomonitoring survey was also conducted at ten sites in relation to the Kapuni wellsites blowdown pit remediation works.

During the period, Shell Todd Oil Services Ltd and M & O Pacific Ltd demonstrated a high level of environmental performance and a high level of administrative compliance with the resource consents. As in 2011-2012, both the Maui and Kapuni Production Stations were well managed and maintained, and monitoring indicated no significant adverse environmental effects resulting from activities at the sites. There were no unauthorised incidents recorded by the Council in relation to the Maui or Kapuni Production Stations, or to the use of blowdown pits within the Kapuni field. The

Council received two notifications from the Company regarding potential discharges to the environment at Maui Production Station. In both cases, an incident report was received from STOS, and the Council investigation found that the Company was in compliance with all applicable conditions in resource consents and provisions in Regional Plans.

This report also includes an update of the ongoing investigations and remediation works in relation to the blowdown pits at the Kapuni wellsites. Monitoring during the period under review showed no evidence of off-site effects upon groundwater or surface water, including the Kapuni Stream.

For reference, in the 2012-2013 year, 35% 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 59% demonstrated a good level of environmental performance and compliance with their consents. In the 2013-2014 year, 60% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance.

This report includes recommendations for the 2014-2015 year.

Table of contents

	Page
1. Introduction	1
1.1 Compliance monitoring programme reports and the Resource Management Act 1991	1
1.1.1 Introduction	1
1.1.2 Structure of this report	1
1.1.3 The Resource Management Act 1991 and monitoring	2
1.1.4 Evaluation of environmental and administrative performance	2
1.2 Consents summary	4
1.2.1 Production stations	4
1.2.2 Wellsites	5
1.3 Monitoring programme	7
1.3.1 Introduction	7
1.3.2 Programme liaison and management	7
1.3.3 Site inspections	7
1.3.4 Chemical sampling	7
1.3.5 Biomonitoring surveys	8
2. Maui Production Station	9
2.1 Process description	9
2.2 Resource consents	10
2.2.1 Water discharge permits	10
2.2.2 Air discharge permit	11
2.2.3 Coastal permit	12
2.3 Results: water	13
2.3.1 Inspections	13
2.3.2 Results of discharge monitoring	15
2.3.3 Results of receiving environment monitoring	20
2.4 Results: air	23
2.4.1 Inspections	23
2.4.2 Results of receiving environment monitoring	23
2.5 Investigations, interventions, and incidents	26
2.6 Discussion of site performance	27
2.7 Environmental effects of exercise of consents	27
2.8 Evaluation of performance	28
2.9 Recommendation from the 2011-2012 Annual Report	31
2.10 Alterations to monitoring programmes for 2014-2015	31
2.11 Exercise of optional review of consent	31
2.12 Recommendations	32

3.	Kapuni Production Station	33
3.1	Process description	33
3.2	Resource consents	34
3.2.1	Water discharge permit	34
3.2.2	Air discharge permit	34
3.2.3	Land use consents	35
3.3	Results: water	36
3.3.1	Inspections	36
3.3.2	Results of discharge monitoring	38
3.3.3	Results of receiving environment monitoring	40
3.4	Results: air	41
3.4.1	Inspections	41
3.4.2	Results of receiving environment monitoring	41
3.5	Investigations, interventions, and incidents	44
3.6	Discussion of site performance	45
3.7	Environmental effects of exercise of consents	45
3.8	Evaluation of performance	45
3.9	Recommendation from the 2011-2012 Annual Report	47
3.10	Alterations to monitoring programmes for 2014-2015	48
3.11	Recommendation	48
4.	Kapuni wellsite blowdown pits	49
4.1	Introduction and historical context	49
4.2	Resource consents	50
4.3	Results	51
4.3.1	Additional inspections and notes	51
4.3.2	Results of biomonitoring	52
4.3.3	Results of consent holder monitoring	56
4.4	Investigations, interventions, and incidents	57
4.5	Discussion of site performance	57
4.6	Evaluation of performance	58
4.7	Recommendations from the 2011-2012 Annual Report	60
4.8	Recommendation	60
5.	Summary of recommendations	61
	Glossary of common terms and abbreviations	62
	Bibliography and references	65
	Appendix I Resource consents held by STOS for Maui Production Station, Kapuni Production Station and the Kapuni wellsites blowdown facilities	
	Appendix II Biomonitoring reports	
	Appendix III Air monitoring reports	

List of tables

Table 1	Resource consents for activities at the Maui Production Station	4
Table 2	Resource consents for activities at the Kapuni Production Station	5
Table 3	Resource consents for production activities at wellsites associated with the Kapuni Production Station	5
Table 4	Results of stormwater discharge monitoring from Maui Production Station (site IND002015)	16
Table 5	Results of oxidation pond discharge monitoring from Maui Production Station (site OXP002006)	16
Table 6	Results of combined discharge monitoring from Maui Production Station (site NPR000072)	17
Table 7	STOS Maui Production Station combined discharge results summary for 2012-2014	17
Table 8	Safety Training Centre stormwater discharge results 2012-2014	20
Table 9	Receiving environment results for the Maui Production Station 2012-2014	21
Table 10	Summary of performance for Consent 0245-3 to discharge treated stormwater from the Maui Production Station to the Ngapirau Stream	28
Table 11	Summary of performance for Consent 0246-3 to discharge treated domestic effluent from the oxidation ponds at the Maui Production Station to the Ngapirau Stream	28
Table 12	Summary of performance for Consent 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 [held by Wood Group M & O]	29
Table 13	Summary of performance for Consent 4052-4 to discharge emissions into the air from the refining and distribution of hydrocarbons and associated processes at the Maui Production Station site	29
Table 14	Summary of performance for Consent 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	30
Table 15	Results of discharge monitoring from Kapuni Production Station (site STW002014)	38
Table 16	STOS Kapuni Production Station stormwater discharge results summary for 2012-2014	39
Table 17	Receiving environment results for the Kapuni Production Station 2012-2014	40
Table 18	Summary of performance for Consent 0633-2 to discharge up to 250 litres/second of treated stormwater from an oil and gas production plant into the Kapuni Stream	45
Table 19	Summary of performance for Consent 4054-5 to discharge emissions into the air from combustion involving flaring of petroleum products incidental to the treatment of gas at the Kapuni Production Station	46
Table 20	Summary of performance for Consent 5960-1 to erect, place, use and maintain a concrete ford on the bed of the Kapuni Stream for access purposes	47
Table 21	Consents for Kapuni blowdown pits	50
Table 22	Summary of performance for Consent 7114-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-6/11 wellsite	58

Table 23	Summary of performance for Consent 7113-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-8/12/15 wellsite	58
Table 24	Summary of performance for Consent 7005-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-13 wellsite	59

List of figures

Figure 1	Maui Production Station and associated sampling sites	15
Figure 2	Biomonitoring sites in the Ngapirau Stream adjacent to the Maui Production Station	22
Figure 3	March 2013 air monitoring site and sample details for Maui Production Station	24
Figure 4	August 2013 air monitoring site and sample details for Maui Production Station	25
Figure 5	Kapuni Production Station and associated sampling sites	38
Figure 6	March 2013 air monitoring site and sample details for Kapuni Production Station	42
Figure 7	June 2014 air monitoring site and sample details for Kapuni Production Station	43

List of photos

Photo 1	Maui Production Station	9
Photo 2	Silt cloth installed in a perimeter stormwater drain at the Maui Production Station, April 2013	19
Photo 3	Emissions sources at the Maui Production Station	23
Photo 4	Kapuni Production Station	33

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Biennial Report for the period July 2012-June 2014 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by Shell Todd Oil Services Ltd [STOS] for the Maui Production Station situated on Tai Road, Oaonui, and the Kapuni Production Station situated on Palmer Road, Kapuni, together with its associated wellsites.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by STOS that relate to discharges of water within the Ngapirau, Oaonui and Kapuni catchments, structures in the coastal marine area, and emissions to air from the production station sites.

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 Taranaki Regional Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 24th combined report by the Taranaki Regional Council for the Maui and Kapuni Production Stations.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, a summary of the resource consents held by STOS, and the nature of the monitoring programmes in place for the period under review.

Section 2 contains a description of the activities and operations conducted within the Ngapirau and Oaonui catchments and sets out the resource consents held by STOS in relation to the Maui Production Station. It presents the results of monitoring during the period under review, including scientific and technical data. It also discusses the results, their interpretation, and their significance for the environment, and makes recommendations.

Section 3 contains a description of the activities and operations conducted within the Kapuni catchment and sets out the resource consents held by STOS in relation to the Kapuni Production Station. It presents the results of monitoring during the period under review, including scientific and technical data. It also discusses the results, their interpretation, and their significance for the environment, and makes recommendations.

Section 4 contains information on the consenting, use, and monitoring of blowdown pits at various wellsites in the Kapuni field. The monitoring of production activities at

wellsites generally consists of one annual inspection. However, additional work is being carried out in respect of these sites and is reported herein.

Section 5 presents a summary of proposed recommendations, to be implemented in the 2014-2015 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

The Resource Management Act 1991 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 (eg, recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

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

Events that were beyond the control of the consent holder and unforeseeable (i.e. 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 compliance

- **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 2012-2013 year, 35% 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 59% demonstrated a good level of environmental performance and compliance with their consents. In the 2013-2014 year, 60% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance.

1.2 Consents summary

1.2.1 Production stations

A summary of the consents for activities at the Maui and Kapuni Production Stations is given in Tables 1 and 2. These consents are discussed in more detail in Sections 2.2 and 3.2. Copies of the consents are attached in Appendix I.

Table 1 Resource consents for activities at the Maui Production Station

Consent number	Purpose of consent	Issue Date	Next review	Expiry
0245-3	Discharge treated stormwater	11/10/2000	-	2018
0246-3	Discharge treated domestic effluent	11/10/2000	-	2018
4052-4	Discharge emissions to air	09/01/2003	2018	2024
5224-2	Pipelines	10/03/1998	2015	2025
1228-4*	Discharge treated stormwater and wastewater	11/10/2000	-	2018

*This consent for the Fire Training Centre at MPS is held by Wood Group M & O

Table 2 Resource consents for activities at the Kapuni Production Station

Consent number	Purpose of consent	Issue Date	Next review	Expiry
0633-3	Discharge treated stormwater	01/08/2011	2017	2029
4054-5	Discharge emissions to air	09/11/2001	-	2017
5960-1	Ford	13/02/2002	2017	2023

1.2.2 Wellsites

STOS also hold consents for production activities at wellsites associated with the Kapuni Production Station and these are summarised in Table 3.

Table 3 Resource consents for production activities at wellsites associated with the Kapuni Production Station

Wellsite	Consent	Purpose	Issue Date	Expiry
KA-1/7/19/20	6200-1	To discharge treated stormwater and treated site water from hydrocarbon exploration and production operations onto and into land at the KA-1/7 wellsite	16/09/2003	2017
	6646-1	To take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-1/7 wellsite	18/07/2005	2023
	6822-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-1/7 wellsite	21/03/2006	2023
KA-2	0611-3	To take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-2 wellsite	18/07/2005	2023
	3267-3	To discharge stormwater from the KA-2 wellsite into the Kapuni Stream	02/08/2011	2029
	6823-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-2 wellsite	21/03/2006	2023
KA-3	0610-3	To take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-3 wellsite	18/07/2005	2023
	3268-3	To discharge stormwater from the KA-3 wellsite into an unnamed tributary of the Inaha Stream	02/08/2011	2029
	6824-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-3 wellsite	21/03/2006	2023
KA-4/14	2365-3	To discharge stormwater from the KA-4/14 wellsite into an unnamed tributary of the Waiokura Stream	02/08/2011	2029
	6645-1	To take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-4/14 wellsite	18/07/2005	2023
	6825-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-4/14 wellsite	21/03/2006	2023
KA-5/10	6199-1	To discharge treated stormwater and treated site water from hydrocarbon exploration and production operations onto and into land at the KA-5/10 wellsite	16/09/2003	2017

Wellsite	Consent	Purpose	Issue Date	Expiry
	6826-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-5/10 wellsite	21/03/2006	2023
KA-6/11/17	3266-3	To discharge stormwater from the KA-6/11/17 wellsite into an unnamed tributary of the Inaha Stream	02/08/2011	2029
	6827-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-6/11 wellsite	21/03/2006	2023
	7114-1	To discharge liquids onto and into land from a purpose built, blow down pit at the KA-6/11 wellsite	19/06/2007	2023
KA-8/12/15/18	3265-3	To discharge stormwater from the KA-8/12/15/18 wellsite into an unnamed tributary of the Inaha Stream	02/08/2011	2029
	6828-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-8/12/15 wellsite	21/03/2006	2023
	7113-1	To discharge liquids onto and into land from a purpose built, blow down pit at the KA-8/12/15 wellsite	19/06/2007	2023
KA-9	5871-1	To discharge stormwater from hydrocarbon exploration and production operations at the KA-9 wellsite onto land and into an unnamed tributary of the Inaha Stream	23/08/2001	2017
	5873-1	To discharge emissions into the air from long-term hydrocarbon processing facilities and miscellaneous emissions at the KA-9 wellsite	23/08/2001	2017
	5874-1	To erect, place, use and maintain a pipebridge over the Kapuni Stream	23/08/2001	2017
KA-13	1105-3	To discharge stormwater from the KA-13 wellsite into the Kapuni Stream	02/08/2011	2029
	6829-1	To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-13 wellsite	21/03/2006	2023
	7005-1	To discharge liquids onto and into land from a purpose built, blow down pit at the KA-13 wellsite	24/11/2006	2023
Ngarewa	5881-1	To discharge stormwater from hydrocarbon exploration and production operations at the Ngarewa wellsite onto and into land in the vicinity of the Inaha Stream	04/09/2001	2017
	5883-1	To discharge emissions into the air from long-term hydrocarbon processing facilities and miscellaneous emissions at the Ngarewa wellsite	04/09/2001	2017
Patea-A	6079-1	To discharge emissions to air from flaring associated with production activities and miscellaneous emissions at the Patea-A wellsite	09/12/2002	2016
	6080-1	To discharge treated stormwater, treated site water and treated production water from hydrocarbon exploration and production operations at the Patea-A Wellsite onto and into land	05/11/2002	2016
Various	6647-1	To take and use water from the Kapuni Stream for fire fighting, well killing and well workover purposes for emergency backup supply at various wellsites	27/09/2005	2023

1.3 Monitoring programme

1.3.1 Introduction

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

The Taranaki Regional 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 programmes for the two production stations consisted of four primary components.

1.3.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional 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.

1.3.3 Site inspections

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

1.3.4 Chemical sampling

The Taranaki Regional Council undertook sampling of both the discharges from the sites and the water quality upstream and downstream of the discharge points and mixing zones.

The Maui Production Station discharges were sampled on four occasions, and the samples analysed for alkalinity, conductivity, enterococci bacteria, faecal coliforms, hydrocarbons, ammoniacal nitrogen, pH and suspended solids. The Ngapirau Stream

was sampled concurrently, and the samples analysed for the same constituents as the discharges. The Kapuni Production Station discharge was sampled on four occasions, and the samples analysed for conductivity, hydrocarbons, pH and suspended solids. The Kapuni Stream was sampled concurrently, and the samples analysed for the same constituents.

Ambient carbon monoxide and gas monitoring was undertaken on two occasions at each site in the period under review, and the Company supplied data on flaring causes and gas volumes throughout the year.

1.3.5 Biomonitoring surveys

Biomonitoring surveys were performed on two occasions in each of the Ngapirau and Kapuni Streams to determine whether the discharges from the sites have had a detrimental effect upon communities of the streams. The Council performed an extended biomonitoring survey in the Kapuni, Inaha and a tributary of the Waiokura Streams in May 2012 to establish baseline stream ecological conditions prior to site works at the Kapuni wellsites. Follow-up surveys were undertaken in July and November 2013.

2. Maui Production Station

2.1 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 (Photo 1) 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.

2.2 Resource consents

2.2.1 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 Taranaki Regional 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. Results in this report are measured against the revised conditions. The consent is due to expire on 1 June 2018.

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 Taranaki Regional Council on 11 October 2000 under Section 87(e) of the RMA. It is due to expire on 1 June 2018.

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 Taranaki Regional 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.

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.

2.2.2 Air discharge permit

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

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 Taranaki Regional 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 1991. 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.

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, and 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, and 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, and 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.

2.2.3 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 Taranaki Regional Council on 10 March 1998 under Section 87(c) of the RMA. It is due to expire on 1 June 2025.

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

Condition 2 stipulates that during maintenance works the Company 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.

2.3 Results: water

2.3.1 Inspections

Twelve inspections were carried out at the Maui Production Station in the 2012-14 period. The following was found during the inspections:

13 August 2012

Routine monitoring of the site did not give rise to any concerns. The stormwater and separator systems were well maintained and operating as designed. Bunds were secure and all containment areas were clear. Inspection of the location of the recent discovery of a hydrocarbon and glycol spill showed that proper procedures were employed to prevent any discharge of contaminants or off site effects. Containment and clean up were handled in accordance with best practice. Minimal flaring was being undertaken at the time of inspection and this was in compliance with consent conditions.

17 December 2012

A site inspection was undertaken with Bruce Colgan (STOS) after self-monitoring by the Company found elevated levels of glycol in the stormwater system. A survey of the system was being undertaken to locate potential sources of the glycol. Methods for controlling algal growth in the open ponds were also being investigated. Algal growth was present in the stormwater separators resulting in a slight clouding of the discharge. These were to be cleaned out shortly. Ring drains and bunds were secure and clean. A pilot flame was being maintained from the flare with no visible effects. General site management was excellent.

31 January 2013

A flaring notification was received regarding flaring to take place on this day. Ambient monitoring of this activity showed that the short, slightly smoky flaring events were not giving rise to any off site effects. The smoke was dispersing well before reaching the site boundary fence. Everything was satisfactory.

30 April 2013

The site was inspected following recent heavy rain. The ring drains and bunds were clear. Minimal flaring was occurring at time of inspection. No effects from the sewage discharge were noted. The site was neat and tidy. Everything was satisfactory.

23 May 2013

Inspection of the site was undertaken following significant rainfall over the previous few days. Water in the site ring drains was clean and the discharge to the Ngapirau Stream was very clear. There were no effects from the discharge of the oxidation pond system to the tributary. Minimal flaring was occurring and no odours or smoke were noted. The site was neat and tidy. Everything was satisfactory.

24 June 2013

The site was inspected following recent heavy rain. All ring drains and bunds were clear of contaminants. Minimal flaring was occurring at the time of inspection. The Ngapirau Stream at the foreshore showed no effects of any discharge.

26 August 2013

The site was inspected during showery/squally weather generally from the south to south west direction. All ring drains and bunds were clear of contaminants. The API separators were well maintained and operating correctly. Water in the Ngapirau Stream was clear and no downstream effects were evident. Only a pilot flare was burning which did not give rise to any off site odours. Everything was satisfactory.

18 November 2013

Site inspection did not give rise to any environmental concerns. Only a pilot flare was evident with no odours or smoke. There was smoke noted from the fire training area, but it was of short duration. Significant riparian planting was being undertaken and silt control measures were placed in effective positions. No contaminants were apparent in the stormwater system. Resident invertebrates were indicative of a healthy environment. Everything was satisfactory.

8 January 2014

The site was inspected after persistent rain. It was not raining at the time of inspection. A pilot flare was evident but there were no effects as a result. The site was neat and tidy. The main stormwater separation chamber was clear of any contaminants. All ring drains and bunds were clear. Everything was satisfactory.

14 April 2014

The site was inspected following a recent shutdown involving intensive maintenance programmes associated with the plant. The site was generally neat and tidy. Some materials were being removed off site by a contractor at the time of inspection. The stormwater system was clear of any contaminants. The API separator area was clean, tidy and well maintained. Some flaring was underway during inspection but no off site effects were noted. The discharge point of the Ngapirau Stream to the Tasman Sea did not show any effects from the production station stormwater discharges. Everything was satisfactory.

20 May 2014

The site was inspected after the previous week's heavy rainfall. Clean up after the plant shutdown had been completed. The stormwater system was all clear with no debris or contaminants in the ring drains. The discharge to the Ngapirau Stream was very clear with no discolouration apparent from the sewage ponds. Minimal flaring was being undertaken with no smoke or odours noticed downwind.

26 June 2014

Inspection was undertaken with Bruce Colgan (STOS) following recent very heavy rainfall. All ring drains were clear of contaminants. The final separator and the water at the discharge point to the Ngapirau Stream were very clean. No effects were noted from the recent rainfall. Some flaring was being undertaken at the time of inspection. No effects or smoke/odours were noted downwind. Bunds were checked and found to be clear. The fire water pond was clean and the sewage ponds and discharge were also found to be causing no effects. The site was tidy. Everything was satisfactory.

2.3.2 Results of discharge monitoring

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.

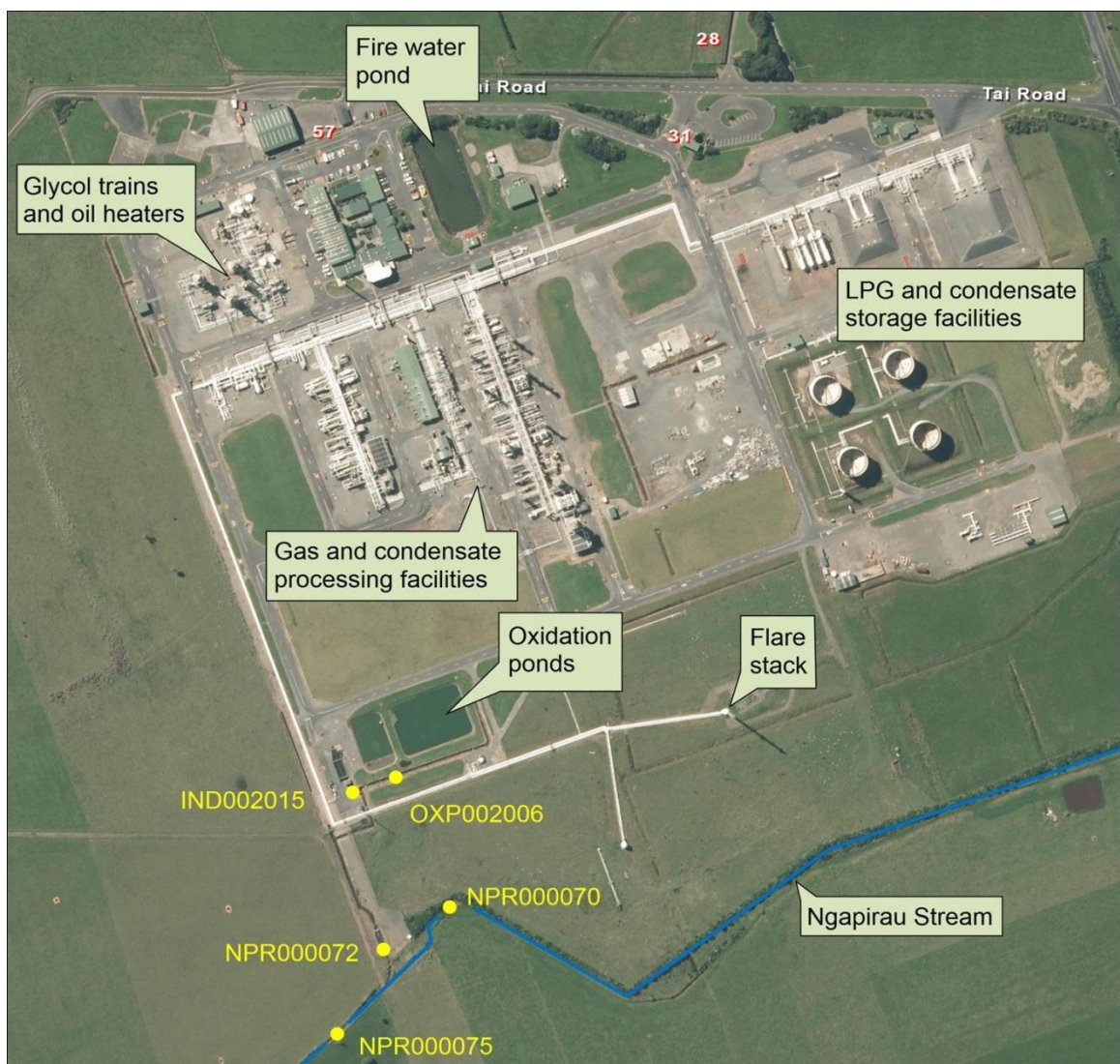


Figure 1 Maui Production Station and associated sampling sites

Chemical water quality sampling of the treated stormwater discharge from the production station was undertaken on three occasions during the 2012-2014 period. The location of the sampling site (IND002015) is shown in Figure 1. Table 4 presents the

results of this sampling. Because access to the Ngapirau Stream sites was blocked by farming activities during the fourth sample run on 24 June 2014, the bottles carried on site for sampling the stormwater flow were instead used to sample the combined discharge at the boundary fence (immediately upstream of site NPR000072).

Table 4 Results of stormwater discharge monitoring from Maui Production Station (site IND002015)

Parameter	Units	2 Apr 2013	11 Jun 2013	10 Jun 2014	Consent limits
Temperature	Deg.C	18.8	13.3	-	-
Conductivity	mS/m	27.2	22.3	16.5	-
Hydrocarbons	g/m ³	< 0.5	0.6	< 0.5	15
Suspended solids	g/m ³	4	4	10	100
pH		7.8	7.0	6.8	-

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

Domestic wastewater

STOS have treated their domestic sewage on site since 1979 using an aerobic oxidation two pond 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 three times during the monitoring period. There was no flow from the ponds during the sample run on 2 April 2013. The results are presented in Table 5 and the sampling site (EXP002006) is shown in Figure 1.

Table 5 Results of oxidation pond discharge monitoring from Maui Production Station (site EXP002006)

Parameter	Units	11 Jun 2013	10 Jun 2014	24 June 2014
Alkalinity	g/m ³ CaCO ₃	44	22	47
Conductivity	mS/m	23.3	10.2	22.5
Enterococci bacteria	/100 ml	240	710	62
Faecal coliforms	/100 ml	120	540	23
Ammoniacal nitrogen	g/m ³ N	0.081	0.012	0.241
Suspended solids	g/m ³	4	2	< 2
pH		7.2	6.8	7.2

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. Enterococci and faecal coliform counts were below the site's historical median values of 250/100 ml and 560/100 ml, respectively, with the exception of the relatively elevated

enterococci count in the 10 June 2014 sample. However, the enterococci count in the receiving waters upstream of the production station discharge on this day was significantly higher at 1,300/100 ml (see Table 9).

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 on four occasions during the period under review. The sample on 24 June 2014 was taken from the combined discharge flow inside the site boundary, below the final separator and immediately upstream of NPR000072, because access to the stream sites was blocked by farming activities. The results of this sampling are presented in Table 6.

Table 6 Results of combined discharge monitoring from Maui Production Station (site NPR000072)

Parameter	Units	2 April 2013	11 Jun 2013	10 Jun 2014	24 June 2014
Temperature	Deg.C	20.8	13.4	13.4	-
Alkalinity	g/m ³ CaCO ₃	64	39	24	46
Conductivity	mS/m	21.3	29.0	12.0	26.5
Enterococci bacteria	/100 ml	-	82	1,200	-
Faecal coliforms	/100 ml	160	40	560	-
Hydrocarbons	g/m ³	< 0.5	< 0.5	< 0.5	< 0.5
Ammoniacal nitrogen	g/m ³ N	0.013	0.052	0.035	0.191
Suspended solids	g/m ³	10	< 2	4	< 2
pH		7.9	7.1	6.9	7.1

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 9.

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 7.

Table 7 STOS Maui Production Station combined discharge results summary for 2012-2014

Month	Hydrocarbons (g/m ³)		Suspended solids (g/m ³)		Glycol (g/m ³)	
<i>Consent 0245-3 limits</i>	15		100		-	
	Max	Average	Max	Average	Max	Average
July 2012	1.7	< 0.5	34	8	0	0
August 2012	1.4	0.6	26	11	8	0.5

Month	Hydrocarbons (g/m ³)		Suspended solids (g/m ³)		Glycol (g/m ³)	
<i>Consent 0245-3 limits</i>	15		100		-	
	Max	Average	Max	Average	Max	Average
September 2012	2.6	< 0.5	26	10	0	0
October 2012	1.0	< 0.5	13	6	2	0
November 2012	1.0	< 0.5	42	10	0	0
December 2012	1.7	< 0.5	57	33	2	0
January 2013	1.0	< 0.5	83	23	0	0
February 2013	1.0	< 0.5	59	24	0	0
March 2013	2.1	< 0.5	117	27	0	0
April 2013	1.1	< 0.5	81	20	0	0
May 2013	1.0	< 0.5	49	15	0	0
June 2013	1.8	0.5	38	16	0	0
July 2013	1.1	< 0.5	37	15	0	0
August 2013	4.2	< 0.5	74	13	0	0
September 2013	0.7	< 0.5	46	18	0	0
October 2013	< 0.5	< 0.5	48	15	0	0
November 2013	0.9	< 0.5	62	17	0	0
December 2013	1.8	< 0.5	46	15	0	0
January 2014	0.6	< 0.5	45	18	0	0
February 2014	0.7	< 0.5	35	17	0	0
March 2014	0.7	< 0.5	26	18	10	1
April 2014	0.6	< 0.5	59	23	0	0
May 2014	2.0	< 0.5	39	13	0	0
June 2014	0.5	< 0.5	60	14	0	0
Days limit exceeded	0		2		No limit. Total of 10 detections.	

Hydrocarbon results were well below the limit stipulated by consent 0245-3 throughout the monitoring period. Suspended solids content was low on average, with two minor exceedances of the consent limit in March 2013. STOS immediately notified the Council of these exceedances, which related to a period of heavy rainfall following an extended dry spell. Similar high sediment loadings in stormwater were noted at numerous sites around the province at the time due to this combination of weather. As a result of this event, actions were taken by the Company to prevent reoccurrence: including the clearing of all drains, installation of silt traps, and initiation of a project to investigate long term solutions for improving the performance of the Maui Production Station stormwater system.



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

There were ten instances of trace levels of glycol being detected in the Company's daily combined stormwater discharge samples during the two year period under review. These related to four separate events. In each case, the Company notified the Council and took immediate action to prevent off-site discharge by pumping stormwater from the API separator to the oxidation ponds if necessary; using a suction truck to remove any potentially contaminated liquids from drains and sumps; cleaning and flushing the stormwater system to remove residual glycol; and retesting water in the system to confirm that it was clear of contamination. Where the source of the glycol was not obvious, an investigation was undertaken by the Company to locate and remedy the issue. No adverse environmental effects were recorded as a result of these discharges.

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 the Company'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 2012-2014 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 8.

Table 8 Safety Training Centre stormwater discharge results 2012-2014

Date	Hydrocarbons (g/m ³)	Suspended solids (g/m ³)
<i>Consent 1228-4 limits</i>	15	50
9 August 2012	0.5	25
12 September 2012	1.5	32
26 September 2012	< 0.5	31
5 November 2012	< 0.5	31
7 March 2013	0.8	24
9 May 2013	5.9	7
30 May 2013	0.5	24
20 June 2013	< 0.5	49
23 September 2013	1.8	41
25 November 2013	< 0.5	35
6 January 2014	< 0.5	28
22 April 2014	< 0.5	32
12 May 2014	< 0.5	40
Median (and maximum) values	< 0.5 (5.9)	31 (49)

The STOS monitoring results demonstrate compliance with consent conditions and indicate that discharges from the Fire Training Centre were unlikely to cause any adverse effects in the Oaonui Stream.

2.3.3 Results of receiving environment monitoring

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 Ngapirau Stream above the confluence with the tributary carrying the Maui Production Station discharge was completely dry on 2 April 2013, and the stream sites could not be accessed on 24 June 2014 due to farming activities. The results are shown in Table 9, and the sampling sites are shown in Figure 1.

Table 9 Receiving environment results for the Maui Production Station 2012-2014

Parameter	Units	2 April 2013		11 June 2013		10 June 2014	
		Upstream	Down-stream	Upstream	Down-stream	Upstream	Down-stream
Temperature	Deg.C	(No flow)	20.3	14.1	13.7	14.0	13.8
Alkalinity	g/m ³	-	62	27	33	34	27
Conductivity	mS/m	-	21.0	37.1	32.9	31.4	18.0
Enterococci	/100mL	-	-	37	66	1300	1300
Faecal coliforms	/100mL	-	58	200	100	610	590
Hydrocarbons	g/m ³	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Ammoniacal N	g/m ³ N	-	0.012	0.011	0.032	0.097	0.048
Turbidity	NTU	-	25	7.8	5.8	30	10
pH			7.8	7.0	7.1	6.9	7.0

The results indicate that the Maui Production Station discharge was not causing adverse effects in the Ngapirau Stream at the times of sampling. In a number of instances, the results for parameters at the downstream site were an improvement on those at the upstream site. This suggests a positive impact on water quality in the Ngapirau Stream resulting from inflows between the upstream and downstream sites, including the main contribution coming from the production station discharge.

Biomonitoring

The Council's standard 'kick-sampling' technique was used at two established sites (NPR000100 and NPR000190) to collect streambed macroinvertebrates from the Ngapirau Stream on two occasions during the period under review. These sites are shown in Figure 2. Sites 2 and 3 are approximately 500 and 1,600 metres downstream of the production station discharge, respectively. Site 1 was removed from the biomonitoring 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. 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.

22 November 2012

This spring 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 moderate flow conditions in spring.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa at both sites where the communities were dominated mainly by 'tolerant' taxa. Only one 'moderately sensitive' taxon was abundant at each site. At both sites, taxonomic richness (number of taxa) and MCI scores had not changed significantly at the time of this spring survey compared to previous surveys. There was some improvement in SQMCI_s scores at both sites, with site 3 recording a new maximum score. This is considered to be reflection of slightly improved habitat at this site, primarily through improved shading and reduced algal growth, although overall, the scores at both sites were reflective of the poor habitats over the spring period.

MCI and SQMCI_s scores indicated that the stream communities were of above average but poor 'health', although probably typical of communities in drain-like habitats in spring.

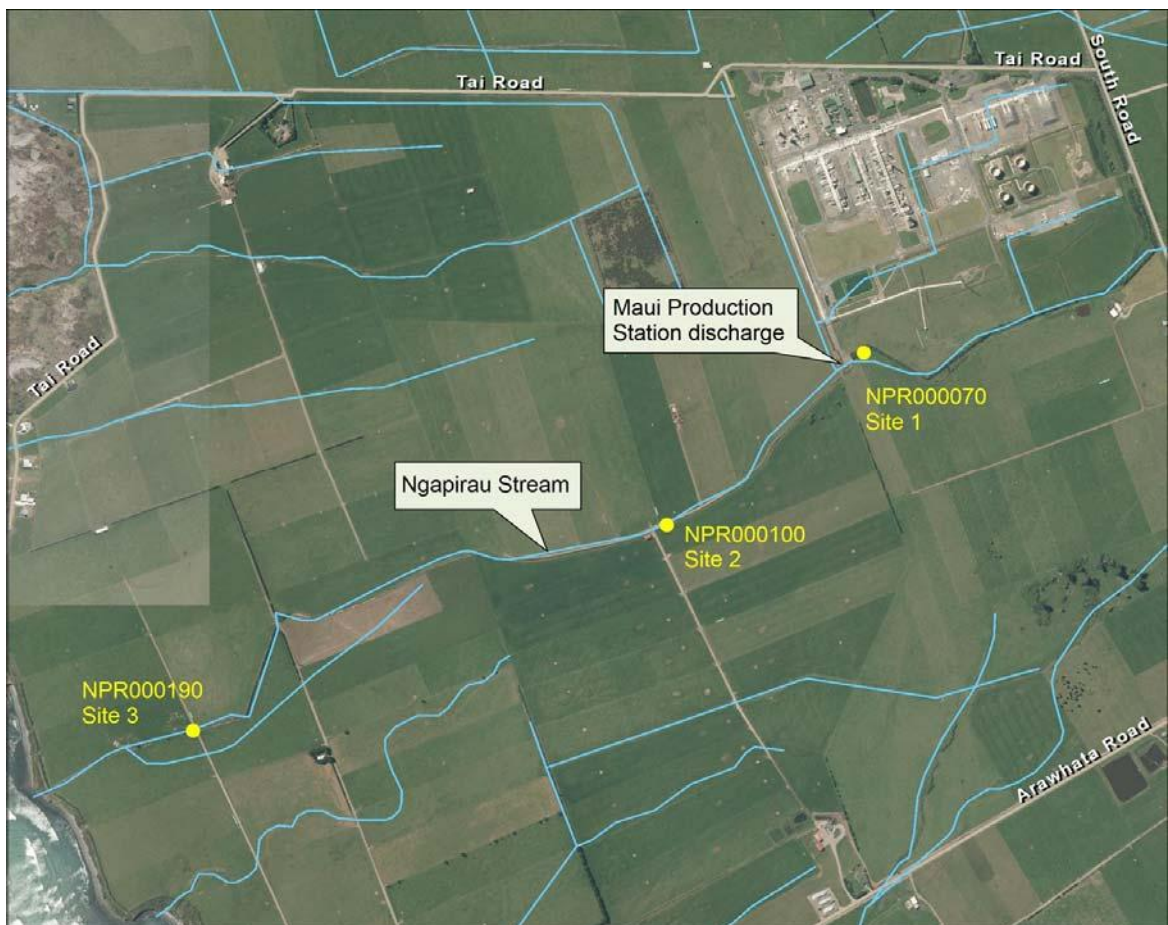


Figure 2 Biomonitoring sites in the Ngapirau Stream adjacent to the Maui Production Station

16 December 2013

This 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 moderate flow conditions in summer.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa. No 'sensitive' taxa were found in abundance at site 2 and only three 'sensitive' taxa were found in abundance at site 3. At both sites, taxonomic richness (number of taxa) and MCI scores had not changed significantly at the time of this summer survey compared to previous surveys. The SQMCI_s scores at site 2 had increased significantly from the previous surveys, whereas the SQMCI_s score at site 3 was relatively similar to the previous survey, but significantly higher than the historical median.

MCI and SQMCI_s scores indicated that the stream communities were of above average but poor 'health' although probably typical of communities in drain-like habitats in early summer.

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

2.4 Results: air

2.4.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in section 2.3.1 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

2.4.2 Results of receiving environment monitoring

During the period under review, STOS kept the Council informed of all non-routine flaring events. The Council received 64 notifications for flaring events in the 2012-13 year, and 53 notifications for 2013-14. The majority of flaring events were caused by factors such as planned maintenance and equipment replacement programmes, planned plant shutdowns, flaring of purge gas, loss of power supply to the site, or compressor trip-outs.

Council monitoring

During the period under review, a multi-gas meter was deployed on two occasions in the vicinity of the plant, on 4 March 2013 and 29 August 2013. The instrument was placed in a downwind position at the start of each deployment. Monitoring consisted of continual 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.

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/m³ for an eight hour average or 30 mg/m³ for a 1 hour average exposure.

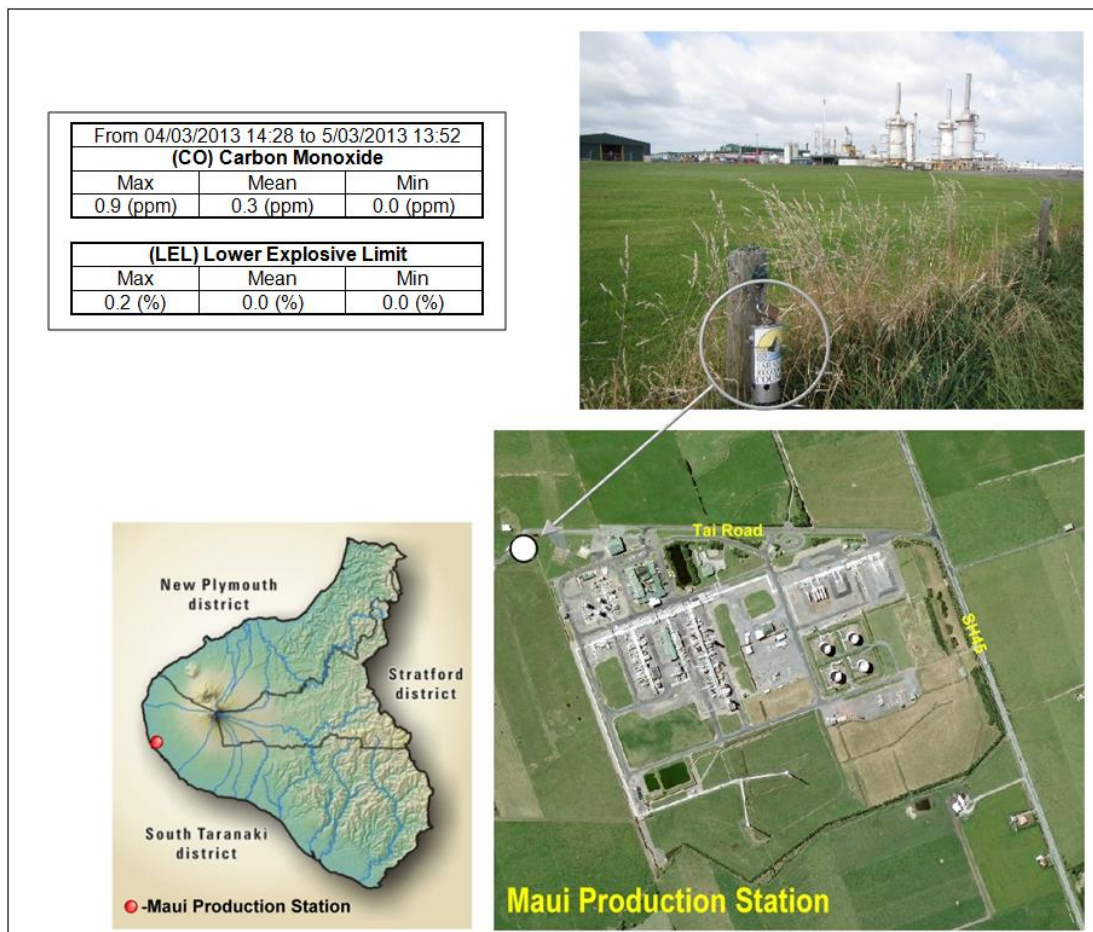


Figure 3 March 2013 air monitoring site and sample details for Maui Production Station

LEL% gives the percentage of the lower explosive limit, expressed as methane, which 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 a dangerous level of airborne contaminants, including any risk of explosion.

4 March 2013

The deployment lasted approximately 24 hours. The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 3 above. The maximum concentration of carbon monoxide found during the monitoring run was only 0.9 ppm or 0.8 mg/m³ which complies with the consent condition. At no time did the level of explosive gases downwind of the Maui Production Station reach any more than a trivial level.

29 August 2013

The deployment lasted approximately 47 hours. The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 4. The maximum concentration of carbon monoxide found during the monitoring run was only 1.8 ppm or 1.5 mg/m³ which complies with the consent condition. This continues the pattern found in previous years. At no time did the level of explosive gases downwind of the Maui Production Station reach any more than a trivial level.

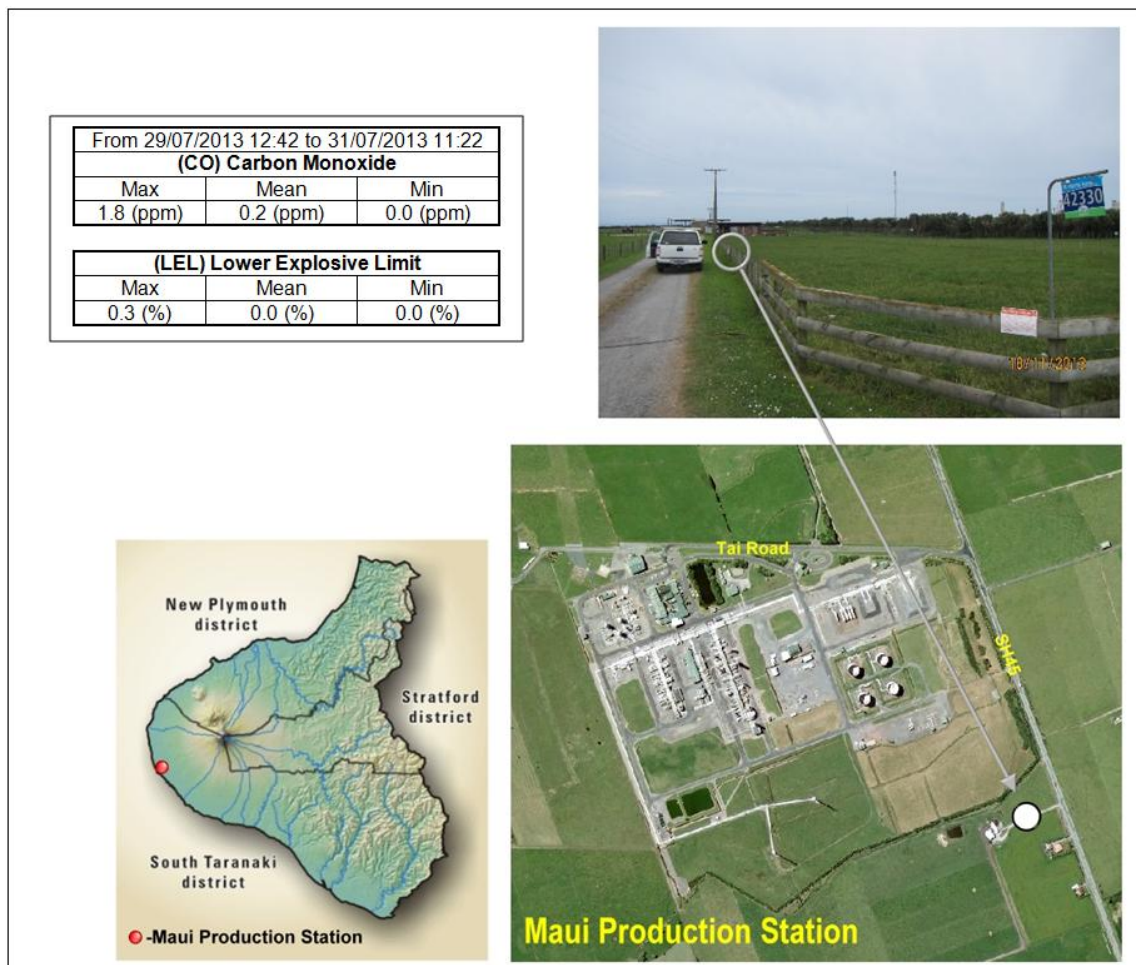


Figure 4 August 2013 air monitoring site and sample details for Maui Production Station

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

Company monitoring and report

STOS provided the Council with two annual reports on flaring and emissions during the 2012-2014 period, as required by consent 4052-4.

2012-2013 report summary

Of the 64 flaring events in the period, 49 generated light smoke. The median duration of these events was 107 minutes. No complaints were received from the public regarding flaring at the production station.

As previously noted, optimisation and simplification measures at Maui Production Station, including the permanent reduction to a single flare in 2010, have significantly reduced purge gas use and hence flaring volumes. The total volume flared in the 2012-2013 year was 1.45 million cubic metres of gas, which is consistent with the 1.46 million cubic metres of gas flared in the previous year.

During the 2012-2013 period, the amount of flaring was relatively consistent from month to month, reflecting the absence of any major shutdowns or changes in operating conditions. A flow transmitter error for the Low Temperature Separator stream meant that approximately 30% of the monthly flared gas volumes for April, May and June 2013 were estimated from previous throughput volumes. This issue has since been resolved.

2013-2014 report summary

Of the 53 flaring events in the period, 49 generated light smoke. The median duration of these events was 119 minutes. No complaints were received from the public regarding flaring at the production station.

The total volume flared in the 2013-2014 year was 1.55 million cubic metres of gas, which is a slight increase on the 1.45 million cubic metres of gas flared in the previous year.

During the 2013-2014 period, there was a planned shutdown in February which required plant depressurisation. A total volume of 29,170 cubic metres of gas was flared during the depressurisation which, coupled with significantly reduced flaring volumes while the plant was not operating through February, caused a variation in normal monthly flaring volumes.

2.5 Investigations, interventions, and incidents

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

The Taranaki Regional 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

Unauthorised Incident Register (UIR) 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 2012-2014 period, the Council received two notifications from the Company regarding potential discharges to the environment at Maui Production Station.

On 6 July 2012, self-notification was received concerning soil contaminated with hydrocarbons which was unearthed during excavations to undertake repairs at the production station. This contamination was possibly related to the early construction phase of the site because a current source for the hydrocarbons could not be located.

On 27 July 2012, self-notification was received about a possible glycol spill at the production station. Inspection found that a bunded tank used for the storage of glycol had been emptied. The tank had then been flushed with water. Some of the rinse water had drained to a series of sumps with the potential to discharge to a nearby waterbody. The sumps were being emptied by Transpacific Ltd at the time of inspection. The stormwater was tested and no glycol was detected.

In both cases, an incident report was received from STOS, and the Council investigation found that the Company was in compliance with all applicable conditions in resource consents and provisions in Regional Plans.

2.6 Discussion of site performance

Inspections of the Maui Production Station during the 2012-2014 monitoring period found that the site was well managed and maintained. There were two self-reported incidents in relation to the site, which involved a discovery of contaminated soil and a potential discharge of glycol tank washings to the stormwater system. Investigation of these incidents found no adverse environmental effects and confirmed that the Company was in compliance with all applicable conditions in resource consents.

2.7 Environmental effects of exercise of consents

Receiving water inspections, in conjunction with sampling conducted by both the Council and STOS during the 2012-2014 period, showed that the discharges were not causing any adverse effects on the Ngapirau Stream. This was supported by the findings of the macroinvertebrate surveys carried out in the stream.

Ambient air quality monitoring at the site showed that levels of carbon monoxide and combustible gases 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 from neighbours in relation to flaring and emissions from the site.

2.8 Evaluation of performance

A tabular summary of the Company's compliance record for the period under review is set out in Tables 10 to 14.

Table 10 Summary of performance for Consent 0245-3 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	No. Two minor exceedances in self-monitoring results
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	Changed consent issued 4 Sept 2013	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		Good
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 11 Summary of performance for Consent 0246-3 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		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 12 Summary of performance for Consent 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 [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	Yes
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		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 13 Summary of performance for Consent 4052-4 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	Not measured, sampling in previous years	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
9. Limit on maximum ground level concentration of carbon monoxide	Air quality monitoring	Yes
10. Limit on maximum ground level concentration for other contaminants	Air quality monitoring	Yes
11. Consultation with Council prior to significant alterations to plant, processes, or operations	Site inspections and liaison with consent holder	Yes
12. Notification of flaring more than five minutes in duration	Flaring notifications received	Yes
13. Notification to Council of incidents or hazardous situations	No incidents or hazardous situations to notify this period	Yes
14. Record of smoke emitting events	Site inspections, records kept by consent holder, and liaison with consent holder	Yes
15. Maintenance of log of continuous flaring incidents	Site inspections, records kept by consent holder, and liaison with consent holder	Yes
16. 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
17. Optional review provision	Next option for review in June 2018	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 14 Summary of performance for Consent 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

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	Next option for review in June 2015	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

During the period under review, the Company demonstrated an overall high level of environmental performance and a high level of administrative compliance with the

resource consents as defined in Section 1.1.4. The Maui facilities were well managed and maintained.

2.9 Recommendation from the 2011-2012 Annual Report

In the 2011-2012 Annual Report, it was recommended:

1. THAT the monitoring programme for the Maui Production Station in the 2012-2013 year remains unchanged from that scheduled for 2011-2012, together with the carryover of sampling not completed during 2011-2012.

This recommendation was implemented, with the exception that additional sampling was not undertaken as the Company did not consider it necessary to redress the shortfall in monitoring from previous years with additional work in the period under review.

2.10 Alterations to monitoring programmes for 2014-2015

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA the obligations of the Act in terms of monitoring emissions/discharges and effects, and subsequently reporting to the regional community. The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that for 2014-2015 the monitoring programme is amended to reflect the Council's changes to the structure of all monitoring programmes, primarily to provide for increased recognition of health and safety requirements. A recommendation to this effect is attached to this report.

2.11 Exercise of optional review of consent

Resource consent 5224-2 provides for an optional review of the consent in June 2015. Condition 4 allows the Council to review the consent for the purpose of ensuring that the conditions adequately deal with the environmental effects arising from the exercise of this consent which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

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

A recommendation to this effect is attached to this report.

2.12 Recommendations

1. THAT monitoring of consented activities at the Maui Production Station in the 2014-2015 year be amended from that undertaken in 2013-2014 to reflect the Council's changes to the structure of all monitoring programmes.
2. THAT the option for a review of resource consent 5224-2 in June 2015, as set out in condition 4 of the consent, not be exercised, on the grounds that the current conditions are considered adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent.

3. Kapuni Production Station

3.1 Process description



Photo 4 Kapuni Production Station

The Kapuni Production Station is located approximately in the middle of the Kapuni gas field, and adjacent to the Vector Gas Ltd facility called the Kapuni Gas Treatment Plant [KGTP]. Exploration of the Kapuni Field began in 1959, and production began at Kapuni in 1969.

The function of the Kapuni Production Station (Photo 4) is to gather the gas and condensate from the wellsites. The gas is delivered to KGPT for processing. The condensate gathered at the production station is treated and stabilised for storage and export to the Paritutu Tank Farm. LPG is delivered to the production station from KGTP for storage and export via road and rail tankers.

Three flares operate continuous pilots, which burn as yellow flames and are visible at night. The Kapuni Stream separates two of the flares from the remainder of the Kapuni Production Station site. The flares are linked to the main site by high and low pressure piping systems carried on a single span girder bridge with vehicular access via a ford through the Kapuni Stream. The flares are surrounded by farmland and the nearest dwelling is more than 300 metres from the flare stacks. The other flare is located in the north eastern corner of the site.

3.2 Resource consents

3.2.1 Water discharge permit

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

STOS holds water discharge permit **0633-3** to discharge treated stormwater from the Kapuni Production Station into the Kapuni Stream. The latest renewal was issued by the Taranaki Regional Council on 1 August 2011 under Section 87(e) of the RMA. It is due to expire on 1 June 2029.

Condition 1 requires the consent holder to apply the best practicable option for preventing or minimising environmental effects when exercising the consent.

Conditions 2 and 3 prescribe the size of stormwater catchment and the controls that must be applied to stormwater.

Conditions 4 and 5 impose limits on contaminants in the discharge, and stipulate that the discharge shall not cause any significant adverse effect on the freshwater biological communities or the water quality of the Kapuni Stream.

Condition 6 requires a contingency plan to be maintained which outlines measures and procedures to prevent spillage or accidental discharge and measures to remedy or mitigate the effects of an accidental spillage or discharge.

Condition 7 makes it clear that any significant plant changes must be evaluated for potential implications for the consent, and condition 8 is the review provision.

The permit is attached to this report in Appendix I.

3.2.2 Air discharge permit

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

STOS holds air discharge permit **4054-5** to discharge emissions into the air from combustion involving flaring of petroleum products incidental to the treatment of gas at the Kapuni Production Station. The latest renewal was issued by the Taranaki Regional Council on 9 November 2001 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 Resource Management Act 1991. A change to special condition 4 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 2017.

Conditions 1, 2, 3, and 5 relate to use and maintenance of equipment to minimise emissions and impacts.

Condition 4 requires an annual report from the Company including information on flaring, emissions, plant efficiency, and mitigation measures.

Condition 6 stipulates that the discharge shall not give rise to offensive or obnoxious or objectionable odour at or beyond the site boundary.

Condition 7 requires consultation with the Council prior to significant changes on the site.

Conditions 8 and 10 relates to notifying the Council of flaring which lasts more than five minutes, and requires all practicable steps to be taken to minimise flaring.

Conditions 9 and 12 relate to record keeping.

Condition 11 stipulates that depressurisation of the plant must be carried out over a sufficient period of time to prevent dense black smoke from being discharged from the flares, except in emergencies.

Condition 13 provides for review of the consent.

The permit is attached to this report in Appendix I.

3.2.3 Land use consent

Section 13(1) of the Resource Management Act 1991 stipulates that in relation to the bed of any lake or river, no person may use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed unless the activity is expressly allowed for by a rule in a regional plan, or a resource consent.

STOS holds consent **5960-1** to erect, place, use and maintain a concrete ford on the bed of the Kapuni Stream for access purposes. The consent was issued on 13 February 2002 and is due to expire on 1 June 2023.

Condition 1 requires initial construction and any maintenance to only be undertaken between 1 November and 30 April.

Conditions 2 and 3 relate to notification of the Council before undertaking works, and constructing and maintaining the structure in accordance with documentation submitted for the application.

Conditions 4 and 5 require the consent holder to observe every practicable measure to prevent discharges, and to minimise disturbance of the streambed.

Condition 6 stipulates that the structure shall not obstruct fish passage.

Condition 7 requires the structure to be removed and the area reinstated if the structure is no longer required.

Condition 8 provides for review of the consent.

The permit is attached to this report in Appendix I.

3.3 Results: water

3.3.1 Inspections

Thirteen inspections were carried out at the Kapuni Production Station in the 2012-14 period. The following was found during the inspections:

29 October 2012

The site was neat and tidy. Flaring was being undertaken at the time of inspection with no effects or odours noted. The separators, skimmer pits and ring drains were all clear. Everything was satisfactory.

19 February 2013

A visual inspection was carried out. The site was undergoing an emergency shutdown test and all of the flare stacks were in use. Smoke was observed from this flaring. At the time of the inspection there was no wind and the smoke was rising vertically. The site was dry.

30 April 2013

The site was inspected following recent heavy rainfall. The skimmer pits and separators were clear. There were no apparent effects from any discharge to Kapuni Stream. The ring drains and bunds were all fit for purpose. No flaring was occurring at the time of inspection. Everything was satisfactory.

15 May 2013

Ambient monitoring of the Kapuni Production Station was carried out. At the time of inspection no flame or smoke was observed to be emanating from the flare stacks. An inspection of the Kapuni Stream was undertaken and it appeared clear with no effects visible from operations at the Kapuni Production Station.

24 May 2013

A site inspection was undertaken following significant rainfall. The API separators were well maintained and the stormwater discharge to Kapuni Stream was not giving rise to any visual effects. Minimal flaring was occurring at the time of inspection, with the wind blowing across the compound from the south east. No odours were noted. The bunds and ring drains were clear of contaminants. The site was neat and tidy. Everything was satisfactory.

5 June 2013

The site was inspected following very heavy rainfall in the previous 24 hours. The ring drains and bunds were all clear of contaminants and debris. The API separators were effective and fit for purpose. The stormwater discharge to the Kapuni Stream was showing no effects or contamination. Three minimal flares were evident at the time of inspection. A strong south east wind was blowing back over the production station from the direction of the two streamside flares and no odours or smoke emissions were detected. The site was neat and tidy. Everything was satisfactory.

26 June 2013

The site was neat and tidy. All stormwater was directed for treatment through the API separators prior to discharge into the Kapuni Stream. No effects were visible from this. Minimal flaring was being undertaken. Everything was satisfactory.

27 August 2013

Inspection was undertaken following a morning of showery weather coming in squalls from the south west. The ring drains, bunds, skimmer pits and API separators were all operating as designed. There were no apparent effects from any discharge to the Kapuni Stream. The re-injection well at the back of the site was no longer used. The fire water and pumping area was well maintained. Minimal flaring was being undertaken, with no off site odours noted. The site was neat and tidy. Everything was satisfactory.

18 November 2013

Site inspection was undertaken during routine flaring. Notifications had been received from STOS which were commensurate with the activity. No smoke or odours were noted during off site downwind monitoring. The ring drains, bunds, API separators and skimmer pits were all clear of any contaminants. The site was neat and tidy. A request was made to the Company to clear overgrowth from the track to the discharge point on banks of Kapuni Stream to facilitate monitoring of this site.

8 January 2014

Site inspection was undertaken following consistent rainfall periods over the previous few days. The top API separators were being cleaned out by Transpacific. The bottom separator down by the river was clear of contaminants, but some evidence of a greyish (sewage type) fungus was evident. This was also present down by the Kapuni Stream attached to willow roots at the discharge point. No discolouration of water was apparent. This may have been caused by some additional nutrients entering the system. The Company was informed and was to investigate this issue. Access to the stormwater discharge point adjacent to the Kapuni Stream had been markedly improved with the spraying of pest plants in the area. Minimal flaring was being undertaken at the time of inspection, with no effects noted.

14 April 2014

Inspection was undertaken following showery weather experienced after a long dry period. No contaminants were noted in the site stormwater separator, or at its discharge point to the Kapuni stream. There was no evidence of the algae or fungus found at this point during the previous inspection. The investigation by STOS did not reveal any concerns with nutrient entrainment in the stormwater system. No flaring was occurring and any odours noted were contained within the site boundaries. The site was neat and tidy. Everything was satisfactory.

20 May 2014

The site was inspected during fine weather following some heavy rainfall over preceding week. The ring drains and bunds were secure. The stormwater discharge point to the Kapuni Stream was very clean. Minimal flaring was being undertaken at time of inspection. Everything was satisfactory.

27 June 2014

Inspection was undertaken with Bruce Colgan (STOS) following recent heavy rainfall. Minimal flaring was being undertaken at the time. This did not give rise to any smoke or off site odours. Riparian planting had recently been undertaken alongside the banks of the Kapuni Stream. All separators, bunds and ring drains were clear of contaminants. The site was neat and tidy. Everything was satisfactory.

3.3.2 Results of discharge monitoring

Stormwater at the Kapuni Production Station is treated using two API separators. Stormwater captured beneath equipment and in bunded areas around storage facilities is directed to the first separator for initial treatment. It is then treated in a second separator prior to discharge to the Kapuni Stream. Stormwater from other areas, such as roads, is directed to the second separator.

Chemical water quality sampling of the treated stormwater discharge from the production station was undertaken on four occasions during the 2012-2014 period. Table 15 presents the results of this sampling. The location of the sampling site at the outlet of the second API separator (STW002014) is shown in Figure 5.

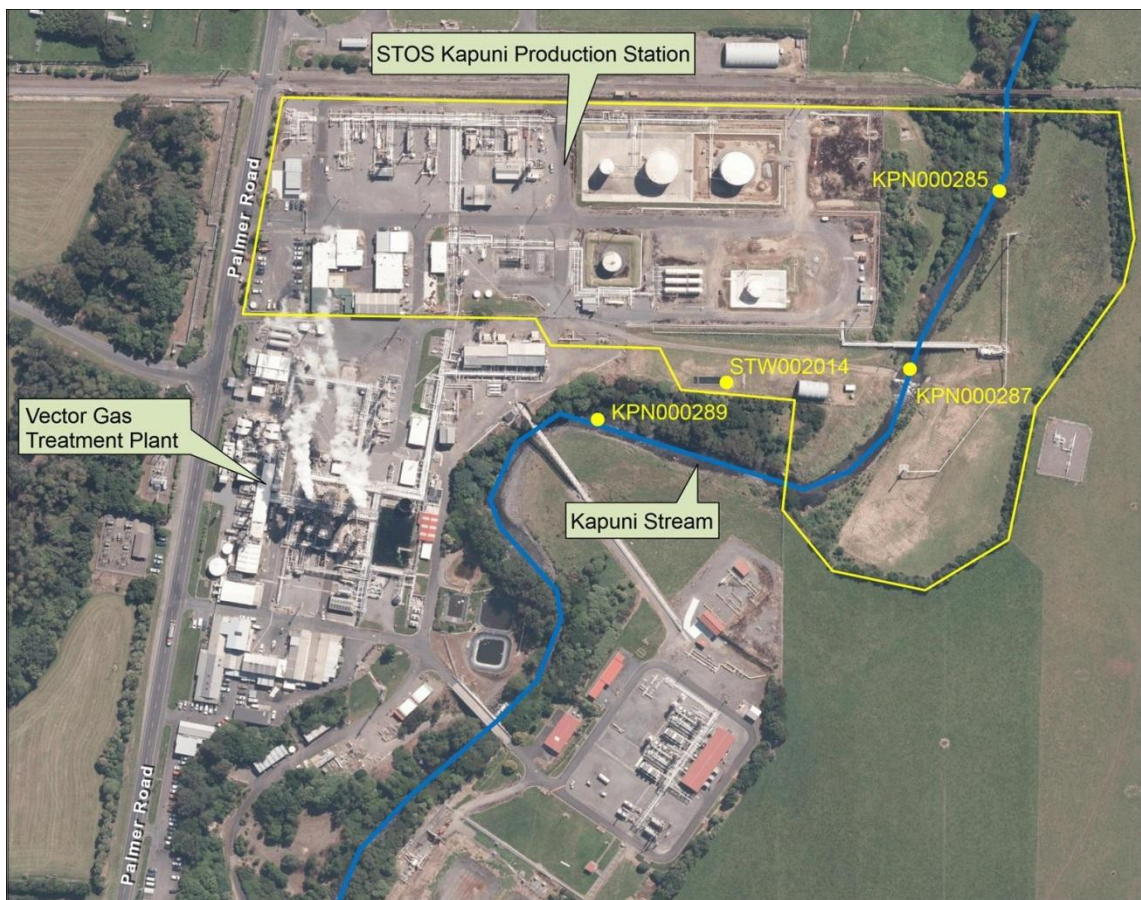


Figure 5 Kapuni Production Station and associated sampling sites

Table 15 Results of discharge monitoring from Kapuni Production Station (site STW002014)

Parameter	Units	2 Apr 2013	7 Jun 2013	10 Jun 2014	24 Jun 2014	Consent limits
Conductivity	g/m ³	12.0	11.2	8.5	9.9	-
Hydrocarbons	g/m ³	< 0.5	0.6	0.5	< 0.5	15
Suspended solids	g/m ³	4	5	3	3	100
pH		6.5	6.6	6.3	6.4	6.0 – 9.0

The results show compliance with consent conditions at the times of sampling and are indicative of a very clean discharge.

Every month, STOS provided the Council with the results for daily composite samples of the Kapuni Production Station stormwater discharge, sampled at the outfall from the final separator. The results are summarised in Table 16.

Table 16 STOS Kapuni Production Station stormwater discharge results summary for 2012-2014

Month	Hydrocarbons (g/m ³)		Suspended solids (g/m ³)		pH	
<i>Consent 0633-3 limits</i>	15		100		6.0 – 9.0	
	Max	Average	Max	Average	Range	Average
July 2012	0.7	< 0.5	20	7	6.5 – 7.9	7.0
August 2012	0.7	< 0.5	14	6	6.5 – 7.7	7.2
September 2012	1.1	< 0.5	11	7	6.3 – 8.2	7.1
October 2012	1.2	< 0.5	13	7	6.2 – 7.8	7.0
November 2012	2.2	< 0.5	37	10	6.7 – 7.9	7.2
December 2012	0.7	< 0.5	30	14	7.2 – 7.9	7.6
January 2013	1.3	< 0.5	27	14	6.8 – 8.2	7.3
February 2013	1.6	< 0.5	36	16	7.0 – 8.7	7.3
March 2013	2.0	< 0.5	24	7	6.9 – 7.9	6.9
April 2013	1.0	< 0.5	17	6	6.9 – 7.6	7.3
May 2013	0.6	< 0.5	11	6	6.4 – 7.7	7.2
June 2013	0.9	< 0.5	14	6	7.0 – 7.8	7.4
July 2013	3.1	< 0.5	8	5	6.6 – 7.8	7.4
August 2013	1.6	< 0.5	11	6	7.0 – 7.9	7.5
September 2013	2.0	< 0.5	26	11	6.4 – 7.8	7.4
October 2013	0.8	< 0.5	16	9	7.2 – 8.0	7.5
November 2013	0.7	< 0.5	28	13	6.0 – 8.1	7.2
December 2013	0.5	< 0.5	26	12	5.6 – 8.0	7.2
January 2014	1.2	< 0.5	21	7	6.4 – 8.0	7.0
February 2014	0.8	< 0.5	8	5	6.4 – 7.1	6.7
March 2014	1.7	< 0.5	38	7	6.9 – 8.0	7.3
April 2014	0.9	< 0.5	63	15	6.6 – 7.9	7.4
May 2014	1.7	< 0.5	14	9	6.7 – 8.5	7.5
June 2014	2.5	< 0.5	31	10	7.3 – 8.7	7.7
Days limit exceeded	0		0		1	

The STOS monitoring results show a remarkably consistently clean discharge. The sole exceedance of the consent limits from two years of daily monitoring was a slightly low pH of 5.6 on 18 December 2013. This would not be expected to give rise

to more than minor effects in the receiving waters of the Kapuni Stream. Maximum values for hydrocarbons and suspended solids were well below the consent limits throughout the period under review.

3.3.3 Results of receiving environment monitoring

Chemical

Chemical water quality sampling of the Kapuni Stream was undertaken in conjunction with discharge monitoring at points upstream (KPN00287) and downstream (KPN00289) of the discharge point. The results are shown in Table 17 and the sampling sites are shown in Figure 5.

Table 17 Receiving environment results for the Kapuni Production Station 2012-2014

	Parameter	Conductivity	Hydrocarbons	pH	Suspended solids
Date	Site	mS/m	g/m ³		g/m ³
2 Apr 2013	Upstream [KPN00287]	9.6	< 0.5	7.8	< 2
	Downstream [KPN00289]	9.6	< 0.5	7.9	< 2
7 Jun 2013	Upstream [KPN00287]	8.6	2.2	7.7	< 2
	Downstream [KPN00289]	8.5	< 0.5	7.7	< 2
10 Jun 2014	Upstream [KPN00287]	6.3	< 0.5	7.4	5
	Downstream [KPN00289]	6.3	< 0.5	7.4	5
24 Jun 2014	Upstream [KPN00287]	9.5	< 0.5	7.6	2
	Downstream [KPN00289]	9.6	< 0.5	7.5	2

There was negligible difference in receiving water quality upstream and downstream of the production station discharge. This indicates that the discharge was in compliance with consent conditions regarding receiving environment quality.

Biomonitoring

The Council's standard 'kick-sampling' technique was used at two established sites (KPN00285 and KPN00289) to collect streambed macroinvertebrates from the Kapuni Stream on two occasions during the period under review to assess whether stormwater discharges from the STOS Kapuni Production Station have had any adverse effects on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), MCI and SQMCI_s scores for each site. These sites are shown in Figure 5.

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 environmental conditions. The SQMCI_s takes into account taxa abundances as well as sensitivity to pollution. It may indicate

subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI_s between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

13 March 2013

This March 2013 biological survey of the Kapuni Stream performed under very low late summer flow conditions indicated that stormwater discharges from the Kapuni Production Station had not had any recent significant impacts on the macroinvertebrate communities of the stream. These communities had high community richnesses, an increase on that recorded in the previous survey. Similar characteristic taxa were recorded in the communities at both sites, resulting in similar SQMCI_s scores. The MCI scores were also similar, and the score recorded at the upstream site (KPN000285) was significantly higher than the median for this site. This similarity in MCI score reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and is less suited to snails or midge larvae. These results were indicative of the absence of any recent impacts from stormwater discharges from the Kapuni Production Station.

24 February 2014

This February 2014 biological survey of the Kapuni Stream performed under low summer flow conditions indicated that stormwater discharges from the Kapuni Production Station had not had any recent significant impacts on the macroinvertebrate communities of the stream. These communities had moderate community richnesses, although less than that recorded in the previous survey. Similar characteristic taxa were recorded in the communities at both sites, resulting in similar SQMCI_s scores. The MCI score was also not statistically significantly different to that recorded at site 2b (Stark, 1998), and the score recorded at site 2 was ten units higher than the median for this site. This similarity in MCI scores reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and is less suited to snails or midge larvae. These results were indicative of the absence of any recent impacts of any stormwater discharges from the Kapuni Production Station.

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

3.4 Results: air

3.4.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in section 3.3.1 above. Air discharges were all found to be satisfactory, and no offensive, obnoxious or objectionable odours were noted during the inspections.

3.4.2 Results of receiving environment monitoring

During the period under review, STOS kept the Council informed of all non-routine flaring events at Kapuni Production Station. The Council received 28 notifications for flaring events in the 2012-13 year, and 62 notifications for 2013-14. The majority of flaring

events were caused by factors such as plant reliability issues, re-starting low pressure wells and planned maintenance.

Council monitoring

During the period under review, a multi-gas meter was deployed on two occasions in the vicinity of the plant, on 14 March 2013 and 12 June 2014. The instrument was placed in a downwind position at the start of each 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.

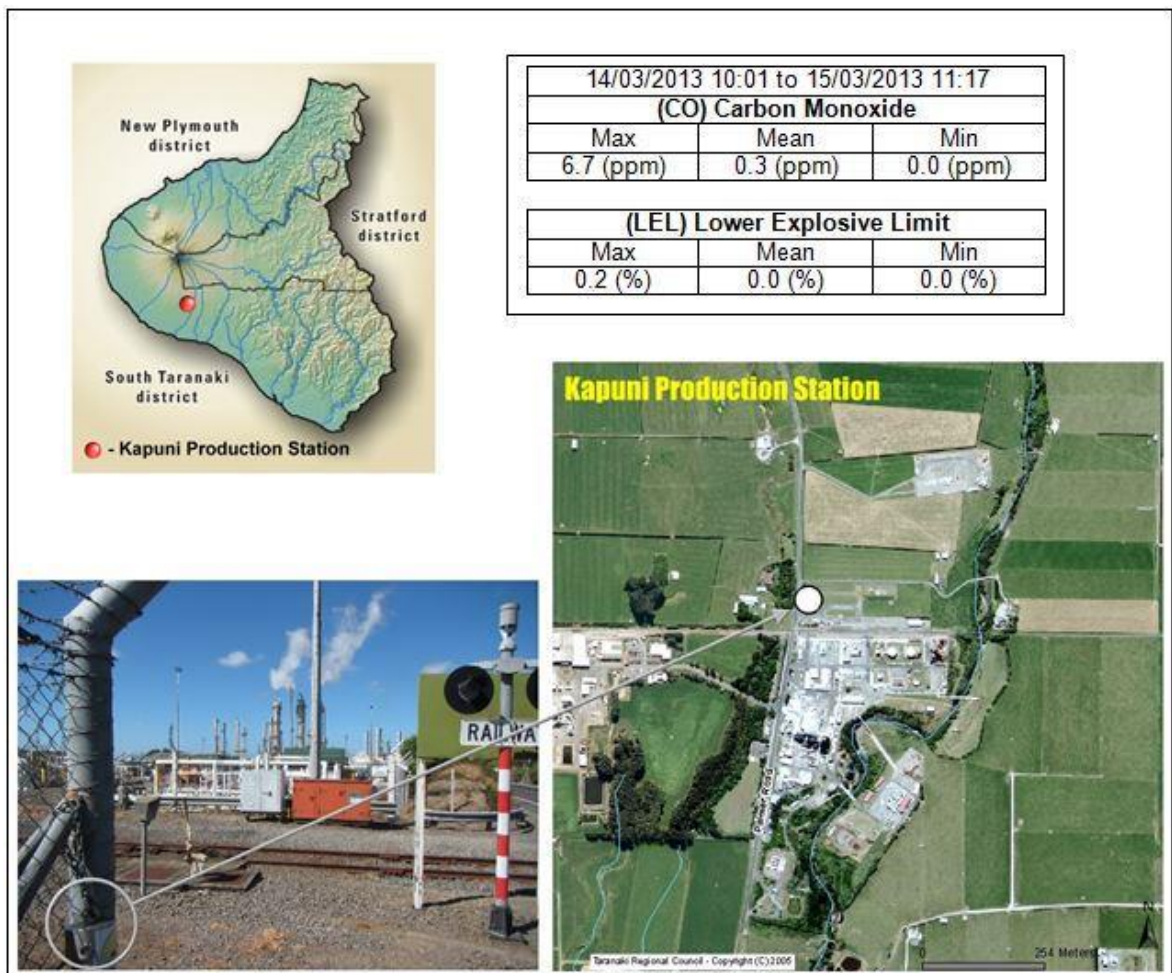


Figure 6 March 2013 air monitoring site and sample details for Kapuni Production Station

Consent 4054-5 for air discharges from the Kapuni Production Station does not have specific limits related to particular gases. The National Environmental Standards for Air Quality [NES AQ] sets the limit for carbon monoxide at 10 mg/m^3 (12ppm) averaged over an 8 hour exposure period.

LEL% gives the percentage of the lower explosive limit, expressed as methane, which 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 a dangerous level of airborne contaminants, including any risk of explosion.

14 March 2013

The deployment lasted approximately 25 hours. The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 6. The maximum concentration of carbon monoxide found during the monitoring run was 5.7 mg/m³ (6.7 ppm) and the average concentration was only 0.26 mg/m³, which complies with the NES AQ. At no time did the level of explosive gases downwind of the Kapuni Production Station reach any more than a trivial level.

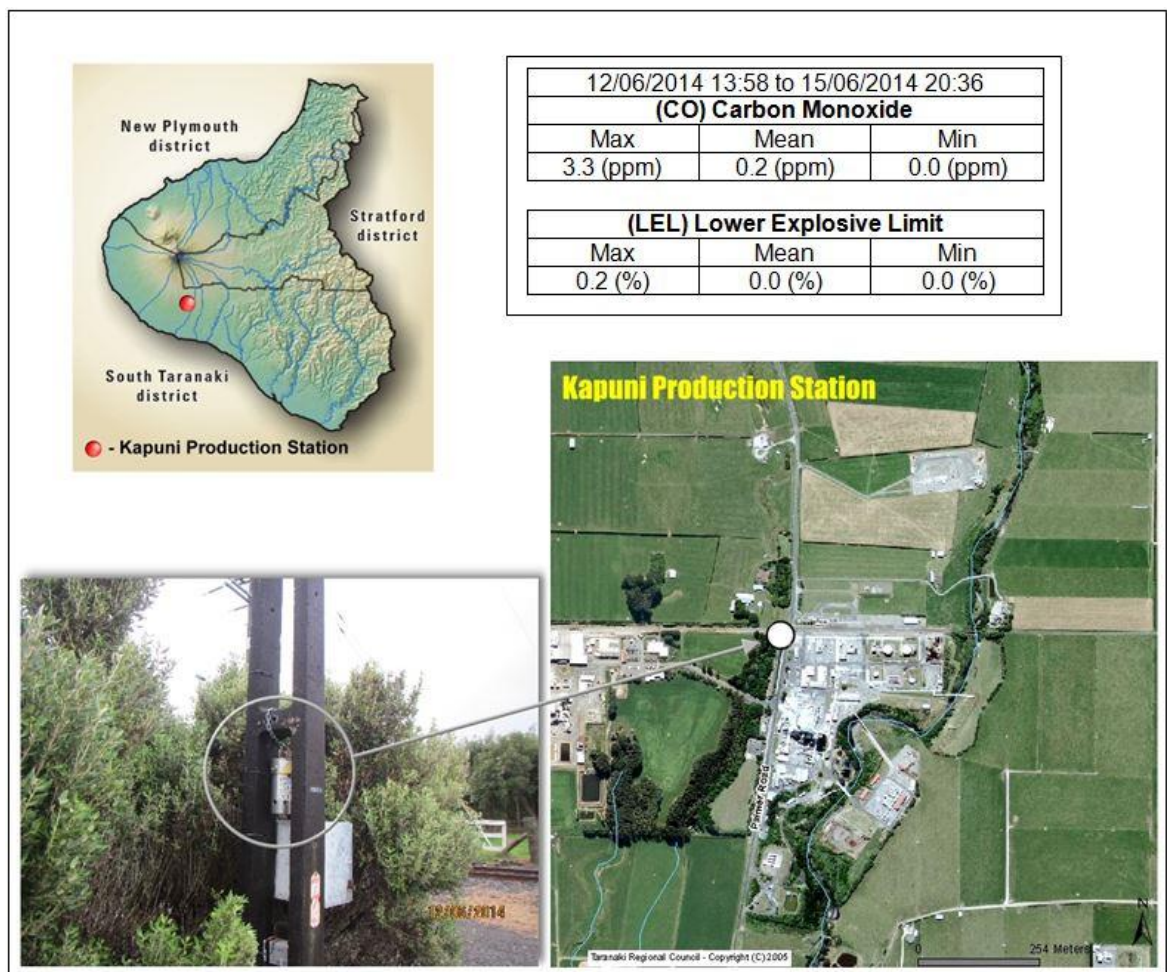


Figure 7 June 2014 air monitoring site and sample details for Kapuni Production Station

12 June 2014

The deployment lasted approximately 76 hours. The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 7. The maximum concentration of carbon monoxide found during the monitoring run was only 2.8 mg/m³ (3.3 ppm) and the average concentration was only 0.17 mg/m³, which complies with the NES AQ. At no time did the level of explosive gases downwind of the Kapuni Production Station reach any more than a trivial level.

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

Company monitoring and report

STOS provided the Council with two annual reports on flaring and emissions during the 2012-2014 period, as required by consent 4054-5.

2012-2013 report summary

Of the 28 flaring events in the period, only two generated light smoke. The median duration of these events was 30 minutes. No complaints were received from the public regarding flaring at the production station.

The total volume flared in the 2012-2013 year was 310,600 cubic metres of gas, which was similar to the 363,600 cubic metres of gas flared over the previous 13 month period. One of the main causes of flaring is compressor downtime. The Company minimises the need for this flaring by planning compressor downtime and maintenance to reduce the frequency of compressor problems. The highest volume of flaring (61,200 cubic metres of gas) occurred during February 2013 due to depressurisation of the plant for a site shutdown.

2013-2014 report summary

Of the 62 flaring events in the period, only five generated light smoke. The median duration of these events was 18 minutes. No complaints were received from the public regarding flaring at the production station.

The total volume flared in the 2013-2014 year was 258,600 cubic metres of gas, which is a moderate decrease on the 310,600 cubic metres of gas flared in the previous year.

Increases in flaring volume during the 2013-2014 period were due to: commissioning and isolation of the flare knock out drum, which required the flaring of 9,750 cubic metres of gas in November; shutdown and restart of the wells in January; and the shutdown of the production station for planned maintenance in April.

3.5 Investigations, interventions, and incidents

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

The Taranaki Regional 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 Unauthorised Incident Register (UIR) 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 2012-2014 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 relating to the Kapuni Production Station.

3.6 Discussion of site performance

Inspections of the Kapuni Production Station during the 2012-2014 monitoring period found that the site was well managed and maintained. There were no compliance issues and there were no unauthorised incidents in relation to the site.

3.7 Environmental effects of exercise of consents

Stormwater discharge inspections showed that discharges from the site complied with consent conditions. Receiving water monitoring inspections and sampling showed that the discharge was not causing any adverse effects on the Kapuni Stream at the time of monitoring. This was supported by the findings of the macroinvertebrate surveys carried out in the stream.

Ambient air quality monitoring at the site showed that levels of carbon monoxide and combustible gases 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 from neighbours in relation to flaring and emissions from the site.

3.8 Evaluation of performance

A tabular summary of the consent holder's compliance record for the period under review is set out in Tables 18-20.

Table 18 Summary of performance for Consent 0633-2 to discharge up to 250 litres/second of treated stormwater from an oil and gas production plant into the Kapuni Stream

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Limits on hydrocarbons or total organic carbon in the discharge	Inspections and sampling	Yes
2. Limit on the concentration of suspended solids	Inspections and sampling	Yes
3. In-stream effects	Inspections, sampling, biomonitoring	Yes
4. Contingency plan	Plan reviewed and approved	Yes
5. Review of consent	Next option for review in June 2017	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 19 Summary of performance for Consent 4054-5 to discharge emissions into the air from combustion involving flaring of petroleum products incidental to the treatment of gas at the Kapuni Production Station

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. Effective liquid separation and recovery to avoid smoke emissions during flaring	Site inspections	Yes
4. Provision of annual report on flaring to council	Report received	Yes
5. Appropriate maintenance and operation of equipment	Site inspections	Yes
6. No offensive, obnoxious or objectionable odours beyond site boundary	Site inspections	Yes
7. Consultation with Council prior to significant alterations to plant, processes, or operations	Site inspections and liaison with consent holder	Yes
8. Notification of flaring more than five minutes in duration	Flaring notifications received	Yes
9. Maintenance of log of continuous flaring incidents	Information received	Yes
10. Take all practicable steps to minimise flaring	Site inspections, review of information received, liaison with consent holder	Yes
11. 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
12. Record of smoke emitting events and complaints	Site inspections, records kept by consent holder, and liaison with consent holder	Yes
13. Optional review provision re environmental effects, best practicable option or mass discharge quantities or ambient concentrations	No further option for review	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 20 Summary of performance for Consent 5960-1 to erect, place, use and maintain a concrete ford on the bed of the Kapuni Stream for access purposes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Construction and maintenance only between 1 November and 30 April	Inspections. No maintenance undertaken during this monitoring period	N/A
2. Notify Council before undertaking construction and maintenance works	No maintenance undertaken during this monitoring period	N/A
3. Constructed and maintained in accordance with application	Inspections. No maintenance undertaken during this monitoring period	N/A
4. During maintenance works observe measures to prevent discharge and minimise disturbance	Inspections. No maintenance undertaken during this monitoring period	N/A
5. Minimise disturbance and reinstate any disturbed areas	Inspections. No maintenance undertaken during this monitoring period	N/A
6. The structure shall not obstruct fish passage	Site inspection	Yes
7. Structures to be removed and area reinstated when no longer required	N/A	N/A
8. Review of consent	Next option for review in June 2017	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

During the period under review, the Company demonstrated an overall high level of environmental performance and a high level of administrative compliance with the resource consents as defined in Section 1.1.4. The Kapuni facilities were well managed and maintained.

3.9 Recommendation from the 2011-2012 Annual Report

In the 2011-2012 Annual Report, it was recommended:

1. THAT the monitoring programme for the Kapuni Production Station in the 2012-2013 year remains unchanged from that scheduled for 2011-2012, together with the carryover of sampling not completed during 2011-2012.

This recommendation was implemented, with the exception that additional sampling was not undertaken as the Company did not consider it necessary to redress the shortfall in monitoring from previous years with additional work in the period under review.

3.10 Alterations to monitoring programmes for 2014-2015

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA the obligations of the Act in terms of monitoring emissions/ discharges and effects, and subsequently reporting to the regional community. The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/ discharging to the environment.

It is proposed that for 2014-2015 the monitoring programme is amended to reflect the Council's changes to the structure of all monitoring programmes, primarily to provide for amended health and safety requirements. A recommendation to this effect is attached to this report.

3.11 Recommendation

1. THAT monitoring of consented activities at the Kapuni Production Station in the 2014-2015 year be amended from that undertaken in 2013-2014 to reflect the Council's changes to the structure of all monitoring programmes.

4. Kapuni wellsite blowdown pits

4.1 Introduction and historical context

Most wellsites in the Kapuni field contained a blowdown pit. In some cases they were constructed from the original wellsite flare pit, although there were also purpose-built pits at some sites. As flare pits, they were intended to receive initial well flows (gas and condensate along with produced water and drilling muds), so that combustible material along with residues that could not be processed through the Production Station could be safely recovered and disposed of by flaring. The pits were subsequently used from time to time for the temporary containment of fluids produced as a result of various well maintenance or workover activities. As with well clean-up materials, this would allow for the management by flaring of combustible and volatile components within the residues and products of well workover activities, if this was found necessary as a safety measure. The pits were generally been used on an intermittent and short-term basis only. The fluids, which at times contained hydrocarbons, were removed and transported to the production station upon the completion of well maintenance activities.

The discharge of well fluids to blowdown pits had been occurring without any specific resource consents covering their use for this particular purpose (the discharge of well fluids to the pits for the purpose of flaring was consented).

Following monitoring in the 1990s, STOS engaged consultants to conduct an assessment of options for the future environmental management of the flare pits at the Kapuni asset in 2000. STOS then began on-going monitoring of the sites in order to improve understanding of groundwater characteristics in the vicinity of the pits. This monitoring found evidence of limited contamination at some sites, primarily within soil and groundwater beneath the pits.

In late 2006, following discussions with the Council to determine the appropriate way to address the current situation and to set out a future path, STOS applied for and was granted a discharge consent for the KA-13 wellsite. Particularly, this consent required monitoring if any use was to be made of the pit in the future, and it required remediation of any contamination of soil and groundwater within the term of the consent (ie prior to the expiry, cancellation, or surrendering of the consent). Further, the Company was to minimise any potential for infiltration into the underlying soil and watertable, by managing the volume of returned fluids and by minimising the time fluids were left within the pit. The volcanic ash deposits found in the area are of low hydraulic conductivity, and as such can slow dispersion and migration, and it was noted that there were no known users of shallow groundwater in the vicinity. Earlier studies around KA-1/7 had confirmed degradation processes effectively reduced contaminant concentrations within groundwater.

Two further consents were sought and granted in mid 2007 (refer to Table 21 for consent details). On 21 December 2007, the Council received applications for a further three discharge consents at other wellsites. However, after a period of further discussion with the Council, the applications were withdrawn, the Company noting that the use of unlined earthen blowdown pits was no longer consistent with industry best practice and that it was considered alternatives would become available within an acceptable operational timeframe. Furthermore, there was a high risk of a potential for

significant adverse environmental effects occurring if this use was to continue indefinitely and without control. Subsequently STOS advised the Council it intended to cease using all blowdown pits. The Company investigated alternatives, and now uses impervious containment systems to receive and recover blowdown as and when required.

Since 2012, STOS has pursued a programme of staged wellsite soil remediation and comprehensive groundwater monitoring, beginning at site KA-2. A detailed description of this project and additional historical context is included in the Council's Shell Todd Oil Services Ltd Maui and Kapuni Production Stations Monitoring Programmes Annual Report 2011-2012 (Technical Report 2012-35). STOS has engaged URS NZ Ltd [URS] to undertake the assessment, decommissioning, impacted soil remediation and remediation validation works at the blowdown pit sites.

4.2 Resource consents

Section 15(1)(c) of the Resource Management Act stipulates that no person may discharge any contaminant from any industrial or trade premises onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

Consents are held by STOS for discharges to blowdown pits at three wellsites in the Kapuni field. Details are shown in Table 21.

Table 21 Consents for Kapuni blowdown pits

Wellsite	Consent	Purpose / Comments	Issue Date	Review	Expiry
KA-6/11	7114-1	To discharge liquids onto and into land from a purpose built, blowdown pit at the KA-6/11 wellsite	19/06/2007	2017	2023
KA-8/12/15	7113-1	To discharge liquids onto and into land from a purpose built, blowdown pit at the KA-8/12/15 wellsite	19/06/2007	2017	2023
KA-13	7005-1	To discharge liquids onto and into land from a purpose built, blowdown pit at the KA-13 wellsite	24/11/2006	2017	2023

STOS holds discharge permit **7005-1** to discharge liquids onto and into land from a purpose built blowdown pit at the KA-13 wellsite. The permit was issued by the Taranaki Regional Council on 24 November 2006 under Section 87(e) of the Resource Management Act and is due to expire on 1 June 2023.

Conditions 1 and 2 require the consent holder to undertake the activity in a manner that applies the best practicable option for preventing or minimising effects, and that is consistent with the application's documentation.

Conditions 3 and 6 stipulate that the exercise of the consent is not to adversely impact the quality of surface or groundwater.

Condition 4 requires the removal of discharged fluids generally within 24 hours or in any case as soon as is practicable.

Condition 5 is a notification requirement.

Condition 7 requires the maintenance of monitoring bores, and condition 8 requires monitoring after each use of the pit. Condition 9 requires the supply of information to the Council.

Conditions 10 and 11 require that the soil and groundwater shall comply with remediation guidelines, prior to relinquishment of the site.

Conditions 12 and 13 are standard lapse and review provisions.

STOS holds discharge permits **7113-1 and 7114-1** to discharge liquids onto and into land from a purpose built blowdown pit at the KA-8/12/15 wellsite and KA-6/11 wellsite, respectively. The permits were issued by the Taranaki Regional Council on 19 June 2007 under Section 87(e) of the Resource Management Act and are due to expire on 1 June 2023.

The conditions on these consents mirror those of 7005-1, with the exception that Conditions 3 and 6 of 7005-1 have effectively been combined into a single condition on the two later consents.

4.3 Results

4.3.1 Additional inspections and notes

Details of the majority of the inspections and monitoring at the Kapuni wellsites during the period under review are contained within the respective wellsite reports. The following are additional inspections and notes specifically relating to the blowdown pit remediation works.

2 August 2012: KA-2

The KA-2 wellsite was visited with URS contractors to collect soil samples from the base of the excavated blowdown pit prior to reinstatement. Four samples in total were taken from material excavated while on site. These were from the lower SE, S and SW walls, and the base of the pit. URS collected samples of the same material. A strong hydrocarbon odour was present in all samples. These were stored, to be tested if required.

9 August 2012: KA-2

An inspection of the site was carried out as part of the monitoring programme for the blowdown pit remediation works. It was observed from the boundary of the site that the pit had been filled in with earth. The soil bund and silt control measures had been removed from site. The remaining earth that wasn't used to fill the flare pit had been levelled and placed over the site. It was raining heavily at the time of inspection and stormwater was entering the ring drain and skimmer pits. Stormwater in the ring drain looked clean, indicating that there was not a lot of suspended solids or hydrocarbons contained in the stormwater. The skimmer pits were empty and it is possible that stormwater may have been discharging into groundwater. The Company was advised to ensure that the skimmer pits were impermeable so contaminants that may enter the pits could be effectively captured and treated.

19 February 2013: KA-3

A Council Inspector met with representatives from STOS at the KA-3 wellsite. The steps that were to be taken to remediate the blowdown pit were discussed; including storage, bunding, waste disposal and groundwater monitoring. Works had not commenced at the time of inspection, but equipment was being brought to the site.

19 March 2013: KA-3, KA-8/12/15/18 and KA-13

An inspection of the blowdown pit remediation works to date was carried out at KA-3, KA-8/12/15/18 and KA-13. The bund around the pit had been removed from KA-3. The pit at KA-8 had been excavated and tested, and uncontaminated earth was being placed back into the pit. Monitoring bores had been installed in the vicinity. KA-13 had been excavated and a large hole remained while soil sampling was carried out. There was good bunding of earth piles on all sites, with no run off observed.

14 August 2013: KA-4/14

All stormwater was being diverted to the skimmer pits via the drains. Sediment control systems were in place as remediation work to decommission the blowdown pit was underway. Clean fill was stored on site to fill the void once the contaminated soil had been removed. Works to upgrade the second skimmer pit had been completed, with future plans in place to upgrade and increase the overall skimmer pit sizes but retain the current outflow system. Water from the second skimmer pit near the outflow was sampled (results: chlorides 30.4 g/m³, hydrocarbons 2.9 g/m³, pH 6.4, suspended solids 51 g/m³). The pit was not discharging at time of inspection.

18 October 2013: KA-6/11/17

Works on the production facilities were in progress during inspection. The blowdown pit remediation was continuing. Silt control measures for the soil piles were in place. Works on the perimeter drain had been completed. The skimmer pit levels were low. It was possible they had been pumped out recently. Water in the second skimmer pit was sampled (results: chlorides 9.7 g/m³, hydrocarbons < 0.5 g/m³, pH 7.4, suspended solids 8 g/m³). All wellsite consents were being complied with at the time of inspection.

4.3.2 Results of biomonitoring**4.3.2.1 KA-8/12/15, KA-4/14, KA-13 and KA-5/10**

The Council's standard 'kick-sampling' and 'vegetation sweep' sampling techniques were used to collect streambed macroinvertebrates from the Kapuni Stream and tributaries of the Inaha stream and Waiokura Stream in relation to the remediation of the KA-8/12/15, KA-4/14, KA-13 and KA-5/10 wellsites. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. Samples were processed to provide number of taxa (richness), 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 environmental conditions. The SQMCI_s takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic

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

KA-8/12/15

The pre-remediation survey of the KA-8/12/15 wellsite, undertaken in May 2012 in the unnamed tributary of the Inaha Stream and the Kapuni Stream found that communities at both sites in the unnamed tributary of the Inaha Stream contained typical community richnesses, and that these communities were in moderate biological health. There was little difference between sites, with the MCI scores being within six units of each other, and the SQMCI_s scores being within 0.5 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the discharge from the KA-8/12/15 well site was not having any adverse effects on the macroinvertebrate communities of the unnamed tributary of the Inaha Stream.

Communities at both sites in the Kapuni Stream contained typical community richnesses, and MCI scores indicated macroinvertebrate communities were in good biological health. There was only a very slight difference between sites, with the MCI scores being within three units of each other, and the SQMCI_s scores being within 0.1 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the contamination present at the KA8/12/15 well site was not having any adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA-8/12/15 wellsite, undertaken in July 2013, found that taxa richness in the unnamed tributary of the Inaha Stream were moderate and similar to that recorded during the pre-remediation survey. The MCI score upstream at INH000204 was similar to that recorded in the pre-remediation survey and indicated moderate biological health. There was however a significant decrease (Stark, 1998) at this site in SQMCI_s score from the pre-remediation to the interim-remediation survey, which can be attributed to seasonal differences. Similarly, a significant decrease in SQMCI_s score was recorded downstream at INH000205, again a likely result of seasonal differences but also to disturbance to the stream bank through the removal of the pines. In addition, there was a significant decrease (Stark, 1998) in MCI score at INH000205 from the pre-remediation and interim-remediation surveys and also between this and the upstream site, which may be attributed to the disturbance of the stream bank, a change in habitat and also to the small area surveyed a result of difficulty in sampling at this site.

The interim-remediation survey of the KA-8/12/15 wellsite, undertaken in July 2013, found that taxa richnesses in the Kapuni Stream were high and had increased by 8-9 taxa from the pre-remediation survey. MCI scores were similar to those recorded in the pre-remediation survey and indicated good biological health. The SQMCI_s score recorded upstream at KPN000212 was the same as that recorded during the pre-remediation survey and slightly higher than the median score for 'control' sites in similar streams at this altitude. The SQMCI_s score recorded downstream at KPN000216 was similar to that recorded in the pre-remediation survey and also slightly higher than the median score for 'control' sites in similar streams at this altitude.

The results from the pre-remediation and the interim-remediation surveys of the KA-8/12/15 wellsite indicate that there was no impact on macroinvertebrate communities from the remediation activities undertaken at the KA-8/12/15 wellsite. The Kapuni

Stream site results showed no significant changes in taxa richness, MCI or SQMCI_S scores between the pre-remediation and interim-remediation surveys and results were similar to those recorded at 'control' sites at similar streams at similar altitudes about the region. The unnamed tributary of the Inaha Stream results showed a significant decrease in SQMCI_S score at both sites and a significant decrease in MCI score at the lower site from the pre-remediation to the interim-remediation surveys which can be attributed to the bankside disturbance caused by the removal of pines at this downstream site, rather than to the remediation activities taking place at the wellsite.

KA-4/14

The pre-remediation survey of the KA-4/14 wellsite, undertaken May 2012 in the unnamed tributary of the Waiokura Stream found that the community at WKR000653 contained typical community richnesses, and that these communities were in moderate biological health. The MCI score was similar to that recorded at 'control' sites in similar streams at comparable altitudes whereas the SQMCI_S score was significantly higher (Stark, 1998). These results indicated that the discharge and/or contamination from the KA-4/14 wellsite was not having an affect on the macroinvertebrate communities of the unnamed tributary of the Waiokura Stream.

The interim-remediation survey of KA-4/14 wellsite, undertaken in July 2013, found that the taxa richness and MCI score recorded at WKR000653 in the unnamed tributary of the Waiokura Stream had decreased slightly from the pre-remediation survey, however was still similar to scores recorded in 'control' sites in similar streams at comparable altitudes. A significant decrease in SQMCI_S score was recorded between the pre-remediation and interim-remediation surveys, however the score was still significantly higher than the median score of 'control' sites in similar streams at comparable altitudes (Stark, 1998). The significant decrease in SQMCI_S score can be attributed to the change in substrate recorded and to a change in sampling method used between the two surveys, rather than the remediation activities.

KA-13

The pre-remediation survey of the KA-13 wellsite, undertaken May 2012 at two sites in the Kapuni Stream found that the macroinvertebrate communities at both sites contained typical community richnesses, and that these communities were in good biological health. The MCI and SQMCI_S scores recorded at both sites were similar to the median scores for 'control' sites in similar streams at comparable altitudes. There was little difference between sites, with the MCI scores being within four units of each other, and the SQMCI_S scores being within 0.1 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the discharge from the KA-13 wellsite was not having any adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA-13 wellsite, undertaken in July 2013, found that taxa richness, MCI and SQMCI_S scores upstream at site 1 (KPN00030) in the Kapuni Stream were similar to those recorded during the pre-remediation survey and similar to the median scores for 'control' sites in similar streams at comparable altitudes. The taxa richness recorded downstream at KPN000304 was similar to that recorded in the pre-remediation survey and the SQMCI_S score recorded was the same for the pre-remediation and interim-remediation surveys. The MCI score at KPN000304 however, was significantly higher than that recorded during the pre-remediation

survey. This can be attributed to several minor differences in taxa presence, including the absence of three 'tolerant' taxa and the presence of nine rare 'sensitive' taxa. These results suggest no significant impacts on macroinvertebrate communities from the remediation activities undertaken at the KA-13 wellsite.

KA-5/10

The pre-remediation survey of the KA-5/10 wellsite, undertaken May 2012 at two sites in the unnamed tributary of the Inaha Stream found that the macroinvertebrate communities at both sites contained typical community richnesses, and that these communities were in moderate biological health. The MCI and SQMCI_s scores recorded at both sites were similar to the median scores for 'control' sites in similar streams at comparable altitudes. SQMCI_s scores at the two sites were the same; however there was a slight difference between sites, with the MCI scores being within nine units of each other. These results reflect the similarity in the habitats observed at each site, and also the fact that the discharge from the KA-5/10 wellsite was not having any significant adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA-5/10 wellsite, undertaken in July 2013, found at the upstream site (INH000426) taxa richness was lower and MCI and SQMCI_s scores were significantly lower than those recorded during the pre-remediation survey. At the time of this survey it was noted that the site had previously been impounded by a blocked culvert. It is likely the macroinvertebrate community at this site was affected by a long period of very low flow followed by a short period of very high flow. In addition there was evidence of stock damage, which had possibly caused some habitat damage and nutrient enrichment as indicated by the 'tolerant' macroinvertebrate taxa that characterised this site (ostracod seed shrimps, orthoclad midges and *Chironomus* blood worms). The taxa richness and MCI score recorded at the downstream site at INH000427 was similar to that recorded in the pre-remediation survey, however the SQMCI_s score was significantly lower than that recorded in the pre-remediation survey. Again this can be attributed to the impoundment of the stream and the consequent very low then high flows and also possibly to compounding effects from stock damage that occurred 50 metres upstream.

Results suggest no significant impacts on macroinvertebrate communities from the remediation activities undertaken at the KA-5/10 wellsite, rather the impacts were caused by stock damage and the impoundment of the stream prior to the interim-remediation survey.

4.3.2.2 KA-6/11/17

The Council's standard 'vegetation sweep' and a combination of the 'streambed-kick' and 'vegetation sweep' sampling techniques were used at two sites to collect streambed macroinvertebrates from the unnamed tributary of the Inaha Stream in relation to the remediation of the KA-6/11/17 wellsite. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. Samples were processed to provide number of taxa (richness), MCI and SQMCI_s scores for each site.

The pre-remediation survey, undertaken in May 2012 found that communities at both sites contained lower than typical community richnesses. The MCI score recorded by site 1 was significantly (Stark, 1998) below the median score of what would normally be expected at similar sites at this altitude, while the MCI score recorded at site 2 was very similar to the median score. The significant difference in MCI score recorded between site 1 and site 2 during the pre-remediation survey may be attributed to the change in sampling method used. A combination of the 'vegetation sweep' and 'streambed-kick' sampling methods was used at site 2, thus is likely to have targeted more 'sensitive' taxa than the 'vegetation sweep' method alone which was employed at site 1. The SQMCI_s scores were however very similar which reflects the similarity in the habitats observed at each site, and also the fact that the contamination present at the KA-6/11/17 wellsite was not having any adverse effects on the macroinvertebrate communities of the unnamed tributary of the Inaha Stream.

The interim-remediation survey, undertaken in November 2013 recorded similar community richnesses to that observed in the previous survey at site 2, but slightly lower community richnesses at site 1. There was no significant change in MCI score at site 1 between the pre-remediation and interim-remediation surveys, however there was a significant (Stark, 1998) decrease in the MCI score recorded at site 2, which can be attributed mainly to seasonal differences, in particular to the greater length of time after a 3x median fresh that preceded the November 2013 survey. The communities at site 2 were very similar between the pre-remediation and interim-remediation surveys and were dominated by the same taxa, which resulted in a similar SQMCI_s score at this site. At site 1 there were six significant changes in taxon abundances between the pre-remediation and interim-remediation surveys, which again can be attributed to seasonal differences. Despite the significant change in taxon abundances at this site, the SQMCI_s scores recorded by the pre-remediation and interim-remediation surveys were not significantly different (Stark, 1998).

The results from the pre-remediation and the interim-remediation surveys of the KA-6/11/17 wellsite indicate that there was no impact on macroinvertebrate communities from the remediation activities undertaken. The unnamed tributary of the Inaha Stream site results showed no significant changes in SQMCI_s scores between the pre-remediation and interim-remediation surveys and results were similar to those recorded at 'control' sites at similar streams at similar altitudes about the region. The unnamed tributary of the Inaha Stream results did however show a decrease in MCI score upstream at site 1 and a significant decrease (Stark, 1998) in MCI score downstream at site 2 from the pre-remediation to the interim-remediation survey. This can be attributed to seasonal differences, in particular to a longer period of settled flows and higher stream temperatures recorded during the interim-remediation survey rather than to any affects caused by the remediation activities taking place at the KA-6/11/17 wellsite.

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

4.3.3 Results of consent holder monitoring

The Kapuni KA-13 Wellsite Blowdown Pit Decommissioning and Remediation Report (URS, 2013) was received by the Council in December 2013. This extensive report documents the assessment, decommissioning, impacted soil remediation and

remediation validation works conducted in the vicinity of the blowdown pit at KA-13 by URS and their civil works contractor, Downer NZ Ltd.

A total of approximately 1,500 tonnes of impacted material was removed from KA-13 for offsite disposal. As a minimum, soils in the area of the blowdown pit were remediated to comply with soil quality guideline levels for commercial/industrial land use. A report detailing the investigation of potential groundwater quality impacts related to the use of the KA-13 blowdown pit is pending.

Additional reports covering the remediation works at other Kapuni wellsites are being prepared by URS.

4.4 Investigations, interventions, and incidents

In the 2012-2014 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 relating to the Kapuni blowdown pits or the remediation works.

4.5 Discussion of site performance

The Company no longer uses unlined pits within its operations i.e. the consents are no longer being exercised. For any future activities it has moved to the use of impervious containment systems such as steel tanks, lined pits, and/or separators. There is no evidence of off-site effects outside the conditions of the consents, upon groundwater or more especially the Kapuni Stream.

The Company's consultants have concluded that there is low risk to the stream environment, on the basis of ground and surface water samples to date. Extensive investigation and remediation works are ongoing. The Company has indicated to the Council that it wishes to address any contamination at all wellsites as soon as practicable, rather than wait until 2023 as allowed for under the consents, with the intention of relinquishing the consents following remediation.

4.6 Evaluation of performance

A tabular summary of the consent holder's compliance record for the period under review is set out in Tables 22-24.

Table 22 Summary of performance for Consent 7114-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-6/11 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt the best practicable option to minimise effects	Not exercised in period under review	N/A
2. Undertake activity as outlined in consent application	Not exercised in period under review	N/A
3. No adverse impacts on ground or surface water if consent is exercised further	Inspections, sampling of ground and surface water	Yes
4. Remove any new discharges within 24 hours	Not exercised in period under review	N/A
5. Notification of usage to Council	Not exercised in period under review	N/A
6. Maintenance of monitoring bores	Inspections and liaison	Yes
7. Sampling after usage	Not exercised in period under review	N/A
8. Record keeping	Not exercised in period under review	N/A
9. Remediation of soil prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
10. Remediation of groundwater prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
11. Lapse provision	Consent exercised	N/A
12. Review provision	Next option for review in 2017	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 23 Summary of performance for Consent 7113-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-8/12/15 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt the best practicable option to minimise effects	Not exercised in period under review	N/A
2. Undertake activity as outlined in consent application	Not exercised in period under review	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
3. No adverse impacts on ground or surface water if consent is exercised further	Inspections, sampling of ground and surface water	Yes
4. Remove any new discharges within 24 hours	Not exercised in period under review	N/A
5. Notification of usage to Council	Not exercised in period under review	N/A
6. Maintenance of monitoring bores	Inspection and liaison	Yes
7. Sampling after usage	Not exercised in period under review	N/A
8. Record keeping	Not exercised in period under review	N/A
9. Remediation of soil prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
10. Remediation of groundwater prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
11. Lapse provision	Consent exercised	N/A
12. Review provision	Next option 2017	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 24 Summary of performance for Consent 7005-1 to discharge liquids onto and into land from a purpose built, blowdown pit at the KA-13 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt the best practicable option to minimise effects	Not exercised in period under review	N/A
2. Undertake activity as outlined in consent application	Not exercised in period under review	N/A
3. No adverse impacts on ground or surface water if consent is exercised further	Inspections, sampling of ground and surface water	Yes
4. Remove any new discharges within 24 hours	Not exercised in period under review	N/A
5. Notification of usage to Council	Not exercised in period under review	N/A
6. Acceptable effects within Kapuni Stream	Inspections, sampling, surveys	No effects found in surveys in period under review. No activity.

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. Maintenance of monitoring bores	Inspection and liaison	Yes
8. Sampling after usage	Not exercised in period under review	N/A
9. Record keeping	Not exercised in period under review	N/A
10. Remediation of soil prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
11. Remediation of groundwater prior to expiry or surrender	Inspection and liaison	Company liaising with Council over advancing the programme
12. Lapse provision	Consent exercised	N/A
13. Review provision	Next option 2017	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

4.7 Recommendations from the 2011-2012 Annual Report

In the 2011-2012 Annual Report, it was recommended:-

1. THAT the Council notes STOS is addressing the question of remediation of soil and groundwater in the vicinity of the Kapuni field wellsite blowdown pits on a proactive basis.
2. THAT monitoring of the exercise of and compliance with consents 7005-1, 7113-1, and 7114-1, and of remediation works at other wellsites, continues in the 2012-2013 year at a level adequate to cover the implementation and completion of site remediation works of blowdown pits and to ensure compliance with the conditions of the consents or the Regional Fresh Water Plan more generally.

These recommendations were implemented.

4.8 Recommendation

1. THAT monitoring of consents 7005-1, 7113-1, and 7114-1, and of remediation works at other wellsites, continues in the 2014-2015 year at a level adequate to ensure compliance with the conditions of the consents and provisions in Regional Plans.

5. Summary of recommendations

1. THAT monitoring of consented activities at the Maui Production Station in the 2014-2015 year be amended from that undertaken in 2013-2014 to reflect the Council's changes to the structure of all monitoring programmes.
2. THAT the option for a review of resource consent 5224-2 in June 2015, as set out in condition 4 of the consent, not be exercised, on the grounds that the current conditions are considered adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent.
3. THAT monitoring of consented activities at the Kapuni Production Station in the 2014-2015 year be amended from that undertaken in 2013-2014 to reflect the Council's changes to the structure of all monitoring programmes.
4. THAT monitoring of consents 7005-1, 7113-1, and 7114-1, and of remediation works at other wellsites, continues in the 2014-2015 year at a level adequate to ensure compliance with the conditions of the consents and provisions in Regional Plans.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m ³ s ⁻¹).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m 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.
l/s	Litres per second.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH ₃	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO ₃	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM 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	<i>Resource Management Act</i> 1991 and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
Zn*	Zinc.

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount

of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

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

Bibliography and references

- Taranaki Regional Council (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

Blowdown pits

URS NZ Ltd (August 2013): Kapuni Wellsite Blowdown Pit Decommissioning and Remediation Report. Prepared for STOS Ltd, August 2013 (ref 42789550)

MWH New Zealand Limited (14 April 2008): KA13 Groundwater Sampling – March 2008

MWH New Zealand Limited (14 April 2008): KA8/12/15 Groundwater Sampling – March 2008

MWH New Zealand Limited (February 2008): Environmental Site Assessment Gas Production Well-Site KA5/10, Kapuni, Taranaki

MWH New Zealand Limited (February 2008): Environmental Site Assessment Gas Production Well-Site KA4/14, Kapuni, Taranaki

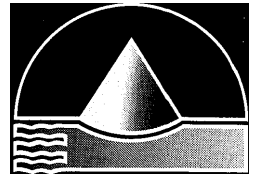
MWH New Zealand Limited (31 January 2008): KA6/11 Groundwater Sampling – November 2007

Pattle Delamore Partners Limited (12 May 2004): Wellsite KA-1/7, Kapuni, Six Monthly Environmental Monitoring Report

Ministry for the Environment (1999): Guidelines for Assessment and Management of Petroleum Hydrocarbon Contaminated Sites

Appendix I

Resource consents held by STOS for Maui Production Station, Kapuni Production Station and the Kapuni wellsites blowdown facilities



**TARANAKI
REGIONAL
COUNCIL**

PRIVATE BAG 713
47CLOTEN ROAD
STRATFORD
NEWZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

**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 Limited
Private Bag 2035
NEW PLYMOUTH

Consent Granted
Date: 11 October 2000

Conditions of Consent

Consent Granted: To discharge treated domestic effluent from the oxidation ponds at the Maui Production Station to the Ngapirau Stream at or about GR: P20:800-999

Expiry Date: 1 June 2018

Review Date(s): June 2006, June 2012

Site Location: Maui Production Station, Tai Road, Oaonui

Legal Description: Lot 1 DP 11402 Pt Ngatitara 6C 6D 6E & 7C Blocks Blk XV
Opunake SD

Catchment: Ngapirau stream between the Oaonui Stream and the
Okawe Stream

Consent 0246-3

General conditions

- 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 consent holder shall properly and efficiently maintain and operate the oxidation ponds system, which shall be regularly maintained in an aerobic condition, to ensure that the conditions of this consent are met.
2. That after allowing for reasonable mixing, within a mixing zone extending 20 metres below the discharge point, the discharge [in conjunction with any other discharges pertaining to the same property] shall not give rise to any of the following effects in the receiving waters:
 - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
 - b) any conspicuous change in the colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life, habitats or ecology.
3. The consent holder shall upgrade the treatment system to avoid effects as a result of algal blooms in the oxidation ponds. The upgrade shall be in accordance with the URS New Zealand Ltd 30 August 2000 report recommendations and be completed by 30 November 2000.
4. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, for the purpose of assessing the effectiveness of works required under special condition 3.
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(l)(a) of the Resource Management Act 1991 to take account of operation requirements or the results of monitoring.

Consent 0246-3

6. 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 significant 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 11 October 2000

For and on behalf of
Taranaki Regional Council

A black rectangular box containing a white handwritten signature in cursive script.

Chief Executive

TRK985224



PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

COASTAL 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 LIMITED
PRIVATE BAG 2035 NEW PLYMOUTH**

Granted Date: **10 March 1998**

CONDITIONS OF CONSENT

Consent Granted: **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 AT OR ABOUT
GR: P20:782-999**

Expiry Date: **1 June 2025**

Review Date[s]: **June 2005 and June 2015**

Site Location: **OAONU BEACH TO OUTER LIMIT OF THE TERRITORIAL SEA,
OAONU**

Catchment: **TASMAN SEA 904.000**

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

TRK985224

General conditions

- a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), 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. THAT the consent holder shall notify the Taranaki Regional Council at least 48 hours prior to undertaking any major maintenance works which could involve disturbance of, or discharge to, the coastal marine area.
2. THAT during any subsequent maintenance works, the consent holder must observe every practicable measure to prevent the discharge of silt and/or debris and/or any other contaminants to, and to minimise the disturbance of, the bed of the coastal marine area.
3. THAT where practicable, the structures licensed by this consent shall be removed and the area reinstated, if and when they are no longer required, to the satisfaction of the General Manager, Taranaki Regional Council.
4. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005 and/or June 2015, for the purpose of ensuring that the conditions adequately deal with the environmental effects arising from the exercise of this consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Signed at Stratford on 10 March 1998

For and on behalf of
TARANAKI REGIONAL COUNCIL



DIRECTOR - RESOURCE MANAGEMENT

Consent 5960-1



PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

Land Use Consent
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 Limited
Private Bag 2035
NEW PLYMOUTH

Consent Granted
Date: 13 February 2002

Conditions of Consent

Consent Granted: To erect, place, use and maintain a concrete ford on the bed of the Kapuni Stream for access purposes at or about GR: Q20:113-915

Expiry Date: 1 June 2023

Review Date(s): June 2005, June 2011, June 2017

Site Location: 318 Palmer Road, Kapuni

Legal Description: Pt Lot 1 DP 5227 Lot 1 DP 12628 Blk XVI Kaupokonui SD

Catchment: Kapuni

Consent 5960-1

General conditions

- 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

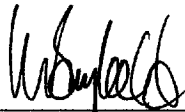
1. The initial construction and any further disturbance of parts of the riverbed covered by water and/or any works which may result in downstream discolouration of water shall be undertaken only between 1 November and 30 April, except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.
2. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to the commencement and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.
3. The structure[s] authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.
4. The consent holder shall adopt the best practicable option to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.
5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.
6. The structure which is the subject of this consent shall not obstruct fish passage.
7. The structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

Consent 5960-1

8. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2005, June 2011, and June 2017, for the purpose of ensuring that the conditions adequately deal with the environmental effects arising from the exercise of this consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 13 February 2002

For and on behalf of
Taranaki Regional Council



Director-Resource Management

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

Name of
Consent Holder: Shell Todd Oil Services Limited
Private Bag 2035
NEW PLYMOUTH

Consent Granted
Date: 24 November 2006

Conditions of Consent

Consent Granted: To discharge liquids onto and into land from a purpose
built, blow down pit at the KA-13 wellsite at or about
GR: Q20:109-904

Expiry Date: 1 June 2023

Review Date(s): June 2011, June 2017

Site Location: KA-13 wellsite, 1049 Skeet Road, Kapuni

Legal Description: Lot 1 DP 14598

Catchment: Kapuni

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

- 1. The consent holder shall adopt the best practicable option [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential adverse effects on the environment arising from the discharge, including but not limited to any water body or soil.
- 2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4423. In the case of any contradiction between the documentation submitted in support of application 4423 and the conditions of this consent, the conditions of this consent shall prevail.
- 3. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.
- 4. The consent holder shall ensure that the well fluids are removed from the blow down pit within 24 hours of being discharged or as soon as practicable.
- 5. The consent holder shall advise the Chief Executive, Taranaki Regional Council, where practicable, at least 24 hours prior and in any case, within 24 hours following each use of the pit.

Consent 7005-1

6. The exercise of this consent shall not result in any of the following effects on the Kapuni Stream:
 - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;
 - b) any conspicuous change in the colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life.
7. The consent holder shall maintain the four monitoring bores set out in the documentation submitted in support of application 4423 and according to the requirements of the Chief Executive, Taranaki Regional Council.
8. The consent holder shall sample the bores after seven days but before 28 days after each use of the pit, and analyse for Total Petroleum Hydrocarbons, Xylenes and Polycyclic Aromatic Hydrocarbons [free phase and formation water], and groundwater table elevation, and provide results to the satisfaction of the Chief Executive, Taranaki Regional Council.
9. The consent holder shall keep records of the following:
 - a) volumes of material discharged
 - b) dates and times of commencement and completion of discharge
 - c) sampling, analysis and results of monitoring

and shall make the records available to the Chief Executive, Taranaki Regional Council, upon request.
10. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the soil shall comply with the guideline values for sandy soil in the surface layer [less than 1 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
11. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the groundwater shall comply with the guideline values for potable groundwater set out in Tables 5.11 and 5.12 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
12. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 7005-1

13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 24 November 2006

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: Shell Todd Oil Services Limited
Private Bag 2035
NEW PLYMOUTH

Consent Granted
Date: 19 June 2007

Conditions of Consent

Consent Granted: To discharge liquids onto and into land from a purpose
built, blow down pit at the KA-8/12/15 wellsite at or about
GR: Q20:117-963

Expiry Date: 1 June 2023

Review Date(s): June 2011, June 2017

Site Location: KA-8/12/15 wellsite, 939 Eltham Road, Kapuni

Legal Description: Lot 1 DP 11292

Catchment: Inaha

Consent 7113-1

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential adverse effects on the environment arising from the discharge, including but not limited to any water body or soil.
2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4632. In the case of any contradiction between the documentation submitted in support of application 4632 and the conditions of this consent, the conditions of this consent shall prevail.
3. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.
4. The consent holder shall ensure that the well fluids are removed from the blow down pit within 24 hours of being discharged.
5. The consent holder shall advise the Chief Executive, Taranaki Regional Council, where practicable, at least 24 hours prior and in any case, within 24 hours following each use of the pit. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.
6. The consent holder shall maintain the four monitoring bores set out in the documentation submitted in support of application 4632 and according to the requirements of the Chief Executive, Taranaki Regional Council.

Consent 7113-1

7. The consent holder shall sample the bores after seven days but before 28 days after each use of the pit, and analyse for Total Petroleum Hydrocarbons, Xylenes and Polycyclic Aromatic Hydrocarbons [free phase and formation water], and groundwater table elevation, and provide results to the satisfaction of the Chief Executive, Taranaki Regional Council.
8. The consent holder shall keep records of the following:
 - a) volumes of material discharged
 - b) dates and times of commencement and completion of discharge
 - c) sampling, analysis and results of monitoring

and shall provide records to the Chief Executive, Taranaki Regional Council, in July of each year for the previous July - June period and upon request.

9. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the soil shall comply with the guideline values for sandy soil in the surface layer [less than 1 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
10. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the groundwater shall comply with the guideline values for potable groundwater set out in Tables 5.11 and 5.12 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
11. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
12. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 19 June 2007

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: Shell Todd Oil Services Limited
Private Bag 2035
NEW PLYMOUTH

Consent Granted
Date: 19 June 2007

Conditions of Consent

Consent Granted: To discharge liquids onto and into land from a purpose
built, blow down pit at the KA-6/11 wellsite at or about
GR: Q21:119-893

Expiry Date: 1 June 2023

Review Date(s): June 2011, June 2017

Site Location: KA-6/11 wellsite, 849 Ahipaipa Road, Kapuni

Legal Description: Lot 1 DP 10950 Blk XVI Kaupokonui SD

Catchment: Inaha

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential adverse effects on the environment arising from the discharge, including but not limited to any water body or soil.
2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4633. In the case of any contradiction between the documentation submitted in support of application 4633 and the conditions of this consent, the conditions of this consent shall prevail.
3. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.
4. The consent holder shall ensure that the well fluids are removed from the blow down pit within 24 hours of being discharged.
5. The consent holder shall advise the Chief Executive, Taranaki Regional Council, where practicable, at least 24 hours prior and in any case, within 24 hours following each use of the pit. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.
6. The consent holder shall maintain the four monitoring bores set out in the documentation submitted in support of application 4633 and according to the requirements of the Chief Executive, Taranaki Regional Council.

Consent 7114-1

7. The consent holder shall sample the bores after seven days but before 28 days after each use of the pit, and analyse for Total Petroleum Hydrocarbons, Xylenes and Polycyclic Aromatic Hydrocarbons [free phase and formation water], and groundwater table elevation, and provide results to the satisfaction of the Chief Executive, Taranaki Regional Council.
8. The consent holder shall keep records of the following:
 - a) volumes of material discharged
 - b) dates and times of commencement and completion of discharge
 - c) sampling, analysis and results of monitoring

and shall provide records to the Chief Executive, Taranaki Regional Council, in July of each year for the previous July - June period and upon request.

9. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the soil shall comply with the guideline values for sandy soil in the surface layer [less than 1 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
10. Prior to the expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the groundwater shall comply with the guideline values for potable groundwater set out in Tables 5.11 and 5.12 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].
11. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
12. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and/or June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 19 June 2007

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: M & O Pacific Limited
P O Box 265
NEW PLYMOUTH 4340

Consent Granted
Date: 11 October 2000

Conditions of Consent

Consent Granted: To discharge treated stormwater and wastewater from fire fighting at the Fire Training Centre at the Maui Production Station to the Oaonui Stream at or about (NZTM) 1669945E-5638740N

Expiry Date: 1 June 2018

Review Date(s): June 2006, June 2012

Site Location: Fire Training Centre, Maui Production Station,
Tai Road, Oaonui

Legal Description: Ngatitara 7C Block Blk XV Opunake SD

Catchment: Oaonui

General conditions

- 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 settling ponds 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:

<u>Contaminant</u>	<u>Concentration</u>
Total recoverable hydrocarbons	15 gm ⁻³
Suspended solids	50 gm ⁻³
3. That, other than specified in condition 2, no chemicals or agents may be discharged without the written approval of the Chief Executive, of the Taranaki Regional Council.
4. After allowing for reasonable mixing, within a mixing zone extending 10 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving water:
 - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
 - b) any conspicuous change in 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.
5. 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.

Consent 1228-4

6. 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.
7. 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.

Transferred at Stratford on 24 November 2009

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: Shell Todd Oil Services Ltd
Private Bag 2035
NEW PLYMOUTH 4342

Decision Date: 1 August 2011

Commencement
Date: 1 August 2011

Conditions of Consent

Consent Granted: To discharge treated stormwater from the Kapuni Production
Station into the Kapuni Stream at or about (NZTM)
1701051E-5629618N

Expiry Date: 1 June 2029

Review Date(s): June 2017, June 2023

Site Location: Kapuni Production Station, Palmer Road, Kapuni

Legal Description: Pt Lot 1 DP 5227 Blk XVI Kaupokonui SD [Discharge source]
Lot 1 DP 15254 [Discharge site]

Catchment: Kapuni

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

General condition

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

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
2. The stormwater discharged shall be from a catchment area not exceeding four hectares.
3. All stormwater shall be directed for treatment through the stormwater treatment system for discharge in accordance with the special conditions of this permit.
4. Constituents of the discharge shall meet the standards shown in the following table.

<u>Constituent</u>	<u>Standard</u>
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm ⁻³
total recoverable hydrocarbons	Concentration not greater than 15 gm ⁻³
chloride	Concentration not greater than 50 gm ⁻³

This condition shall apply before entry of the treated stormwater into the receiving waters at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

5. After allowing for reasonable mixing, within a mixing zone extending 25 metres downstream of the discharge point, the discharge shall not, either by itself or in combination with other discharges, give rise to any or all of the following effects in the Kapuni Stream:
 - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
 - b) any conspicuous change in the colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life.
6. The consent holder shall maintain a contingency plan. The contingency plan shall be adhered to in the event of a spill or emergency and shall, to the satisfaction of the Chief Executive, Taranaki Regional Council, detail measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.

Consent 0633-3

7. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to making any changes to the processes or operations undertaken at the site, or the chemicals used or stored on site, that could alter the nature of the discharge. Any such change shall then only occur following receipt of any necessary approval under the Resource Management Act.
8. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review:
 - a) during the month of June 2017 and/or June 2023; and/or
 - b) within 3 months of receiving a notification under special condition 7 above;

for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 1 August 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of
Consent Holder: Shell Todd Oil Services
Private Bag 2035
NEW PLYMOUTH 4342

Decision Date 9 August 2013
[change]:

Commencement Date 9 August 2013 [Granted: 9 November 2001]
[change]:

Conditions of Consent

Consent Granted: To discharge emissions into the air from combustion involving flaring of petroleum products incidental to the treatment of gas at the Kapuni Production Station

Expiry Date: 1 June 2017

Site Location: Kapuni Production Station, Palmer Road, Kapuni

Legal Description: Pt Lot 1 DP 5227 Lot 1 DP 12628 Bk XVI Kaupokonui SD

Grid Reference (NZTM) 1701044E-5629660N

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

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants into the environment from the flare emissions.
2. The consent holder shall minimise the emissions and impacts of air contaminants discharged from the flares by the selection of the most appropriate process equipment, process control equipment, emission control equipment, methods of control, supervision and operation, and the proper and effective operation, supervision, control and maintenance of all equipment and processes.
3. The consent holder shall undertake effective liquid separation and recovery, as far as is practicable, to avoid or mitigate smoke emissions during flaring.
4. The consent holder shall provide to the Taranaki Regional Council during August of each year, for the duration of this consent, a report:
 - i) detailing gas combustion in the flares under condition 9;
 - ii) detailing smoke emissions as required under condition 12;
 - iii) detailing any measures to reduce smoke emissions;
 - iv) detailing any measures to reduce flaring;
 - v) providing data on the emitted and/or ambient concentrations and/or mass discharge rates and/or an emission inventory, of such contaminants the Chief Executive, Taranaki Regional Council, may from time to time specify; and
 - vi) addressing any other issue relevant to the minimisation or mitigation of emissions from the flares.

Consent 4054-5

5. All equipment used to avoid, remedy or mitigate any effect on the environment from the discharge of emissions into the air shall be maintained in good condition and shall be operated within design parameters at all times that the flares are in operation.
6. The discharges authorised by this consent shall not give rise to any offensive or obnoxious or objectionable odour at or beyond the site boundary in the opinion of an enforcement officer of the Taranaki Regional Council.
7. Prior to undertaking any alterations to the plant, processes or operations, which may significantly change the nature or quantity of contaminants emitted to air from the flares, the consent holder shall first consult with the Chief Executive and shall obtain any necessary approvals under the Resource Management Act 1991.
8. The consent holder shall, whenever practicable, notify the Chief Executive whenever the continuous flaring of hydrocarbons [other than purge gas] is expected to occur for more than five minutes in duration.
9. The consent holder shall keep and maintain a log of all continuous flaring incidents longer than 2 minutes and any intermittent flaring lasting for an aggregate of 4 minutes or longer in any 60-minute period. Such a log shall contain the date, the start and finish times, the quantity and type of material flared, and the reason for flaring. This log shall be made available to the Chief Executive upon request, and summarised annually in the report required under condition 4.
10. All practicable steps shall be taken to minimise flaring.
11. Other than in emergencies, or during tests or exercises to simulate emergencies to a maximum frequency of twice per year, depressurisation of the plant, or sections of the plant, shall be carried out over a sufficient period of time to prevent dense black smoke from being discharged from the flares.
12. The consent holder shall keep and make available to the Chief Executive, upon request, a record of all smoke emitting incidents, noting time, duration and cause. The consent holder shall also keep, and make available to the Chief Executive, upon request, a record of all complaints received as a result of the exercise of this consent.

Consent 4054-5

13. Subject to the provisions of this condition, the Council may within six months of receiving a report prepared by the consent holder pursuant to condition 4 of this consent but not more often than once every three years, or in June 2005 and/or June 2011, serve notice that it intends to review the conditions of this resource consent in accordance with section 128(1)(a) of the Resource Management Act 1991 for the purposes of:
- (a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with; and/or
 - (b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
 - (c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant or contaminants.

Signed at Stratford on 09 August 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of Consent Holder: Shell Todd Oil Services Ltd
Private Bag 2035
NEW PLYMOUTH 4342

Decision Date (Change): 9 August 2013

Commencement Date (Change): 9 August 2013 [Granted: 9 January 2003]

Conditions of Consent

Consent Granted: To discharge emissions into the air from the refining and distribution of hydrocarbons and associated processes at the Maui Production Station site

Expiry Date: 1 June 2024

Review Date(s): June 2018

Site Location: Maui Production Station, Tai Road, Oaonui

Legal Description: Ngatitara 6D & 6E Blk XVI Lot 1 DP 11402 Opunake SD

Grid Reference (NZTM) 1670046E-5638140N

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

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants into the air from the site.
2. The consent holder shall minimise the emissions and impacts of air contaminants discharged from the site by the selection of the most appropriate process equipment, process control equipment, emission control equipment, methods of control, supervision and operation, and the proper and effective operation, supervision, control and maintenance of all equipment and processes.
3. All equipment used to avoid, remedy, or mitigate any effect on the environment from the discharge of emissions into the air shall be maintained in good condition and shall be operated within design parameters at all times that the plant is in operation.
4. The consent holder shall undertake effective liquid separation and recovery, as far as is practicable, to avoid or mitigate smoke emissions during flaring.
5. The consent holder shall provide to the Taranaki Regional Council during August of each year, for the duration of this consent, a report:
 - a) detailing gas combustion in the flares under condition 16, such information to be compiled on a month by month basis;
 - b) detailing smoke emissions as required under condition 15;
 - c) detailing any measures to reduce smoke emissions;
 - d) detailing any measures to reduce flaring;
 - e) providing data on the emitted and/or ambient concentrations and/or mass discharge rates and/or an emission inventory, of such contaminants the Chief Executive, Taranaki Regional Council, may from time to time specify;

Consent 4052-4

- f) detail current measures by the consent holder to improve plant efficiency on the site; and
 - g) addressing any other issue relevant to the minimisation or mitigation of emissions from the flares or from elsewhere on the site.
6. The discharges authorised by this consent shall not give rise to any offensive or obnoxious or objectionable odour at or beyond the site boundary in the opinion of an enforcement officer of the Taranaki Regional Council.
 7. The consent holder shall control all emissions of sulphur dioxide to the atmosphere from the site, in order that the maximum ground level concentration of sulphur dioxide arising from the exercise of this consent measured under ambient conditions does not exceed $350 \mu\text{g m}^{-3}$ [one-hour average exposure] or $125 \mu\text{g m}^{-3}$ [twenty-four hour average exposure] at or beyond the boundary of the site.
 8. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the site, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed $100 \mu\text{g m}^{-3}$ [twenty-four hour average exposure], or $200 \mu\text{g m}^{-3}$ [one-hour average exposure] at or beyond the boundary of the site.
 9. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the site arising through the exercise of any other consent, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10mg m^{-3} [eight-hour average exposure], or 30mg m^{-3} one-hour average exposure] at or beyond the boundary of the property on which the production station flare is located.
 10. The consent holder shall control all emissions of benzene to the atmosphere from the site, in order that the maximum ground level concentration of benzene arising from the exercise of this consent measured under ambient conditions does not exceed the relevant Ministry for the Environment Ambient Air Quality Guideline for benzene [$10 \mu\text{g m}^{-3}$ [annual average exposure] from 2002 until 2010 and $3.6 \mu\text{g m}^{-3}$ [annual average exposure] from 2010] at or beyond the boundary of the site.
 11. The consent holder shall control all emissions to the atmosphere from the site of contaminants other than carbon dioxide, sulphur dioxide, carbon monoxide, and nitrogen oxides, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the site is not increased above background levels:
 - a) by more than 1/30th of the relevant Occupational Threshold Value-Time Weighted Average, or by more than the Short Term Exposure Limit at any time, [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or
 - b) if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average at any time, [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

Consent 4052-4

12. Prior to undertaking any alterations to the plant, processes or operations, which may significantly change the nature or quantity of contaminants emitted to air from the site, the consent holder shall first consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act.
13. The consent holder shall whenever practicable notify the Chief Executive, Taranaki Regional Council, whenever the continuous flaring of hydrocarbons (other than purge gas) is expected to occur for more than five minutes in duration.
14. Any incident having air environment impact or potential impact which has or is liable to cause significant substantiated complaint or a hazardous situation beyond the boundary of the consent holder's site, shall be notified to the Taranaki Regional Council, as soon as possible, followed by a written report to the Chief Executive, Taranaki Regional Council, within one week of the incident, with comment about the measures taken to minimise the impact of the incident and to prevent re-occurrence.
15. The consent holder shall keep and make available to the Chief Executive, upon request, a record of all smoke emitting incidents, noting time, duration and cause. The consent holder shall also keep, and make available to the Chief Executive, upon request, a record of all complaints received as a result of the exercise of this consent.
16. The consent holder shall keep and maintain a log of all continuous flaring incidents longer than five minutes, and any intermittent flaring lasting for an aggregate of ten minutes or longer in any 120-minute period. Such a log shall contain the date, the start and finish times, the quantity and type of material flared, and the reason for flaring. This log shall be made available to the Chief Executive upon request, and summarised annually in the report required under condition 5. All practicable steps shall be taken to minimise flaring.
17. Other than in emergencies, or during tests or exercises to simulate emergencies to a maximum frequency of twice per year, depressurisation of the plant, or sections of the plant, shall be carried out over a sufficient period of time to prevent dense black smoke from being discharged from the flares.
18. Subject to the provisions of this condition, the Council may within six months of receiving a report prepared by the consent holder pursuant to condition 5 of this consent but not more often than once every three years, or in June 2006 and/or June 2012 and/or June 2018, serve notice that it intends to review the conditions of this resource consent in accordance with section 128(1)(a) of the Resource Management Act 1991 for the purposes of:
 - a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with; and/or
 - b) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by the discharge; and/or
 - c) to alter, add or delete limits on mass discharge quantities or discharge or ambient concentrations of any contaminant or contaminants; and/or

Consent 4052-4

- d) taking into account any Act of Parliament, regulation, national policy statement or national environmental standard which relates to limiting, recording, or mitigating emissions of carbon dioxide, sulphur dioxide, nitrogen dioxide and/or benzene, and which is relevant to the air discharge from the Maui Production Station.

Signed at Stratford on 09 August 2013

For and on behalf of
Taranaki Regional Council

Director-Resource Management

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

Name of Consent Holder:	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:

<u>Contaminant</u>	<u>Concentration</u>
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.

Consent 0245-3

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 reports

To Callum McKenzie, Job Manager
 From Bart Jansma, Scientific Officer
 File 03-02-005-13/01; 0245; 0246;
 Report No BJ194
 Doc No 1214873
 Date 26 October 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

Introduction

This spring biological survey of an unnamed coastal stream receiving wastewater from the Maui gas treatment plant at Oaonui was the only survey scheduled for the 2012-2013 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 22 November 2012 by the Taranaki Regional Council. The sampling method employed was the 'kick-net' sampling technique, which is very similar to Protocol C1 (hard-bottomed, semi-quantitative), and the 'sweep-sampling' technique is very similar to Protocol C2 (soft-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 morning survey, the water temperatures in the stream were 19.6°C at site 2, approximately 500m downstream of the production station and 15.7°C at site 3,

approximately 1,600m downstream of the production station. The moderate and steady stream flow was uncoloured but cloudy 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 relatively soft, being dominated by sand, silt and fine gravel at both sites. Slippery films of periphyton were present at both sites, while site 2 sites also had widespread growths of filamentous algae. It was noted during the survey, that the degree of filamentous algal growth at site 2 was severe, and likely to severely impact on the macroinvertebrate community health. Site 3 was partially shaded by long grass. Both sites had macrophyte growth on the edges of the stream, and some of this habitat may have been disturbed while undertaking the kick sampling. 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 five surveys.

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 autumn 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=22)		
		Range	Median	Current survey	Range	Median	Current survey	Range	Median	Current survey
2	42	8-21	16	15	44-75	62	72	1.1-3.7	2.4	2.5
3	31	9-26	16	16	58-72	66	74	1.3-4.6	2.6	4.6

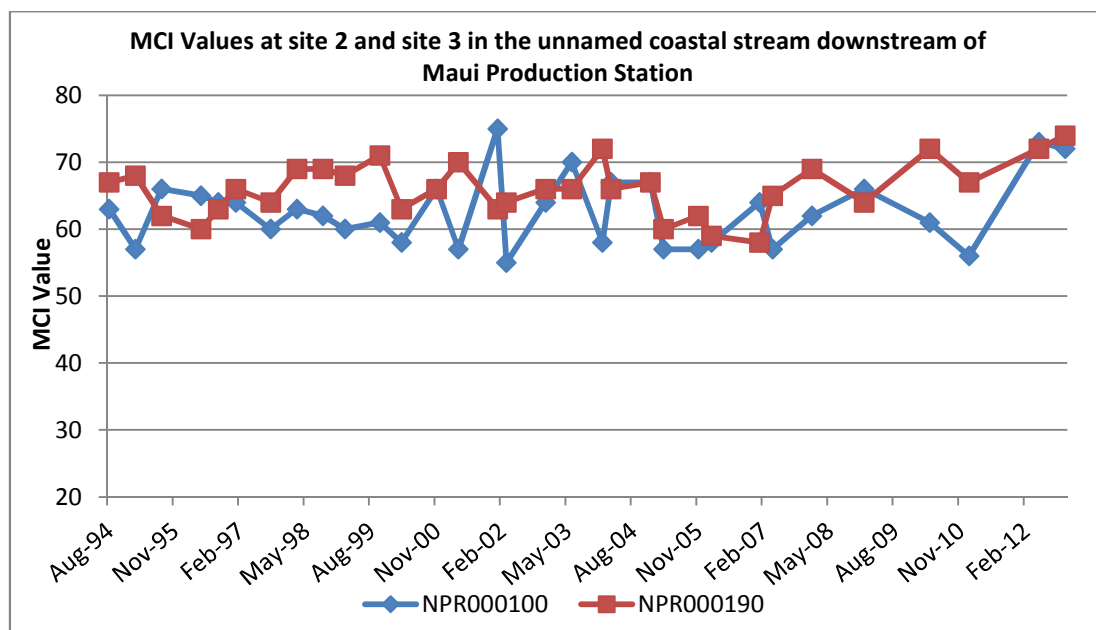


Figure 2 MCI values recorded in the unnamed (‘Ngapirau’) coastal stream that receives discharges from the Maui Production Station since August 1994

Table 3 Macroinvertebrate fauna of an unnamed coastal stream ('Ngapirau' Stream) in relation to the Maui Production Station, sampled on 22 November 2012

Taxa List	Site Number	MCI score	2	3
	Site Code		NPR000100	NPR000190
	Sample Number		FWB12436	FWB12437
ANNELIDA (WORMS)	Oligochaeta	1	XA	A
	Lumbricidae	5	R	R
MOLLUSCA	<i>Physa</i>	3	A	-
	<i>Potamopyrgus</i>	4	XA	A
CRUSTACEA	Ostracoda	1	A	A
	<i>Paracalliope</i>	5	-	XA
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	-	R
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	C	C
COLEOPTERA (BEETLES)	Elmidae	6	-	R
	Dytiscidae	5	R	-
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	A	R
	<i>Oxyethira</i>	2	C	C
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	-	R
	<i>Paralimnophila</i>	6	R	-
	<i>Zelandotipula</i>	6	R	-
	<i>Chironomus</i>	1	-	R
	<i>Maoridiamesa</i>	3	C	-
	Orthocladinae	2	A	R
	<i>Polypedilum</i>	3	-	R
	Tanytarsini	3	R	-
	Ephydriidae	4	C	-
	<i>Austrosimulium</i>	3	-	A
ACARINA (MITES)	Acarina	5	-	R
No of taxa			15	16
MCI			72	74
SQMCI _s			2.5	4.6
EPT (taxa)			1	2
%EPT (taxa)			7	13
'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 one taxon lower than 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 five 'tolerant' taxa (oligochaete worms (extremely abundant); snails (*Physa* and *Potamopyrgus*), ostracod seed-shrimps and orthoclad midge larvae).

This site's slow flowing, nutrient-enriched and soft-bed habitat supported a predominance of 'tolerant' taxa (67% of taxa number), resulting in the 'poor' MCI score of 72 units. This score was ten units higher than the median of all previous scores (Table 2) and the third highest score recorded to date at this site (Figure 2). The extreme abundance of 'tolerant' oligochaete worms and *Potamopyrgus* was reflected in the moderately low SQMCI_s value of 2.5 units. Although this continues to indicate poor water quality preceding this survey, it is not dissimilar to the median SQMCI_s score for this site, and reflective of the significant algal cover observed at the time. increased macrophyte cover. Compared with the previous survey, the abundance of the damselfly larvae *Xanthocnemis* has decreased. This is

considered to reflect the reduced macrophyte habitat, rather than being a possible indication of impacts caused by the Maui Production Station discharge. In general, the current results are relatively typical for this site, and indicate that the lack of good invertebrate habitat is also contributing.

Site 3

A similar community richness of 16 taxa was found at site 3, equal to the median richness for this site (Table 2). The community was dominated by four 'tolerant' taxa (oligochaete worms, snail (*Potamopyrgus*), ostracod seed shrimp and *Austrosimulium* sandfly larvae) and one 'moderately sensitive' taxon (*Paracalliope* amphipods).

This softer-bottomed, nutrient enriched habitat again supported a predominance of 'tolerant' taxa (56% of taxa number), resulting in the MCI score of 74 units. This score was not significantly different to the median MCI score for this site, and was almost identical to that recorded at site 2 upstream (Figure 2) (Table 2). The significantly reduced abundance of a number 'tolerant taxa', including oligochaete worms and *Physa* snails of ostracod seed shrimps coupled with the increased abundance of amphipods resulted in a significant improvement in SQMCI_s score (4.6 units), from that recorded at site 2 upstream. This score is also significantly higher than the median for this site, and equal to that recorded in the previous survey, which recorded the maximum score of the 22 samples collected previously at this site. Like two of the previous three surveys, community compositions were somewhat dissimilar at the two sites with 35% of the total taxa (23) found in the reach of the stream surveyed, present at both sites. This is likely related to the poorer habitat at site 2 and the increased shading at site 3.

Conclusions

This spring 2012 biomonitoring survey of a small coastal stream that receives wastewater (including treated sewage) from the Oaonui Production Station was undertaken during a relatively normal spring period, although the stream had been in recession for just over a week 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 the upper site 2 also indicated a lack of impacts of the discharge on the stream, with only subtle improvement in the quality of the macroinvertebrate communities with distance downstream. The MCI values were almost identical at sites 2 and 3, although the SQMCI_s score improved significantly at site 3, and this is considered to be reflection of slightly improved habitat at this site, primarily through improved shading and reduced algal growth, although overall, the scores at both sites were reflective of the poor habitats over the spring period.

Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from an unnamed coastal stream. 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 spring 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 moderate flow conditions in spring.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa at both sites where the communities were dominated mainly by 'tolerant' taxa. Only one 'moderately sensitive' taxon was abundant at each site. At both sites, taxonomic richness (number of taxa) and MCI scores had not changed significantly at the time of this autumn survey compared to previous surveys. There was some improvement in SQMCI_s scores at both sites, with site 3 recording a new maximum score. This is considered to be reflection of slightly improved habitat at this site, primarily through improved shading and reduced algal growth, although overall, the scores at both sites were reflective of the poor habitats over the spring period.

MCI and SQMCI_s scores indicated that the stream communities were of above average but poor 'health' although probably typical of communities in drain-like habitats in spring.

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

To Job Manager, C MacKenzie
 From Freshwater Biologist, B Jansma
 File 03-02-005-13/01; 0633;
 Report No BJ220
 Document No 1287429
 Date 6 December 2013

Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2013

Introduction

This biological survey of two sites in the Kapuni Stream was conducted to monitor effects related to the discharge of stormwater from the Kapuni Production Station. The survey fulfilled the biological monitoring requirements for this industry in the 2012-2013 monitoring year. Results from surveys performed since the 2000-2001 monitoring year are discussed in reports referenced in this report.

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from two established sites in the Kapuni Stream related to the Kapuni Production Station stormwater discharge (Table 1, Figure 1) on 13 March 2013. This 'kick-sampling' technique 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).

Table 1 Biomonitoring sites in the Kapuni Stream, related to the Kapuni Production Station

Site No.	Site Code	Map Reference	Location
2	KPN000285	Q20: 112914	Upstream of Kapuni Production Station
2b	KPN000289	Q20: 111914	50 metres downstream of Production Station discharge

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using 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. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The

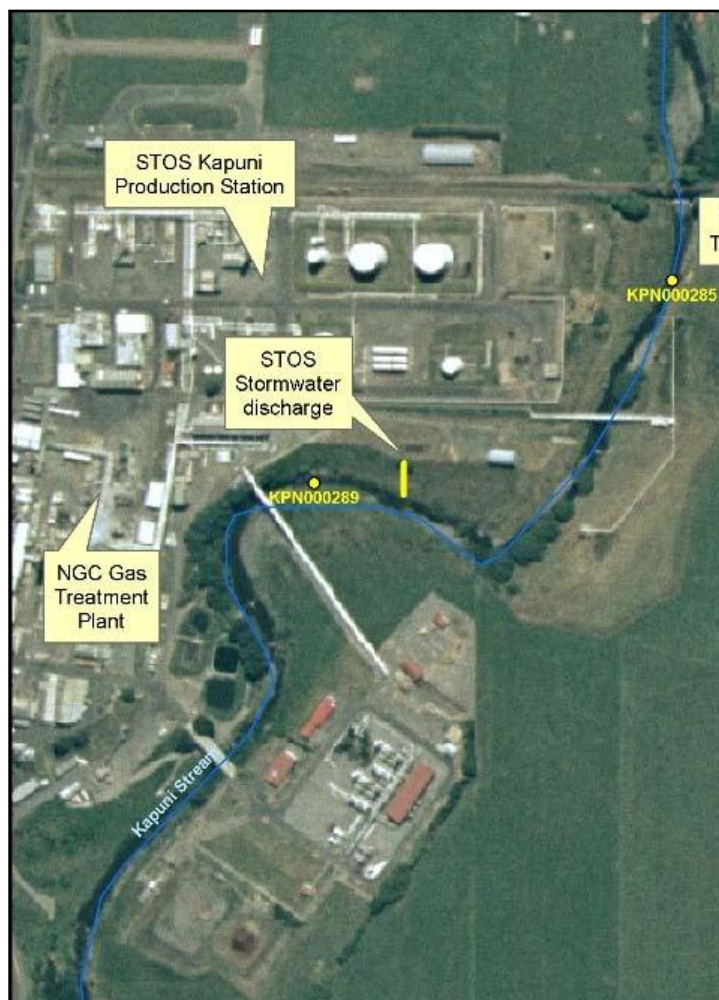


Figure 1 Biomonitoring sites in the Kapuni Stream related to the Kapuni Production Station

MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities 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, so that its corresponding range of values is 20x lower.

Results and discussion

At the time of this early afternoon survey there was a clear, uncoloured, very low flow in the Kapuni Stream and the water temperatures ranged from 18.9°C to 19.9°C at the two sites. The bed of the stream was predominantly comprised of cobble and gravel with some boulder also recorded at site 2b. Thin films of periphyton were present at both sites, but no filamentous algae despite little shade from riparian vegetation. This survey was performed during late summer, following a relatively dry period, and followed a moderate low flow

period, 36 and 37 days after freshes in excess of three times and seven times median flows respectively.

Macroinvertebrate communities

Previous biological surveys in the Kapuni Stream have generally recorded macroinvertebrate communities that would be expected in clean, mid reaches of Taranaki ring plain streams. The communities have had moderate to relatively good numbers of taxa and relatively high MCI values. The results of previous surveys are summarised in Table 2 together with current results and are illustrated in Figure 2 and Figure 3. The results for site 2b also include results from the long term monitoring programme performed by Cawthron Institute/Stark Environmental for other consented discharges. The full macroinvertebrate results of this survey are presented in Table 3.

Table 2 Numbers of taxa and MCI values recorded in previous surveys in the Kapuni Stream in relation to the Kapuni Production Station since May 1987, together with current results.

Site no.	Site	Number of previous surveys	Numbers of taxa			MCI values		
			Median	Range	Current Survey	Median	Range	Current Survey
2	KPN000285	22	23	18-33	33	105	94-132	116
2b	KPN000289	100	19	11-35	30	113	90-145	115

Site 2 Upstream of Kapuni Production Station

A high richness of thirty three taxa was recorded at site 2, upstream of the Kapuni Production Station; ten taxa more than the median found by 22 previous surveys (Table 2), and somewhat higher than that of the last few surveys, being equal to the previous maximum recorded in 2001 (Figure 2). Nine 'highly sensitive' taxa were present, with the community characterised by three of these 'highly sensitive' taxa (mayfly (*Deleatidium* & *Nesameletus*) and caddisfly (*Beraeoptera*)); as well as six 'moderately sensitive' taxa (very abundant mayfly (*Coloburiscus*), dobson fly larvae (*Archichauliodes*), stony cased caddis (*Pycnocentroides*), abundant *Hydrobiosis* caddisfly and *Aphrophila* crane fly); and one 'tolerant' taxon (net-building caddisfly (*Aoteapsyche*)).

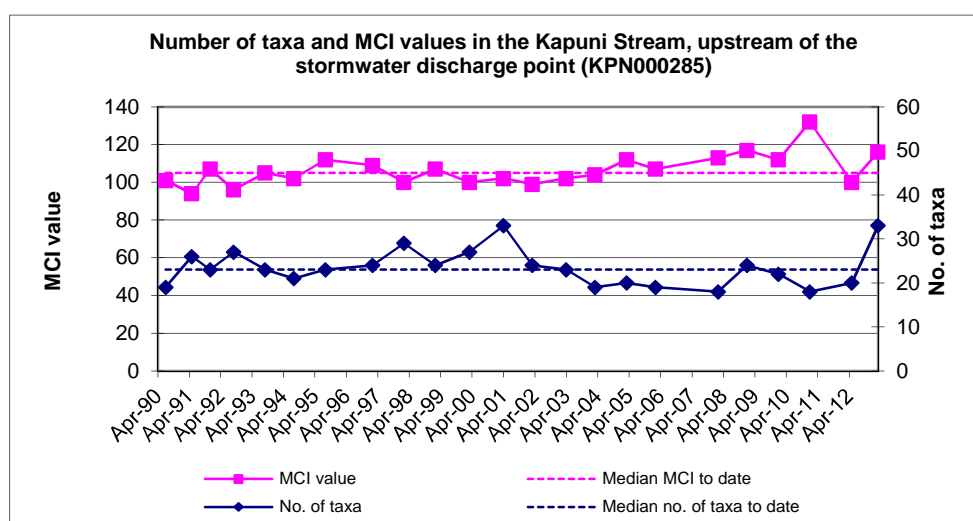


Figure 2 Number of taxa and MCI values in the Kapuni Stream upstream of STOS discharge

Table 3 Macroinvertebrate fauna of the Kapuni River re STOS Kapuni Production Station sampled on 13 March 2013

Taxa List	Site Number	MCI score	2	2b	
	Site Code		KPN000285	KPN000289	
	Sample Number		FWB13154	FWB13155	
NEMERTEA	Nemertea	3	R	R	
ANNELIDA (WORMS)	Oligochaeta	1	C	C	
	Lumbricidae	5	-	R	
MOLLUSCA	<i>Potamopyrgus</i>	4	R	R	
EPHEMEROPTERA (MAYFLIES)	<i>Ameletopsis</i>	10	R	-	
	<i>Austroclima</i>	7	C	C	
	<i>Coloburiscus</i>	7	VA	A	
	<i>Deleatidium</i>	8	XA	XA	
	<i>Nesameletus</i>	9	A	R	
	<i>Zephlebia group</i>	7	R	-	
PLECOPTERA (STONEFLIES)	<i>Austroperla</i>	9	-	R	
	<i>Megaleptoperla</i>	9	R	R	
	<i>Stenoperla</i>	10	R	-	
	<i>Zelandobius</i>	5	R	-	
	<i>Zelandoperla</i>	8	-	R	
COLEOPTERA (BEETLES)	Elmidae	6	XA	VA	
	Hydraenidae	8	C	R	
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	VA	A	
TRICHOPTERA (CADDISFLIES)	<i>Aoleapsyche</i>	4	VA	VA	
	<i>Costachorema</i>	7	R	C	
	<i>Hydrobiosis</i>	5	A	C	
	<i>Plectrocnemia</i>	8	R	-	
	<i>Psilochorema</i>	6	R	R	
	<i>Beraeoptera</i>	8	VA	C	
	<i>Olinga</i>	9	C	R	
	<i>Pycnocentria</i>	7	-	R	
	<i>Pycnocentroides</i>	5	VA	C	
	<i>Triplectides</i>	5	-	R	
	DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	A	A
		Eriopterini	5	C	C
		<i>Maoridamesa</i>	3	-	R
Orthoclaadiinae		2	C	A	
<i>Polypedilum</i>		3	R	C	
Tanypodinae		5	R	-	
Tanytarsini		3	R	-	
Ephydriidae		4	-	R	
<i>Austrosimulium</i>		3	R	R	
Tabanidae		3	R	-	
Tanyderidae	4	R	-		
ACARINA (MITES)	Acarina	5	R	-	
		No of taxa	33	30	
		MCI	116	115	
		SQMCI	6.7	6.8	
		EPT (taxa)	17	16	
		%EPT (taxa)	52	53	
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa		

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

The moderate proportion of 'sensitive' taxa (70% of taxa numbers) comprising the community was reflected in the MCI score of 116 units, which was significantly higher than that recorded in the previous survey (Stark, 1998), and the median of all past survey scores (Figure 2 and Table 2). This is a return to the trend observed from 2005 to 2011, when this site recorded MCI scores well above the median score. In addition, the score was similar to the predicted score for this site, 18.1 km downstream of the National Park boundary (Stark and Fowles, 2009). A reasonably high SQMCI (6.7 units) reflected the relative dominance of 'highly sensitive' taxa in the community at this site.

Site 2b 50 m downstream of Kapuni Production Station discharge

A similar richness (30 taxa) was recorded at site 2b, a further 300m downstream and 50 m below the production station stormwater discharge. This richness was eleven taxa above the

median found by the long term record of 100 previous surveys at this site and nine more than that recorded by the previous survey at this site (Table 2 and Figure 3). There were eight 'highly sensitive' taxa present, indicative of good preceding physicochemical water quality. The community was characterised by one 'highly sensitive' taxon (extremely abundant mayfly (*Deleatidium*)); four 'moderately sensitive' taxa (abundant mayfly (*Coloburiscus*), very abundant elm mid beetles, abundant dobson fly larvae (*Archichauliodes*) and crane fly (*Aphrophila*)) and two 'tolerant' taxa (very abundant net-spinning caddisfly (*Aoteapsyche*) and abundant orthoclad midges). Six of these abundant taxa were also recorded in abundance at site 2b.

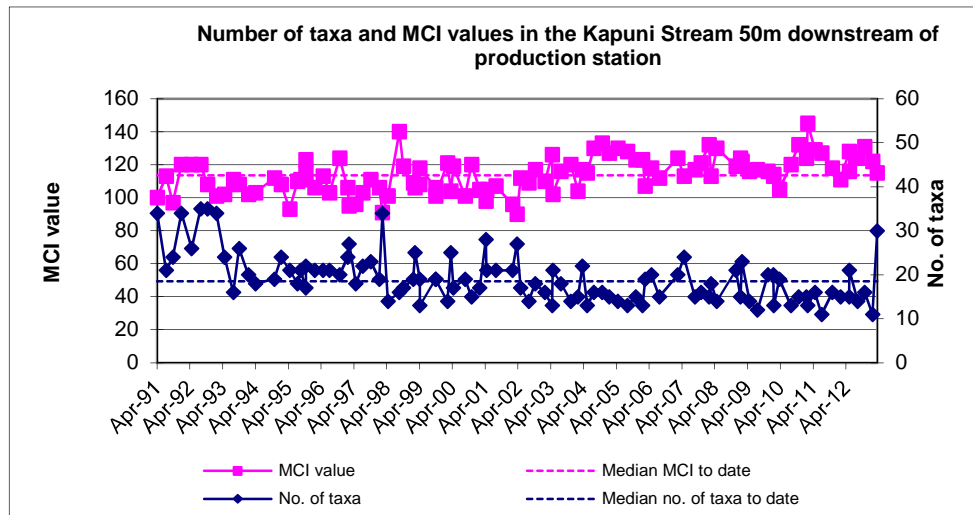


Figure 3 Number of taxa and MCI values in the Kapuni Stream 50m d/s of the Kapuni production station discharge.

There were three significant changes in individual taxa abundance recorded between sites, with two 'highly sensitive' and one highly sensitive taxon reducing in abundance from site 2 to 2b. Generally the dominant taxa at the two sites were very similar, which were reflected in the SQMCI_s scores, which were not statistically significantly different to each other (Table 2 and Table 3) (Stark, 1998). Similarly, the MCI score (115) was only one unit lower than that recorded at site 2b (Stark, 1998), which was not significantly different to the median for this site. This similarity reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and was less suited to snails or midge larvae. This is the eighth consecutive above average score recorded at this site (Figure 3).

Summary and Conclusions

The Council's standard 'kick-net' sampling technique was used at two sites to collect streambed macroinvertebrates from the Kapuni Stream to assess whether stormwater discharges from the STOS Kapuni Production Station have had any adverse effects on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), 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 environmental conditions. The SQMCI_s takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring.

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

This March 2013 biological survey of the Kapuni Stream performed under very low late summer flow conditions indicated that stormwater discharges from the Kapuni Production Station had not had any recent significant impacts on the macroinvertebrate communities of the stream. These communities had high community richnesses, an increase on that recorded in the previous survey. Similar characteristic taxa were recorded in the communities at both sites, resulting in similar SQMCI_s scores. The MCI score was also similar to recorded at site 2b (Stark, 1998), and the score recorded at site 2 was significantly higher than the median for this site. This similarity in MCI score reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and was less suited to snails or midge larvae and was indicative of the absence of any recent impacts of any stormwater discharges from the Kapuni Production Station.

References

- Colgan BG, 2003: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, April 2003. TRC report BC008.
- Dunning KJ, 2001: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, April 2001. TRC report KD69.
- Dunning KJ, 2002: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2002. TRC report KD117.
- Fowles CR and Jansma B, 2008: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, February 2008. TRC report CF455.
- Fowles CR and Moore SC, 2004: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2004. TRC report CF316.
- Fowles CR and Hope KJ, 2005: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2005. TRC report CF386.
- Hope KJ, 2006: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, February 2006. TRC report KH083.
- Jansma B, 2009: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2009. TRC report BJ066.
- Jansma B, 2011: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2010. TRC Report BJ130.
- Jansma B, 2011: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2011. TRC Report BJ160.

- Jansma B, 2012: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, May 2012. TRC Report BJ177.
- McWilliam, 2000: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2000. TRC report HM215.
- 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 Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Stark JD and Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ring plain stream. Prepared for Taranaki Regional Council. Stark Environmental Report No. 2009-01. 47p.
- Taranaki Regional Council, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrates surveys performed during the period from January 1980 to 31 December 1998. (State of the Environment Monitoring Reference Report). Technical Report 99-17

To Callum McKenzie & Victoria McKay; Job Managers
 From Brooke Thomas & Bart Jansma; Scientific Officers
 Report No BT022
 Doc No 1386097
 Date 08 August 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

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 2013-2014 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 16 December 2013 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.

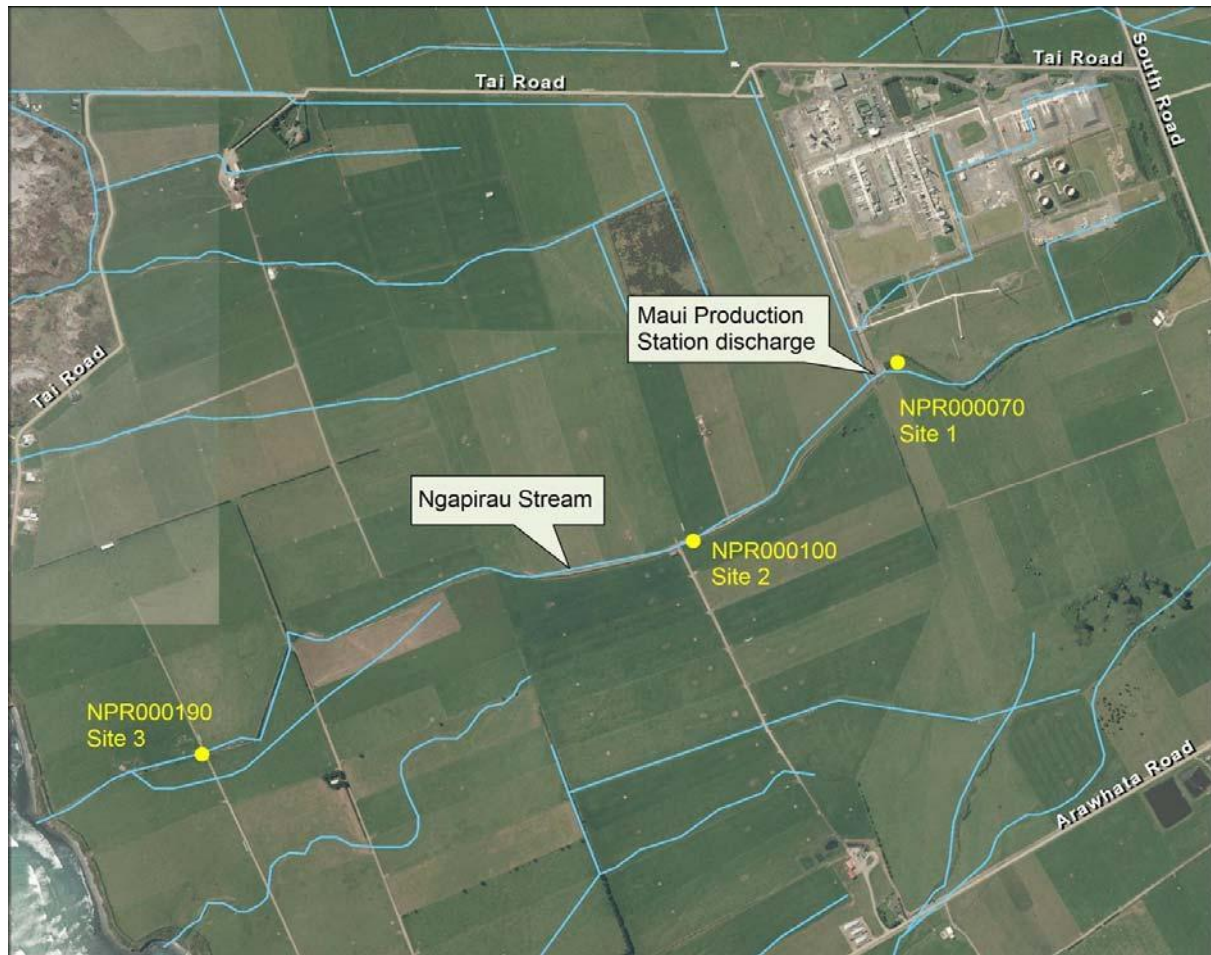


Figure 1 Biomonitoring sites in the unnamed ('Ngapirau') coastal stream adjacent to the Maui Production Station

Results and discussion

At the time of this midday survey, the water temperatures in the stream were 23.6°C at site 2, approximately 500m downstream of the production station and 20.7°C at site 3,

approximately 1,600m downstream of the production station. The moderate and swift stream flow was uncoloured and clear at both sites and followed a short recession period, 10 days after the most recent fresh (above 3 times median flow) in the nearby Punehu Stream.

The streambed was comprised mainly of bedrock, cobbles and boulders at site 2, with the addition of some silt, sand and gravels. The substrate at site 3 was relatively soft, and was dominated by sand, silt and fine gravel. Site 2 had extensive patchy algal mats (some in floating mats) and widespread filamentous algae. Site 3 had less severe algae mats, and only patchy filamentous algae. Site 2 was completely unshaded whereas site 3 was partially shaded. Unlike the previous survey, no macrophyte growth was recorded on the edges of the stream. 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 six surveys.

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=22)		
		Range	Median	Current survey	Range	Median	Current survey	Range	Median	Current survey
2	43	8-21	15	14	44-75	62	67	1.1-3.7	2.4	3.6
3	32	9-26	16	16	58-74	66	72	1.3-4.6	2.6	4.3

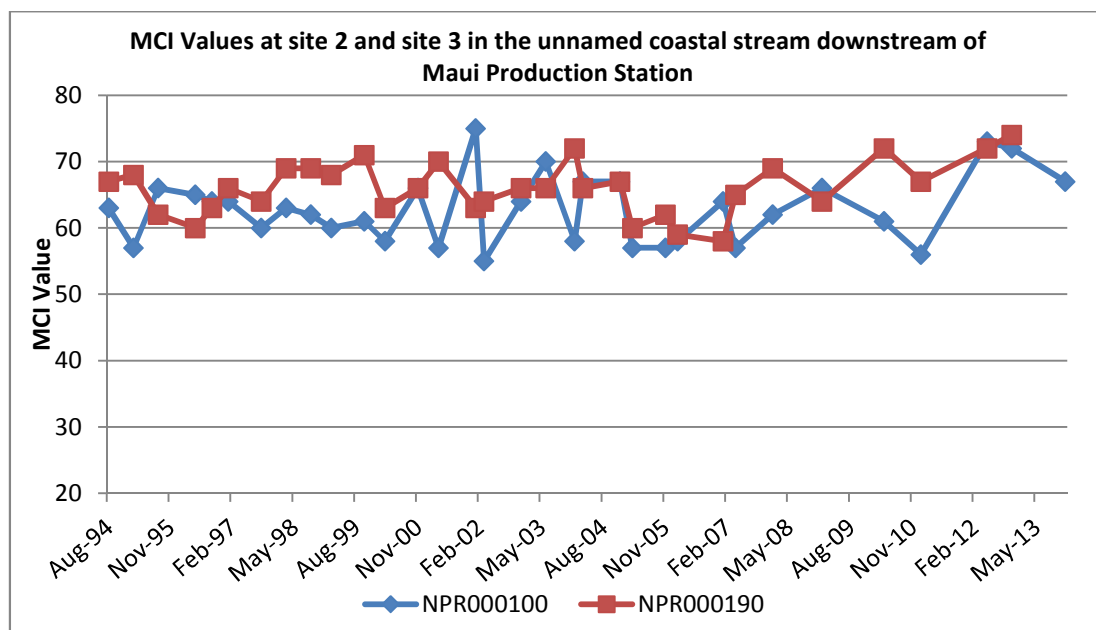


Figure 2 MCI values recorded in the unnamed (‘Ngapirau’) coastal stream that receives discharges from the Maui Production Station since August 1994

Table 3 Macroinvertebrate fauna of an unnamed coastal stream ('Ngapirau' Stream) in relation to the Maui Production Station, sampled on 16 December 2013

Taxa List	Site Number	MCI score	Site 2	Site 3
	Site Code		NPR000100	NPR000190
	Sample Number		FWB13377	FWB13378
COELENTERATA	Coelenterata	3	-	R
ANNELIDA (WORMS)	Oligochaeta	1	C	VA
	Lumbricidae	5	R	R
MOLLUSCA	<i>Physa</i>	3	R	-
	<i>Potamopyrgus</i>	4	VA	VA
CRUSTACEA	Ostracoda	1	C	R
	Isopoda	5	-	A
	<i>Paracalliope</i>	5	R	XA
	Talitridae	5	-	R
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	-	R
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	R	A
	<i>Oxyethira</i>	2	C	R
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	R	R
	<i>Maoridiamesa</i>	3	R	-
	Orthoclaadiinae	2	C	R
	<i>Polypedilum</i>	3	R	-
	Tanytarsini	3	-	R
	<i>Austrosimulium</i>	3	R	C
ACARINA (MITES)	Acarina	5	R	R
No of taxa			14	16
MCI			67	73
SQMCI _s			3.6	4.3
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 fourteen taxa was found at site 2 which was one taxon lower than 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 one 'tolerant' taxon, [snails, (*Potamopyrgus*)].

This site's habitat supported a predominance of 'tolerant' taxa (64% of taxa number), resulting in the 'poor' MCI score of 67 units. This score was five units higher than the median of all previous scores (Table 2). The very abundant 'tolerant' taxon *Potamopyrgus* was tempered by the presence of five rare 'sensitive' taxa, resulting in the SQMCI_s value of 3.6 units. This indicates moderate water quality preceding this survey, and is significantly higher than the median SQMCI_s score for this site (by 1.2 units). In the current survey the damselfly larvae taxon *Xanthocnemis* was absent. This is considered to reflect the reduced macrophyte habitat, rather than being a possible indication of impacts caused by the Maui Production Station discharge. In general, the current results are relatively typical for this site, and indicate that the lack of good invertebrate habitat is also contributing.

Site 3

A similar community richness of 16 taxa was found at site 3, equal to the median richness for this site (Table 2). The community was dominated by two 'tolerant' taxa [oligochaete worms and snails (*Potamopyrgus*)], and three 'sensitive' taxa [amphipods (*Paracalliope*), isopods, and free-living caddis (*Hydrobiosis*)].

This softer-bottomed, nutrient enriched habitat again supported a predominance of 'tolerant' taxa (56% of taxa number), resulting in the MCI score of 73 units. This score was not significantly different to the median MCI score for this site, and was 6 units higher than recorded at site 2 upstream (Figure 2) (Table 2). The increased abundance of three 'sensitive' taxa, resulted in an improvement in SQMCI_s score (4.3 units), from that recorded at site 2 upstream. This score is significantly higher than the median for this site, and similar to that recorded in the previous two surveys, which recorded the maximum scores of the 22 samples collected previously at this site. Unlike three of the previous four surveys, community compositions were relatively similar at the two sites with 58% of the total taxa (19) found in the reach of the stream surveyed, present at both sites.

Conclusions

This early summer 2013 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 10 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 only subtle improvement in the quality of the macroinvertebrate communities with distance downstream. The MCI values were very similar at sites 2 and 3, although the SQMCI_s score improved at site 3, and this is considered to be reflection of slightly improved habitat at this site, primarily through improved shading and reduced algal growth, although overall, the scores at both sites were reflective of the poor habitats over the summer period.

Summary

The Council's standard 'streambed-kick' technique was used at two established sites to collect streambed macroinvertebrates from an unnamed coastal stream. 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 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 moderate flow conditions in summer.

The macroinvertebrate communities of the stream contained few 'sensitive' taxa. No 'sensitive' taxa were found in abundance at site 2 and only three 'sensitive' taxa were found in abundance at site 3. At both sites, taxonomic richness (number of taxa) and MCI scores had not changed significantly at the time of this summer survey compared to previous surveys. The SQMCI_s scores at site 2 had increased significantly from the previous surveys, whereas the SQMCI_s score at site 3 was relatively similar to the previous survey, but significantly higher than the historical median.

MCI and SQMCI_s scores indicated that the stream communities were of above average but poor '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.
- 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

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

To Job Manager; Callum McKenzie
 From Scientific Officers; Bart Jansma and Brooke Thomas
 Report No BT030
 Date 2 October 2014

Biomonitoring of the Kapuni Stream and tributaries of the Inaha Stream and Waiokura Stream before and during well site remediation by Shell Todd Oil Services Ltd at KA8/12/15, KA4/14, KA13, and KA5/10 wellsites, May 2012 & July 2013

Introduction

These biological surveys, performed before and during remediation works were, undertaken at four wellsites; KA8/12/15, KA4/14, KA13 and KA5/10. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. This provided an indication as to whether the groundwater contamination was having an influence on these macroinvertebrate communities prior to remediation and also whether the remediation works themselves caused an impact.

Methods

The standard 'kick-sampling' and 'vegetation sweep' sampling techniques were used to collect streambed macroinvertebrates in the Kapuni stream and unnamed tributaries of the Inaha and Waiokura Streams that were monitored in relation to four wellsites; KA8/12/15, KA4/14, KA13, and KA5/10 (Table 1).

The 'kick-sampling' technique is very similar to C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). The 'vegetation sweep' technique is very similar to Protocol C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Table 1 Biomonitoring sites and sampling techniques used in relation to remediation works carried out by Shell Todd Oil Services Ltd

Wellsite	Site code	GPS reference (NZTM)	Location	Sampling method used pre-remediation	Sampling method used interim-remediation
KA8/12/15	INH000204	E 1701782 N 5634587	700m d/s Eltham Rd, u/s of stormwater discharge	Vegetation sweep	Vegetation sweep
	INH000205	E 1701772 N 5634530	70m d/s of discharge from wellsite	Vegetation sweep	Vegetation sweep
	KPN000212	E 1701313 N 5634767	Approx. 450m d/s of Eltham Rd, u/s of wellsite KA-8/12/15 boundary	Streambed kick	Streambed kick
	KPN000216	E 1701247 N 5634420	Approx. 90m u/s of unnamed tributary, d/s of wellsite KA-8/12/15 boundary	Streambed kick	Streambed kick
KA4/14	WKR000653	E 1700717 N 5632521	Immediately u/s of Neil Rd, d/s of stormwater discharge	Vegetation sweep	Streambed kick
KA13	KPN000301	E 1700745 N 5628820	30m d/s of Skeet Rd & 50m d/s of Kapuni WTP discharge	Streambed kick	Streambed kick

Wellsite	Site code	GPS reference (NZTM)	Location	Sampling method used pre-remediation	Sampling method used interim-remediation
KA13	KPN000304	E 1700744 N 5628460	Ford at 400m d/s Skeet Rd, 50m d/s of stormwater discharge	Streambed kick	Streambed kick
KA5/10	INH000426	E 1701770 N 5628889	5m upstream of Skeet Rd	Vegetation sweep	Vegetation sweep
	INH000427	E 1701753 N 5628838	20m downstream of Skeet Road	Vegetation sweep	Vegetation sweep

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using Protocol P1 of NZMWG protocols of 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.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities 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, so that its corresponding range of values is 20x lower.

Results and discussion

KA8/12/15

Four sites were monitored in relation to the KA8/12/15 wellsite (Figure 1). The water temperature in the unnamed tributary of the Inaha Stream during the pre-remediation survey was 13.8°C at INH000204 and 12.6 at INH000206. The water temperature in the Kapuni Stream was 10.2°C at both sites. In the unnamed tributary of the Inaha Stream there was an uncoloured, clear, low and slow flow present at both sites during the pre-remediation survey. During the interim-remediation survey, the flow remained uncoloured and clear although was moderate rather than low at both sites. In the Kapuni Stream there was an uncoloured, clear, moderate and swift flow at both sites during both the pre-remediation and interim-remediation surveys. The substrate in the unnamed tributary of the Inaha Stream was comprised entirely of silt. The substrate in the Kapuni Stream comprised of gravels, cobbles,

boulders and sand. No periphyton was present in the unnamed tributary of the Inaha Stream, whereas slippery mats were recorded in the Kapuni Stream. Macrophytes were present at the edges and on the bed of the unnamed tributary of the Inaha stream, whereas no macrophytes were recorded in the Kapuni Stream. The bed of the stream was partially shaded at INH000206 during the pre-remediation survey, although was not shaded during the interim-remediation during. The remaining three sites were completely unshaded during both the pre-remediation and interim-remediation surveys.



Figure 1 Biomonitoring sites in the Kapuni stream and unnamed tributary of the Inaha Stream sampled in relation to the KA8/12/15 wellsite

Macroinvertebrate communities at KA8/12/15 wellsite

Table 2 summarises the results of the two macroinvertebrate surveys performed in relation to the remediation of the KA8/12/15 wellsite. Comparative data for sites in similar streams to the unnamed tributary of the Inaha Stream are presented in Table 3. Comparative data for sites in similar streams to the Kapuni Stream are presented in Table 4. The full macroinvertebrate results of both surveys are presented in Table 5 (unnamed tributary of the Inaha Stream) and Table 6 (Kapuni Stream).

Table 2 Number of taxa, MCI and SQMCI_s values for the unnamed tributary of the Inaha Stream and the Kapuni Stream prior to and during remediation of the KA8/12/15 wellsite

Stream	Site code	No of taxa		MCI value		SQMCI _s value	
		Pre-remediation	Interim-remediation	Pre-remediation	Interim - remediation	Pre-remediation	Interim - remediation
Inaha: unnamed tributary	INH000204	23	18	82	84	4.3	2.9
Inaha: unnamed tributary	INH000205	17	16	86	73	4.8	2.9
Kapuni	KPN000212	18	27	114	111	7.4	7.4
Kapuni	KPN000216	21	29	115	118	7.5	7.3

Table 3 Range and median number of taxa, MCI values and SQMCI_s scores for ring plain streams rising outside of the National Park at altitudes 250-299 m asl (TRC, 1999 (updated 2013))

	No. of taxa	MCI value	SQMCI _s value
No. samples	75	75	42
Range	3-31	65-121	1.4-7.6
Median	18	91	4.0

Table 4 Range and median number of taxa, MCI values and SQMCI_s scores for ring plain streams rising inside of the National Park at altitudes 250-299 m asl (TRC, 1999 (updated 2013))

	No. of taxa	MCI value	SQMCI _s value
No. samples	170	170	122
Range	12-36	86-148	2.0-8.0
Median	25	115	7.0

Pre-remediation survey INH000204

A moderate community richness of 23 taxa was found at site INH000204 (Table 2 and Table 5), five taxa more than the median richness found at similar sites elsewhere in the region (Table 3). The macroinvertebrate community was comprised of a significant proportion of 'tolerant' taxa (56 %), which was reflected in the MCI score of 82 units. This MCI score was slightly lower (by 9 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 3).

The community at this site was characterised by five 'tolerant' taxa (oligochaete worms, *Potamopyrgus* snail, dixid midge larvae, Ephydrid fly larvae and Psychodid fly larvae) and one 'sensitive' taxon (amphipod Paraleptamphopidae).

The numerical dominance of many 'tolerant' taxa resulted in a SQMCI_s score of 4.3 units, which was slightly higher (by 0.3 unit) than the median score for 'control' sites in similar streams at this altitude (Table 3).

Pre-remediation survey INH000205

A moderate community richness of 17 taxa was found below the discharge point at site INH000206 (Table 2 and Table 5). This was one taxon less than the median richness found at similar sites elsewhere in the region and six taxa less than that found at the upstream site (INH000204) (Table 3). The macroinvertebrate community was comprised of a significant proportion of 'moderately sensitive' taxa (53%), which was reflected in the MCI score of 86 units. This MCI score was slightly lower (by 5 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes but slightly higher (by four units) than recorded at the upstream site (Table 3).

The community at this site was characterised by three 'tolerant' taxa (oligochaete worms, ostracod seed shrimps, and dixid midge larvae) and two 'sensitive' taxa (amphipod *Paracalliope* and mayfly *Zephlebia* group).

The numerical dominance of one 'sensitive' taxon was tempered by the abundance of three 'tolerant' taxa, resulting in the SQMCI_s score of 4.8 units, which was slightly higher (by 0.8 unit) than the median score for 'control' sites in similar streams at this altitude and slightly higher (by 0.5 unit) than that recorded at the upstream site (Table 3).

Table 5 Macroinvertebrate fauna of the Inaha Stream in relation to the KA8/12/15 pre-remediation and interim-remediation surveys sampled 07 May 2012 and 04 July 2013

Taxa List	Site Number	MCI score	Pre-remediation	Pre-remediation	Interim-remediation	Interim-remediation
	Site Code		INH000204	INH000205	INH000204	INH000205
	Sample Number		FWB12248	FWB12249	FWB13233	FWB13234
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	R	C	-
NEMATODA	Nematoda	3	-	-	-	C
ANNELIDA (WORMS)	Oligochaeta	1	A	A	XA	A
	Lumbricidae	5	R	-	R	-
MOLLUSCA	Lymnaeidae	3	R	-	-	-
	<i>Potamopyrgus</i>	4	XA	C	A	A
CRUSTACEA	Sphaeriidae	3	-	-	R	-
	Copepoda	5	-	R	-	C
	Ostracoda	1	R	A	VA	A
	<i>Paracalliope</i>	5	-	XA	A	-
	Paraleptamphopidae	5	XA	C	XA	A
	Talitridae	5	-	-	R	-
	<i>Paranephrops</i>	5	-	-	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Zephlebia group</i>	7	-	A	-	-
HEMIPTERA (BUGS)	<i>Microvelia</i>	3	C	-	-	-
COLEOPTERA (BEETLES)	Dytiscidae	5	R	-	-	R
	Hydraenidae	8	R	-	-	-
	Hydrophilidae	5	R	-	-	R
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	-	-	-	C
	<i>Polypectropus</i>	6	-	C	-	-
	<i>Psilochorema</i>	6	-	R	R	-
	<i>Oxyethira</i>	2	-	-	-	A
DIPTERA (TRUE FLIES)	<i>Paralimnophila</i>	6	R	R	R	C
	<i>Zelandotipula</i>	6	R	C	R	C
	<i>Chironomus</i>	1	-	-	-	C
	<i>Maoridiamesa</i>	3	R	-	-	-
	Orthocladiinae	2	C	C	-	A
	<i>Polypedilum</i>	3	-	-	R	-
	Tanypodinae	5	C	R	C	-
	<i>Paradixa</i>	4	VA	A	A	-
	Empididae	3	R	R	-	-
	Ephydriidae	4	VA	R	C	R
	Pelecorhynchidae	9	R	-	-	-
	Psychodidae	1	A	-	-	-
	Sciomyzidae	3	R	-	-	-
	<i>Austrosimulium</i>	3	-	-	-	C
Stratiomyidae	5	R	-	-	-	
ACARINA (MITES)	Acarina	5	-	-	C	-
No of taxa			23	17	18	16
MCI			82	86	84	73
SQMCIs			4.3	4.8	2.9	2.9
EPT (taxa)			0	3	1	1
%EPT (taxa)			0	18	6	6
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa		

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

Table 6 Macroinvertebrate fauna of the Kapuni Stream in relation to the KA8/12/15 pre-remediation and interim-remediation surveys sampled 25 May 2012 and 04 July 2013

Taxa List	Site Number	MCI score	Pre-remediation	Pre-remediation	Interim-remediation	Interim-remediation
	Site Code		KPN000212	KPN000216	KPN000212	KPN000216
	Sample Number		FWB12291	FWB12292	FWB13231	FWB13232
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	-	-	R	R
ANNELIDA (WORMS)	Oligochaeta	1	R	C	R	R
MOLLUSCA	<i>Potamopyrgus</i>	4	-	-	R	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	-	-	C	R
	<i>Coloburiscus</i>	7	A	A	VA	XA
	<i>Deleatidium</i>	8	XA	XA	XA	XA
	<i>Nesameletus</i>	9	C	A	A	A
	<i>Zephlebia group</i>	7	-	-	R	-
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	-	-	R	-
	<i>Megaleptoperla</i>	9	-	-	-	C
	<i>Stenoperla</i>	10	-	-	-	R
	<i>Zelandobius</i>	5	-	R	R	-
	<i>Zelandoperla</i>	8	C	C	C	C
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA	VA	VA
	Hydraenidae	8	-	-	R	R
	Ptilodactylidae	8	-	R	-	-
	Scirtidae	8	-	-	-	R
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	C	R	A	A
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	A	C	A	VA
	<i>Costachorema</i>	7	R	R	C	C
	<i>Hydrobiosis</i>	5	R	C	C	C
	<i>Psilochorema</i>	6	R	R	R	R
	<i>Beraeoptera</i>	8	A	A	XA	XA
	<i>Confluens</i>	5	-	-	-	R
	<i>Olinga</i>	9	C	R	A	C
	<i>Pycnocentroides</i>	5	-	R	VA	A
	<i>Triplectides</i>	5	-	-	-	R
	DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	C	C	A
Eriopterini		5	A	A	C	C
<i>Maoridiamesa</i>		3	R	R	R	-
Orthoclaadiinae		2	R	R	R	C
<i>Polypedilum</i>		3	-	-	-	R
Tanytarsini		3	-	-	R	-
Empididae		3	R	R	-	R
<i>Austrosimulium</i>		3	-	-	R	-
Tanyderidae		4	-	-	-	R
No of taxa			18	21	27	29
MCI			114	115	111	118
SQMCIs			7.4	7.5	7.4	7.3
EPT (taxa)			10	12	15	16
%EPT (taxa)			56	57	56	55
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa		

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

Interim-remediation survey INH000204

A moderate community richness of 18 taxa was found at INH000204 (Table 2 and Table 5), five taxa fewer than what was recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (56%) was slightly higher than recorded in the pre-remediation survey, and the proportion of 'tolerant' taxa was slightly lower (44%), resulting in a slight increase in MCI score of two units (84 units).

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of one 'sensitive' taxon (amphipod *Paracalliope*) and one 'tolerant' taxon (ostracod seed shrimp) and reduction of two 'tolerant' taxa (Ephydrid fly larvae and Psychodid fly larvae).

The numerical dominance of 'tolerant' taxa was tempered by two 'moderately sensitive' taxa, resulting in a SQMCI_s score of 2.9 units, which was significantly lower (by 1.4 units) than that recorded in the pre-remediation survey, and significantly lower (by 1.1 units) than the median score for 'control' sites in similar streams at this altitude (Table 3) (Stark, 1998). This change can be attributed mainly to the significant increase of two 'tolerant' taxa (oligochaete worms and ostracod seed shrimp). It is likely seasonal change was responsible for this significant decrease.

Interim-remediation survey INH000205

A moderate community richness of 16 taxa was found at INH000205 (Table 2 and Table 5), one taxon less than that recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (44%) was slightly lower than recorded in the pre-remediation survey (53%), resulting in a significant decrease in MCI score of 13 units (73 units). This MCI score was also significantly lower (by 11 units) than that recorded at the upstream site (Stark, 1998).

The community at this site was dominated by five 'tolerant' taxa (oligochaete worms, *Potamopyrgus* snails, ostracod seed shrimp, caddisfly *Oxyethira* and orthoclad midge larvae) and one 'sensitive' taxon (amphipod Paraleptamphopidae).

The numerical dominance of 'tolerant' taxa resulted in the SQMCI_s score of 2.9 units, which was the same as that recorded at the upstream site but significantly lower (by 1.9 units) than that recorded in the pre-remediation survey, and significantly lower (by 1.1 units) than the median score for 'control' sites in similar streams at this altitude (Table 3) (Stark, 1998). This change can be attributed to the significant reduction in abundance of three 'sensitive' taxa and significant increase in the abundance of four 'tolerant' taxa. At the time of this interim-remediation survey it was noted that numerous pine trees near the stream had been removed causing disturbance to the bankside and a complete loss of shading at the site. This together with the naturally very limited macroinvertebrate habitat at this site explains the significant decrease in SQMCI_s and MCI scores recorded.

Pre-remediation survey KPN000212

A moderate community richness of 18 taxa was found at site KPN000212 (Table 2 and Table 6), seven taxa less than the median richness found at similar sites elsewhere in the region (Table 4). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (72%), which was reflected in the MCI score of 114 units. This MCI score was very similar to the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 4).

The community at this site was characterised by one 'tolerant' taxon (net-building caddis *Aoteapsyche*), three 'moderately sensitive' taxa (mayfly *Coloburiscus*, crane fly Eriopterini and elm mid beetles) and two 'highly sensitive' taxa (mayfly *Deleatidium* and caddisfly Beraeoptera). The extreme abundance of one 'highly sensitive' taxon and abundance of four other 'sensitive' taxa resulted in the SQMCI_s score of 7.4 units, which was slightly higher (by 0.4 unit) than the median score for 'control' sites in similar streams at this altitude (Table 4).

Pre-remediation survey KPN000216

A moderate community richness of 21 taxa was found at site KPN000216 (Table 2 and Table 6), four taxa less than the median richness found at similar sites elsewhere in the region but three taxa more than that recorded at the upstream site (Table 4). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (76%), which was reflected in the MCI score of 115 units. This MCI score was the same as the median MCI score for 'control' sites in similar streams at comparative altitudes and one unit above that recorded at the upstream site (Table 4).

The community at this site was characterised by three 'moderately sensitive' taxa (mayfly *Coloburiscus*, crane fly Eriopterini and elm mid beetles) and three 'highly sensitive' taxa (caddisfly Beraeoptera and mayflies *Deleatidium* and *Nesameletus*).

The extreme abundance of one 'highly sensitive' taxon and abundance of four other 'sensitive' taxa resulted in the SQMCI_s score of 7.5 units, which was very similar to that recorded at the upstream site and slightly higher (by 0.5 unit) than the median score for 'control' sites in similar streams at this altitude (Table 4).

Interim-remediation survey KPN000212

A high community richness of 27 taxa was found at KPN000212 (Table 2 and Table 6), nine taxa more than that recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (70%) was similar to that recorded in the pre-remediation survey and resulted in the MCI score of 111 which was three units less than that recorded in the pre-remediation survey.

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of five 'sensitive' taxa; (mayfly *Nesameletus*, dobsonfly *Archichauliodes*, crane fly Aphrophila and caddisflies *Olinga* and *Pycnocentroides*). There was only one taxon recorded in abundance in the pre-remediation survey not found in the interim-remediation survey, the 'sensitive' crane fly (Eriopterini).

The numerical dominance of 'highly sensitive' taxa, resulted in the SQMCI_s score of 7.4 units, which was the same as that recorded in the pre-remediation survey, and slightly higher (by 0.4 units) than the median score for 'control' sites in similar streams at this altitude (Table 4)

Interim-remediation survey KPN000216

A high community richness of 29 taxa was found at KPN000216 (Table 2 and Table 6), eight taxa more than that recorded in the pre-remediation survey. The macroinvertebrate community was again comprised of a significant proportion of 'sensitive' taxa (72%), resulting in the MCI score of 118 units. This MCI score was slightly higher than the median recorded at similar sites in the region (by three units) and by that recorded in the pre-remediation survey.

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of four 'sensitive' taxa; (dobsonfly *Archichauliodes*, net-building

caddis *Aoteapsyche*, cranefly *Aphrophila* and caddisfly *Pycnocentroides*). Like the upstream site there was only one taxon recorded in abundance in the pre-remediation survey not abundant in the interim-remediation survey the common 'sensitive' cranefly (Eriopterini).

The numerical dominance of 'highly sensitive' taxa, resulted in the SQMCI_s score of 7.3 units, which was 0.2 unit less than that recorded in the pre-remediation survey, but slightly higher (by 0.3units) than the median score for 'control' sites in similar streams at this altitude (Table 4)

KA4/14

One site (WKR000653) was monitored in relation to the KA4/14 wellsite (Figure 2). Further upstream the unnamed tributary had been piped, which meant an upstream sample could not be collected. The water temperature in the unnamed tributary of the Waiokura Stream during the pre-remediation survey was 13.6°C. An uncoloured, clear, moderate and steady flow was recorded. The substrate was comprised entirely of silt. Macrophytes (namely water cress) were recorded growing at the edges and on the bed of the stream. No periphyton was recorded and the stream bed was not shaded. During the interim-remediation survey the water temperature was not recorded. Again, an uncoloured, clear, moderate and steady flow was noted. Macrophytes were recorded growing at the edges but not on the bed of the stream. Unlike the pre-remediation survey slippery mats of periphyton were present. The substrate differed from the pre-remediation survey and comprised of silt, sand, cobbles and gravels.



Figure 2 Biomonitoring site in the unnamed tributary of the Waiokura Stream sampled in relation to the KA4/14 wellsite

Macroinvertebrate communities at KA4/14 wellsite

Table 7 summarises the results of the two macroinvertebrate surveys performed in relation to the remediation of the KA4/14 wellsite. Comparative data for sites in similar streams to the unnamed tributary of the Waiokura Stream are presented in Table 8. The full macroinvertebrate results of both surveys are presented in Table 9.

Table 7 Number of taxa, MCI and SQMCI_s values for the unnamed tributary of the Waiokura Stream prior to and during remediation of the KA4/14 wellsite

Stream	Site code	No of taxa		MCI value		SQMCI _s value	
		Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation
Unnamed tributary: Waiokura Stream	WKR000653	22	15	93	91	6.6	5.6

Table 8 Range and median number of taxa, MCI values and SQMCI_s scores for ring plain streams rising outside of the National Park at altitudes 200-249 m asl ((TRC, 1999 (updated 2013)).

	No. of taxa	MCI value	SQMCI _s value
No. Samples	98	98	38
Range	2-37	60-116	1.9-5.1
Median	24	94	4.0

Table 9 Macroinvertebrate fauna of the unnamed tributary of the Waiokura Stream in relation to the KA4/14 pre-remediation and interim-remediation surveys sampled 07 May 2012 and 04 July 2013

Taxa List	Site Number	MCI score	Pre-remediation	Interim-remediation
	Site Code		WKR000653	WKR000653
	Sample Number		FWB12250	FWB13237
ANNELIDA (WORMS)	Oligochaeta	1	R	A
MOLLUSCA	<i>Potamopyrgus</i>	4	R	R
CRUSTACEA	Ostracoda	1	-	R
	Paraleptamphopidae	5	VA	VA
	Talitridae	5	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Paranephrops</i>	5	R	R
	<i>Austroclima</i>	7	R	-
	<i>Coloburiscus</i>	7	C	-
COLEOPTERA (BEETLES)	<i>Zephlebia group</i>	7	XA	VA
	Staphylinidae	5	R	-
	TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	C
	<i>Orthopsyche</i>	9	A	A
	<i>Psilochorema</i>	6	C	R
	Oeconesidae	5	R	R
DIPTERA (TRUE FLIES)	<i>Paralimnophila</i>	6	-	R
	<i>Zelandotipula</i>	6	R	C
	Orthoclaadiinae	2	C	R
	<i>Polypedilum</i>	3	C	A
	Dolichopodidae	3	R	-
	<i>Paradixa</i>	4	R	R
	Ephyridae	4	C	R
	Psychodidae	1	C	-
	<i>Austrosimulium</i>	3	R	-
ACARINA (MITES)	Acarina	5	R	-
		No of taxa	22	15
		MCI	93	91
		SQMCI _s	6.6	5.6
		EPT (taxa)	7	4
		%EPT (taxa)	32	27
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa	
R = Rare	C = Common	A = Abundant	VA = Very Abundant	XA = Extremely Abundant

Pre-remediation survey WKR000653

A moderately high community richness of 22 taxa was found at site WKR000653 (Table 7 and Table 9), two taxa less than the median richness found at similar sites elsewhere in the region (Table 8). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (59 %), which was reflected in the MCI score of 93 units. This MCI score was slightly lower (by 1 unit) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 9).

The community at this site was characterised by two 'moderately sensitive' taxa (amphipods *Paraleptamphopidae* and mayfly *Zephlebia group*) and one 'highly sensitive' taxon net-building caddis *Orthopsyche*).

The numerical dominance of three 'sensitive' taxa resulted in a SQMCI_s score of 6.6 units, which was significantly higher (by 2.6 units) than the median score for 'control' sites in similar streams at this altitude (Table 8).

Interim-remediation survey WKR000653

A moderate community richness of 15 taxa was found at WKR000653 (Table 7 and Table 9), seven taxa fewer than what was recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (53%) was slightly lower than that recorded in the pre-remediation survey, resulting in a slight decrease in MCI score of two units (91 units).

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of two 'tolerant' taxa (oligochaete worms and midge *Polypedilum*).

The numerical dominance of three 'sensitive' taxa was tempered by two 'tolerant' taxa, resulting in a SQMCI_s score of 5.6 units, which was significantly lower (by 1.0 unit) than that recorded in the pre-remediation survey, but significantly higher (by 1.6 units) than the median score for 'control' sites in similar streams at this altitude (Table 8) (Stark, 1998). The significant decrease in SQMCI_s score from the pre-remediation survey can be attributed to a significant increase in abundance of two 'tolerant' taxa and significant decrease in abundance of two 'sensitive' taxa. A change in sampling method used (from vegetation-sweep to streambed-kick sampling) is likely to have affected results as well as the change in the available habitat (from mainly macrophytes /silt to periphyton/cobbles, gravels silt and sand).

KA13

Two sites (KPN000301 and KPN000304) were monitored in the Kapuni Stream in relation to the KA13 wellsite (Figure 3). During the pre-remediation survey water temperatures in the Kapuni Stream were 12.1°C at KPN000301 and 12.2°C at KPN000304. During both the pre-remediation and interim-remediation surveys an uncoloured, clear, moderate and swift flow was recorded at both sites. The substrate at both sites comprised of cobbles, boulders, fine and coarse gravels and sand, with more boulders at site KPN000301 compared to KPN000304. No macrophytes were recorded at either site, whereas slippery mats of periphyton were present at both sites. Site KPN000301 was not at all shaded, whereas KPN000304 was partially shaded.



Figure 3 Biomonitoring sites in the Kapuni Stream sampled in relation to the KA13 wellsite

Macroinvertebrate communities at KA13 wellsite

Table 10 summarises the results of the two macroinvertebrate surveys performed in relation to the remediation of the KA13 wellsite. Comparative data for sites in similar streams to the Kapuni Stream are presented in Table 11. The full macroinvertebrate results of both surveys are presented in Table 12.

Table 10 Number of taxa, MCI and SQMCI_s values for the Kapuni Stream prior to and during remediation of the KA13 wellsite

Stream	Site code	No of taxa		MCI value		SQMCI _s value	
		Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation
Kapuni	KPN000301	22	21	114	112	7.7	7.3
Kapuni	KPN000304	18	23	111	127	7.6	7.6

Table 11 Range and median number of taxa, MCI values and SQMCI_s scores for ring plain streams rising inside of the National Park at altitudes 155-199 m asl ((TRC, 1999 (updated 2013)).

	No. of taxa	MCI value	SQMCI _s value
No. samples	358	358	255
Range	1-38	64-160	1.9-8.0
Median	20	107	6.0

Table 12 Macroinvertebrate fauna of the Kapuni Stream in relation to the KA13 pre-remediation and interim-remediation surveys sampled 08 May 2012 and 04 July 2013

Taxa List	Site Number	MCI score	Pre-remediation	Pre-remediation	Interim-remediation	Interim-remediation
	Site Code		KPN000301	KPN000304	KPN000301	KPN000304
	Sample Number		FWB12272	FWB12273	FWB13238	FWB13239
NEMERTEA	Nemertea	3	-	R	-	-
NEMATODA	Nematoda	3	-	R	-	-
ANNELIDA (WORMS)	Oligochaeta	1	R	C	C	C
	Lumbricidae	5	-	-	R	-
MOLLUSCA	<i>Physa</i>	3	R	-	-	-
	<i>Potamopyrgus</i>	4	-	R	R	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	-	-	R	R
	<i>Coloburiscus</i>	7	A	A	A	A
	<i>Deleatidium</i>	8	XA	XA	XA	XA
	<i>Nesameletus</i>	9	R	R	R	C
	<i>Zephlebia group</i>	7	R	-	-	-
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	-	-	-	R
	<i>Megaleptoperla</i>	9	-	R	-	R
	<i>Spaniocerca</i>	8	R	-	-	-
	<i>Stenoperla</i>	10	-	-	-	R
	<i>Zelandobius</i>	5	R	-	C	C
COLEOPTERA (BEETLES)	Elmidae	6	A	A	VA	A
	Hydrophilidae	5	-	-	-	R
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	R	R	C	C
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	A	A	A	A
	<i>Costachorema</i>	7	C	C	C	C
	<i>Hydrobiosis</i>	5	R	C	C	R
	<i>Psilochorema</i>	6	-	-	C	R
	<i>Beraeoptera</i>	8	A	C	VA	A
	<i>Olinga</i>	9	C	-	R	R
	<i>Pycnocentria</i>	7	R	R	-	-
DIPTERA (TRUE FLIES)	<i>Pycnocentrodes</i>	5	R	-	A	C
	<i>Aphrophila</i>	5	C	C	R	C
	Eriopterini	5	C	C	A	C
	<i>Maoridiamesa</i>	3	R	-	-	-
	Orthoclaadiinae	2	-	R	C	-
	<i>Polypeditum</i>	3	R	-	-	-
	Tanytarsini	3	R	-	-	-
	Empididae	3	-	-	R	-
	Pelecorhynchidae	9	-	-	-	R
	No of taxa			22	18	21
MCI			114	111	112	127
SQMCIs			7.7	7.6	7.3	7.6
EPT (taxa)			13	9	12	15
%EPT (taxa)			59	50	57	65
'Tolerant' taxa		'Moderately sensitive' taxa		'Highly sensitive' taxa		

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

Pre-remediation survey KPN000301

A moderate community richness of 22 taxa was found at site KPN000301 (Table 10 and Table 12), two taxa more than the median richness found at similar sites elsewhere in the region (Table 11). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (73 %), which was reflected in the MCI score of 114 units. This MCI score was higher (by 7 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 11).

The community at this site was characterised by one 'tolerant' taxon (net-building caddis *Aoteapsyche*), two 'moderately sensitive' taxa (mayfly *Coloburiscus* and elmids beetles) and two 'highly sensitive' taxa (mayfly *Deleatidium* and caddisfly *Beraeoptera*).

The numerical dominance of one 'highly sensitive' taxon resulted in the SQMCI_s score of 7.7 units, which was significantly higher (by 1.7 units) than the median score for 'control' sites in similar streams at this altitude (Table 11).

Pre-remediation survey KPN000304

A moderate community richness of 18 taxa was found at site KPN000304 (Table 10 and Table 12), two taxa less than the median richness found at similar sites elsewhere in the region (Table 11). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (67 %), which was reflected in the MCI score of 111 units. This MCI score was higher (by 4 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes, but slightly lower than that recorded at the upstream site (KPN000301) (Table 11).

The community at this site was characterised by the same taxa as that recorded at the upstream site, with the exception of the 'highly sensitive' caddisfly (*Beraeoptera*) which was recorded as 'common'.

The numerical dominance of one 'highly sensitive' taxon resulted in a SQMCI_s score of 7.6 units, which was significantly higher (by 1.6 units) than the median score for 'control' sites in similar streams at this altitude and only slightly lower than that recorded at the upstream site (Table 11).

Interim-remediation survey KPN000301

A moderate community richness of 21 taxa was found at KPN000301 (Table 10 and Table 12), one taxon less than that recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (76%) was slightly higher than that recorded in the pre-remediation survey, however the MCI score decreased by two units (112 units).

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of two 'moderately sensitive' taxa (stony-cased caddis *Pycnocentroides* and crane-fly *Eriopterini*).

The numerical dominance of 'sensitive' taxa resulted in the SQMCI_s score of 7.3 units, which was slightly lower (by 0.4 unit) than that recorded in the pre-remediation survey, but significantly higher (by 1.3 units) than the median score for 'control' sites in similar streams at this altitude (Table 11) (Stark, 1998).

Interim-remediation survey KPN000304

A moderate community richness of 23 taxa was found at KPN000304 (Table 10 and Table 12), five taxa more than that recorded in the pre-remediation survey. The proportion of 'sensitive' taxa recorded in the community (87%) was higher than that recorded in the pre-remediation survey, and the MCI score (127 units) had increased significantly (by 16 units) from the pre-remediation survey (Stark, 1998). This can be attributed to several minor differences in taxa presence, including the absence of three 'tolerant' taxa and the presence of nine rare 'sensitive' taxa in the interim-remediation survey.

The dominant community at this site was similar to that recorded in the pre-remediation survey, with the addition of one 'highly sensitive' taxon (caddisfly *Beraeoptera*).

The numerical dominance of 'sensitive' taxa resulted in the SQMCI_s score of 7.6 units, which was the same as that recorded in the pre-remediation survey, but significantly higher (by 1.6 units) than the median score for 'control' sites in similar streams at this altitude (Table 11) (Stark, 1998).

KA5/10

Two sites (INH000426 and INH000427) were monitored in the unnamed tributary of the Inaha Stream in relation to the KA5/10 wellsite (Figure 4). During the pre-remediation survey water temperatures in the unnamed tributary of the Inaha Stream were 10.9°C at INH000426 and 10.7°C at INH000427. At both sites an uncoloured, clear and slow flow was recorded. Macrophytes were recorded growing at the edges and on the bed of the stream and no periphyton was recorded at either site. Silt comprised the substrate and shade was absent at both sites.

During the interim-remediation survey, habitat conditions were similar at INH000426, however a moderate and steady, rather than low and slow flow was recorded and patchy filaments of periphyton presently absent, were recorded. In addition, it was noted that there was evidence the site had likely experienced a period of very low flows followed by a short period of high flows, the result of a blocked culvert which had impounded the stream. There was also evidence of stock grazing in and around the stream at this site. At INH000427 there was also evidence of previous high flows, a likely result of the blockage to the culvert being released. Habitat conditions were similar to the pre-remediation survey at this site, with only a slight change to substrate recorded, including the addition of sand, fine gravel and hard clay to a previously entire silt substrate.



Figure 4 Biomonitoring sites in the unnamed tributary of the Inaha Stream sampled in relation to the KA5/10 wellsite

Macroinvertebrate communities at KA5/10 wellsite

Table 13 summarises the results of the two macroinvertebrate surveys performed in relation to the remediation of the KA5/10 wellsite. Comparative data for sites in similar streams to the unnamed tributary of the Inaha Stream are presented in Table 14. The full macroinvertebrate results of both surveys are presented in Table 15.

Table 13 Number of taxa, MCI and SQMCI_s values for the unnamed tributary of the Inaha Stream prior to and during remediation of the KA5/10 wellsite

Stream	Site code	No of taxa		MCI value		SQMCI _s value	
		Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation	Pre-remediation	Interim-remediation
Unnamed tributary: Inaha Stream	INH000426	18	14	91	64	4.5	1.9
Unnamed tributary: Inaha Stream	INH000427	18	20	82	78	4.5	1.9

Table 14 Range and median number of taxa, MCI values and SQMCI_s scores for ring plain streams rising outside of the National Park at altitudes 155-199 m asl ((TRC, 1999 (updated 2013)).

	No. of taxa	MCI value	SQMCI _s value
No. samples	57	57	33
Range	8-29	64-108	1.4-6.1
Median	20	89	4.0

Table 15 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream in relation to the KA5/10 pre-remediation and interim-remediation surveys sampled 07 May 2012 and 04 July 2013

Taxa List	Site Number	MCI score	Pre-remediation	Pre-remediation	Interim-remediation	Interim-remediation
	Site Code		INH000426	INH000427	INH000426	INH000427
	Sample Number		FWB12251	FWB12252	FWB13235	FWB13236
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	-	R	-	-
NEMERTEA	Nemertea	3	-	R	-	R
NEMATODA	Nematoda	3	-	-	R	C
ANNELIDA (WORMS)	Oligochaeta	1	-	R	C	XA
	Lumbricidae	5	A	C	R	A
MOLLUSCA	<i>Potamopyrgus</i>	4	XA	XA	C	VA
	Sphaeriidae	3	-	-	-	R
CRUSTACEA	Cladocera	5	-	-	R	-
	Ostracoda	1	-	-	A	C
	Isopoda	5	R	-	-	-
	<i>Paracalliope</i>	5	A	A	R	C
	Paraleptamphopidae	5	XA	XA	-	A
	Talitridae	5	C	C	-	R
	<i>Paranephrops</i>	5	R	R	-	-
EPHEMEROPTERA (MAYFLIES)	<i>Zephlebia group</i>	7	A	A	-	-
HEMIPTERA (BUGS)	<i>Microvelia</i>	3	C	-	-	-
COLEOPTERA (BEETLES)	Hydrophilidae	5	R	-	-	-
	Staphylinidae	5	R	-	-	-
TRICHOPTERA (CADDISFLIES)	<i>Psilochorema</i>	6	R	R	-	-
	<i>Oxyethira</i>	2	-	-	C	R
DIPTERA (TRUE FLIES)	Eriopterini	5	-	-	-	R
	Hexatomini	5	R	-	R	C
	<i>Paralimnophila</i>	6	R	-	-	R
	<i>Zelandotipula</i>	6	-	C	-	A
	<i>Chironomus</i>	1	-	-	A	-
	Orthoclaadiinae	2	R	A	VA	C
	Dolichopodidae	3	-	R	-	-
	<i>Paradixa</i>	4	C	R	-	-
	Empididae	3	-	-	R	R
	Ephydriidae	4	R	C	-	R
	Muscidae	3	-	-	R	-
	Psychodidae	1	C	R	-	-
	Stratiomyidae	5	-	-	-	R
ACARINA (MITES)	Acarina	5	-	C	R	R
No of taxa			18	18	14	20
MCI			91	82	64	78
SQMCIs			4.5	4.5	1.9	1.9
EPT (taxa)			2	2	0	0
%EPT (taxa)			11	11	0	0
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa			

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

Pre-remediation survey INH000426

A moderate community richness of 18 taxa was found at site INH000426 (Table 13 and Table 15), two taxa less than the median richness found at similar sites elsewhere in the region (Table 14). The macroinvertebrate community was comprised of a significant proportion of 'sensitive' taxa (67%), which was reflected in the MCI score of 91 units. This MCI score was higher (by 2 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes (Table 14).

The community at this site was characterised by one 'tolerant' taxon (*Potamopyrgus* snail) and four 'moderately sensitive' taxa (lumbricid worms, amphipod *Paracalliope* and *Paraleptamphopidae* and mayfly *Zephlebia* group).

The extreme abundance by one 'tolerant' taxon and one 'moderately sensitive' taxon was tempered by the numerical dominance of three other 'moderately sensitive' taxa, which resulted in the SQMCI₅ score of 4.5 units, which was slightly higher (by 0.5 unit) than the median score for 'control' sites in similar streams at this altitude (Table 14).

Pre-remediation survey INH000427

A moderate community richness of 18 taxa was found at site INH000427 (Table 13 and Table 15), two taxa less than the median richness found at similar sites elsewhere in the region, and the same as that recorded at the upstream site at INH000426 (Table 14). The macroinvertebrate community was comprised of an equal proportion of 'tolerant' and 'sensitive' taxa, which was reflected by the MCI score of 82 units. This MCI score was slightly lower (by 7 units) than the median MCI score for 'control' sites in similar streams at comparative altitudes and slightly lower than that recorded at the upstream site (by 9 units) (Table 14).

The community at this site was characterised by similar taxa to the upstream site with the addition of one 'tolerant' taxon (orthoclad midges) and a drop in abundance in one 'moderately sensitive' taxon (lumbricid worms), from abundant (20-99 individuals) to common (5-19 individuals).

The extreme abundance by one 'tolerant' taxon and one 'moderately sensitive' taxon was tempered by the numerical dominance of two other 'moderately sensitive' taxa, which resulted in the SQMCI₅ score of 4.5 units, which was slightly higher (by 0.5 unit) than the median score for 'control' sites in similar streams at this altitude and the same as that recorded upstream at INH000426 (Table 14).

Interim-remediation survey INH000426

A moderate community richness of 14 taxa was found at INH000426 (Table 13 and Table 15), four taxa less than that recorded in the pre-remediation survey and six taxa less than the median number of taxa recorded for 'control' sites at similar streams at this altitude (Table 14). The proportion of 'sensitive' taxa recorded in the community (36%) was significantly lower than that recorded in the pre-remediation survey (67%), which was reflected in the MCI score of 64 units. This significant decrease in MCI score (by 27 units) can be attributed to stream disturbance at this site, due to either the stock damage or to the disruption of flow at this site.

The macroinvertebrate community at this site was characterised by three 'tolerant' taxa tolerant of nutrient enriched conditions (ostracod seed shrimps, orthoclad midges and *Chironomus* blood worms), all taxa frequently found in nutrient enriched habitats.

The numerical dominance of 'tolerant' taxa resulted in the low SQMCI₅ score of 1.9 units, which was significantly lower (by 2.6 units) than that recorded in the pre-remediation survey, and significantly lower (by 2.1 units) than the median score for 'control' sites in similar streams at this altitude (Table 14) (Stark, 1998). This drop in SQMCI₅ score can be attributed to numerous significant changes in taxon abundance including the significant increase of five 'tolerant' taxa and significant decrease of six 'sensitive' taxa.

Interim-remediation survey INH000427

A moderate community richness of 20 taxa was found at INH000427 (Table 13 and Table 15), two taxa more than that recorded in the pre-remediation survey and the same number of taxa as the median number of taxa recorded for 'control' sites at similar streams at this altitude (Table 14). Similarly to pre-remediation survey the proportion of 'sensitive' and 'tolerant' taxa recorded in the community was equal, which was reflected by the MCI score of 78 units (Table 13 and Table 15). This MCI score was slightly lower than that recorded in the pre-remediation survey (by 4 units) and significantly (Stark, 1998) lower than the median score for 'control' sites in similar streams at this altitude (Table 14).

The macroinvertebrate community at this site was characterised by two 'tolerant' taxa (oligochaete worms and *Potamopyrgus* snails) and three 'moderately sensitive' taxa (lumbricid worms, amphipod Paraleptamphopidae and crane fly *Zelandotipula*).

The numerical dominance of 'tolerant' taxa resulted in the low SQMCI_s score of 1.9 units, the same SQMCI_s score as that recorded at the upstream site which was significantly lower (by 2.6 units) than that recorded in the pre-remediation survey, and significantly lower (by 2.1 units) than the median score for 'control' sites in similar streams at this altitude (Table 14) (Stark, 1998). This drop in SQMCI_s score can be attributed to five significant changes in taxon abundance including the increase of three 'tolerant' taxa and significant decrease of one 'sensitive' taxon. The significant decrease in SQMCI_s score can be attributed to both the disturbance to flow caused by the blocked culvert and possibly to the enrichment through stock access that occurred further upstream.

Summary and conclusions

The Council's standard 'kick-sampling' and 'vegetation sweep' sampling techniques were used to collect streambed macroinvertebrates from the Kapuni Stream and tributaries of the Inaha stream and Waiokura Stream in relation to the remediation of the KA8/12/15, KA4/14, KA13 and KA5/10 wellsites. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. Samples were processed to provide number of taxa (richness), 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 environmental conditions. The SQMCI_s takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI_s between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

KA8/12/15

The pre-remediation survey of the KA8/12/15 wellsite, undertaken in May 2012 in the unnamed tributary of the Inaha Stream and the Kapuni Stream found that communities at both sites in the unnamed tributary of the Inaha Stream contained typical community richnesses, and that these communities were in moderate biological health. There was little difference between sites, with the MCI scores being within six units of each other, and the SQMCI_s scores being within 0.5 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the discharge from the KA8/12/15 well site was

not having any adverse effects on the macroinvertebrate communities of the unnamed tributary of the Inaha Stream.

Communities at both sites in the Kapuni Stream contained typical community richnesses, and MCI scores indicated macroinvertebrate communities were in good biological health. There was only a very slight difference between sites, with the MCI scores being within three units of each other, and the SQMCI_s scores being within 0.1 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the contamination present at the KA8/12/15 well site was not having any adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA8/12/15 wellsite, undertaken in July 2013, found that taxa richness in the unnamed tributary of the Inaha Stream were moderate and similar to that recorded during the pre-remediation survey. The MCI score upstream at INH000204 was similar to that recorded in the pre-remediation survey and indicated moderate biological health. There was however a significant decrease (Stark, 1998) at this site in SQMCI_s score from the pre-remediation to the interim-remediation survey, which can be attributed to seasonal differences. Similarly, a significant decrease in SQMCI_s score was recorded downstream at INH000205, again a likely result of seasonal differences but also to disturbance to the stream bank through the removal of the pines. In addition, there was a significant decrease (Stark, 1998) in MCI score at INH000205 from the pre-remediation and interim-remediation surveys and also between this and the upstream site, which may be attributed to the disturbance of the stream bank, a change in habitat and also to the small area surveyed a result of difficulty in sampling at this site.

The interim-remediation survey of the KA8/12/15 wellsite, undertaken in July 2013, found that taxa richness's in the Kapuni Stream were high and had increased by 8-9 taxa from the pre-remediation survey. MCI scores were similar to those recorded in the pre-remediation survey and indicated good biological health. The SQMCI_s score recorded upstream at KPN000212 was the same as that recorded during the pre-remediation survey and slightly higher than the median score for 'control' sites in similar streams at this altitude. The SQMCI_s score recorded downstream at KPN000216 was similar to that recorded in the pre-remediation survey and also slightly higher than the median score for 'control' sites in similar streams at this altitude.

The results from the pre-remediation and the interim-remediation surveys of the KA8/12/15 wellsite indicate that there was no impact on macroinvertebrate communities from the remediation activities undertaken at the KA8/12/15 wellsite. The Kapuni Stream site results showed no significant changes in taxa richness, MCI or SQMCI_s scores between the pre-remediation and interim-remediation surveys and results were similar to those recorded at 'control' sites at similar streams at similar altitudes about the region. The unnamed tributary of the Inaha Stream results showed a significant decrease in SQMCI_s score at both sites and a significant decrease in MCI score at the lower site from the pre-remediation to the interim-remediation surveys which can be attributed to the bankside disturbance caused by the removal of pines at this downstream site, rather than to the remediation activities taking place at the wellsite.

KA4/14

The pre-remediation survey of the KA4/14 wellsite, undertaken May 2012 in the unnamed tributary of the Waiokura Stream found that the community at WKR000653 contained typical

community richnesses, and that these communities were in moderate biological health. The MCI score was similar to that recorded at 'control' sites in similar streams at comparable altitudes whereas the SQMCI_s score was significantly higher (Stark, 1998). These results indicated that the discharge and/or contamination from the KA4/14 wellsite was not having an affect on the macroinvertebrate communities of the unnamed tributary of the Waiokura Stream.

The interim-remediation survey of KA4/14 wellsite, undertaken in July 2013, found that the taxa richness and MCI score recorded at WKR000653 in the unnamed tributary of the Waiokura Stream had decreased slightly from the pre-remediation survey, however was still similar to scores recorded in 'control' sites in similar streams at comparable altitudes. A significant decrease in SQMCI_s score was recorded between the pre-remediation and interim-remediation surveys, however the score was still significantly higher than the median score of 'control' sites in similar streams at comparable altitudes (Stark, 1998). The significant decrease in SQMCI_s score can be attributed to the change in substrate recorded and to a change in sampling method used between the two surveys, rather than the remediation activities.

KA13

The pre-remediation survey of the KA13 wellsite, undertaken May 2012 at two sites in the Kapuni Stream found that the macroinvertebrate communities at both sites contained typical community richnesses, and that these communities were in good biological health. The MCI and SQMCI_s scores recorded at both sites were similar to the median scores for 'control' sites in similar streams at comparable altitudes. There was little difference between sites, with the MCI scores being within four units of each other, and the SQMCI_s scores being within 0.1 unit of each other. This reflects the similarity in the habitats observed at each site, and also the fact that the discharge from the KA13 wellsite was not having any adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA13 wellsite, undertaken in July 2013, found that taxa richness, MCI and SQMCI_s scores upstream at site 1 (KPN00030) in the Kapuni Stream were similar to those recorded during the pre-remediation survey and similar to the median scores for 'control' sites in similar streams at comparable altitudes. The taxa richness recorded downstream at KPN000304 was similar to that recorded in the pre-remediation survey and the SQMCI_s score recorded was the same for the pre-remediation and interim-remediation surveys. The MCI score at KPN000304 however, was significantly higher than that recorded during the pre-remediation survey. This can be attributed to several minor differences in taxa presence, including the absence of three 'tolerant' taxa and the presence of nine rare 'sensitive' taxa. These results suggest no significant impacts on macroinvertebrate communities from the remediation activities undertaken at the KA13 wellsite.

KA5/10

The pre-remediation survey of the KA5/10 wellsite, undertaken May 2012 at two sites in the unnamed tributary of the Inaha Stream found that the macroinvertebrate communities at both sites contained typical community richnesses, and that these communities were in moderate biological health. The MCI and SQMCI_s scores recorded at both sites were similar to the median scores for 'control' sites in similar streams at comparable altitudes. SQMCI_s scores at the two sites were the same; however there was a slight difference between sites, with the MCI scores being within nine units of each other. These results reflect the similarity in the habitats observed at each site, and also the fact that the discharge from the KA5/10 wellsite was not

having any significant adverse effects on the macroinvertebrate communities of the Kapuni Stream.

The interim-remediation survey of the KA5/10 wellsite, undertaken in July 2013, found at the upstream site (INH000426) taxa richness was lower and MCI and SQMCI_S scores were significantly lower than those recorded during the pre-remediation survey. At the time of this survey it was noted that the site had previously been impounded by a blocked culvert. It is likely the macroinvertebrate community at this site was affected by a long period of very low flow followed by a short period of very high flow. In addition there was evidence of stock damage, which had possibly caused some habitat damage and nutrient enrichment as indicated by the 'tolerant' macroinvertebrate taxa that characterised this site (ostracod seed shrimps, orthoclad midges and *Chironomus* blood worms). The taxa richness and MCI score recorded at the downstream site at INH000427 was similar to that recorded in the pre-remediation survey, however the SQMCI_S score was significantly lower than that recorded in the pre-remediation survey. Again this can be attributed to the impoundment of the stream and the consequent very low then high flows and also possibly to compounding effects from stock damage that occurred 50 metres upstream.

Results suggest no significant impacts on macroinvertebrate communities from the remediation activities undertaken at the KA5/10 wellsite, rather the impacts were caused by stock damage and the impoundment of the stream prior to the interim-remediation survey.

References

- Fowles C, 2012: Macroinvertebrate biomonitoring of the Kapuni Stream - a possible ringplain reference stream. TRC Report CF554.
- 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 Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Stark JD, & Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ring plain streams. Stark Environmental Report No 2009-01 47p.
- TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998 (statistics updated October 2013). Technical Report 99-17.

To Job Manager, Callum McKenzie
 From Scientific Officers, Bart Jansma and Brooke Thomas
 Report No BT033
 Date 15 October 2014

Biomonitoring of an unnamed tributary of the Inaha Stream before and during wellsite remediation by Shell Todd Oil Services Ltd at the KA6/11/17 wellsite, May 2012 & November 2013.

Introduction

These biological surveys were performed before and during remediation works were undertaken at the KA6/11/17 wellsite. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. This provided an indication as to whether the groundwater contamination was having an influence on these macroinvertebrate communities prior to remediation and also whether the remediation works themselves caused an impact.

Methods

The ‘vegetation sweep’ and a combination of the ‘streambed-kick’ and ‘vegetation sweep’ sampling techniques were used at two sites to collect streambed macroinvertebrates upstream and downstream of the stormwater discharge point in the unnamed tributary of the Inaha Stream, on 07 May 2012 and 21 November 2013 (Table 1). The ‘kick-sampling’ technique is very similar to C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). The ‘vegetation sweep’ technique is very similar to Protocol C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

The KA6/11/17 wellsite stormwater was discharged from a skimmer pit directly to the unnamed tributary of the Inaha Stream (Figure 1). The two sites monitored in the unnamed tributary of the Inaha stream were situated 50m upstream of the stormwater discharge point (site 1) and 20m downstream of the stormwater discharge point (site 2) (Table 1).

Table 1 Biomonitoring sites in the unnamed tributary of the Inaha Stream related to the KA6/11/17 wellsite

Site No.	Site code	GPS Reference (NZTM)	Location	Sampling method used pre-remediation	Sampling method used interim-remediation
1	INH000428	E1701824 N5627781	50m upstream of the stormwater discharge point	Vegetation sweep	kick-sweep
2	INH000429	E1701796 N5627722	20m downstream of the stormwater discharge point	kick-sweep	kick-sweep

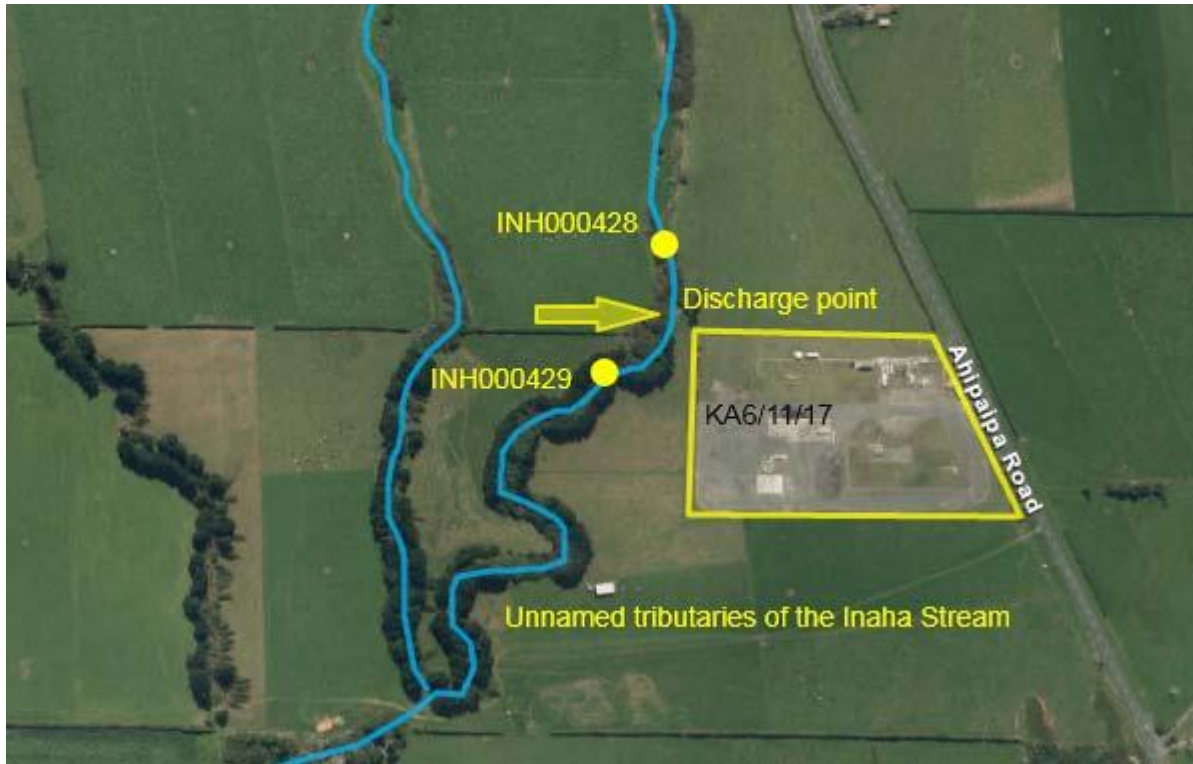


Figure 1 Biomonitoring sites in the unnamed tributary of the Inaha stream sampled in relation to the KA6/11/17 wellsite

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using Protocol P1 of NZMVG protocols of 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.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities 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, so that its corresponding range of values is 20x lower.

Results and discussion

During the May 2012 survey the water temperature in the unnamed tributary of the Inaha Stream was 11.7°C at site 1 and 12.1°C at site 2. During the November 2013 survey the water temperature at site 1 was 16.6°C and 16.4°C at site 2. A moderate flow, of clear and uncoloured water was present at both sites during both surveys. During the May 2012 survey the substrate comprised entirely of silt at site 1, while wood and roots were also present at site 2. During the November 2013 survey the substrate at site 2 was comprised entirely of silt, while some wood and root in addition to silt was recorded at site 1. No periphyton was recorded at either site during both surveys and macrophytes were recorded as widespread. During the May 2012 survey there was no shading at site 1 and partial shading at site 2, whereas during the November 2013 survey there was partial shading at site 1 and complete shading at site 2.

Macroinvertebrate communities

Table 2 summarises the results of the two macroinvertebrate surveys performed in relation to the remediation of the KA6/11/17 wellsite and includes comparative data for sites of similar streams to the unnamed tributary of the Inaha Stream. Full results for both surveys are presented in Table 3.

Table 2 Number of taxa, MCI and SQMCI_s values for the unnamed tributary of the Inaha Stream prior to and during remediation works at KA6/11/17 wellsite, together with a summary of results from control sites at a similar altitude (150m) in other ringplain streams that rise outside of the Egmont National Park (TRC, 1999, updated October 2013)

Site No.	Site Code	No of taxa		MCI value		SQMCI _s value	
		7 May 2012	21 Nov 2012	7 May 2012	21 Nov 2012	07 May 2012	21 Nov 2012
1	INH000428	13	19	77	66	4.9	4.6
2	INH000429	14	12	90	75	5.2	5.0
Control sites median result		23 (31 samples)		94 (31 samples)		5.0 (25 samples)	

Table 3 Macroinvertebrate fauna of the unnamed tributary of the Inaha Stream sampled on 7 May 2012 and 21 November 2013 in relation to the remediation of the KA6/11/17 wellsite

Taxa List	Site Number	MCI	Pre-	Interim-	Pre-	Interim-
-----------	-------------	-----	------	----------	------	----------

	Site Code	score	remediation	remediation	remediation	remediation
			INH000428	INH000428	INH000429	INH000429
			FWB12246	FWB13340	FWB12247	FWB13341
COELENTERATA	Coelenterata	3	-	C	-	R
NEMERTEA	Nemertea	3	-	-	-	R
NEMATODA	Nematoda	3	-	C	-	R
ANNELIDA (WORMS)	Oligochaeta	1	R	A	C	C
MOLLUSCA	Lymnaeidae	3	-	R	-	-
	<i>Potamopyrgus</i>	4	VA	VA	C	C
CRUSTACEA	Ostracoda	1	R	A	-	R
	Isopoda	5	R	-	-	-
	<i>Paracalliope</i>	5	XA	XA	VA	XA
	Paraleptamphopidae	5	XA	C	XA	A
	<i>Paranephrops</i>	5	C	-	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Zephlebia group</i>	7	A	A	VA	A
ODONATA (DRAGONFLIES)	<i>Austrolestes</i>	4	-	R	-	-
TRICHOPTERA (CADDISFLIES)	<i>Polypectropus</i>	6	R	-	R	-
	<i>Triplectides</i>	5	-	-	C	-
DIPTERA (TRUE FLIES)	Hexatomini	5	-	R	-	-
	<i>Paralimnophila</i>	6	-	-	R	-
	<i>Zelandotipula</i>	6	-	-	R	R
	<i>Corynoneura</i>	3	-	R	-	-
	Orthoclaadiinae	2	C	R	R	-
	Tanytarsini	3	-	A	-	R
	<i>Paradixa</i>	4	C	C	R	R
	Empididae	3	-	R	-	-
	Ephydriidae	4	R	-	R	-
	Psychodidae	1	R	R	-	-
<i>Austrosimulium</i>	3	-	-	R	-	
Stratiomyidae	5	-	R	-	-	
Syrphidae	1	-	R	-	-	
No of taxa			13	19	14	12
MCI			77	66	90	75
SQMCIs			4.9	4.6	5.2	5.0
EPT (taxa)			2	1	3	1
%EPT (taxa)			15	5	21	8
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa			
R = Rare		C = Common	A = Abundant	VA = Very Abundant	XA = Extremely Abundant	

Site 1

Pre-remediation survey

On 7 May 2012, 13 taxa were found at site 1, upstream of the KA6/11/17 wellsite discharge point (Table 2). This was less than the median number of taxa (23 taxa) found by 31 previous surveys at 'control' sites at a similar altitude in other ringplain streams that rise outside of Egmont National Park (TRC, 1999 (updated 2013)) (Table 2), and at the lower end of the range of what could be expected. The community was characterised by one 'tolerant' taxon (*Potamopyrgus* snails) and three 'moderately sensitive' taxa (amphipods *Paracalliope* and Paraleptamphopidae and mayfly *Zephlebia* group) (Table 3).

A moderately high proportion of 'tolerant' taxa in the community (54% of taxa) was reflected in the MCI score (77 units) which was significantly lower than the median MCI score (94)

recorded from 31 previous surveys conducted at similar 'control' sites (TRC, 1999 (updated 2013)) (Stark, 1998) and represented poor biological health at this site.

The SQMCI_s score of 4.9 units recorded at this site was similar to the median SQMCI_s score (5.0) recorded from 25 previous surveys conducted at similar 'control' sites (TRC, 1999 (updated 2013)).

Interim-remediation survey

On 21 November 2013, 19 taxa were recorded in this community, higher than that recorded in the previous survey, but still below the median richness from similar control sites (Table 2). An increased proportion of 'tolerant' taxa was present in the community at this time (74%), and this resulted in a lower MCI score of 66 units when compared with the pre-remediation survey. The macroinvertebrate community was characterised by four 'tolerant' taxa (oligochaete worms, *Potamopyrgus* snails, ostracod seed shrimp, and midge Tanytarsini) and two 'moderately sensitive' taxa (amphipod *Paracalliope* and mayfly *Zephlebia* group) (Table 3).

There were six significant changes in taxon abundances between the pre-remediation and interim-remediation surveys including the significant increase of five 'tolerant' taxa and significant decrease of one 'moderately sensitive' taxon. These changes in abundance are considered to be a direct reflection of the flows that preceded the surveys. There was a 36 day period between a 3 x median fresh and the November 2013 survey, whereas there was only a 10 day period between a 3 x median fresh and the May 2012 survey. Higher flows can lead to the flushing out of some 'tolerant' taxa, while long periods of low flow can support 'tolerant' taxa. Despite these significant changes in abundance, there was only a (0.3 unit) difference in SQMCI_s score between the two surveys (Table 2). The SQMCI_s score of 4.6 was similar to the median SQMCI_s score recorded by similar 'control' sites around the region (TRC, 1999 (updated 2013)).

Overall, the MCI and SQMCI_s scores indicated relatively poor water quality in the weeks preceding these surveys, and that the greater length of time between freshes prior to the November survey in comparison to the May 2012 survey was the primary determinant of the differences recorded between the two surveys undertaken at site 1.

Site 2

Pre-remediation survey

On 07 May 2012, 14 taxa were found at site 2, downstream of the of the KA6/11/17 wellsite discharge point. This was one taxon more than that recorded at site 1, upstream of the wellsite discharge (Table 2). This community comprised 57% 'sensitive' taxa, resulting in an MCI score of 90 units. This was a significant (Stark, 1998) 13 units more than that recorded upstream during the same survey and similar to the median MCI score recorded by similar 'control' sites around the region (TRC, 1999 (updated 2013)).

The community was dominated by three 'moderately sensitive' taxa (amphipods *Paracalliope* and Paraleptamphopidae and mayfly *Zephlebia* group) (Table 3). There were only two significant changes in abundance from site 1, being a decrease in abundance of 'tolerant' *Potamopyrgus* snails and an increase in abundance of the 'moderately sensitive' stick caddis *Triplectides*. Neither changes are considered an indication of any real change in community composition and this is reflected by the SQMCI_s score (5.2), which was an insignificant (Stark, 1998) 0.3 unit higher than that recorded upstream at site 1 (Table 3).

Interim-remediation survey

A moderately low community richness of 12 taxa was recorded at this site which was two taxa less than that recorded in the May 2012 survey and seven taxa less than that recorded at the upstream site (Table 2). The proportion of 'sensitive' taxa (33%) had decreased from the previous survey which was reflected in the MCI score of 75 units, which was a significant (Stark, 1998) 15 units fewer than that recorded by the previous survey at this site. This MCI score was however not significantly different to that recorded upstream at site 1.

The community at site 2 during the interim-remediation survey was dominated by the same taxa as those recorded by the pre-remediation survey at this site (Table 3). The SQMCI_s score of 5.0 units was similar to the score recorded by the pre-remediation survey at this site and slightly higher (by 0.4 unit) to that recorded upstream at site 1 (Table 2).

Overall, there was a significant (Stark, 1998) decrease in MCI scores between the pre and interim-remediation surveys at this site, however only a slight decrease in MCI scores between this and the upstream site. The significant decrease in MCI between the two surveys at this site can be attributable to seasonal differences, in particular to the higher stream temperature and to the greater length of time between freshes that preceded this survey in comparison to the pre-remediation survey. The SQMCI_s score however, did not change significantly between the two surveys or from that recorded at the upstream site.

Summary and Conclusions

The Council's standard 'vegetation sweep' and a combination of the 'streambed-kick' and 'vegetation sweep' sampling techniques were used at two sites to collect streambed macroinvertebrates from the unnamed tributary of the Inaha Stream in relation to the remediation of the KA6/11/17 wellsite. The intention of these surveys was to determine the health of the macroinvertebrate communities prior to the remediation, which then allowed a comparison with the health of the macroinvertebrate communities during remediation. Samples were processed to provide number of taxa (richness), 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 environmental conditions. The SQMCI_s takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI_s between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

The pre-remediation survey, undertaken in May 2012 found that communities at both sites contained lower than typical community richnesses. The MCI score recorded by site 1 was significantly (Stark, 1998) below the median score of what would normally be expected at similar sites at this altitude, while the MCI score recorded at site 2 was very similar to the median score. The significant difference in MCI score recorded between site 1 and site 2 during the pre-remediation survey may be attributed to the change in sampling method used. A combination of the 'vegetation sweep' and 'streambed-kick' sampling methods was used at site 2, thus is likely to have targeted more 'sensitive' taxa than the 'vegetation sweep' method alone which was employed at site 1. The SQMCI_s scores were however very similar which reflects the similarity in the habitats observed at each site, and also the fact that the contamination present at the KA6/11/17 wellsite was not having any adverse effects on the macroinvertebrate communities of the unnamed tributary of the Inaha Stream.

The interim-remediation survey, undertaken in November 2013 recorded similar community richnesses to that observed in the previous survey at site 2, but slightly lower community richnesses at site 1. There was no significant change in MCI score at site 1 between the pre-remediation and interim-remediation surveys, however there was a significant (Stark, 1998) decrease in the MCI score recorded at site 2, which can be attributed mainly to seasonal differences, in particular to the greater length of time after a 3x median fresh that preceded the November 2013 survey. The communities at site 2 were very similar between the pre-remediation and interim-remediation surveys and were dominated by the same taxa, which resulted in a similar SQMCI_S score at this site. At site 1 there were six significant changes in taxon abundances between the pre-remediation and interim-remediation surveys, which again can be attributed to seasonal differences. Despite the significant change in taxon abundances at this site, the SQMCI_S scores recorded by the pre-remediation and interim-remediation surveys were not significantly different (Stark, 1998).

The results from the pre-remediation and the interim-remediation surveys of the KA6/11/17 wellsite indicate that there was no impact on macroinvertebrate communities from the remediation activities undertaken. The unnamed tributary of the Inaha Stream site results showed no significant changes in SQMCI_S scores between the pre-remediation and interim-remediation surveys and results were similar to those recorded at 'control' sites at similar streams at similar altitudes about the region. The unnamed tributary of the Inaha Stream results did however show a decrease in MCI score upstream at site 1 and a significant decrease (Stark, 1998) in MCI score downstream at site 2 from the pre-remediation to the interim-remediation survey. This can be attributed to seasonal differences, in particular to a longer period of settled flows and higher stream temperatures recorded during the interim-remediation survey rather than to any affects caused by the remediation activities taking place at the KA6/11/17 wellsite.

References

- Fowles C, 2012: Macroinvertebrate biomonitoring of the Kapuni Stream - a possible ringplain reference stream. TRC Report CF554.
- 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 Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.
- Stark JD, & Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ring plain streams. Stark Environmental Report No 2009-01 47p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998 (statistics updated October 2013). Technical Report 99-17.

To Job Manager, C MacKenzie
 From Freshwater Biologist, B Jansma
 File 03-02-005-13/01; 0633;
 Report No BJ245
 Document No 1449374
 Date 15 December 2014

Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, February 2014

Introduction

This biological survey of two sites in the Kapuni Stream was conducted to monitor effects related to the discharge of stormwater from the Kapuni Production Station. The survey fulfilled the biological monitoring requirements for this industry in the 2013-2014 monitoring year. Results from surveys performed since the 2000-2001 monitoring year are discussed in reports referenced in this report.

Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from two established sites in the Kapuni Stream related to the Kapuni Production Station stormwater discharge (Table 1, Figure 1) on 24 February 2014. This 'kick-sampling' technique 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).

Table 1 Biomonitoring sites in the Kapuni Stream, related to the Kapuni Production Station

Site No.	Site Code	Map Reference	Location
2	KPN000285	Q20: 112914	Upstream of Kapuni Production Station
2b	KPN000289	Q20: 111914	50 metres downstream of Production Station discharge

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using 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. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The



Figure 1 Biomonitoring sites in the Kapuni Stream related to the Kapuni Production Station

MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities 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, so that its corresponding range of values is 20x lower.

Results and discussion

At the time of this morning survey there was a clear, uncoloured, low flow in the Kapuni Stream and the water temperature was 14.7°C at site 2. The bed of the stream was predominantly comprised of cobble and gravel with some boulder also recorded. Thin films of periphyton were present at both sites, but no filamentous algae despite little shade from riparian vegetation. This survey was performed during late summer, following a relatively dry period, and followed a moderately long low flow period, 29 and 50 days after freshes in excess of three times and seven times median flows respectively.

Macroinvertebrate communities

Previous biological surveys in the Kapuni Stream have generally recorded macroinvertebrate communities that would be expected in clean, mid reaches of Taranaki ring plain streams. The communities have had moderate to relatively good numbers of taxa and relatively high MCI values. The results of previous surveys are summarised in Table 2 together with current results and are illustrated in Figure 2 and Figure 3. The results for site 2b also include results from the long term monitoring programme performed by Cawthron Institute/Stark Environmental for other consented discharges. The full macroinvertebrate results of this survey are presented in Table 3.

Table 2 Numbers of taxa and MCI values recorded in previous surveys in the Kapuni Stream in relation to the Kapuni Production Station since May 1987, together with current results.

Site no.	Site	Number of previous surveys	Numbers of taxa			MCI values		
			Median	Range	Current Survey	Median	Range	Current Survey
2	KPN000285	23	23	18-33	22	105	94-132	118
2b	KPN000289	105	18	9-35	22	115	90-145	125

Site 2 Upstream of Kapuni Production Station

A moderate richness of twenty-two taxa was recorded at site 2, upstream of the Kapuni Production Station; one taxon less than the median found by 23 previous surveys (Table 2), typical of most previous surveys, but somewhat lower than that recorded in the previous survey (Figure 2). Six 'highly sensitive' taxa were present, with the community characterised by three of these 'highly sensitive' taxa (mayfly (*Deleatidium* & *Nesameletus*) and caddisfly (*Beraeoptera*)); as well as five 'moderately sensitive' taxa (abundant mayfly (*Coloburiscus*), elmid beetles, dobson fly larvae (*Archichauliodes*), stony cased caddis (*Pycnocentroides*) and *Aphrophila* crane-fly); and one 'tolerant' taxon (net-building caddisfly (*Aoteapsyche*)).

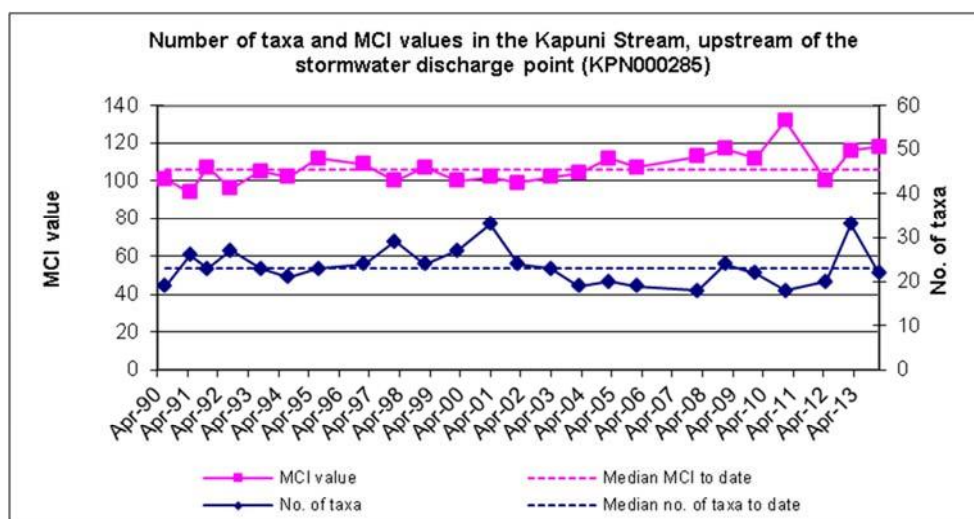


Figure 2 Number of taxa and MCI values in the Kapuni Stream upstream of STOS discharge

Table 3 Macroinvertebrate fauna of the Kapuni River re STOS Kapuni Production Station sampled on 24 February 2014

Taxa List	Site Number	MCI	2	2b

	Site Code	score	KPN000285	KPN000289
	Sample Number		FWB14147	FWB14148
MOLLUSCA	<i>Potamopyrgus</i>	4	R	R
EPHEMEROPTERA (MAYFLIES)	<i>Ameletopsis</i>	10	-	R
	<i>Austroclima</i>	7	C	C
	<i>Coloburiscus</i>	7	A	A
	<i>Deleatidium</i>	8	XA	XA
	<i>Nesameletus</i>	9	A	C
	<i>Zephlebia group</i>	7	R	-
PLECOPTERA (STONEFLIES)	<i>Zelandoperla</i>	8	-	R
COLEOPTERA (BEETLES)	Elmidae	6	VA	XA
	Hydraenidae	8	R	R
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	A	A
	<i>Hydrobiosis</i>	5	C	C
	<i>Plectrocnemia</i>	8	R	-
	<i>Psilochorema</i>	6	C	R
	<i>Beraeoptera</i>	8	VA	VA
	<i>Olinga</i>	9	R	R
	<i>Pycnocentria</i>	7	-	R
	<i>Pycnocentrodes</i>	5	VA	A
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	A	A
	Eriopterini	5	-	R
	Hexatomini	5	R	-
	Orthoclaadiinae	2	-	R
	<i>Polypedilum</i>	3	R	-
	Tanypodinae	5	-	R
	Muscidae	3	R	-
	<i>Austrosimulium</i>	3	R	R
	Tabanidae	3	R	-
No of taxa			22	22
MCI			118	125
SQMCI			7.2	7.0
EPT (taxa)			12	13
%EPT (taxa)			55	59
'Tolerant' taxa		'Moderately sensitive' taxa	'Highly sensitive' taxa	

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

The moderate proportion of 'sensitive' taxa (73% of taxa numbers) comprising the community was reflected in the MCI score of 118 units, which was similar to that recorded in the previous survey, but significantly higher than the median of all past survey scores (Stark, 1998), (Figure 2 and Table 2). This is similar to the trend observed from 2005 to 2011, when this site recorded MCI scores well above the median score. In addition, the score was similar to the predicted score for this site, 18.1 km downstream of the National Park boundary (Stark and Fowles, 2009). A reasonably high SQMCI (7.2 units) reflected the relative dominance of 'highly sensitive' taxa in the community at this site.

Site 2b 50 m downstream of Kapuni Production Station discharge

An equivalent richness (22 taxa) was recorded at site 2b, a further 300m downstream and 50 m below the production station stormwater discharge. This richness was four taxa above the median found by the long term record of 105 previous surveys at this site but eight less than

that recorded by the previous survey at this site (Table 2 and Figure 3). There were seven 'highly sensitive' taxa present, indicative of good preceding physicochemical water quality. The community was characterised by two 'highly sensitive' taxa (extremely abundant mayfly (*Deleatidium*) and very abundant caddisfly (*Beraeoptera*)); five 'moderately sensitive' taxa (abundant mayfly (*Coloburiscus*), extremely abundant elmid beetles, abundant dobson fly larvae (*Archichauliodes*), stony cased caddis (*Pycnocentroides*) and crane fly (*Aphrophila*)) and one 'tolerant' taxon (abundant net-spinning caddisfly (*Aoteapsyche*)). All of these abundant taxa were also recorded in abundance at site 2b.

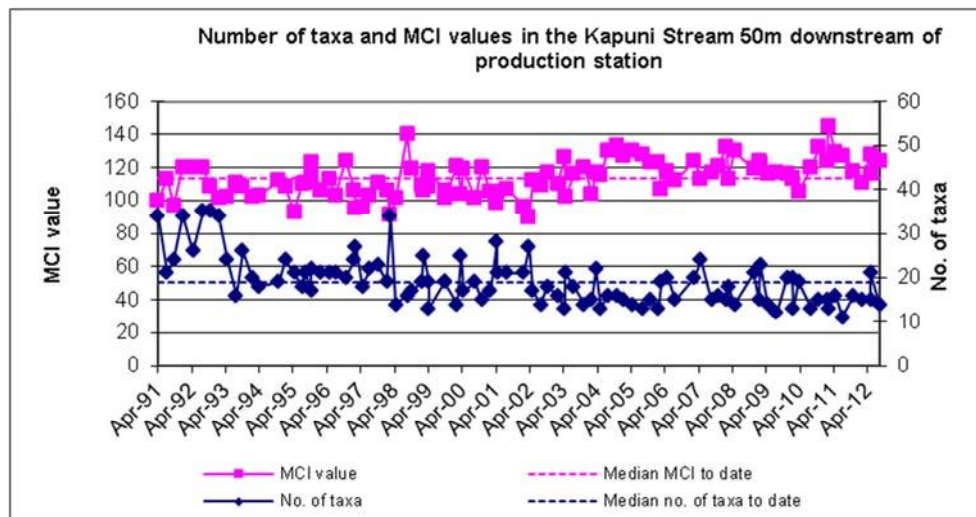


Figure 3 Number of taxa and MCI values in the Kapuni Stream 50m d/s of the Kapuni production station discharge.

There were no significant changes in individual taxa abundance recorded between sites. Generally the dominant taxa at the two sites were very similar, which were reflected in the SQMCI₅ scores, which were not statistically significantly different to each other (Table 2 and Table 3) (Stark, 1998). Similarly, the MCI score (125) was seven units higher than recorded at site 2b (Stark, 1998), which was not a statistically significant difference, and ten units higher than the median for this site. This similarity reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and was less suited to snails or midge larvae. This is the ninth consecutive above average score recorded at this site (Figure 3).

Summary and Conclusions

The Council's standard 'kick-net' sampling technique was used at two sites to collect streambed macroinvertebrates from the Kapuni Stream to assess whether stormwater discharges from the STOS Kapuni Production Station have had any adverse effects on the macroinvertebrate communities of this stream. Samples were processed to provide number of taxa (richness), MCI and SQMCI₅ 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 environmental conditions. The SQMCI₅ takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI₅ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This February 2014 biological survey of the Kapuni Stream performed under low summer flow conditions indicated that stormwater discharges from the Kapuni Production Station had not had any recent significant impacts on the macroinvertebrate communities of the stream. These communities had moderate community richnesses, although less than that recorded in the previous survey. Similar characteristic taxa were recorded in the communities at both sites, resulting in similar SQMCI_s scores. The MCI score was also not statistically significantly different to that recorded at site 2b (Stark, 1998), and the score recorded at site 2 was ten units higher than the median for this site. This similarity in MCI scores reflects the similar habitat present at both sites, with the lack of periphyton being an important factor. When gravel and cobble substrate supports little periphyton, the habitat is more suited to 'sensitive' taxa such as stoneflies, and was less suited to snails or midge larvae and was indicative of the absence of any recent impacts of any stormwater discharges from the Kapuni Production Station.

References

- Colgan BG, 2003: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, April 2003. TRC report BC008.
- Dunning KJ, 2001: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, April 2001. TRC report KD69.
- Dunning KJ, 2002: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2002. TRC report KD117.
- Fowles CR and Jansma B, 2008: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, February 2008. TRC report CF455.
- Fowles CR and Moore SC, 2004: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2004. TRC report CF316.
- Fowles CR and Hope KJ, 2005: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2005. TRC report CF386.
- Hope KJ, 2006: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, February 2006. TRC report KH083.
- Jansma B, 2009: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2009. TRC report BJ066.
- Jansma B, 2011: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2010. TRC Report BJ130.
- Jansma B, 2011: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, January 2011. TRC Report BJ160.
- Jansma B, 2012: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, May 2012. TRC Report BJ177.

Jansma B, 2013: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2013. TRC Report BJ220.

McWilliam, 2000: Biomonitoring of the Kapuni Stream in relation to the Kapuni Production Station of Shell Todd Oil Services Ltd, March 2000. TRC report HM215.

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

Stark JD and Fowles CR, 2009: Relationships between MCI, site altitude, and distance from source for Taranaki ring plain stream. Prepared for Taranaki Regional Council. Stark Environmental Report No. 2009-01. 47p.

Taranaki Regional Council, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrates surveys performed during the period from January 1980 to 31 December 1998. (State of the Environment Monitoring Reference Report). Technical Report 99-17

Appendix III

Air monitoring reports

Memorandum

To Callum MacKenzie – Job Manager
From Scientific Officer - Air Quality, Brian Cheyne
File 4054, FRODO-#1326228
Date March 20, 2014

Ambient gas monitoring at Kapuni Production Station (Year 2012-2013)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately twenty-five hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 1.

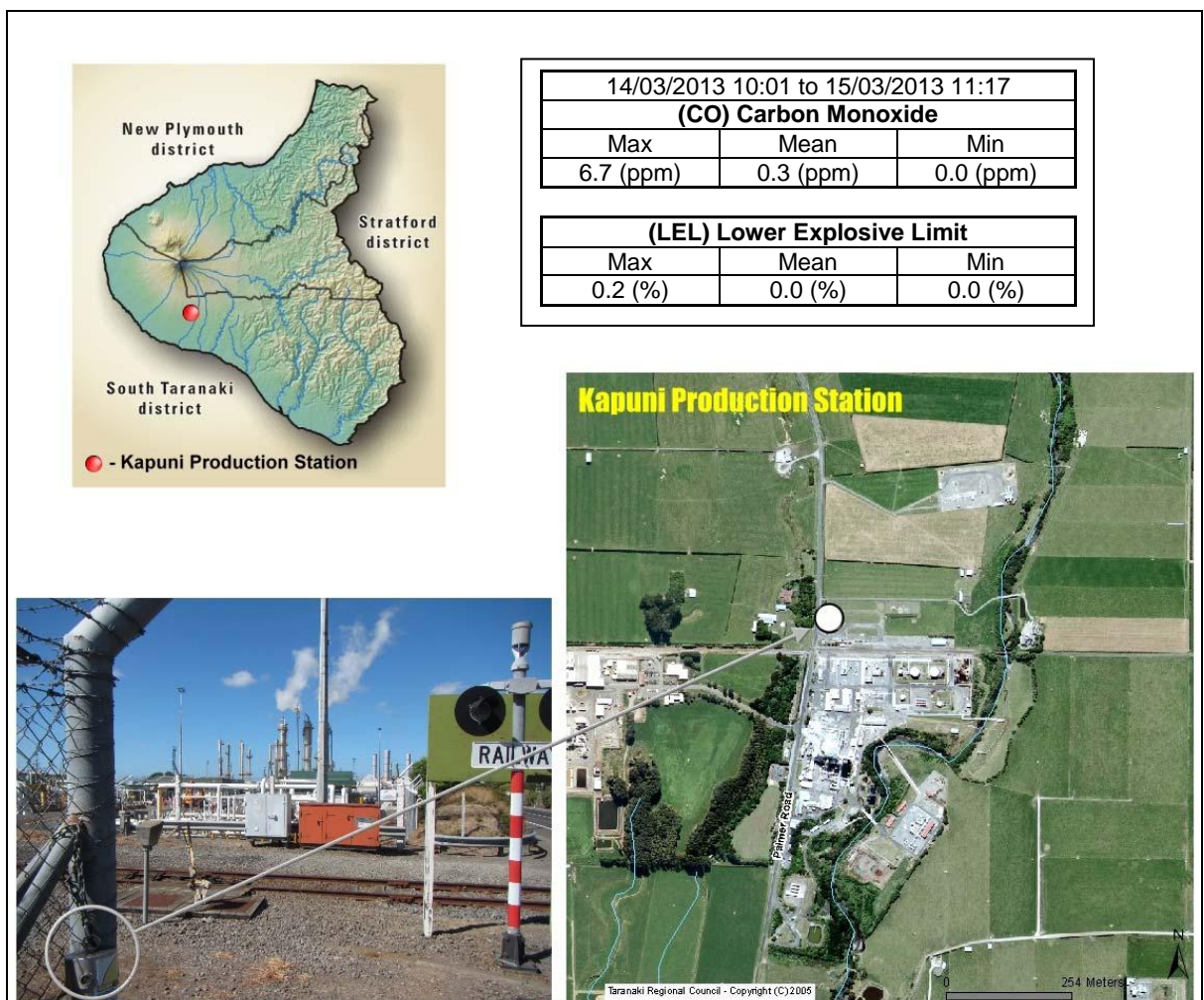


Figure 1 Air monitoring site and sample details – Kapuni Production Station (year 2012-13)

- Note: (1) the instrument records in units of ppm. At 15°C
 $1\text{ppm CO} = 0.85\text{ mg m}^{-3}$
 (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 %LEL by 20.

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.

The details of the sample are presented graphically in Figure 2. The consent 4054-5 covering air discharges from the Kapuni Production Station does not have specific limits related to particular gases. The National Environmental Standards for Air Quality sets limit for carbon monoxide at 10mg/m^3 (12ppm) averaged over an 8 hour exposure period. At no time during the 2012-2013 monitoring year were this limit exceeded. The maximum concentration of carbon monoxide found during the monitoring run was 5.7mg/m^3 and average concentration was only 0.26 mg/m^3 which complies with the NES AQ. This continues the pattern found in previous years.

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 a dangerous level of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Kapuni Production Station reach any more than a trivial level.

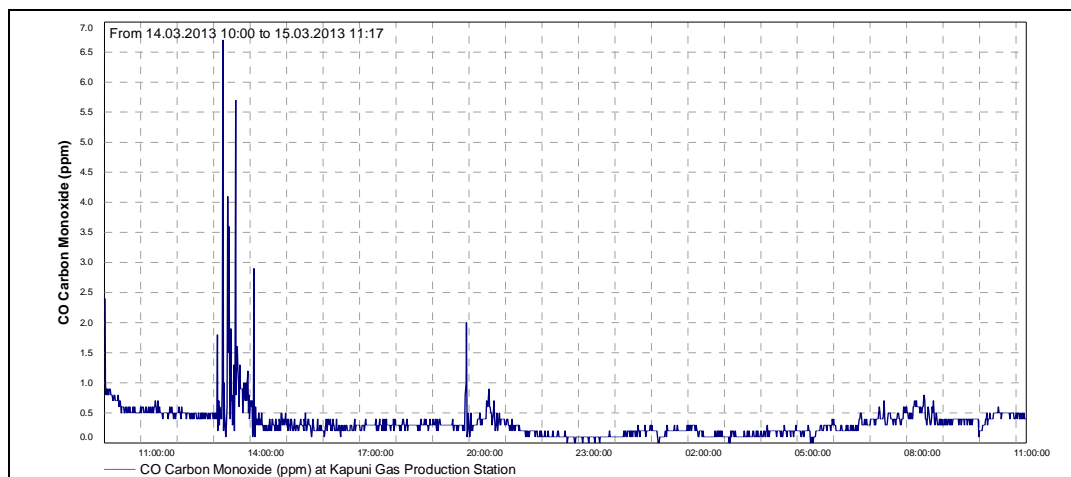


Figure 2 Graphs of ambient gas levels in the vicinity of the Kapuni PS (year 2012-13)

Memorandum

To Callum MacKenzie – Job Manager
From Scientific Officer - Air Quality, Brian Cheyne
File FRODO-#1326306, 4052 (Consent)
Date March 20, 2014

Ambient gas monitoring at Maui Production Station (Year 2012-2013)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately twenty-four hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 1.

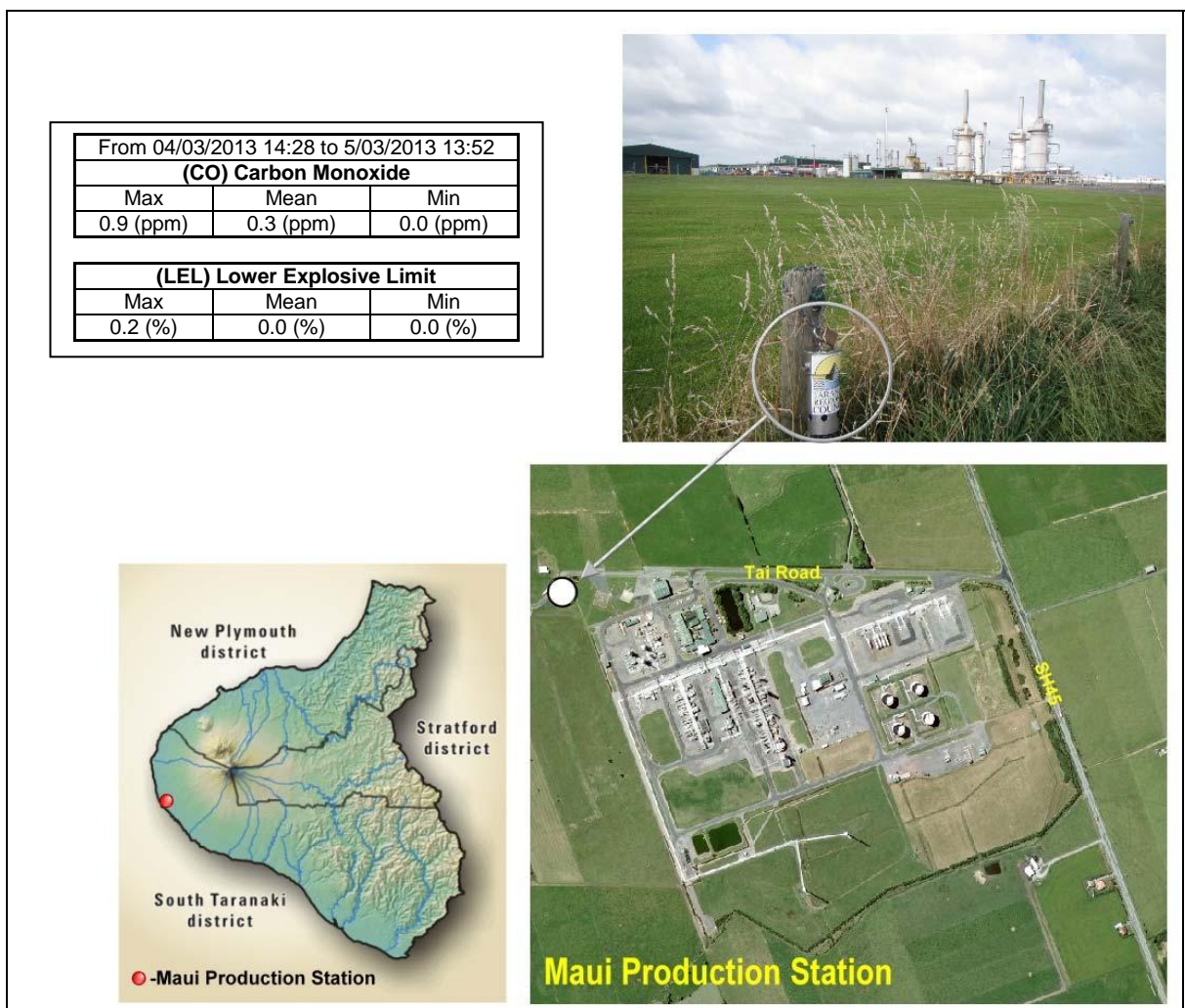


Figure 1 Air monitoring sites and sample details – Maui Production Station (year 2012-2013)

Note: (1) the instrument records in units of ppm. At 15°C

$$1\text{ppm CO} = 0.85 \text{ mg m}^{-3}$$

(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 %LEL by 20.

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.

The details of the sample are presented graphically in Figure 2.

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/m³ for an eight hour average or 30 mg/m³ for a 1 hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was only 0.9ppm or 0.8 mg/m³ which complies with the consent condition. This continues the pattern found in previous years.

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 a dangerous level 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.

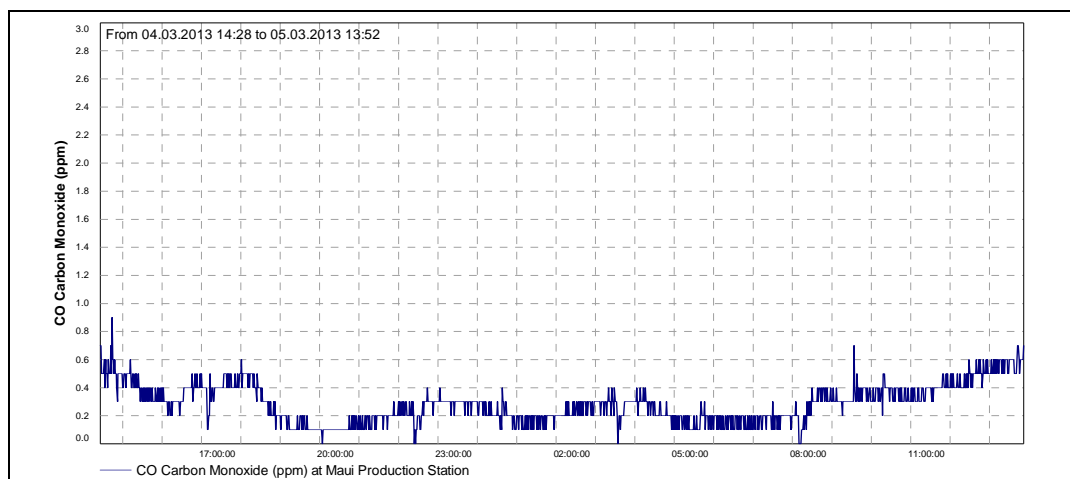


Figure 2 Graphs of ambient gas levels in the vicinity of the Maui PS (year 2012-13)

Memorandum

To Callum MacKenzie – Job Manager
From Scientific Officer - Air Quality, Brian Cheyne
File FRODO-#1384890, 4052 (Consent)
Date August 07, 2014

Ambient gas monitoring at Maui Production Station (Year 2013-2014)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately forty seven hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 1.

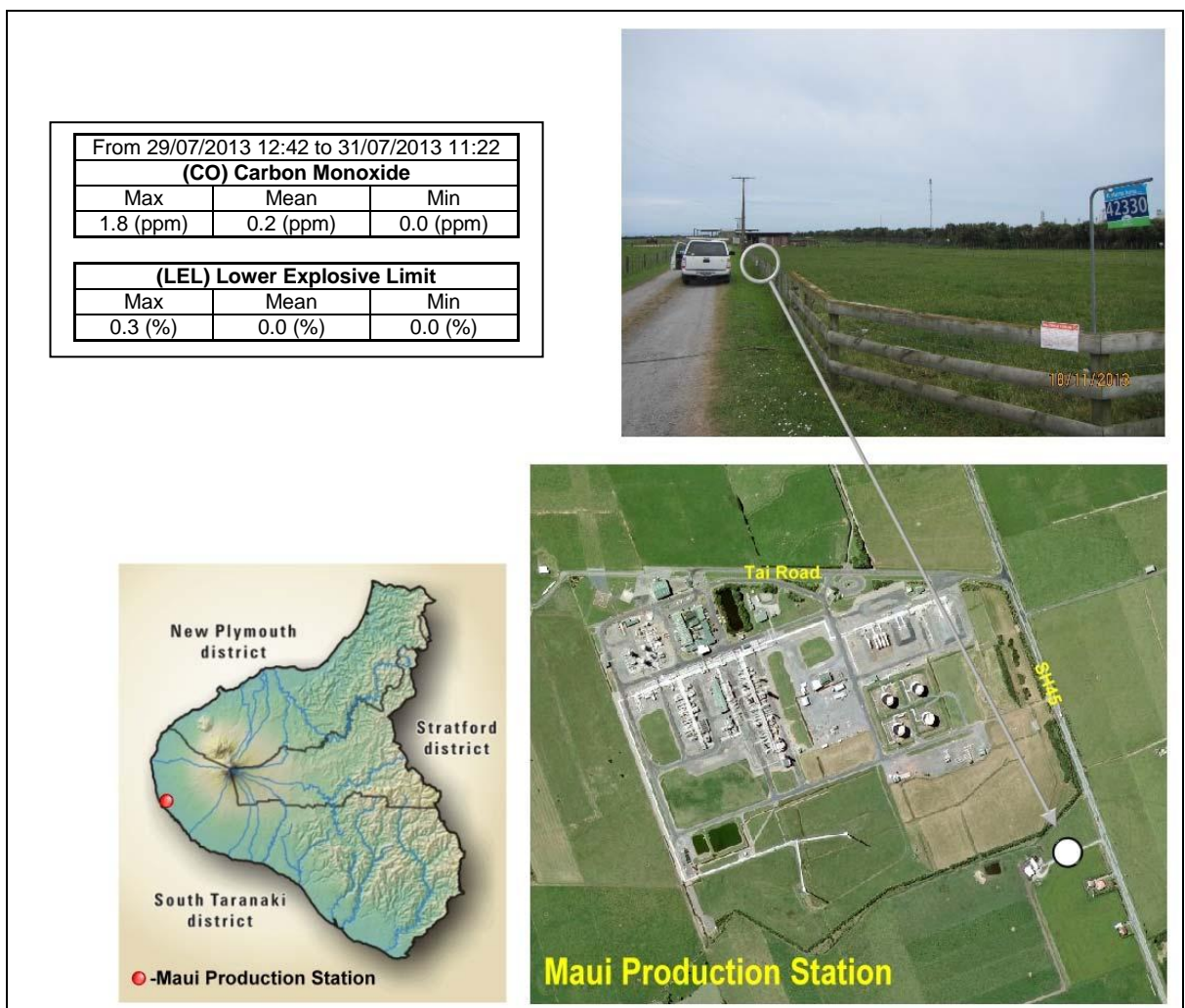


Figure 1 Air monitoring sites and sample details – Maui Production Station (year 2013-2014)

Note: (1) the instrument records in units of ppm. At 15°C

$$1\text{ppm CO} = 0.85\text{ mg m}^{-3}$$

(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 %LEL by 20.

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.

The details of the sample are presented graphically in Figure 2.

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/m³ for an eight hour average or 30 mg/m³ for a 1 hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was only 1.8ppm or 1.5 mg/m³ which complies with the consent condition. This continues the pattern found in previous years.

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 a dangerous level 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.

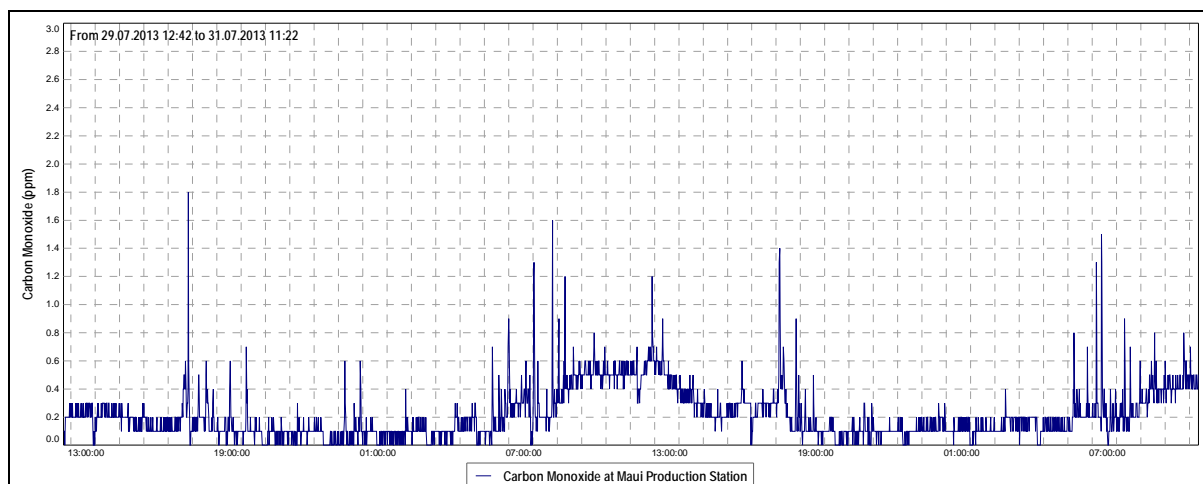


Figure 2 Graphs of ambient gas levels in the vicinity of the Maui PS (year 2013-14)

Memorandum

To Callum MacKenzie – Job Manager
From Scientific Officer - Air Quality, Brian Cheyne
File 4054, FRODO-#1384892
Date August 07, 2014

Ambient gas monitoring at Kapuni Production Station (Year 2013-2014)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately seventy six hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 1.

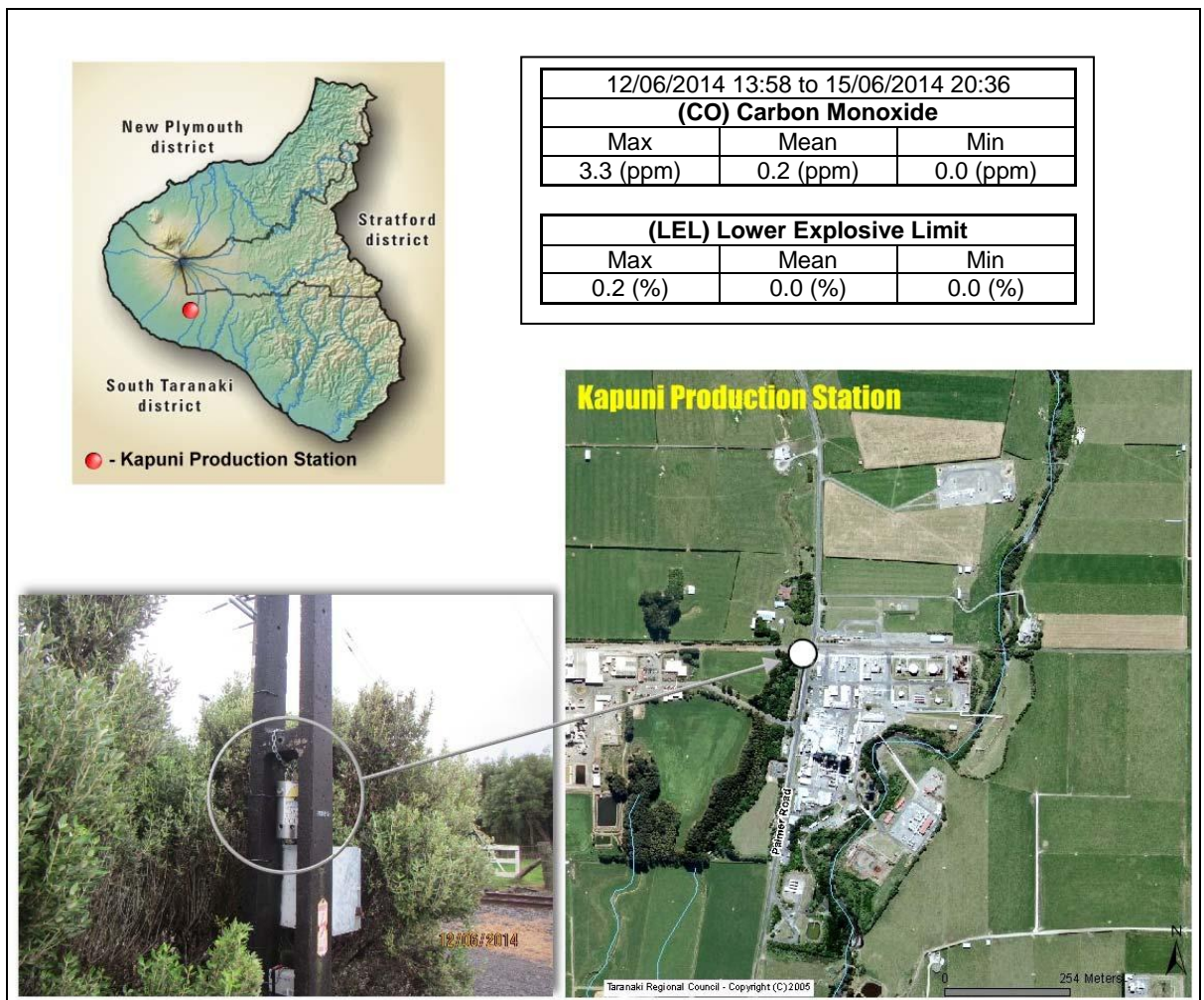


Figure 1 Air monitoring site and sample details – Kapuni Production Station (year 2013-14)

- Note: (1) the instrument records in units of ppm. At 15°C
 $1\text{ppm CO} = 0.85\text{ mg m}^{-3}$
 (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 %LEL by 20.

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.

The details of the sample are presented graphically in Figure 2. The consent 4054-5 covering air discharges from the Kapuni Production Station does not have specific limits related to particular gases. The National Environmental Standards for Air Quality sets limit for carbon monoxide at 10mg/m^3 (12ppm) averaged over an 8 hour exposure period. At no time during the 2013-2014 monitoring year were this limit exceeded. The maximum concentration of carbon monoxide found during the monitoring run was 2.8mg/m^3 and average concentration was only 0.17 mg/m^3 which complies with the NES AQ. This continues the pattern found in previous years.

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 a dangerous level of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Kapuni Production Station reach any more than a trivial level.

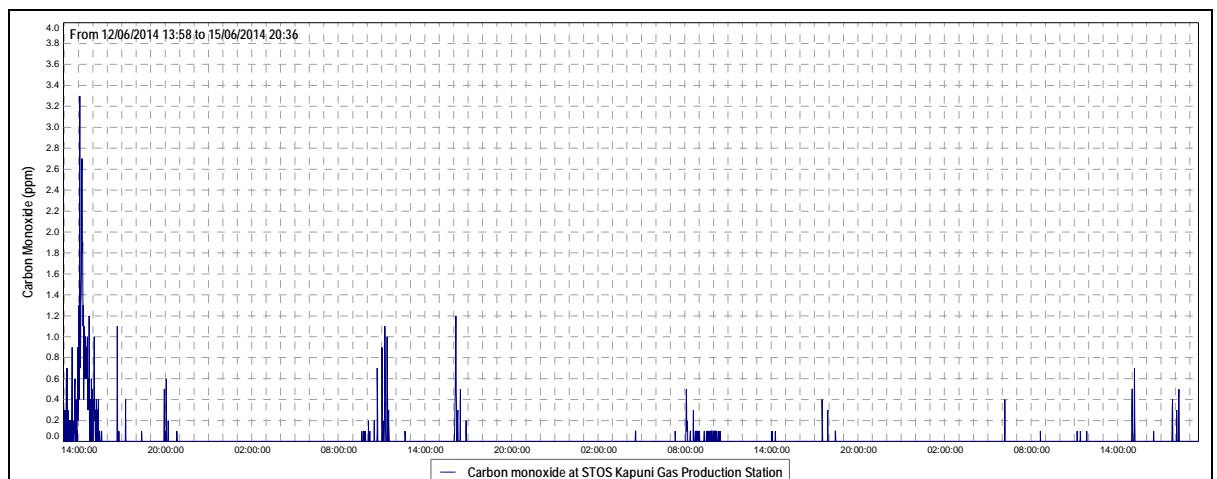


Figure 2 Graphs of ambient gas levels in the vicinity of the Kapuni PS (year 2013-14)