Waste Remediation Services Ltd (WRS)
Symes Manawapou Landfarm
Monitoring Programme
Annual Report
2017-2018

Technical Report 2018-84

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Executive summary

Waste Remediation Services Ltd (WRS) operates a landfarm (Symes Manawapou) located on Manawapou Road, near Manutahi, in the Manawapou catchment, South Taranaki. The original consent was granted in 2012 and was then transferred to WRS in June 2014. This report marks the fourth year that WRS have been in charge of the landfarm and it is the sixth report by the Council for this facility.

This report for the period July 2017 to June 2018 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess WRS's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of WRS's activities.

WRS holds one resource consent, which includes 27 conditions setting out the requirements that the WRS must satisfy. WRS hold one resource consent to discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land in the practice known as landfarming.

During the monitoring period, Waste Remediation Services demonstrated an overall good level of environmental performance.

The Council's monitoring programme for the year under review included six inspections, 15 water samples and 13 composite soil samples.

The monitoring showed that the previously landfarmed areas of RNZ 1, 2, 3, X, M1408 and M1610, post assessment, were found to have reached surrender conditions. These areas of land were landfarmed between 2013 and 2016. One additional landfarmed area (M1810) is in the process of landfarming. Compliance soils samples will be collected once the work has been completed, to assess the remediation over time.

Monitoring of groundwater indicated that two of the four groundwater monitoring wells recorded values of total dissolved salts in excess of 2,500 g/m^3. However subsequent initial 2018-2019 period monitoring has indicated that the values are now below the consented maximum and this demonstrates a short term impact in two wells

There were no unauthorised incidents recording non-compliance in respect of this consent holder during the period under review.

During the year, WRS demonstrated a good level of environmental and a high level of administrative performance with their resource consent.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

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

This report includes recommendations for the 2018-2019 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2017 to June 2018 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consent held by Waste Remediation Services (WRS). WRS operates a landfarm situated on Manawapou Road, near Manutahi, South Taranaki. In this report it is referred to as Symes Manawapou Landfarm.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by WRS that relate to the discharges of drilling waste to land within the Manawapou catchment.

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

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by WRS in the Manawapou catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in WRS's site/catchment.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2018-2019 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;
c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

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

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

1.2 Process description

1.2.1 Drilling waste

Waste drilling material is produced during well drilling for hydrocarbon exploration. The primary components of this waste are drilling fluids (muds) and rock cuttings. Drilling fluids are engineered to perform several crucial tasks in the drilling of a hydrocarbon well. These include: transporting cuttings from the drill bit to the well surface for disposal; controlling hydrostatic pressure in the well; supporting the sides of the hole and preventing the ingress of formation fluids; and lubricating and cooling the drill bit and drill pipe in the hole.

Drilling fluids

Oil and gas wells may be drilled with either synthetic-based mud (SBM) or water-based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil-based muds (diesel/crude oil based) have also been used. Their use has declined since the 1980s due to their ecotoxicity; they have been replaced by SBM. SBM use olefins, paraffin or esters as a base material. While this is technically still a form of oil based fluid, these fluids have been engineered to remove polycyclic aromatic

hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

Common constituents of WBM and SBM include weighting agents, viscosifiers, thinners, lost circulation materials (LCM), pH control additives, dispersants, corrosion inhibitors, bactericides, filtrate reducers, flocculants and lubricants. Of these, the naturally occurring clay mineral barite (barium sulphate) is generally the most common additive. It is added to most drilling muds as a wetting and weighting agent.

Drilling fluids may be intentionally discharged in bulk for changes to the drilling fluid programme or at the completion of drilling. Depending on operational requirements and fluid type and properties, fluids may be re-used in multiple wells.

Cuttings

Cuttings are produced as the drill bit penetrates the underlying geological formations. They are brought to the surface in the drilling fluid where they pass over a shaker screen that separates the cuttings and drilling fluids. The drilling fluids are recycled for reuse within the drilling process, but small quantities of drilling fluids remain adhered to the cuttings. The cuttings and smaller particle material from the drill fluid treatment units drain into sumps. If sumps cannot be constructed, corrals or special bins are used. During drilling this material is the only continuous discharge.

1.2.2 Landfarming

The landfarming process has typically been used in the Taranaki region to assist the conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about $3-4,000/ha to $30-40,000/ha (2013).

Landfarming uses natural and assisted bioremediation to reduce the concentration of petroleum compounds through degradation. The basic steps in the landfarming process are:

1. Drilling waste is transported from wellsites by truck (cuttings) or tanker (liquids). It may be discharged directly to land or placed in a dedicated storage pit.
2. The required area is prepared by scraping back and stockpiling existing pasture/topsoil and leveling out uneven ground.
3. Waste is transferred to the prepared area by excavator and truck and spread out with a bulldozer. Liquids may be discharged by tanker or a spray system.
4. Waste is allowed to dry sufficiently before being tilled into the soil to the required depth with a tractor and discs.
5. The disposal area is leveled with chains or harrows.
6. Stockpiled or brought in topsoil/clay is applied to aid stability and assist in grass establishment.
7. Fertiliser may be applied and the area is sown in crop or pasture at a suitable time of year.

The landfarming process utilised at the site is on a single application basis. This means dedicated spreading areas each receive only a single application of waste. When disposal is complete, the area will be reinstated and monitored until consent surrender criteria have been met.

Photo 1 WRS Symes Manawapou Landfarm post discharge and reinstatement pre-seeding

1.3 Site locations and description

The site is located on Manawapou Road, Manutahi, South Taranaki. This site is positioned on marginal coastal farm land situated on reworked dune fields. An extensive (100-250 m) foredune is located seaward of the consented site, and will remain undisturbed by site activities. The foredune provides a considerable natural buffer from prevailing onshore winds. A natural gas pipeline runs adjacent to the length of the site on the seaward side, marking the seaward extent of the disposal site. In addition, a QE II covenant is located in the north western end of the site, and Lake Taumaha (which is a QE II covenant and a Key Native Ecosystem) is located east of the site. The proximity of the site to these recognised ecosystems has been taken into account in the setting of buffer distances and location of the stockpiling facilities.

The predominant soil type has been identified as black loamy sand and vegetation growth is primarily a mixture of pasture and dune grasses. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m in the pit area, revealing extensive compacted, low permeable clays underlying coastal dune sands. Pit construction revealed mostly tightly packed sand at the pit bases (approximately 4-5 m below surface). Average annual rainfall for the site is 1,023 mm (taken from the nearby 'Duffy' monitoring station). As with the other South Taranaki coastal sites, this site is subject to strong winds.

Figure 1 Aerial image of WRS's Symes Manawapou Landfarm with total consented area

Site data

Location	
Word descriptor:	Manawapou Road, Manutahi, Taranaki
Map reference:	E 1717244
(NZTM)	N 5608736
Mean annual rainfall:	1,023 mm
Mean annual soil temperature:	~15.1°C
Mean annual soil moisture:	~32.9%
Elevation:	~40 m
Geomorphic position:	Dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining

1.4 Resource consents

WRS holds one resource consent, the details of which are summarised in the table below and outlined in sections 1.4.1 below.

Table 1 Consent held by WRS in respect of Symes Manawapou Landfarm

Consent number	Purpose	Granted	Review	Expires
7795-1	To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming.	May 2012	June 2022	June 2028

1.4.1 Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

WRS holds discharge permit **7795-1** to cover the discharge of drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming.

This permit was issued by the Council on 1 May 2012 under Section 87(e) of the RMA. It was transferred to the current consent holder (WRS) in June 2014. It is due to expire on 1 June 2028.

A brief summary of the resource consent conditions are provided below.

- Condition 1 sets out definitions;
- Condition 2 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects;
- Condition 3 sets out the requirements for a management plan;
- Condition 4 sets out the requirements for the installation of groundwater monitoring bores prior to the exercise of the consent;
- Conditions 5 to 9 set out the requirements for a management plan, notifications, monitoring and reporting;
- Conditions 10, 12, 13, 14 and 15 specify discharge limits, locations and loading rates;
- Condition 11 requires a buffer zone between areas of disposal and surface water bodies, property boundaries, and QEII Key Native Ecosystems;
- Conditions 16 and 17 regard operational requirements;
- conditions 18 to 24 specify receiving environment limits for both soil and water;
- Condition 25 concerns archaeological remains; and
- Conditions 26 and 27 concern lapse provisions and consent reviews.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report.

1.5 Monitoring programme

1.5.1 Introduction

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

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

The monitoring programme for this WRS site consisted of four primary components.

1.5.2 Programme liaison and management

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

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

1.5.3 Site inspections

The Symes Manawapou landfarm was visited six times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company 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.

1.5.4 Chemical sampling

During the monitoring period the Council will assess the mediums of soil and groundwater in relation to compliance at the Symes Manawapou facility. The facility as a consented obligation contains an active groundwater monitoring network which is comprised of four active groundwater monitoring wells.

These wells are sampled four times per annum to ascertain for seasonal fluctuation and to assess for any potential adverse effects permeating from the exercise of the consent. The sampling was conducted through a peristaltic pump and field parameters were captured via a YSi multi parameter probe; the samples were collected once field parameters had been stable within 10 % for three consecutive readings. The Council also collected soil samples to assess the quality and to assess the stage of remediation with respect to the landfarming operation.

The methodology utilised by the Council for the collecting of soil samples across the land farmed area was adapted from the Guidelines for the Safe Application of Biosolids to land in New Zealand (2003). Whereby a soil corer was inserted to a depth of 400 mm +/- to encompass the zone of application. Ten soil cores are

collected, these are spaced 10 meters apart. These ten soil cores are then composited to gain one representative soil sample of an application area. An example of a soil core is provided in Figure 2.

In this monitoring period six soil samples were proposed, however as previously landfarmed areas were submitted for surrender analysis, no compliance soil samples were collected. The soil samples were subjected to the following analysis.

Soil analysis parameters

- Total Heavy Metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc);
- Chloride, conductivity, sodium, and sodium adsorption ratio (SAR);
- Total petroleum hydrocarbons; poly-cyclic aromatic hydrocarbons and mono-cyclic aromatic hydrocarbons; and
- Moisture factor.

Groundwater analysis parameters

- Barium (dissolved and acid soluble), chloride, conductivity (@ 20°C), sodium, total dissolved salts (TDS), pH;
- Benzene, ethylbenzene, total petroleum hydrocarbons (speciated), toluene, meta-xylene, ortha-xylene, and
- In-situ readings: pH, conductivity, dissolved oxygen (DO), oxidation and reduction potential (ORP) and temperature.

Figure 2 An example of an extracted soil core post initial landfarming exercise

Figure 3 An example of an extracted soil core during surrender sampling

1.5.5 Review of consent holder provided data

The consent holder provided information pertains to consent required obligations throughout the monitoring period. This is supplied by means of e-mail notification and associated analysis of drilling waste streams. The consent holder also composes an annual report to the Council, which includes further information with respect to consented obligations. Sources of information provided by the consent holder are assessed by the Council and if required, further information is requested. The annual report is attached in Appendix II.

2 Results

2.1 Water

2.1.1 Inspections

07 August 2017

During an inspection of the WRS Symes Manawapou landfarm the following was observed: No recent landfarming activities had occurred. At the time of this observation, land spread muds were yet to be incorporated into the soil profile and were remaining on the surface of the spreading area. The topsoil bund surrounding the area was observed to have remained stable.

All historic application areas had good pasture cover which appeared healthy. At the time pit 1 was full and pit 2 was draining into pit 4 through the balance pipe. No surface hydrocarbons were observed in the pits. There had been recent deliveries from TAG well sites. No objectionable odours or visible emissions were found during the inspection.

24 August 2017

During an inspection of WRS Symes Manawapou landfarm the following was noted: No deliveries of mud had been recorded since the previous inspection was undertaken earlier this month. Pit 2 had been lowered by approximately 30 cm, while pit 1 was observed to be at capacity. The level of pit 4 was found to be at the balance pipe level. Pit 3 was observed to contain algae and stormwater and the liner remained in a state of disrepair, while all other pit liners appeared in good repair.

Liquids had been removed from pit 2 and were discharged onto land in the southern end of the exposed spreading area, though some ponding was at the time occurring, mainly at the southern extent. No works had occurred to incorporate the muds, though a bull-dozer was onsite at the time. The stockpiled topsoil bund appeared stable. The historic spreading areas were observed to hold good pasture cover which appeared healthy.

24 October 2017

An inspection was undertaken of WRS Symes Manawapou landfarm. The following was noted: No recent mud deliveries had occurred. Though mud deliveries are likely to occur next month and notification to the Council will be given in due course, as required by consent.

The pit liners (in service) were observed and appeared in good repair. Upon delivery the muds will be stockpiled in pit 1, the liquid within the pit was observed to be at the balance pipe level and will be displaced into pit 2 as deliveries occur. Plenty of capacity was available within pit 2. Stockpiled topsoil remained stable. Historic spreading areas had good pasture cover which appeared healthy. No incidents were reported.

09 February 2018

During an inspection of WRS Symes Manawapou landfarm the following as noted: Deliveries of mud from TAG Oil's Pukatea wellsite were occurring. During the inspection two trucks were observed to be discharging into pit 1. At the time the balance pipe (linking pit 1 and pit 2) was partially blocked but operational and was to be hydro-jetted using contractors in the near future. Pits 2 and 4 were also observed to contain material. Recent stormwater from all pits had been spread across southern end of exposed earth and had been harrowed.

Topsoil had been spread across the northern end of the exposed area, though at the time seed was yet to be sown across the areas. The historic spreading areas had good pasture cover which appeared healthy.

23 April 2018

At the time of inspection the following as noted at the WRS Symes Manawapou landfarm: The site was unmanned and no activity was occurring. The recent spreading areas had been worked over and all muds had been incorporated. No grass seed had been sowed at the time of the inspection. Three lined pits at the site were observed to contain drilling muds and residues/liquids. The pit with the ripped liner was not being used (pit 3).

Historic spreading areas had good pasture cover which appeared healthy. No muds were identified at the surface. The shoreline was inspected, no adverse effects were observed.

11 June 2018

During an inspection of the WRS Symes Manawapou landfarm the following was noted: No objectionable odours or visible emissions were found during the inspection. Two lined pits contained stormwater and a third pit had been half excavated of muds. The storage liners appeared in good repair within the 'in-use' pits.

Recent spreading activities had occurred on the area of land to the west of the storage site. The stripped topsoil was stable and was found to be revegetating naturally. The spread muds had been incorporated into the soil profile, however grass seed was yet to be sown.

The historic spreading areas were inspected. Pasture cover was complete across all areas and the pasture appeared healthy. No muds were identified at the soil surface. The shoreline was inspected and no adverse effects were noted at the time of inspection.

2.1.2 Provision of consent holder data

The consent holder provides data on the following by way of e-mail notifications throughout the year and also through an annual report which is provided to the Council.

- The name of the well in which the material originated from.
- The type of waste to be landfarmed.
- The volume of waste to landfarmed.
- The concentrations of specific target analytes by means of laboratory testing.
- The specific location/area where the consent holder intends to undertaken landfarming operations of said material.

This information is provided in the consent holder composed annual report which is appended to this report. Appendix II.

Material received by WRS at Symes Manawapou this period were as follows:

Table 2 Drilling mud deliveries WRS Symes Manawapou 2017-2018

Disposal site	Source	Client	Volume	Date received	Analysis provided
Manawapou	D-1	TAG	756 m^3	5 July- 7 August 2017	Yes
Manawapou	Pukatea	TAG	1,727 m^3	24 October 2017 to 9 March 2018	Yes

2.1.3 Results of receiving environment monitoring

2.1.3.1 Groundwater Analysis

As previously stated in Section 1.5.4 chemical sampling, groundwater monitoring of the site specific monitoring wells is undertaken at the Symes Manawapou landfarm. The facility, in line with its consented obligation, contains four groundwater monitoring wells.

These wells were sampled by the Council four times per annum to account for seasonal variation. The aim is to assess the quality of the groundwater in the first instance and secondly, to assess for any potential adverse effects arising in the groundwater as an exercise of this consent. The locations of the monitoring wells are provided in the following Figure 4. The analysis is provided in the following Tables 3–6.

Figure 4 Groundwater monitoring well locations WRS Symes Manawapou Landfarm

Table 3 GND2300 2017-2018 monitoring

WRS GW	Site	GND2300	GND2300	GND2300	GND2300
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Total dissolved salts	g/m³	2,058	773	**2,630**	**2,584**
Temperature	°C	14.7	16.9	17.1	13.9
Barium (acid soluble)	g/m³	0.087	0.17	NR	0.15
Barium (dissolved)	g/m³	0.083	0.06	0.099	0.122
Chloride	g/m³	858	283	1,070	1,040
Conductivity	mS/m@20C	266	100	340	334
Sodium	g/m³	153	90.2	213	222
pH	pH	6.3	6.1	6	6.1

WRS GW	Site	GND2300	GND2300	GND2300	GND2300
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C_7 - C_9	g/m^3	< 0.06	< 0.06	< 0.06	< 0.06
C_{10} - C_{14}	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C_{15} - C_{36}	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Table 4 GND2301 2017-2018 monitoring

WRS GW	Site	GND2301	GND2301	GND2301	GND2301
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Total dissolved salts	g/m^3	605	628	Dry well	1,330
Temperature	°C	16.3	17.6		15.3
Barium (acid soluble)	g/m^3	0.442	0.46		0.57
Barium (dissolved)	g/m^3	0.442	0.36		0.54
Chloride	g/m^3	91.4	93		368
Conductivity	mS/m@20C	78.2	81.3		172
Sodium	g/m^3	71.5	97		160
pH	pH	6.6	6.2		6.8
Benzene	g/m^3	< 0.0010	< 0.0010		< 0.0010
C_7 - C_9	g/m^3	< 0.06	< 0.06		< 0.06
C_{10} - C_{14}	g/m^3	< 0.2	< 0.2		< 0.2
C_{15} - C_{36}	g/m^3	< 0.4	< 0.4		< 0.4
Total hydrocarbons (C_7 - C_{36})	g/m^3	< 0.7	< 0.7		< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010		< 0.0010
m&p-Xylene	g/m^3	< 0.002	< 0.002		< 0.002
o-Xylene	g/m^3	< 0.0010	< 0.0010		< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010		< 0.0010

Table 5 GND2302 2017-2018 monitoring

WRS GW	Site	GND2302	GND2302	GND2302	GND2302
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Total dissolved salts	g/m^3	400	410	485	592
Temperature	°C	14.7	16.5	16	14.7
Barium (acid soluble)	g/m^3	0.017	0.03	NR	0.035
Barium (dissolved)	g/m^3	0.017	0.03	0.02	0.03
Chloride	g/m^3	90.5	88.9	108	156
Conductivity	mS/m@20C	51.8	53.6	62.7	76.6
Sodium	g/m^3	56.6	56.2	63.1	80.5
pH	pH	6.7	6.4	6.4	6.6
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C_7 - C_9	g/m^3	< 0.06	< 0.06	< 0.06	< 0.06
C_{10} - C_{14}	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C_{15} - C_{36}	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Table 6 GND2303 2017-2018 monitoring

WRS GW	Site	GND2303	GND2303	GND2303	GND2303
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Total dissolved salts	g/m^3	1,586	1,485	1,477	**2,839**
Temperature	°C	14.4	15.8	15	14.4
Barium (acid soluble)	g/m^3	0.2	0.18	NR	0.28
Barium (dissolved)	g/m^3	0.198	0.17	0.148	0.28
Chloride	g/m^3	649	577	582	1,140
Conductivity	mS/m@20C	205	192	191	367
Sodium	g/m^3	150	133	139	209
pH	pH	6.3	6.1	6.1	6.3
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C_7 - C_9	g/m^3	< 0.06	< 0.06	< 0.06	< 0.06
C_{10} - C_{14}	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C_{15} - C_{36}	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4

WRS GW	Site	GND2303	GND2303	GND2303	GND2303
Parameter	Collected	04/09/2017	05/12/2017	28/03/2018	30/05/2018
Total hydrocarbons (C_7 - C_{36})	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Groundwater monitoring was undertaken on four occasions this monitoring period 2017-2018. The analysis indicated the following:

- Four monitoring rounds were completed during the monitoring period. On one occasion (28/03/2018) GND2301 was not monitored due to insufficient water within the well, as it was reported to have run dry.
- Analysis of total petroleum hydrocarbons (TPH) all chains (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36} and C_7-C_{36}) and benzene, toluene, ethylbenzene and xylenes m, p and o, (BTEX) indicated no analysis above the limit of detection for these analytes, in all monitoring rounds undertaken during this period.
- Total dissolved salts (TDS) analysis indicated that all four monitoring wells showed an increasing trend this period. The largest increase was found in monitoring well GND2303 with an increase of 1,253 g/m^3.
- GND2300 and GND2303 contained TDS results above the consented maximum of 2,500 g/m^3 as defined by consent 7795-1 condition 18.
- Correspondingly, chloride, sodium and conductivity also demonstrated an increasing trend throughout the monitoring period in all four monitoring wells.
- Barium (acid soluble) ranged 0.017 g/m^3 (GND2302, September 2017) – 0.57 g/m^3 (GND2301, June 2018).
- Barium (dissolved) ranged from 0.017 g/m^3 (GND2302, September 2017) – 0.422 g/m^3 (GND2301, September 2017).
- Groundwater pH analysis indicated a range across the four wells of 6.0-6.8 pH during this period.

For context, in the previous monitoring period (2016-2017), monitoring well GND2301 (Figure 6) held a concentration above the consented maximum of 2,500 g/m^3 for TDS. In this period, this well was observed to have reduced to below the value of 2,500 g/m^3. However, monitoring wells GND2300 (Figure 5) and GND2303 (Figure 8) indicated an increase in TDS concentration. With the final monitoring round (30/05/2018) indicating TDS values in both of these wells, above the receiving environment limit, as defined by consent 7795-1, condition 18, of 2,500 g/m^3. Noting for GND2300 the final value was reported as 2,584 g/m^3, which was marginally above the limit and for GND2303, the value of 2,839 g/m^3. The consent holder should ensure that saline impacts are minimised moving forward and any further increases may result in enforcement action. The long term TDS monitoring record for all monitoring wells is provided in the following Figures 5-8.

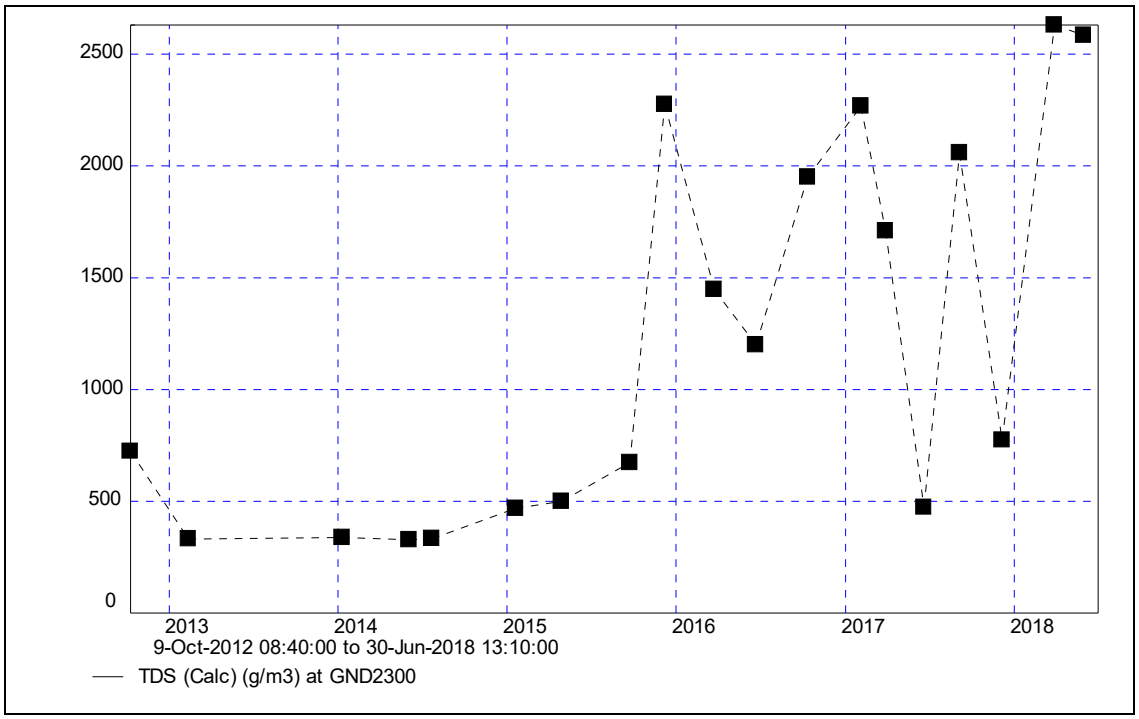

Figure 5 Long term TDS monitoring GND2300 2012-2018

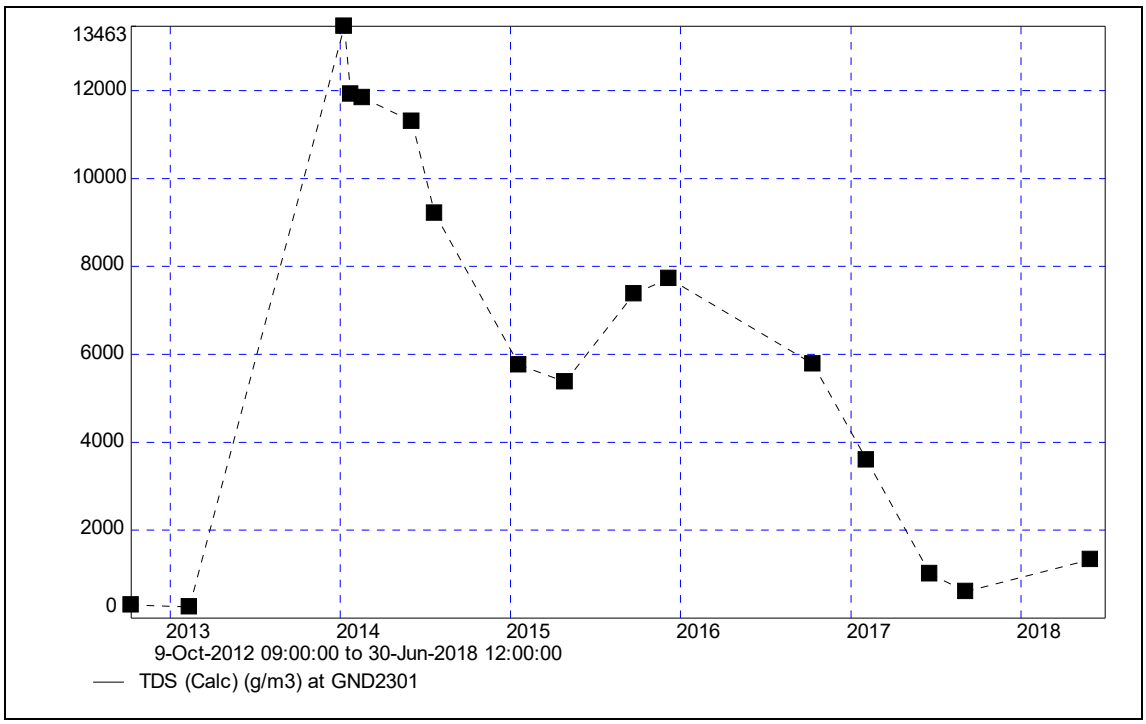

Figure 6 Long term TDS monitoring GND2301 2012-2018

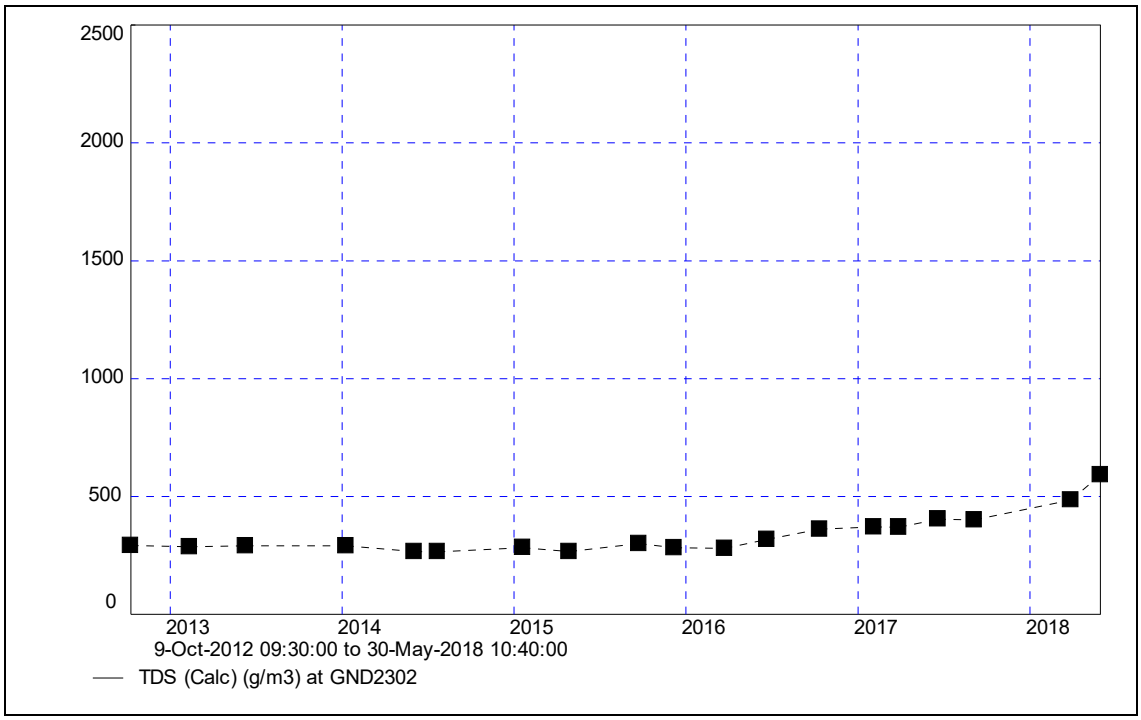

Figure 7 Long term TDS monitoring GND2302 2012-2018

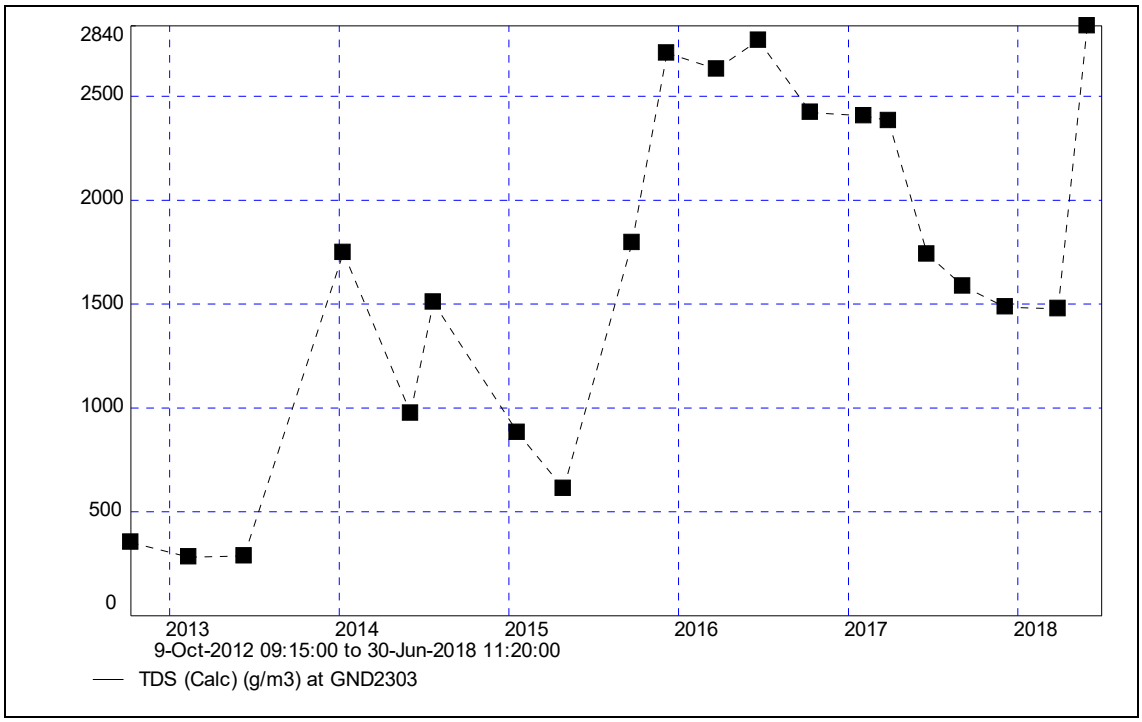

Figure 8 Long term TDS monitoring GND2303

2.1.3.2 Soil analysis

No compliance soil samples were collected by the Council during this monitoring period. The former landfarmed areas were submitted and assessed for surrender analysis. There was one area (defined by the consent holder was M1810) which was in the process of being landfarmed at the time of the surrender sampling. Thus, compliance soil samples will be collected in the upcoming monitoring period from area M1810.

2.1.4 Surrender sampling

The sampling methodology utilised is adapted from the Guidelines for the Safe Application of Biosolids to Land in New Zealand (2003), it is also the method utilised in the compliance sampling undertaken by the Council throughout the year. This is comprised of the composting of 10 soil cores along a GPS marked transect to a depth of 400mm +/- below ground level (bgl). This depth includes the full zone of application and below this zone.

The areas which were proposed for the surrender assessment are provided in the following Figure 5. The dates of the original landfarming exercises is provided in Table 7. The resultant soil transects are provided by Figure 6. The resultant analyses are provided in the following Tables 8 – 11.

As per consent 7795-1, the consent or portions of the consented area, may not be surrendered, unless the following condition has been satisfied.

Condition 23, consent 7795-1

From 1 March 2028 (three months prior to the consent expiry date), constituents in the soil shall not exceed the standards shown in the following table:

Constituent	Standard
conductivity	290 mS/m
chloride	700 mg/kg
sodium	460 mg/kg
total soluble salts	2500 mg/kg
MAHs PAHs TPH	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Ministry for the Environment, 1999). Tables 4.12 and 4.15, for soil type sand.

MAHs - benzene, toluene, ethylbenzene, xylenes

PAHs - napthalene, non-carc. (pyrene), benzo(a)pyrene eq.

TPH - total petroleum hydrocarbons (C7-C9, C10-C14, C15-C36)

The requirement to meet these standards shall not apply if, before 1 March 2028, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

Further to the above surrender condition, the receiving environment during its tenure as a landfarming area must meet these specific standards within the soil prior to being considered for surrender sampling:

Consent 7795-1 Conditions 20-22

20. The conductivity of the soil/waste layer after landfarming shall be less than 400 mS/m, or alternatively, if the background soil conductivity exceeds 400 mS/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.

21. The sodium adsorption ratio (SAR) of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.

22. The concentration of heavy metals in the soil over the disposal area shall at all times comply with the Ministry for the Environment and New Zealand Water & Wastes Assoication's Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:

Constituent	Standard (mg/kg dry weight)
Arsenic	20
Cadmium	1
Chromium	600
Copper	100
Lead	300
Mercury	1
Nickel	60
Zinc	300

Figure 9 WRS provided map of spreading areas

Table 7 Landfarming areas and dates

Area ID	Area (Ha)	Consent no.	Start date	End date	MUD
RNZ 1	0.43	7795-1	18/08/2013	19/09/2013	NA
RNZ 2	0.68	7795-1	19/09/2013	12/10/2013	NA
RNZ 3	0.86	7795-1	12/10/2013	27/01/2014	NA
RNZ X*	unknown	unknown	unknown	unknown	Unknown
M1408	1.38	7795-1	01/07/2014	31/08/2014	DL/S SW
M1610	1.6	7795-1	01/10/2016	30/10/2016	DL/S CS
M1810	1.6	7795-1	20/06/207	On-going Not sampled	DL/S

*no corresponding farming information was provided by the previous consent holder, however a Council soil sample indicated that the area had been landfarmed, thus area RNZX was suggested by Council.

MUD types were as follows: SW = stormwater from the storage cells. DL/S = Drilling liquids and solids.

CS = Contaminated soils. NA = No data available.

Figure 10 Council soil sample transects and associated sample names

Table 8 Surrender sampling area M1610 transects A B and C

	Sample Name:	M1610-A-070518	M1610-B-070518	M1610-C-070518
		07/05/2018	07/05/2018	07/05/2018
Dry Matter	g/100g as rcvd	90	91	91
Soluble Salts	g/100g dry wt	< 0.05	0.07	< 0.05
Electrical Conductivity (EC)	mS/m	2.2	11.1	8.1
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Sodium	mg/kg dry wt	250	290	250
Chloride	mg/kg dry wt	8	21	23
Heavy Metals, Screen Level				
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	22	26	22
Total Recoverable Copper	mg/kg dry wt	12	15	12
Total Recoverable Lead	mg/kg dry wt	1.6	2.3	2
Total Recoverable Nickel	mg/kg dry wt	9	11	9
Total Recoverable Zinc	mg/kg dry wt	87	99	82
BTEX in Soil by Headspace GC-MS				
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil				
1-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.012	< 0.011	< 0.011

	Sample Name:	M1610-A-070518	M1610-B-070518	M1610-C-070518
		07/05/2018	07/05/2018	07/05/2018
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	0.012	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Fluorene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06
Phenanthrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Total Petroleum Hydrocarbons in Soil				
C_7 - C_9	mg/kg dry wt	< 8	< 8	< 8
C_{10} - C_{14}	mg/kg dry wt	< 20	33	47
C_{15} - C_{36}	mg/kg dry wt	230	290	260
Total hydrocarbons (C_7 - C_{36})	mg/kg dry wt	230	330	310

Table 9 Surrender sampling area M1410 transects A B C and spot sample test

	Sample Name:	M1410-C-TEST	M1408-A-070518	M1408-B-070518	M1408-C-070518
		07/05/2018	07/05/2018	07/05/2018	07/05/2018
Dry Matter	g/100g as rcvd	90	94	95	92
Soluble Salts	g/100g dry wt	< 0.05	< 0.05	< 0.05	< 0.05
Electrical Conductivity (EC)	mS/m	1.7	1.6	6.7	2.3
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Sodium	mg/kg dry wt	250	240	196	210
Chloride	mg/kg dry wt	7	7	19	6
Heavy Metals, Screen Level					
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	21	17	12	18
Total Recoverable Copper	mg/kg dry wt	11	10	7	9

	Sample Name:	M1410-C-TEST	M1408-A-070518	M1408-B-070518	M1408-C-070518
		07/05/2018	07/05/2018	07/05/2018	07/05/2018
Total Recoverable Lead	mg/kg dry wt	1.3	1.3	1.6	1.5
Total Recoverable Nickel	mg/kg dry wt	9	7	6	7
Total Recoverable Zinc	mg/kg dry wt	85	61	49	67
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil					
1-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Fluorene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06
Phenanthrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	< 0.011

	Sample Name:	M1410-C-TEST	M1408-A-070518	M1408-B-070518	M1408-C-070518
		07/05/2018	07/05/2018	07/05/2018	07/05/2018
Total Petroleum Hydrocarbons in Soil					
C_7 - C_9	mg/kg dry wt	< 8	< 8	< 8	< 8
C_{10} - C_{14}	mg/kg dry wt	< 20	< 20	< 20	< 20
C_{15} - C_{36}	mg/kg dry wt	< 40	< 40	< 40	< 40
Total hydrocarbons (C_7 - C_{36})	mg/kg dry wt	< 70	< 70	< 70	< 70

Table 10 Surrender sampling area RNZ 1-A, RNZ 2-A and B transects

	Sample Name:	RNZ-1-A-070518	RNZ-2-A-070518	RNZ-2-B-070518
		07/05/2018	07/05/2018	07/05/2018
Dry Matter	g/100g as rcvd	89	90	91
Soluble Salts	g/100g dry wt	< 0.05	< 0.05	< 0.05
Electrical Conductivity (EC)	mS/m	3.3	5.1	4.3
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Sodium	mg/kg dry wt	260	190	197
Chloride	mg/kg dry wt	7	7	6
Heavy Metals, Screen Level				
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	20	20	17
Total Recoverable Copper	mg/kg dry wt	13	11	10
Total Recoverable Lead	mg/kg dry wt	2	2	1.7
Total Recoverable Nickel	mg/kg dry wt	9	9	8
Total Recoverable Zinc	mg/kg dry wt	113	104	87
BTEX in Soil by Headspace GC-MS				
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil				
1-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011

	Sample Name:	RNZ-1-A-070518	RNZ-2-A-070518	RNZ-2-B-070518
		07/05/2018	07/05/2018	07/05/2018
Perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Chrysene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Fluorene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06
Phenanthrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.011
Total Petroleum Hydrocarbons in Soil				
C_7 - C_9	mg/kg dry wt	< 8	< 8	< 8
C_{10} - C_{14}	mg/kg dry wt	< 20	< 20	< 20
C_{15} - C_{36}	mg/kg dry wt	< 40	< 40	< 40
Total hydrocarbons (C_7 - C_{36})	mg/kg dry wt	< 70	< 70	< 70

Table 11 Surrender sampling area RNZ 3-A and B and RNZ-X

	Sample Name:	RNZ-3-A-070518	RNZ-3-B-070518	RNZ-X-070518
		07/05/2018	07/05/2018	07/05/2018
Dry Matter	g/100g as rcvd	94	93	94
Soluble Salts	g/100g dry wt	< 0.05	< 0.05	< 0.05

	Sample Name:	RNZ-3-A-070518	RNZ-3-B-070518	RNZ-X-070518
		07/05/2018	07/05/2018	07/05/2018
Electrical Conductivity (EC)	mS/m	2.2	2.6	5.7
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Sodium	mg/kg dry wt	183	230	186
Chloride	mg/kg dry wt	4	6	6
Heavy Metals, Screen Level				
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	15	18	22
Total Recoverable Copper	mg/kg dry wt	8	9	11
Total Recoverable Lead	mg/kg dry wt	1.8	1.6	1.7
Total Recoverable Nickel	mg/kg dry wt	7	8	9
Total Recoverable Zinc	mg/kg dry wt	57	69	92
BTEX in Soil by Headspace GC-MS				
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil				
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt	< 0.011	< 0.011	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	< 0.011	< 0.011

	Sample Name:	RNZ-3-A-070518	RNZ-3-B-070518	RNZ-X-070518
		07/05/2018	07/05/2018	07/05/2018
Benzo[k]fluoranthene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Chrysene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Dibenzo[a,h]anthracene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Fluoranthene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Fluorene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Naphthalene	**mg/kg dry wt**	< 0.06	< 0.06	< 0.06
Phenanthrene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Pyrene	**mg/kg dry wt**	< 0.011	< 0.011	< 0.011
Total Petroleum Hydrocarbons in Soil				
C_7 - C_9	**mg/kg dry wt**	< 8	< 8	< 8
C_{10} - C_{14}	**mg/kg dry wt**	< 20	< 20	< 20
C_{15} - C_{36}	**mg/kg dry wt**	157	93	119
Total hydrocarbons (C_7 - C_{36})	**mg/kg dry wt**	157	93	119

- The analysis indicated that areas submitted for surrender analysis (RNZ 1, RNZ 2, RNZ 3, M1408, M1610 and RNZX) as defined by consent 7795-1, condition 23, where found to be within surrender concentrations.
- Further, heavy metal concentrations of the soil samples were also similarly compliant with consent condition 22 of consent 7795-1.
- Sodium absorption ratio (SAR) has historically been very low at this facility, thus it was omitted from further surrender related analysis, as per condition 22 of 7795-1.

If the consent holder would like to surrender these areas, to have these areas recognised by the consent, they would be required to apply for a variation of the consent 7795-1.

2.2 Investigations, interventions, and incidents

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

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

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

In the 2017-2018 period, the Council was not required to undertake any significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3 Discussion

3.1 Discussion of site performance

The WRS Symes Manawapou landfarm received material from two sources this monitoring period. These sources of drilling mud were from TAG Oil's Pukatea and D1 wellsite's and encompassed a total of 2,483 m^3 of material. The associated pre-screening analysis, notifications of deliveries of material and landfarming of material, as required by the consent, were supplied by the consent holder, as was the annual report. This for filled the administrative requirement in the year under review.

In terms of actual landfarming in the period under review, one area was landfarmed, M1810. This area is yet to be re-vegetated as the landfarming exercise is still on going. Stockpiled topsoil was noted to be stable. It was observed to be acting as a bund to prevent the fluid land spreading component of the drilling mud and associated stormwater from flowing to other areas of the site. Landfarming of this area will be completed in the upcoming monitoring period. Some ponding was noted during inspections.

Inspections indicated that storage pit 3's liner remains badly damaged. It was also noted that this pit had not been utilised by the consent holder for the past two monitoring periods. Though on occasion it can fill with stormwater. Communication with the consent holder has indicated that this pit may well be reinstated in the upcoming monitoring period. Continued demarcation to prevent the use of the compromised storage liner is encouraged.

Compromised storage liners provide access to the underlying sub soil. If there was a discharge of material into this damaged storage liner it would likely percolate to groundwater, which could adversely affect the surrounding groundwater quality. The other three storage cell liners were noted to be in good order throughout the monitoring period.

The former landfarmed areas were submitted for surrender analysis during this period. Five areas were assessed against consent required surrender conditions and found to be compliant with the analytical requirement for surrender. At the time of this report composition the consent is yet to be amended to reflect these areas and they remain attached the consent. For these compliant areas to be removed from the consent, the consent holder must apply for a variation of consent.

3.2 Environmental effects of exercise of consents

Environmental effects associated with WRS Symes Manwapou landfarm are limited to saline impacts to groundwater, as identified by two of the four groundwater monitoring wells. Two monitoring wells (GND2300 and GND2303) were observed to contain values of total dissolved salt (TDS) above the consent limit of 2,500 g/m^3, this limited the consent holder environmental performance to good.

However, these appear to be short term impacts and the associated first round from the upcoming monitoring period has indicated that these values have now reduced to below the consented limit. The consent holder will make sure they limit any potential for saline impacts to groundwater moving forward.

Surrender sampling analysis indicated that the previously landfarmed areas (RNZ 1, 2, 3 and X, M1610 and M1408) have reached surrender concentrations. These areas were farmed between 2013 and 2016. They were revegetated with minimal issues no issues were reported by the investigating officer this period.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 12.

Table 12 Summary of consent compliance 7795-1 2017-2018 monitoring period

Purpose: ***To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Definitions which apply to the consent	N/A	N/A
2. Best practicable option to be adopted	Inspection and liaison with consent holder. One compromised liner, though not in service. Some ponding noted during spreading of liquid faction/ stormwater from storage pits	Yes
3. The consent holder shall provide a stockpiling and landfarming management plan prior to the exercise of the consent	Management plan received and approved	Yes
4. Install groundwater monitoring wells prior to exercise of consent	Inspections and site records	Yes
5. Notify TRC 48 hrs prior to stockpiling	Notifications received	Yes
6. Notify TRC 48 hrs prior to landfarming	Notifications received	Yes
7. The consent holder shall sample for the following: a. Total petroleum hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Predisposal samples analysis supplied by consent holder as requested	Yes
8. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
9. Report on records in condition 6 to Council by 31 August each year	Report received late however rationale accepted	Yes
10. Discharges made only within area as specified by submitted application	Inspection	Yes

Purpose: *To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
11. No discharge within 25 m of a water body, 10 m from any property boundary and 50 m from the QEII covenant Key Native Ecosystems	Inspection	Yes
12. Maximum application thickness for wastes: a. 100 mm TPH <5% b. 50 mm TPH >5% c. No ponded liquids 1 hr after application	Company records and inspection	Yes
13. Incorporation into soil as soon as practicable to a depth of at least 250 mm	Inspection and sampling	Yes
14. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
15. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	Yes
16. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections.	Yes
17. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
18. Total dissolved salts in any fresh water body shall not exceed 2500 g/m^3	Sampling indicated two wells impacted by salinity above the prescribed 2,500 g/m^3, though reducing	No
19. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling, see above note	No
20. Conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Yes

Purpose: *To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
21. Sodium absorption ratio [SAR] must be less than 18.02, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
22. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling	Yes
23. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mSm^{-1} b. chloride, 700 g/m^3 c. dissolved salts, 2500 g/m^3 d. sodium, 460 g/m^3	Areas RNZ 1, 2, 3 and X, M1408 and M1610 have been assessed against this condition and found to be compliant.	N/A
24. If condition 23 is not met, consent cannot be surrendered	Not applicable , see above	N/A
25. Notification of discovery of archaeological remains	Not applicable – none discovered in this monitoring period	N/A
26. Consent shall lapse on 30 June 2017	Not applicable – consent exercised	N/A
27. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**High**

Table 13 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2012-2013	7795-1				1
2013-2014	7795-1		1		
2014-2015	7795-1		1		
2015-2016	7795-1		1		
2016-2017	7795-1		1		
Totals	-	0	4	0	1
WRS gained consent of the Symes Manawapou facility at the end of the 2013-2014 monitoring period					

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

3.4 Recommendations from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

1. THAT monitoring of consented activities at Symes Manwapou landfarm in the 2017-2018 year continues at the same level as in 2016-2017.

The only variation from the proposed recommendation (1) was that compliance soil samples were not collected. The previously landfarmed areas were submitted for surrender analysis. One new area was in the process of being landfarmed, thus compliance soil samples were not attainable, and will be collected in the upcoming monitoring period, 2018-2019.

3.5 Alterations to monitoring programmes for 2018-2019

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2018-2019 that monitoring of consented activities at the WRS Symes Manwapou landfarm in the 2018-2019 year continue at the same level as in 2017-2018

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at the WRS Symes Manawapou Landfarm in the 2018-2019 year continue at the same level as in 2017-2018.
2. THAT should there be issues with environmental or administrative performance in 2018-2019 period, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

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.
Bund	A wall around a tank to contain its contents in the case of a leak.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1}).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
$g/m^2/day$	grams/$metre^2$/day.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident register	The incident register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
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.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
TDS	Total dissolved salts.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
Zn*	Zinc.

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

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

Bibliography and references

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Waste Remediation Services (WRS) Manawapou (Symes) Disposal Site Annual Report 2015.

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Waste Remediation Services (WRS) Manawapou (Symes) Disposal Site Annual Report 2017.

Waste Remediation Services (WRS) Manawapou (Symes) Disposal Site Annual Report 2018.

Waste Remediation Services Ltd (WRS), Waikaikai (Wards) & Manawapou (Symes) Landfarm Management Plan 2017-2018.

Waste Remediation Services Ltd (WRS), Waikaikai (Wards) & Manawapou (Symes) Landfarm Management Plan 2018-2019.

Appendix I

Resource consents held by WRS Ltd

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

Consent number	Purpose	Granted	Review	Expires
7795-1	To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming.	May 2012	June 2022	June 2028

Discharge Permit

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

Name of Consent Holder:	Waste Remediation Services Limited PO Box 7150 New Plymouth 4341
Decision Date:	01 May 2012
Commencement Date:	01 May 2012

Conditions of Consent

Consent Granted:	To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming
Expiry Date:	01 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	156 Manawapou Road, Manutahi
Legal Description:	Lot 1 DP 7324 (Discharge site)
Grid Reference (NZTM)	1717244E-5608736N
Catchment:	Manawapou

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. For the purposes of this consent the following definitions shall apply:

    a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land for the purpose of interim storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours; and
    b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.

2. The consent holder shall adopt the best practicable option (as defined section 2 of the Resource Management Act 1991) to prevent or minimise any actual or potential effects on the environment arising from the discharge.

Requirements prior to exercise of consent

3. Prior to the exercise of this consent, the consent holder shall provide a stockpiling and landfarming management plan that, to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council, demonstrates the activity can and will be conducted to comply with all of the conditions of this consent. The management plan shall be reviewed annually (on or about the anniversary of the date of issue of this consent) and shall include as a minimum:

    a) procedures for notification to Council of disposal activities;
    b) procedures for the receipt and stockpiling of drilling wastes onto the site;
    c) methods used for the mixing and testing of different waste types;
    d) procedures for site preparation;
    e) procedures for landfarming drilling wastes (including means of transfer from stockpiling area, means of spreading, and incorporation into the soil);
    f) procedures for sowing landfarmed areas, post-landfarming management, monitoring and site reinstatement;
    g) contingency procedures;
    h) sampling regime and methodology;
    i) control of site access; and
    j) documentation for all the procedures and methods listed above.

4. Prior to the exercise of this consent, the consent holder shall after consultation with the Chief Executive, Taranaki Regional Council, install a minimum of three groundwater monitoring bores. The bores shall be at locations and to depths, that enable monitoring to determine any change in groundwater quality resulting from the exercise of this consent. The bores shall be installed in accordance with NZS 4411:2001 and all associated costs shall be met by the consent holder.

Notifications, monitoring and reporting

5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to permitting drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:

   a) the consent number;
   b) the name of the well(s) from which the waste was generated;
   c) the type of waste to be stockpiled; and
   d) the volume of waste to be stockpiled.

6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz.) at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:

   a) the consent number;
   b) the name of the well(s) from which the waste was generated;
   c) the type of waste to be landfarmed;
   d) the volume and weight (or density) of the waste to be landfarmed;
   e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
   f) the specific location and area over which the waste will be landfarmed.

7. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:

   a) total petroleum hydrocarbons (C_6-C_9, C_{10}-C_{14}, C_{15}-C_{36});
   b) benzene, toluene, ethylbenzene, and xylenes;
   c) polycyclic aromatic hydrocarbons screening; and
   d) chloride, nitrogen, pH, potassium, and sodium.

8. The consent holder shall keep records of the following:

   a) wastes from each individual well;
   b) composition of wastes (in accordance with condition 5);
   c) stockpiling area(s);
   d) volumes of material stockpiled;
   e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates;
   f) volumes and weights of wastes landfarmed;
   g) dates of commencement and completion of stockpiling and landfarming events;
   h) dates of sowing landfarmed areas;
   i) treatments applied; and
   j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

   and shall make the records available to the Chief Executive, Taranaki Regional Council.

9. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, by 31 August of each year, a report on all records required to be kept in accordance with condition 6, for the period of the previous 12 months, 1 July to 30 June.

Discharge limits

10. The discharge shall only occur on the disposal sites shown in the Drawing entitled 'Remediation NZ Ltd Proposed Disposal Site' submitted with the application and attached to this consent.

11. There shall be no discharge within buffer zone, being:

    - 25 metres of the Manawapou River;
    - 25 metres of the unnamed tributary;
    - 10 metres from any property boundary; and
    - 50 metres from the QE II covenant Key Native Ecosystem areas.

12. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:

    a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight;
    b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
    c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;

    prior to incorporation into the soil.

13. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.

14. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:

    a) liquid waste has been discharged; or
    b) solid waste has been discharged and incorporated into the soil.

15. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

Operational requirements

16. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.

17. As soon as practicable following landfarming, areas shall be sown into pasture (or into crop). The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

Receiving environment limits - water

18. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m^3.

19. Other than as provided for in condition 18, the exercise of this consent shall not result in any contaminant concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.

Receiving environment limits - soil

20. The conductivity of the soil/waste layer after landfarming shall be less than 400 mS/m, or alternatively, if the background soil conductivity exceeds 400 S/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.

21. The sodium adsorption ratio (SAR) of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.

22. The concentration of heavy metals in the soil over the disposal area shall at all times comply with the Ministry for the Environment and New Zealand Water & Wastes Assoication's Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:

Constituent	Standard (mg/kg dry weight)
Arsenic	20
Cadmium	1
Chromium	600
Copper	100
Lead	300
Mercury	1
Nickel	60
Zinc	300

23. From 1 March 2028 (three months prior to the consent expiry date), constituents in the soil shall not exceed the standards shown in the following table:

Constituent	Standard
conductivity	290 mS/m
chloride	700 mg/kg
sodium	460 mg/kg
total soluble salts	2500 mg/kg
MAHs PAHs TPH	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Ministry for the Environment, 1999). Tables 4.12 and 4.15, for soil type sand.

MAHs - benzene, toluene, ethylbenzene, xylenes
PAHs - napthalene, non-carc. (pyrene), benzo(a)pyrene eq.
TPH - total petroleum hydrocarbons (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36})

The requirement to meet these standards shall not apply if, before 1 March 2028, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

24. This consent may not be surrendered at any time until the standards in condition 23 have been met.

Archaeological remains

25. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive has considered: tangata whenua interest and values, the consent holder's interests, the interests of the public generally, and any archaeological or scientific evidence. The New Zealand Police, Coroner, and Historic Places Trust shall also be contacted as appropriate, and the work shall not recommence in the affected area until any necessary statutory authorisations or consents have been obtained.

Lapse and review

26. This consent shall lapse on 30 June 2017, 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.

27. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 3 June 2014

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix II

WRS supplied annual report

20 October 2018

Chief Executive
Taranaki Regional Council
Private Bag 713
47 Cloten Road
Stratford
Attention Nathan Crook

Dear Nathan

RE: Resource Consent 7795-1 - Manawapou (Symes) - 156 Manawapou Road, RD 2, Patea

As required under special condition 9 of resource consent 7795-1, please find all relevant information recorded from the operational period 1 July 2017 to 30 June 2018 relating to stockpiling and landspreading activities undertaken at Waste Remediation Services (WRS) Manawapou disposal site. It is the fourth the report completed by WRS following the previous periods;
2014-15
2015-16
2016-17

This report is designed to follow on from the previously submitted 2016-17 consent monitoring report and is as such focussed on activities, records and results from the 2017-18 period. This report is structured into 6 sections, as per the following:

1. Overview and Background
2. Wastes Received for Disposal
3. Disposal and Rehabilitation Operations (preparatory earthworks, landspreading/ incorporation and rehabilitation - comprising topsoil application, sowing, additional works)
4. Monitoring
5. Additional Consent Requirements
6. Summary

1. OVERVIEW AND BACKGROUND

WRS began operating the Manawapou disposal site in 2014, replacing the original site operators Remediation NZ Ltd, who were issued resource consent 7795-1 in 2012. Between 2014 and the currently reported on year (2017-18), there have been intermittent periods of activity at the site, reflecting fluctuating levels of activity within the local drilling industry.

2017-2018 has seen a reasonable level of activity at the Manawapou site. At the beginning of the reporting period on 1 July 2017, material from TAG's A2X, E8 and A2 wells had been spread in an area defined as M1709, but final incorporation, topsoil application and sowing had been delayed to allow for some mechanical weathering of muds to occur prior to reinstatement. These works were undertaken in the beginning of the current period, and were completed in September 2017.

Drilling waste was received from a further two TAG wells during the 2017-2018 period, further details are given in Section 2.

This waste was disposed of via landspreading in two prolonged episodes of disposal, relating to the timeframes dictated by wellsite operations. This material was applied to spreading area M1810, which now includes the parcel of land originally called M1709 as described above. More details are given in Section 3.

Monitoring of the site undertaken in the 2017-18 year by both the Taranaki Regional Council (TRC) and WRS management has shown the operations undertaken at Manawapou to be compliant with consent conditions, and no incidents have been recorded against the site in 2017-18.

2. WASTES RECEIVED FOR DISPOSAL

Waste Types and Volumes

Water based muds (WBM) and cuttings were received onsite from two TAG wells during the 2017-18 operational period:

756 m^3 of drilling muds and cuttings were delivered to the Manawapou disposal site from the Cheal D1 hydrocarbon well between 5 July 2017 and 7 August 2017.

1727 m^3 of drilling muds and cuttings were delivered to site from TAG's Pukatea site between 24 October 2017 and 9 March 2018.

The site received a total of 2,483 m^3 of drilling waste during the reporting period. A further 35 m^3 of material from the Cheal D1 well was initially delivered to the Manawapou site, but then transferred to the site at Waikaikai for eventual disposal. Further details of these drilling waste deliveries can be found in the attached mud register, Appendix C.

No further contaminated soils (as per the previous 2016-17 period) were received at the Manawapou site in 2017-18.

Waste Characterisation

Consent 7795-1 requires the site operator to sample and keep records of waste chemical composition. Composite samples are taken (generally by wellsite staff prior to transport) across each waste stream before materials leave the wellsite for delivery. WRS also takes pre-spreading samples from the pits prior to landspreading for further waste characterisation. All samples are sent to RJ Hill Laboratories for analyses. Results are forwarded directly to TRC for their records and for cross referencing purposes. Results are kept and logged by WRS, and are used to calculate required spreading areas as per condition 12 of consent 7795-1 to ensure the hydrocarbon limit in condition 14 is adhered to.

The summary table below gives the basic details of the pre-disposal samples for the Manawapou site in 2017-18.

WRS sample	RJ Hill job	Disposal site	Source	Client	Date received	Date reported
KB1925	1848476	Manawapou	D-1	TAG	23-Sep-17	5-Oct-17
KB1930	1888311	Manawapou	Pre-spread	TAG	2-Dec-17	14-Dec-17
KB1932	1917352	Manawapou	Pukatea	TAG	1-Feb-18	9-Feb-18
KB1940	1963772	Manawapou	Pre-spread	TAG	16-Apr-18	2-May-18

PDF copies of these results are attached to this report as part of Appendix D. Excel/CSV format results can be supplied upon request if required. The wastes received at the Manawapou site in the 2017-18 period were water based muds and cuttings, the results indicate relatively low levels of hydrocarbons (TPH <4 - 15,200 g/m^3) present, well below the post-incorporation soil limit of 50,000 mg/kg. Heavy metal concentrations in the pre-disposal samples are also low, suggesting minimal risk of heavy metal contamination of soil/groundwater post-application of wastes.

Elevated salinity is expected from KCL based mud wastes arriving onsite for disposal. Wastes are analysed for several salinity related parameters, and monitoring of receiving soil and groundwater is conducted by the TRC to check for any adverse effects on soil quality and/or groundwater quality from application of highly saline muds.

3. DISPOSAL AND REHABILITATION OPERATIONS

There have been two extended episodes of spreading and final disposal, subsequent rehabilitation and return to pasture at Manawapou during the 2017-2018 period. As aforementioned, the rehabilitation and sowing of area M1709 was also completed at the start of this period.

Material received from the Cheal D and Pukatea wellsites was handled using a mixture of stockpiling and direct spreading to allow for the most effective/efficient disposal in relation to wellsite operations. The episodes of spreading are grouped as A and B below:

A) Area M1810, commenced October 2017

Material from Cheal D-1, stockpiled from July 2017 onwards was spread in area M1810.

B) Area M1810, commenced January 2018

Mud and cuttings from Pukatea wellsite were also spread in area M1810.

The landspreading processes employed at this site are detailed in the site management plan. WRS closely monitors spreading operations to ensure contractors are consistent with the procedures outlined in the management plan and to ensure application thickness and ponding consent conditions are adhered to. The inspection notices received from the TRC imply these processes were implemented satisfactorily during 2017-18. Several photographs of spreading operations at the Manawapou site are attached as Appendix A as further reference.

4. MONITORING

Site Inspections - WRS

WRS closely supervise site operations to ensure all contractors are following best practice as per the site operation management plan and conditions specified in consent 7795-1. Regular site inspections are also undertaken during periods of inactivity at the site.

Site Inspections – TRC

WRS has received seven inspection notices from the TRC for the 2017-18 year. All notices indicated the TRC inspector was satisfied with the physical state of the site, and with operations being undertaken around the time of inspection. Copies of the TRC inspection notices are attached as Appendix F.

Receiving Environment soil Sampling

During the 2017-18 period receiving environment sampling was exclusively undertaken by TRC staff, following negotiations held in the previous period. TRC staff had always undertaken groundwater sampling at the site, and had also undertaken soil sampling for a reduced suite of parameters as a quality control measure. TRC field staff now complete all soil sampling for the full suite of parameters and report results to WRS when required. To the knowledge of WRS management, all soil sampling undertaken in 2017-18 has yielded results compliant with the limits specified in consent 7795-1.

Additionally, surrender criteria has been reached in all previous spreading areas at this site, in areas RNZ1-3, M1408 and M1610 identified in the Manawapou site map, attached in Appendix B.

5. ADDITIONAL CONSENT REQUIREMENTS

As per condition 3 of consent 7795-1, the site management plan has been reviewed and updated and submitted to the TRC. Operations at the Manawapou landfarm are all undertaken generally in accordance with the WRS' Landfarm Management Plan that covers both the Manawapou and Waikaikai sites. It is a live document and is constantly reviewed and updated as necessary to reflect operational requirements and practices at both sites operated by WRS. This updated plan is attached as Appendix E.

The previous compliance report discussed the status of the stockpiling facilities at the site, particularly discussing the integrity of synthetic pit liners. As of the end of the 2017-18 year the condition/status of the pits remains fairly unchanged, Pit 3 remains unused until such a time as the old liner is replaced, or the pit may be decommissioned and reinstated in favour of a new lined pit.

Pasture establishment and ongoing vegetation coverage are monitored by TRC and by WRS in partnership with the landowner at the Manawapou site. If either the landowner or the TRC are not satisfied with vegetation coverage at the site, WRS and their contractors will work with the landowner to address any issues. In 2017-18 no significant coverage issues were identified.

6. SUMMARY

As in the previous year, there was a reasonable level of activity at the Manawapou site in 2017-18. The area spread at the end of 2016-17 (M1709 now renamed M1810) was completed, and waste material from wells at TAG's Cheal D and Pukatea wellsites was received onsite and disposed of via landspreading in area M1810. At the time of reporting, final remediation works are being undertaken in M1810. Historic spreading areas have met surrender criteria, and no incidents/significant issues have been identified at the site.

Waste Remediation Services Ltd
w +64 6 751 9221 m + 64 275 996 105 f +64 751 9225
Address 141 – 143 Connett Road East, Bell Block 4312, New Zealand
Post PO Box 7150, New Plymouth 4341, New Zealand
Email: **keith@wrsltd.co.nz**

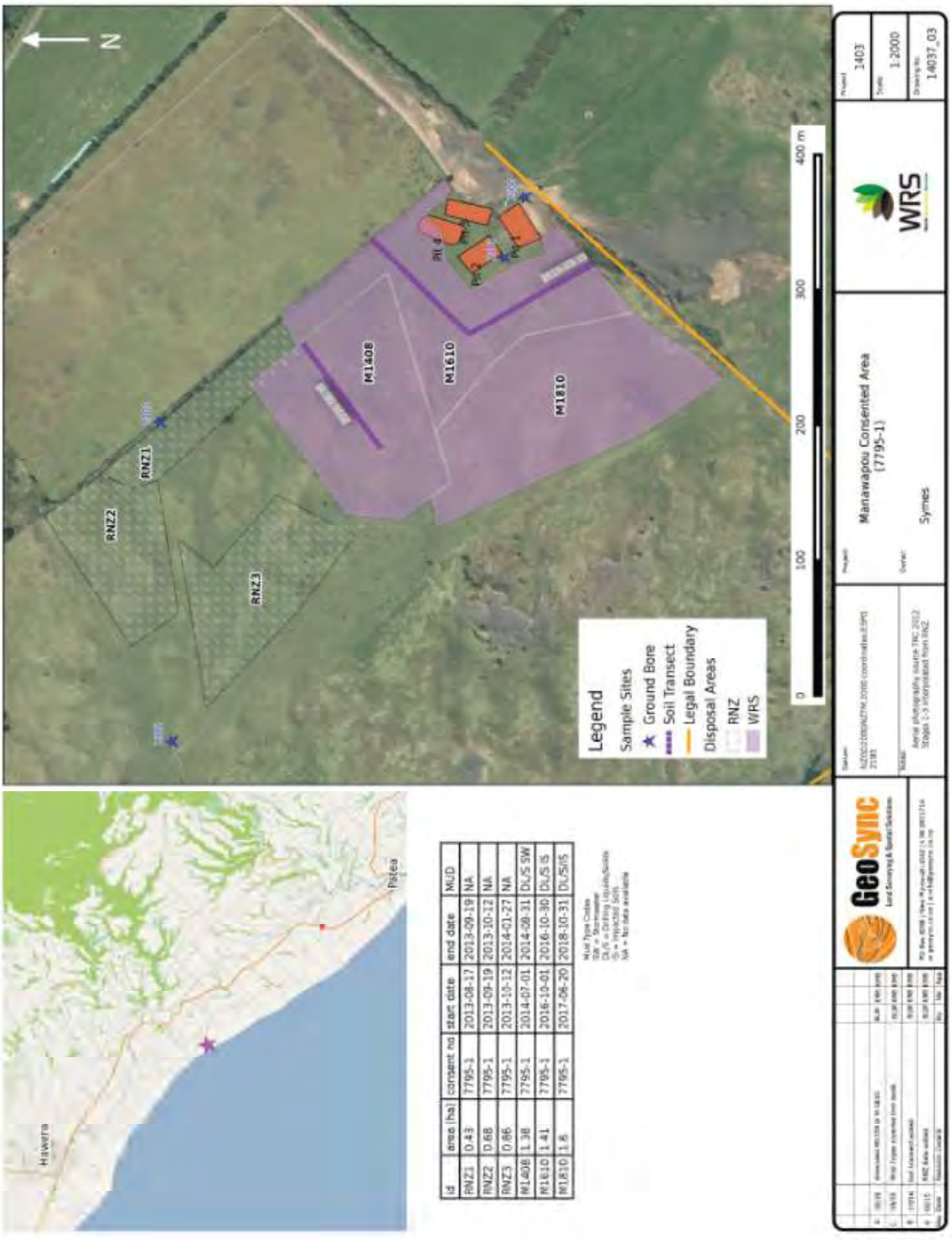
Appendix A Field Photographs

Various photographs showing the storage pits and spreading area M1810.





Appendix B Manawapou Site Map



id	area (ha)	consent no	start date	end date	MUD
RNZ1	0.43	7795-1	2013-08-17	2013-09-19	NA
RNZ2	0.68	7795-1	2013-09-19	2013-10-12	NA
RNZ3	0.86	7795-1	2013-10-12	2014-01-27	NA
M1408	1.38	7795-1	2014-07-01	2014-08-31	DLS SW
M1610	1.41	7795-1	2016-10-01	2016-10-30	DLS IS
M1810	1.6	7795-1	2017-06-20	2018-10-31	DLS/IS

Appendix D RJ Hill Laboratories Chemical Results

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

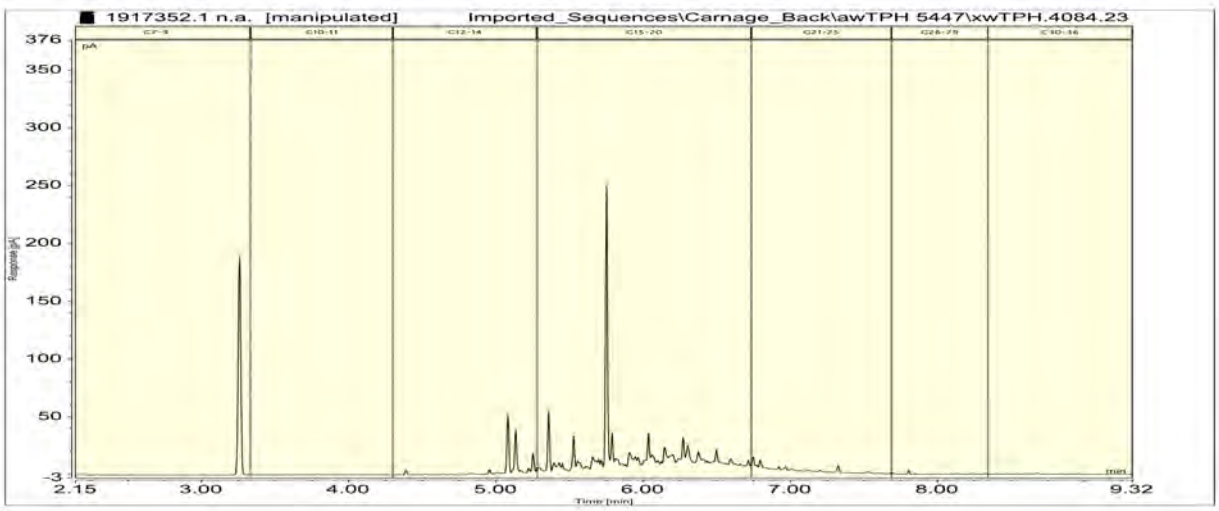
ANALYSIS REPORT

Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1917352 SPv1
Contact:	Keith Brodie	**Date Received:**	01-Feb-2018
	PO Box 77	**Date Reported:**	09-Feb-2018
	Oakura 4345	**Quote No:**	80931
	TARANAKI	**Order No:**	KB 1932
		Client Reference:	Waste characterisation Trade Waste
		Submitted By:	Keith Brodie

Sample Type: Aqueous

Sample Name:		Pukatea 30-Jan-2018 9:00 am				
Lab Number:		1917352.1				
Individual Tests						
pH	pH Units	11.1	-	-	-	-
Electrical Conductivity (EC)	mS/m	4,740	-	-	-	-
Approx Total Dissolved Salts	g/m³	32,000	-	-	-	-
Total Barium	g/m³	79	-	-	-	-
Total Calcium	g/m³	890	-	-	-	-
Total Magnesium	g/m³	95	-	-	-	-
Total Mercury	g/m³	< 0.0021	-	-	-	-
Total Potassium	g/m³	14,300	-	-	-	-
Sodium Absorption Ratio*		7.9	-	-	-	-
Total Sodium	g/m³	930	-	-	-	-
Chloride	g/m³	12,900	-	-	-	-
Total Nitrogen	g/m³	49	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	6.0	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	43	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	0.109	-	-	-	-
Total Cadmium	g/m³	< 0.0027	-	-	-	-
Total Chromium	g/m³	0.43	-	-	-	-
Total Copper	g/m³	0.54	-	-	-	-
Total Lead	g/m³	0.43	-	-	-	-
Total Nickel	g/m³	0.40	-	-	-	-
Total Zinc	g/m³	1.23	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.0010	-	-	-	-
Toluene	g/m³	< 0.0010	-	-	-	-
Ethylbenzene	g/m³	< 0.0010	-	-	-	-
m&p-Xylene	g/m³	< 0.002	-	-	-	-
o-Xylene	g/m³	< 0.0010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	0.30	-	-	-	-
C10 - C14	g/m³	8.0	-	-	-	-
C15 - C36	g/m³	84	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	92	-	-	-	-

1917352.1
Pukatea 30-Jan-2018 9:00 am
Client Chromatogram for TPH by FID



SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

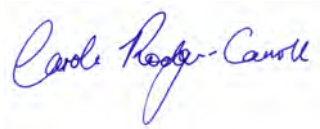
Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0011 - 0.021 g/m^3	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m^3	1
Total Petroleum Hydrocarbons in Water*	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m^3	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Digestion with HCl	Nitric/hydrochloric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter. APHA 4500-H$^+$ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m^3	1
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.11 g/m^3	1
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	1.1 g/m^3	1
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.42 g/m^3	1
Total Mercury	Acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0021 g/m^3	1
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	1.1 g/m^3	1
Sodium Absorption Ratio (Total)*	Calculation: (sodium / 22.99) / [(calcium / 40.078 + magnesium / 24.305)$^{0.5}$].	0.2	1
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.42 g/m^3	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m^3	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3.	0.05 g/m^3	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Nitrate-N + Nitrite-N Screen	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO3- I 22nd ed. 2012 (modified).	0.10 g/m^3	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m^3	1
C7 - C9	Head Space, GCMS analysis.	0.06 g/m^3	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

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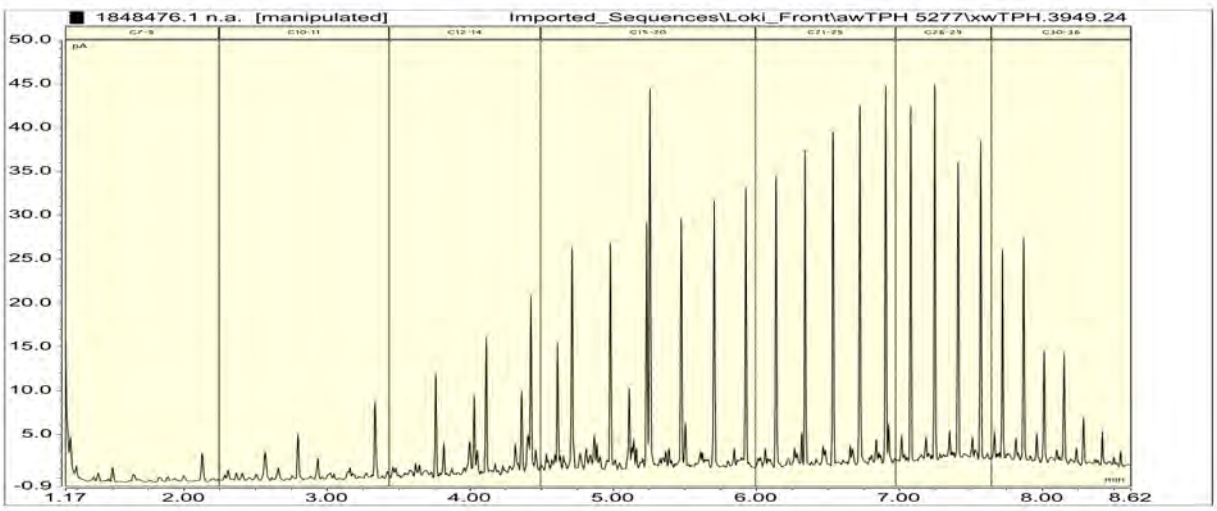
ANALYSIS REPORT

Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1848476	SPv1
Contact:	Keith Brodie	**Date Received:**	23-Sep-2017	
	PO Box 77	**Date Reported:**	05-Oct-2017	
	Oakura 4345	**Quote No:**	80931	
	TARANAKI	**Order No:**	KB1925	
		Client Reference:	Waste characterisation Trade Waste	
		Submitted By:	Keith Brodie	

Sample Type: Aqueous

Sample Name:		D-1 Aug 2017				
Lab Number:		1848476.1				
Individual Tests						
pH	pH Units	7.6	-	-	-	-
Electrical Conductivity (EC)	mS/m	6,190	-	-	-	-
Approx Total Dissolved Salts	g/m³	41,000	-	-	-	-
Total Barium	g/m³	3,700	-	-	-	-
Total Calcium	g/m³	2,400	-	-	-	-
Total Magnesium	g/m³	450	-	-	-	-
Total Mercury	g/m³	< 0.011	-	-	-	-
Total Potassium	g/m³	11,900	-	-	-	-
Sodium Absorption Ratio*		3.8	-	-	-	-
Total Sodium	g/m³	770	-	-	-	-
Chloride	g/m³	22,000	-	-	-	-
Total Nitrogen	g/m³	530	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	1.5	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	530	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	0.61	-	-	-	-
Total Cadmium	g/m³	0.0115	-	-	-	-
Total Chromium	g/m³	2.0	-	-	-	-
Total Copper	g/m³	4.7	-	-	-	-
Total Lead	g/m³	1.65	-	-	-	-
Total Nickel	g/m³	1.66	-	-	-	-
Total Zinc	g/m³	41	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.010	-	-	-	-
Toluene	g/m³	< 0.010	-	-	-	-
Ethylbenzene	g/m³	0.014	-	-	-	-
m&p-Xylene	g/m³	0.06	-	-	-	-
o-Xylene	g/m³	0.027	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	0.9	-	-	-	-
C10 - C14	g/m³	21	-	-	-	-
C15 - C36	g/m³	122	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	144	-	-	-	-

1848476.1
D-1 Aug 2017
Client Chromatogram for TPH by FID



Analyst's Comments

Due to the type of matrix found in sample 1848476.1, the BTEX analysis was done on a smaller amount of sample. Hence the higher detection limit reported.

Sample 1 Comment:
Please note that the TPH C7 - C9 band was analysed by the head space/GCMS method, with all other TPH bands analysed by hexane solvent extraction/GC/FID.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0011 - 0.021 g/m^3	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629] Analysis performed at 1 Clyde Street, Hamilton	0.0010 - 0.002 g/m^3	1
Total Petroleum Hydrocarbons in Water*	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629] Analysis performed at 1 Clyde Street, Hamilton	0.06 - 0.7 g/m^3	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Digestion with HCl	Nitric/hydrochloric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter. APHA 4500-H$^+$ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m^3	1
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.11 g/m^3	1
Total Calcium	Nitric acid digestion, ICP-MS, screen level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	1.1 g/m^3	1
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.42 g/m^3	1
Total Mercury	Acid digestion, ICP-MS, screen level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.0021 g/m^3	1
Total Potassium	Nitric acid digestion, ICP-MS, screen level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	1.1 g/m^3	1
Sodium Absorption Ratio (Total)*	Calculation: (sodium / 22.99) / [(calcium / 40.078 + magnesium / 24.305)$^{0.5}$].	0.2	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Sodium	Nitric acid digestion, ICP-MS, screen level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.42 g/m^3	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3.	0.05 g/m^3	1
Nitrate-N + Nitrite-N Screen	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO3- I 22nd ed. 2012 (modified).	0.10 g/m^3	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m^3	1
C7 - C9	Head Space, GCMS analysis. Analysis performed at 1 Clyde Street, Hamilton.	0.06 g/m^3	1

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Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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ANALYSIS REPORT

Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1888311 SPv1
Contact:	Keith Brodie	**Date Received:**	02-Dec-2017
	PO Box 77	**Date Reported:**	14-Dec-2017
	Oakura 4345	**Quote No:**	80931
	TARANAKI	**Order No:**	KB1930 MZC0046
		Client Reference:	Waste Characterisation Trade Waste
		Submitted By:	Keith Brodie

Sample Type: Aqueous

Sample Name:		Man Pre-Spread 18-Oct-2017 11:00 am				
Lab Number:		1888311.1				
Individual Tests						
Chloride	g/m³	2,900	-	-	-	-
Total Nitrogen	g/m³	83	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	< 0.10	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	83	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.0010	-	-	-	-
Toluene	g/m³	< 0.0010	-	-	-	-
Ethylbenzene	g/m³	< 0.0010	-	-	-	-
m&p-Xylene	g/m³	< 0.002	-	-	-	-
o-Xylene	g/m³	< 0.0010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.06	-	-	-	-
C10 - C14	g/m³	< 1.0	-	-	-	-
C15 - C36	g/m³	< 2	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 4	-	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m³	1
Total Petroleum Hydrocarbons in Water	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m³	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1
Nitrate-N + Nitrite-N Screen	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO3- I 22nd ed. 2012 (modified).	0.10 g/m³	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m^3	1
C7 - C9	Head Space, GCMS analysis.	0.06 g/m^3	1

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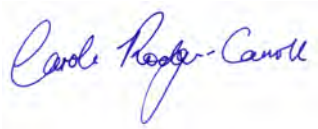

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

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Certificate of Analysis

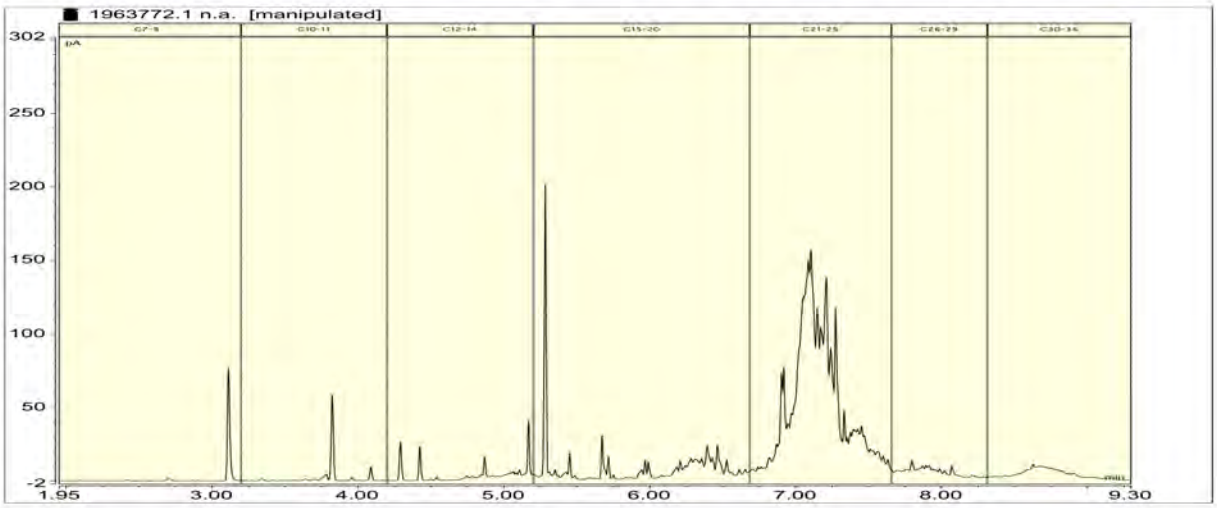
Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1963772 SPv1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	**Date Received:**	16-Apr-2018
		Date Reported:	02-May-2018
		Quote No:	80931
		Order No:	KB1940
		Client Reference:	Waste characterisation
		Submitted By:	Keith Brodie

Sample Type: Sludge

Sample Name:		Man Pre Spread 07-Apr-2018 3:30 pm				
Lab Number:		1963772.1				
Individual Tests						
Dry Matter	g/100g as rcvd	27	-	-	-	-
Approx Total Dissolved Salts	g/m³	31,000	-	-	-	-
Electrical Conductivity (EC)*	mS/m	4,660	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	2,600	-	-	-	-
Total Recoverable Calcium	mg/kg dry wt	37,000	-	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	9,200	-	-	-	-
Total Recoverable Potassium	mg/kg dry wt	55,000	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	4,700	-	-	-	-
Chloride*	mg/kg dry wt	47,000	-	-	-	-
pH	pH Units	9.81	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.13	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	7	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	43	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	50	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	21	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.25	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	28	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	115	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.4	-	-	-	-
Toluene	mg/kg dry wt	< 0.4	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.4	-	-	-	-
m&p-Xylene	mg/kg dry wt	1.1	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.4	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	0.42	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	0.76	-	-	-	-
Perylene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.09	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.10	-	-	-	-
Acenaphthylene	mg/kg dry wt	0.06	-	-	-	-
Acenaphthene	mg/kg dry wt	< 0.04	-	-	-	-
Anthracene	mg/kg dry wt	< 0.04	-	-	-	-

Sample Type: Sludge						
Sample Name:		Man Pre Spread 07-Apr-2018 3:30 pm				
Lab Number:		1963772.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Benzo[a]anthracene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	-	-	-	-
Chrysene	mg/kg dry wt	< 0.04	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.04	-	-	-	-
Fluorene	mg/kg dry wt	0.09	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Naphthalene	mg/kg dry wt	0.42	-	-	-	-
Phenanthrene	mg/kg dry wt	0.07	-	-	-	-
Pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	520	-	-	-	-
C10 - C14	mg/kg dry wt	1,220	-	-	-	-
C15 - C36	mg/kg dry wt	13,500	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	15,200	-	-	-	-

1963772.1
Man Pre Spread 07-Apr-2018 3:30 pm
Client Chromatogram for TPH by FID



Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.002 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil*	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.002 - 60 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1
esICextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m^3	1
Electrical Conductivity (EC)*	Electrical Conductivity measured in 1:5 Solid:Water extract.	0.1 mS/m	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Calcium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Magnesium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Potassium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1
pH	pH meter. APHA 4500-H$^+$ B 22nd ed. 2012.	0.10 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benz(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	1
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k) fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.1 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	1

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Client Services Manager - Environmental