

Waste Remediation Services Ltd
Waikaikai Landfarm
Monitoring Programme
Annual Report
2019-2020

Technical Report 2020-91

ISSN: 1178-1467 (Online)
Document: 2487877 (Word)
Document: 2640833 (Pdf)

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February 2021

Executive summary

Waste Remediation Services Ltd (the Company) operates a drilling waste landfarm (Waikaikai Landfarm) located off Lower Manutahi Road at Manutahi, South Taranaki, in the Mangaroa catchment.

This report for the period July 2019 to June 2020 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company'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 the Company's activities.

The Company holds one resource consent, which includes a total of 32 conditions setting out the requirements that the Company must satisfy. The consent allows the Company to discharge drilling waste from hydrocarbon exploration and production activities from well sites and contaminated soil onto and into land via landfarming.

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

The Council's monitoring programme for the year under review included five inspections, 20 water samples and two composite soil samples collected for physicochemical analysis.

In this monitoring period the Company landfarmed one area, area W1911. This farming operation sequestered drilling waste material from Todd Energy, Westside and NPDC. The Company were prompt in supplying their annual report, as well as notifications and associated drilling waste analysis throughout the monitoring period.

The monitoring showed that no consent exceedance was recorded in the groundwater monitoring well network, across the four rounds, undertaken quarterly. The analysis of the newly landfarmed area of W1911 indicated this area is still bio remediating, with total petroleum hydrocarbons C₁₀-C₁₄ and C₁₅-C₃₆ currently elevated above the consent limit for surrender.

There was one unauthorised incident recording non-compliance in respect of the Company during the period under review. This related to residual material being held within a compromised storage cell liner. This has since been rectified by the Company.

The monitoring indicated that the Company is maintaining a good level of performance, environmentally and a high level, administratively.

For reference, in the 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% 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 2020-2021 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 2019 to June 2020 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Waste Remediation Services Ltd here after referred to the Company. The Company operates a landfarm situated on Lower Manutahi Road at Manutahi, South Taranaki, in the Mangaroa catchment.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by the Company, that relate to the discharges of drilling waste within the Mangaroa catchment, under the practice known as landfarming.

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

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 through annual programmes;
- the resource consents held by the Company in the Mangaroa catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company'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 2020-2021 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 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 during investigations of incidents reported to the Council by a third party 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 during investigations of incidents reported to the Council by a third party. 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 during investigations of incidents reported to the Council by a third party. 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 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% of the consents, a good level of environmental performance and compliance was achieved.¹

1.2 Process description

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

¹ The Council has used these compliance grading criteria for almost two decades. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (OBM) (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, paraffins 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.

Landfarming

The landfarming process has typically been used in the Taranaki region to assist the ultimate 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 levelling 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 levelled 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 Waikakai Landfarm site was initially undertaken on a single application basis. This means dedicated spreading areas receive only single applications of waste. When disposal is complete, the area will be reinstated and monitored until consent surrender criteria have been met.

In a previous monitoring period the consent was varied to allow for the re-application of impacted soils to an area which was initially utilised for landfarming in 2012. The consent holder undertook analysis to quantify the concentrations of specific parameters in the soil which stipulated the area of land was within surrender criteria. Thus the decision was undertaken to allow for the second application of material.

More recently the consent holder requested the surrender of the areas of site which had been re-utilised for the landfarming and as a result of the request additional soil sampling was undertaken by the Council.

1.3 Site location and description

The Company operates a drilling waste landfarm off Manutahi Road, Manutahi. The site is owned by P. F. and K. M. Wards, trading under the name Waikaikai Farms Ltd. The predominant land use was previously dairy farming. The site location is detailed in Figure 1. The predominant soil type has been identified as black loamy sand and vegetation growth consists mostly of pasture. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m both around the waste holding pit area and to the south-western site boundary, revealing alternating layers of sand and clays. Bore construction also revealed localised peat layers within some augured cores (approximately 4–8 m below surface). Average annual rainfall for the site is 1,043 mm (taken from the nearby Patea monitoring station).

Origin Energy Ltd's Kauri D wellsite is situated in the eastern corner of the site, and there is a small coastal lake inland and to the northeast (up gradient) of the storage pit area. Both of these operational features are presented in Figure 1.



Figure 1 WRS Waikaikai Landfarm and regional insert

A summary of the site data is provided below:

Site data:	Waikaikai Landfarm
Location	
Word descriptor:	Lower Manutahi Road, Manutahi, Taranaki
Map reference:	E 1719720
(NZTM)	N 5605515
Mean annual rainfall:	1,043 m
Mean annual soil temperature:	15.1°C
Mean annual soil moisture:	32.9%
Elevation:	~45 m
Geomorphic position:	Dune back slope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian/alluvial deposits
Drainage class:	Free/well-draining

1.4 Resource consents

The Company holds one resource consent, the details of which are summarised in the table below. Summaries of the conditions attached to the permit are set out in Section 3 of this report.

A copy of the consent issued by the Council is included in Appendix I.

Table 1 Consent held by the Company

Consent number	Purpose	Granted	Review	Expires
<i>Discharges of waste to land</i>				
5956-2.0	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites and contaminated soil onto and into land via landfarming	2017	2020	2034

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 the Waikaikai 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;
- 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 Waikaikai Landfarm was visited five times during the monitoring period. 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

Soil sampling

Soil sampling is undertaken to monitor the quality of the landfarming in the first instance. It also serves as a marker for the degree of remediation achieved in the landfarming process at the time of sample collection.

The methodology utilised by the Council for collecting soil samples across the landfarmed area is adapted from the Guidelines for the Safe Application of Biosolids to land in New Zealand (2003).

To collect the sample, a soil corer is inserted to a depth of 400 mm +/- to encompass the zone of application. Ten soil cores are collected, spaced 10 m apart. These ten soil cores are then composited to gain one representative soil sample of an application area. An example of an extracted soil core is provided in Photo 1.



Photo 1 An example of an extracted soil core

Soil analysis parameters

- Total heavy metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc);
- Calcium, chloride, conductivity, magnesium, potassium, sodium, total soluble salts and sodium adsorption ratio (SAR);
- Total petroleum hydrocarbons: C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆ and C₇-C₃₆, poly-cyclic aromatic hydrocarbons and mono-cyclic aromatic hydrocarbons; and
- Moisture factor, ammoniacal nitrogen and nitrate/nitrite nitrogen.

Groundwater monitoring

Groundwater monitoring is also undertaken at this landfarm. The facility, as required by consent, contains an active groundwater monitoring network which is comprised of five groundwater monitoring wells.

Three of the five wells were sampled four times this monitoring year to account for seasonal fluctuation and to assess for any adverse effects resulting from the exercise of the consent. The remaining two wells were sampled on two occasions. The results are presented in Section 2.2.

The sampling was conducted through a peristaltic pump and field parameters are captured via a YSi flow through cell and a multi parameter probe. The samples are collected once field parameters have been stable within 8 % for three consecutive readings.

Groundwater analysis parameters

- Barium (dissolved and acid soluble), chloride, conductivity (@ 25°C), sodium, total dissolved salts (TDS), pH; and
- Benzene, ethylbenzene, total petroleum hydrocarbons (speciated), toluene, meta-xylene, ortho-xylene.
- In-situ readings: pH, conductivity, dissolved oxygen (DO), oxidation and reduction potential (ORP) and temperature.

1.5.5 Review of consent holder data

In accordance with conditions 11 and 12 of the consent, the Company must provide the Council with an annual report. This report contains information relating to the receipt, handling, storage and disposal of wastes.

The annual report was provided by the consent holder for this period. It is attached in Appendix II.

2 Results

2.1 Inspections

1 July 2019

During an inspection the following was observed. No objectionable odour or visible emissions were found during the inspection. A strong mud/hydrocarbon odour was present around the current landfarming areas. The two paddocks at the western corner remain exposed and the muds were weathering well, the material was beginning to break apart easily. The topsoil bund remained around the area and the soil was stable.

A new area had been exposed and was receiving the stormwater component of the storage cells during the inspection. The area had been bunded using topsoil, and no ponding or run-off was occurring. The area is located at 39.68794S/174.39628E.

The pits were inspected. All lined pits had available storage capacity. Surface hydrocarbons were present in two of the pits. It was discussed with the consent holder about the potential for skimming the oil from the surface of the pits prior to landfarming. No incidents were reported.

10 September 2019

During an inspection the following was observed. No objectionable odours or visible emissions were found during the inspection. All lined pits contained drilling wastes which were quite full. Only one pit had visible surface hydrocarbons.

Three spreading areas had been exposed. One had all the muds applied and had been levelled with a dozer and was being left to dry before being incorporated; the other two were still receiving muds. No ponding or run-off was occurring at the time from the spreading areas. The older spreading areas were found to hold complete pasture cover; no mud was identified at the surface.

19 November 2019

During an inspection the following was noted. All landfarmed areas had been worked and pasture had been sown. Pasture strike was observed across all areas and essentially no muds were identified at the surface.

Older spreading areas were found to have complete pasture cover. At the time two lined pits contained muds and both had available capacity for storm water ingress. The pit 2 liner was seriously degraded during mud excavation and the pit will no longer be used.

6 January 2020

During an inspection the following was observed. No recent mud deliveries appeared to have occurred. There were two lined pits in use for mud storage, which also contained stormwater. There was storage capacity available for stormwater ingress.

The pit with the degraded liner contained residual muds. Spreading areas were inspected. Pasture strike was excellent across all recent spreading areas, essentially no mud was identified at the surface, and the pasture appeared healthy. All previous spreading areas had good pasture cover which also appeared healthy.

10 February 2020

During an inspection the following was observed. There were two lined storage pits in use to store liquids and muds. At the time impacted gravels were stored on the edge of the pit with the degraded liner.

No recent spreading activities had occurred. The recent spreading areas had very good crop cover but the recent dry spell had browned the areas. Very little muds were identified around the two paddocks. All historic spreading areas had good pasture cover which appeared healthy.

2.1.1 Provision of consent holder data

The consent holder provided the Council with an annual report of the site operations which have occurred at the Waikaikai Landfarm this monitoring period. Included in this report is delivery information which includes the origin of the material, the supplier and the type of waste received.

Notifications are also supplied by the Company throughout the monitoring period, these occur when the facility is to receive material and also to notify the Council when farming operations are likely to commence. Included in the notifications are the corresponding analyses of the drilling waste, as required by consent condition. A Company supplied overview of material received at the Waikaikai Landfarm in the 2019-2020 monitoring period is supplied below in Table 2.

The Company supplied annual report and associated appendices is appended to this report in Appendix II.

Table 2 Company supplied overview of accepted material in the 2019-2020 monitoring period

Date	Source	Customer	Waste material			
			Solid	Liquid	Direct Spread	Total
2-27 July 2019	Mangahewa MHW G-29	Todd	259.2	408.0		667.2
		MHWG-29 TOTAL	259.2	408.0		667.2
27-31 July 2019	Mangahewa MHW G-30	Todd	264.0	78.0		342.0
2-30 Aug 2019	Mangahewa MHW G-30	Todd	240.7	413.2		653.9
5-26 Sept 2019	Mangahewa MHW G-30	Todd	220.0	8.0		228.0
		MHWG-30 TOTAL	504.7	491.2		995.9
19 September 2019	Kapuni Production Station	Todd	-	-	3.0	3.0
18 October 2019	McKee PS	Todd	3.0	-	-	3.0
26 February 2020	Mangahewa D	Todd	-	20.0	-	20.0
3 March 2020	Mangahewa D	Todd	-	36.0	-	36.0
		TODD TOTAL	3.0	56.0	3.0	62.0
12 February 2020	Manutahi D	Westside	6.0	-	-	6.0
16 March 2020	Manutahi D	Westside	14.0	-	-	14.0
		MANUTAH D TOTAL	20.0	-	-	20.0
5-6 March 2020	Oakura Waterwell	NPDC	-	88.4	-	88.4
		OAKURA WATERWELL TOTAL	-	88.4	-	88.4
6-7 May 2020	Mangahewa G	Todd	-	56.0	-	56.0
		TODD TOTAL	-	56.0	-	56.0
		2019-20 ANNUAL TOTAL m3	786.9	1,099.6	3.0	1,889.5

2.1.2 Results of receiving environment monitoring

2.1.2.1 Groundwater monitoring

The Waikaikai Landfarm contains five purpose built groundwater monitoring wells. These wells, which were a consented obligation, are situated in two locations (Figure 2). Three wells are located down gradient from the lined storage cells (GND2290, 2291 and 2292). The intention of these wells is to assess the groundwater in the immediate vicinity of the storage cells. The remaining two wells (GND2293 and 2294) are situated on the south western boundary of the landfarm to assess for any potential offsite contaminant migration. The analysis of the four monitoring rounds, across the five monitoring wells is provided in the following Tables 3-7.

It can be noted that analyses of total petroleum hydrocarbons (C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆) and benzene, toluene, ethylbenzene and xylenes (m, o and p), collectively termed BTEX, have not been tabulated as the analyses did not recorded any of the analytes above the laboratory defined limit of detection (LOD).



Figure 2 WRS Waikakai Landfarm groundwater monitoring well locations

Table 3 GND 2290 2019-2020 monitoring

GND2290	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	10:05	09:25	10:10	11:45
TEMP	°C	14.8	15.4	15.8	15.8
Electrical Conductivity (EC)	µS/cm	377	279	427	412
	mS/m	37.7	27.9	42.7	41.2
pH	pH Units	6.7	6.7	6.6	6.9
Chloride	g/m ³	32	27	48	37
Total Sodium	g/m ³	21	19.9	21	23
Acid Soluble Barium	g/m ³	< 0.11	< 0.11	< 0.11	< 0.11
Dissolved Barium	g/m ³	0.038	0.024	0.038	0.036
Total Dissolved Solids (TDS)	g/m ³	300	210	300	310

The monitoring of GND2290 indicated the following:

- Temperature ranged 14.8-15.8°C.
- Electrical conductivity (EC) ranged 279-427 µS/cm.
- pH results remained weakly acidic, ranging 6.6-6.9 pH.
- Chloride ranged 27- 48 g/m³.
- Sodium results ranged 19.9-23 g/m³.
- Acid soluble barium was below the limit of detection (LOD).
- Dissolved barium was measurable and ranged 0.024-0.038 g/m³.

- Total dissolved solids ranged 210-310 g/m³.
- No measurable TPH or BTEX was recorded above the LOD.

Table 4 GND2291 2019-2020 monitoring period

GND2291	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	11:20	10:00	10:45	12:15
TEMP	°C	15.4	16	15.3	15.2
Electrical Conductivity (EC)	µS/cm	1,063	1,399	1,005	974
	mS/m	106.3	139.9	100.5	97.4
pH	pH Units	6.3	6.3	6.4	6.3
Chloride	g/m ³	158	260	156	137
Total Sodium	g/m ³	59	75	66	69
Acid Soluble Barium	g/m ³	< 0.11	< 0.11	< 0.11	< 0.11
Dissolved Barium	g/m ³	0.013	0.014	0.01	0.009
Total Dissolved Solids (TDS)	g/m ³	870	1010	690	690

The analysis of GND2291 indicated the following:

- Groundwater temperature ranged 15.2-16 °C.
- EC ranged 974-1,399 µS/cm.
- pH remained slightly acidic, ranging 6.3-6.4 pH.
- Chloride results ranged 137-260 g/m³.
- Sodium results ranged 59-75 g/m³.
- Acid soluble barium results were below the LOD.
- Dissolved barium was measurable, at low concentrations, ranging 0.01-0.014 g/m³.
- Total dissolved solids ranged 690-1,010 g/m³.
- No measurable TPH or BTEX was recorded above the LOD.

Table 5 GND2292 2019-2020 monitoring period

GND2292	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	12:00	10:30	11:30	12:50
TEMP	°C	15.6	16.1	15.4	15.3
Electrical Conductivity (EC)	µS/cm	2,050	2,440	2,490	2,260
	mS/m	205	244	249	226
pH	pH Units	6.3	6.3	6.3	6.4
Chloride	g/m ³	500	680	640	500
Total Sodium	g/m ³	230	270	230	230
Acid Soluble Barium	g/m ³	0.27	0.32	0.28	0.21
Dissolved Barium	g/m ³	0.27	0.33	0.29	0.22
Total Dissolved Solids (TDS)	g/m ³	1350	1630	1680	1570

The analysis of GND 2292 indicated the following;

- Groundwater temperature ranged 15.3-16.1°C.
- EC ranged 2,050-2,260 $\mu\text{S}/\text{cm}$.
- pH remained stable and weakly acidic, ranging 6.3-6.4 pH.
- Chloride ranged 500-680 g/m^3 .
- Sodium ranged 230-270 g/m^3 .
- Acid soluble barium ranged 0.21-0.32 g/m^3 .
- Dissolved barium ranged 0.22-0.33 g/m^3 .
- Total dissolved solids ranged 1,350-1680 g/m^3 .
- No measurable TPH or BTEX was recorded above the LOD.

Table 6 GND2293 2019-2020

GND2293	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	13:00	11:45	13:05	14:00
TEMP	°C	15.1	15.6	15	15.4
Electrical Conductivity (EC)	$\mu\text{S}/\text{cm}$	1,559	1,502	1,317	1,340
	mS/m	155.9	150.2	131.7	134
pH	pH Units	6.7	6.7	6.8	6.7
Chloride	g/m^3	400	390	370	320
Total Sodium	g/m^3	80	75	72	76
Acid Soluble Barium	g/m^3	0.26	0.2	0.16	0.16
Dissolved Barium	g/m^3	0.26	0.192	0.162	0.161
Total Dissolved Solids (TDS)	g/m^3	1280	1150	880	860

The analysis of GND2293 indicated the following:

- Groundwater temperature ranged 15-15.6°C.
- EC ranged 1,317-1,559 $\mu\text{S}/\text{cm}$.
- pH ranged 6.7-6.8 pH.
- Chloride ranged 320-400 g/m^3 .
- Sodium ranged 72-80 g/m^3 .
- Acid soluble barium ranged 0.16-0.26 g/m^3 .
- Dissolved barium ranged 0.161-0.26 g/m^3 .
- Total dissolved solids ranged 860-1,280 g/m^3 .
- No measurable TPH or BTEX was recorded above the LOD.

Table 7 GND2294 2019-2020 monitoring period

GND2294	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	13:35	11:10	12:20	13:25
TEMP	°C	14.6	15.6	14.8	15.1
Electrical Conductivity (EC)	$\mu\text{S}/\text{cm}$	341	341	363	371
	mS/m	34.1	34.1	36.3	37.1

GND2294	Collected	22 Jul 2019	05 Dec 2019	20 May 2020	17 Jun 2020
Parameter	Time	13:35	11:10	12:20	13:25
pH	pH Units	7.3	7.7	7.2	7
Chloride	g/m ³	45	46	44	45
Total Sodium	g/m ³	29	29	30	31
Acid Soluble Barium	g/m ³	< 0.11	< 0.11	< 0.11	< 0.11
Dissolved Barium	g/m ³	< 0.005	< 0.005	0.006	0.007
Total Dissolved Solids (TDS)	g/m ³	230	240	230	260

The analysis of GND2294 indicated the following:

- Groundwater temperature ranged 14.6-15.6°C.
- EC ranged 341-371 µS/cm.
- pH ranged slightly basic, 7-7.7 pH.
- Chloride ranged 44-46 g/m³.
- Sodium ranged 29-31 g/m³.
- Acid soluble barium was not recorded above the LOD this monitoring period.
- Dissolved barium was recorded in two of four samples, at low concentrations, 0.006-0.007 g/m³.
- Total dissolved solids ranged 230-260 g/m³.
- No TPH or BTEX were recorded above the LOD this monitoring period.

The analysis of the groundwater monitoring network indicated results which were within consent conditions for the 2019-2020 monitoring period.

2.1.2.2 Soil monitoring

In this monitoring period one area of land (termed W1911) was landfarmed. The area farmed is depicted in the consent holder provided map (Figure 3). This figure also indicates the other landfarmed areas on the site². The landfarmed location of W1911 largely contained the material from Todd Energy's Mangahewa drilling programme which encompassed 6 wells. Smaller amounts from Westside and NPDC were also farmed in this area.

² For further information on previously landfarmed areas at the WRS Waikakai Landfarm please refer to the reference section of this report.

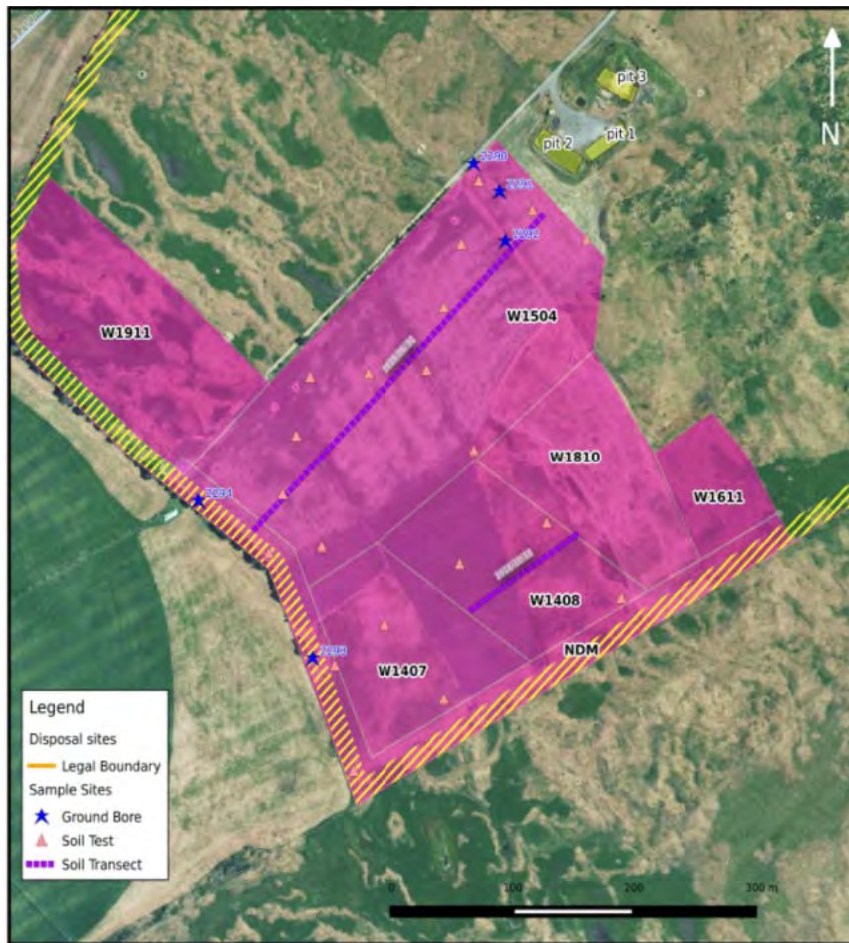


Figure 3 WRS Waikaikai Landfarm landfarmed areas (image provided by WRS)

The Council collected two composite soil samples from the landfarmed area of W1911. The analysis is provided in the following Table 8. It can be noted that polycyclic aromatic hydrocarbons (PAHs) which did not record results above the laboratory defined limit of detection or were not required as part of the consent soil surrender criteria, have not been tabulated in the soil analysis table.

Table 8 WRS Waikaikai Landfarm soil monitoring 2019-2020 monitoring period

WRS Waikaikai W1911	Sample	Consent	Transect A	Transect B
Soil analysis	Date	5956-2.0	02 Jul 2020	02 Jul 2020
Parameter	Unit/time	surrender limit	11:30	11:50
Dry Matter (Env)	g/100g as rcvd		87	88
1-Methylnaphthalene	mg/kg dry wt		< 0.012	0.02
2-Methylnaphthalene	mg/kg dry wt		< 0.012	0.031
Acenaphthene	mg/kg dry wt		0.065	0.061
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027	< 0.012	< 0.012
Benzo[e]pyrene	mg/kg dry wt		< 0.012	0.011
Naphthalene	mg/kg dry wt	7.2	< 0.06	< 0.06
pH	pH Units		7.7	7.5

WRS Waikaikai W1911	Sample	Consent	Transect A	Transect B
Soil analysis	Date	5956-2.0	02 Jul 2020	02 Jul 2020
Parameter	Unit/time	surrender limit	11:30	11:50
Pyrene	mg/kg dry wt	160	< 0.012	0.015
Calcium (Sat Paste)	mg/L		178	377
Magnesium (Sat Paste)	mg/L		34	58
Sodium (Sat Paste)	mg/L		52	83
Chloride	mg/kg dry wt	700	142	270
Sodium Absorption Ratio (SAR)		<18	0.9	1.1
Soluble Salts	g/100g dry wt	0.25	0.08	0.12
Conductivity from soluble salts	mS/cm	2.9	0.2	0.4
Total Recoverable Potassium	mg/kg dry wt		690	880
Total Recoverable Sodium	mg/kg dry wt		470	530
Total Recoverable Magnesium	mg/kg dry wt		1,960	2,400
Total Recoverable Calcium	mg/kg dry wt		7,200	9,200
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05
Toluene	mg/kg dry wt	82	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	59	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	59	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	59	< 0.05	< 0.05
C7 - C9	mg/kg dry wt	210	< 8	< 8
C10 - C14	mg/kg dry wt	150	<u>860</u>	<u>1,210</u>
C15 - C36	mg/kg dry wt	1,300	<u>3,400</u>	<u>4,400</u>
Total hydrocarbons (C7 - C36)	mg/kg dry wt		4,200	5,600
Total Recoverable Arsenic	mg/kg dry wt	17	< 2	2
Total Recoverable Barium	mg/kg dry wt	10,000	2,800	3,400
Total Recoverable Cadmium	mg/kg dry wt	0.8	< 0.10	0.1
Total Recoverable Chromium	mg/kg dry wt	600	11	13
Total Recoverable Copper	mg/kg dry wt	100	10	13
Total Recoverable Lead	mg/kg dry wt	160	2.9	3.6
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	7	8
Total Recoverable Zinc	mg/kg dry wt	300	51	65

The analysis of the two soil samples indicated the following:

- Trace concentrations of the PAH 1-methylnaphthalene, 2-methylnaphthalene were recorded in transect 2.
- Trace concentrations of acenaphthylene were recorded in both transects.
- Benzo (a) pyrene was not recorded above the LOD.
- Benzo (e) pyrene was recorded at a trace concentration in transect B.
- Naphthalene was not recorded above the LOD.
- pH ranged between 7.5 and 7.7 pH.
- Pyrene was recorded at trace concentration in transect B.
- Chloride ranged 142 -270 mg/kg.
- Sodium absorption ratio (SAR) ranged at low concentration 0.9-1.1 SAR.
- Soluble salts ranged 0.08-0.12 g/100g, the limit for surrender is set at 0.25 g/100g, and both these results were well below this limit.
- Soil conductivity ranged 0.2-0.4 mS/cm.
- Potassium ranged 690-880 mg/kg.
- Sodium ranged 470-530 mg/kg.
- Magnesium ranged 1,960-2,400 mg/kg.
- Calcium ranged 7,200-9,200 mg/kg.
- Benzene, toluene ethylbenzene and xylenes (m, o and p) (BTEX) were not recorded above the LOD.
- In terms of petroleum hydrocarbons
 - o C₇-C₉ was not recorded above the LOD.
 - o C₁₀-C₁₄ ranged 560-1,210 mg/kg. The limit for surrender is set at <150 mg/kg. Both these transect are currently above the limit for surrender, for this analyte.
 - o C₁₅-C₃₆ ranged 3,400-4,400 mg/kg; the limit for surrender is <1,300 mg/kg.
- In terms of total recoverable (TR) barium, the two results ranged 2,800-3,400 mg/kg. The maximum consent limit is set at 10,000 mg/kg.
- In terms of TR heavy metals, arsenic cadmium, chromium, copper, lead, mercury, nickel and zinc: the consent defines the maximum allowable concentration for these target heavy metals which must not be exceeded. No exceedance was recorded for these heavy metals

Area W1911 may not be surrendered due to concentrations TPH C₁₀-C₁₄ and C₁₅-C₃₆ currently above the consent criteria for surrender. Soil monitoring in the upcoming monitoring period will assess the degree of bioremediation over time.



Figure 4 Transects A and B location area W1911

2.2 Incidents, investigations, and interventions

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

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

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

In the 2019-2020 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans. However, there was one non-compliance found in this monitoring period.

Table 9 Consent 5956-2.0 non compliance

Date	Details	Compliant (Y/N)	Enforcement Action Taken?	Outcome
February 2020	Observed during inspection that material was being held in compromised storage cell liner	N	Notified as non-compliant July 2020	All material removed and landfarmed.

3 Discussion

3.1 Discussion of site performance

In terms of site performance for the 2019-2020 monitoring period, the consent holder undertook landfarming in one area, W1911. This included material from Todd Energy, Westside and NPDC. This area was revegetated to a high standard with no barren patches noted. The consent holder was prompt in providing their annual report as well as mud delivery notifications and associated drilling mud analysis throughout the monitoring period. The consent holder was also in regular contact with the Council, keeping abreast of current groundwater, soil monitoring and inspections.

Inspections noted that residual drilling mud was held within a compromised liner and the consent holder was reminded of their commitment to hold material within fit for purpose storage liner. While this material was residual it had the potential to impact the surrounding groundwater. Further noted was the storage of contaminated gravel above the compromised pit liner.

The Company were notified that they were non-compliant with this item. As a result, the Company immediately undertook to mitigate the non-compliance. A successful outcome was achieved at the beginning of the 2020-21 monitoring period which rectified the issue.

3.2 Environmental effects of exercise of consents

Minimal environmental effects were noted as a process of the exercise of consent this monitoring period. Groundwater analysis did not record any exceedance in consent conditions.

Soil monitoring of newly landfarmed area of W1911 indicated that the area remains remediating for total petroleum hydrocarbons C₁₀-C₁₄ and C₁₅-C₃₆. These are yet to remediate to below the limit for surrender.

All other landfarmed areas of W1504, W1810, W1611, W1408 and W1407 have met their limit for surrender. If the consent holder intends to return these areas back to their former land use (agriculture) they will need to apply for a variation of resource management consent 5956-2.0, to have these areas removed from the consent active area.

Once this has been undertaken, the consent holder must then supply the District Council with the associated surrender analysis and the updated varied consent for a removal of the temporary industrial zoning.

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 10.

Table 10 Summary of performance for consent 5956-2.0

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions of material	N/A	Yes
2. Application area detailed on attached map	Landfarming occurred in specific area	Yes
3. Adoption of Best Practicable Option (BPO)	Inspections	Yes

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
4. Groundwater monitoring well installation	Inspections and sampling	Yes
5. Cell lined with fit for purpose liner	Inspections noted one liner was compromised and contained residual material with contaminated gravel stored above it	No
6. Storage cell integrity check every 24 months	One cell compromised	No
7. Operation in accordance with management plan	Inspections/ annually reviewed management plan received September 2019	Yes
8. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	Yes
9. Notify TRC 48 hours prior to landfarming wastes	Notifications received	Yes
10. Representative waste sample from each source and each type of waste 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; d) barium, calcium, chloride, magnesium, sodium, potassium, sodium adsorption ratio, nitrogen and pH, and e) heavy metals; arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.	Submitted	Yes
11. Record keeping	Annual report provided and mud delivery log provided. All consent notifications provided by consent holder this period	Yes
12. Annual Report	Report received	Yes
13. No discharge within 25 meters of surface water or property boundaries	Inspections	Yes
14. No hydraulic fracturing fluids	Record check	Yes
15. Contaminated soil may only be brought to site after it has been assessed by condition 10 of this consent and by the Chief Executive	Yes, contaminated soil assessed and agreed prior to being brought to site	Yes

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
16. All waste brought to site must be landfarmed as soon as practicable but no later than 24 months after delivery date	Inspections and liaison with Company	Yes
17. Application of drilling material thickness	Inspections and review of consent holder data	Yes
18. No ponding or overland flow after one hour of application	No ponding noted	Yes
19. As soon as practicable after landfarming shall mix with native topsoil with a minimum of 250 mm	Inspections	Yes
20. Maximum application rate of 20,000 mg/kg (TPH) at any point after incorporation	Inspections and sampling	Yes
21. Secondary application of material is permitted if the standards of condition 29 have been met and the Chief Executive has considered this analysis appropriate	Not required this period	Yes
22. Revegetation as soon as practicable	Achieved	Yes
23. Shall not exceed a value of 2,500 g/m ³ Total Dissolved Salts within any groundwater or surface water	Monitoring	Yes
24. Consent shall not lead or be liable to lead to contaminants entering a surface water body	Monitoring	Yes
25. Shall not result in any adverse impacts on groundwater and or surface water	Minor impacts in terms of salinity, though below consent conditions	Yes
26. Conductivity must be less than 400 mSm ⁻¹ . If background soil has an conductivity greater than 400 mSm ⁻¹ , then conductivity after disposal shall not exceed original conductivity by more than 100 mSm ⁻¹	Inspections and sampling	Yes
27. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Inspections and sampling	Yes
28. The concentration of metals and salts in the soil layer containing the discharge shall comply with certain criteria	Sampling	Yes

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
29. Prior to expiry/cancellation of consent these levels must not be exceeded: a) Conductivity, 290 mSm ⁻¹ b) Chloride, 700 g/m ³ c) Total dissolved salts, 2,500 g/m ³ d) Sodium, 460 g/m ³ e) MAH's/PAH MfE 1999 CS NZ Table 4.12 f) TPH CCME 2008 Table 5.2 Ecological direct contact	Current soil samples indicated area W1911 is above the limit for C ₁₀ -C ₁₄ , C ₁₅ -C ₃₆ .	N/A
30. Consent cannot be surrendered until standards in condition 29 have been met	No consent surrender	N/A
31. Notification of discovery of archaeological remains	None this monitoring period	N/A
32. Review, amend, delete	Not required	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 11 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2011-2012	5956-1	-	-	-	1
2012-2013	5956-1	-	-	-	1
2013-2014	5956-1	-	-	1	-
Waste Remediation Services consent holder from 2014-2015 onwards					
2014-2015	5956-1.7	-	1	-	-
2016-2017	5956-2.0	-	1	-	-
2017-2018	5956-2.0	1	-	-	-
2018-2019	5956-2.0	1	-	-	-
Totals		2	2	1	2

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

3.4 Recommendations from the 2018-2019 Annual Report

In the 2018-2019 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of consented activities at Waikaikai Landfarm in the 2019-2020 year be amended from that undertaken in 2018-2019, by expanding the current groundwater monitoring programme from three wells quarterly and two wells biannually, to all five wells quarterly.
2. Soil sampling will also be expanded from the currently proposed two composite soil samples, to four composite soil samples, to account for the newly landfarmed area.
3. THAT should there be issues with environmental or administrative performance in 2019-2020, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the option for a review of resource consent(s) in June 2020, as set out in condition 32 of the consent, not be exercised, on the grounds that it is currently fit for purpose.

Recommendation 1 was implemented.

Recommendation 2 was not required as field observations indicated that two soil samples were sufficient.

Recommendations 3 and 4 were not required.

3.5 Alterations to monitoring programmes for 2020-2021

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 2020-2021 the monitoring of consented activities at the Waikaikai Landfarm remain unchanged from that undertaken in 2019-2020 monitoring period.

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 2020-2021.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at Waikaikai Landfarm in the 2020-2021 year continue at the same level as in 2019-2020.
2. THAT should there be issues with environmental or administrative performance in 2020-2021, 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.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 25°C and expressed in $\mu\text{S}/\text{cm}$.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second ($1 \text{ m}^3\text{s}^{-1}$).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
F	Fluoride.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
$\text{g}/\text{m}^2/\text{day}$	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.
LOD	Limit of detection: the lowest measurement that analysis can differentiate from a non-detectable result.
L/s	Litres per second.
m^2	Square Metres.

MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
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.
MPN	Most Probable Number. A method used to estimate the concentration of viable microorganisms in a sample.
µS/cm	Microsiemens per centimetre.
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	<i>Resource Management Act 1991</i> and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
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.

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- Ministry for the Environment (2003) Guidelines for the safe application of biosolids to land in New Zealand, Ministry for the Environment.
- Taranaki Regional Council (2014): Waikaikai Farms Ltd Drilling Waste Disposal Monitoring Programme Biennial Report 2011-2013. Technical Report 2013-68.
- Taranaki Regional Council (2015): Waikaikai Farm Ltd Monitoring Programme Annual Report 2013-14. Technical Report 2014-77.
- Taranaki Regional Council (2015): Waste Remediation Services Ltd Waikaikai Landfarm Monitoring Programme Annual Report 2014-15. Technical Report 2015-95.
- Taranaki Regional Council (2016): Waste Remediation Services Ltd Waikaikai Landfarm Monitoring Programme Annual Report 2015-16. Technical Report 2016-91.
- Taranaki Regional Council (2017): Waste Remediation Services Ltd Waikaikai Landfarm Monitoring Programme Annual Report 2016-2017. Technical Report 2017-41.
- Taranaki Regional Council (2018): Waste Remediation Services Ltd Waikaikai Landfarm Monitoring Programme Annual Report 2017-2018 Technical Report 2018-63.
- Taranaki Regional Council (2019): Waste Remediation Services Ltd Waikaikai Landfarm Monitoring Programme Annual Report 2018-2019 Technical Report 2019-70.

Appendix I

Resource consents held by Waste Remediation Services

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

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

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

Name of
Consent Holder: Waste Remediation Services Limited
PO Box 7150
New Plymouth 4341

Decision Date: 19 April 2017

Commencement Date: 19 April 2017

Conditions of Consent

Consent Granted: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming

Expiry Date: 1 June 2034

Review Date(s): Annually until June 2020 and then every three years thereafter

Site Location: Lower Manutahi Road, Manutahi
(Property owner: Waikaikai Farms Limited)

Grid Reference (NZTM) 1720190E-5605380N

Catchment: Mangaroa

*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) drilling wastes consist of; drilling fluids and cuttings from drilling operations with water based muds, and drilling fluids and cuttings from drilling operations with synthetic based muds;
 - b) oily wastes from wellsites consist of; sludge removed from tanks and separators, slops oil removed from well cellars, tank wax which builds up in separators and tanks, oily formation sand, contaminated ground material from leaks and spills;
 - c) contaminated soil refers specifically to the hydrocarbon contaminated soil;
 - d) storage means a discharge of wastes from vehicles, tanks, or other containers onto land for the purpose of temporary storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours;
 - e) landfarming means the discharge of 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. This consent authorises the application of material to land only within the area indicated on the attached map.
3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
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. The bores shall be sampled prior to stockpiling or landfarming for baseline water quality parameters and concentrations of contaminants.
5. Any pits intended for the storage of solid or liquid wastes shall be lined with high-grade (fit for purpose) synthetic liners or equivalent so that they retain liquid without leakage through the base or side walls.
6. At intervals not exceeding 24 months the consent holder shall check the integrity of the pit liners, repair or replace liners as required and demonstrate to the Chief Executive, Taranaki Regional Council they retain liquid as required by condition 5.

7. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the consent conditions of this consent and shall include as a minimum:
- a) control of site access;
 - b) procedures for notification to Council of disposal activities;
 - c) procedures for the receipt and stockpiling of drilling wastes onto the site;
 - d) procedures for the management of stormwater recovered from, or discharging from, the drilling waste stockpiling area;
 - e) procedures for demonstrating storage cell integrity;
 - f) methods used for the mixing and testing of different waste types;
 - g) procedures for landfarming drilling wastes and or contaminated soil (including means of transfer from stockpiling area, means of spreading, and incorporation into the soil);
 - h) contingency procedures;
 - i) sampling regime and methodology; and
 - j) post-landfarming management, monitoring and site reinstatement.

Notification and sampling requirements

8. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to permitting wastes onto the site for storage. Notification shall include the following information:
- a) the consent number;
 - b) the name of the well and wellsite, or other source, from which the waste was generated;
 - c) the type of waste to be stored; and
 - d) the volume of waste to be stored.
9. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to landfarming stored 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)/or location from which the waste was generated;
 - c) the type(s) of waste to be landfarmed;
 - d) the volume and weight of the waste to be landfarmed;
 - e) the specific concentrations of Metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), Salts (Barium, Calcium, Chloride, Magnesium, Sodium, Potassium) and Sodium Adsorption Ratio. Hydrocarbons (Total Petroleum Hydrocarbons, Mono Cyclic Aromatic Hydrocarbons and Poly Cyclic Aromatic Hydrocarbons) and Nitrogen in the waste prior application to land;
 - f) results of sampling undertaken in accordance with condition 8, including in a spreadsheet compatible format;
 - g) proposed loading rate and required area calculations showing compliance with condition 18; and
 - h) the specific location and area over which the waste will be landfarmed.

10. 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 (C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆);
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening;
 - d) barium, calcium, chloride, magnesium, sodium, potassium, sodium adsorption ratio, nitrogen and pH, and
 - e) heavy metals; arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

The consent holder shall record the data from these results onto a master spreadsheet to be supplied to the Taranaki Regional Council in accordance with conditions 8 and 9.

Monitoring and reporting

11. The consent holder shall keep records of the following:
- a) wastes from each individual well/ source;
 - b) analytical composition of wastes;
 - c) stockpiling area(s);
 - d) volumes of material stockpiled;
 - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates and up-to-date GIS shapefiles;
 - 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.
12. The consent holder shall provide to the Chief Executive, Taranaki Regional Council:
- a) by 31 August of each year, a report on all records required to be kept in accordance with conditions 8, 9, 10 and 11 for the period of the previous 12 months, 1 July to 30 June;
 - b) monthly records of all movements of waste to the site in spreadsheet format, including source, material type, transporter, volumes and receiving storage pit.

Discharge Limits

13. No discharge shall take place within 25 metres of surface water or property boundaries.
14. Waste brought to the site shall not contain any hydraulic fracturing fluids.
15. Contaminated soil may be brought to the site only after the Chief Executive, Taranaki Regional Council has assessed the analysis required by condition 10 and advised that the material is suitable for bioremediation.
16. All wastes must be landfarmed as soon as practicable, but no later than 24 months after being brought onto the site.
17. For the purposes of landfarming, solid 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; or
 - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight.
18. For the purposes of landfarming, liquid wastes shall be applied to land:
 - a) at a rate such that there is no overland flow of liquids; and
 - b) at a rate such that no ponded liquids remain after one hour, after application.
19. When landfarming, as soon as practicable following the application of solid wastes to land, the consent holder shall mix the wastes with, as a minimum, the top 250 mm of native soil.
20. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 20,000 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.
21. The secondary application of material to land may only occur if:
 - a) the areas of application meet the standards of surrender as shown in conditions 28 and 29 of this consent;
 - b) the Chief Executive, Taranaki Regional Council, having considered the appropriate soil analysis, has confirmed that the standards specific in a) above have been met.
22. 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 environmental limits for water

23. The exercise of this consent shall not result in a level of total dissolved salts within any surface or groundwater of more than 2,500 gm³.
24. The exercise of this consent, including the design, management and implementation of the discharge, shall not lead or be liable to lead to contaminants entering a surface water body.
25. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council

Receiving environmental limits for soil

26. The conductivity of the soil/waste layer after application shall be less than 400 mSm, or alternatively, if the background soil conductivity exceeds 400 mSm, the landfarming of waste shall not increase the soil conductivity by more than 100 mSm.
27. The application of waste shall not increase the sodium adsorption ratio (SAR) of the soil by more than 2.0 and in no case shall the SAR of the soil/waste layer exceed 18.0 after application.
28. The concentration of metals and salts in the soil layer containing the discharge shall comply with the following criteria:

Metal/ Salt	Maximum value (mg/kg)
Arsenic ¹	17
Barium – Barite ²	10,000
Extractable Barium ²	250
Cadmium ¹	0.8
Chromium ³	600
Copper ³	100
Lead ¹	160
Nickel ³	60
Mercury	1
Zinc ³	300
¹ SCS – Rural Residential MfE 2011b; ² Alberta Environment 2009; ³ NZWWA 2003, lowest of protection of human health and ecological receptors. (Biosolids to land)	

Consent 5956-2.0

29. From 1 March 2034 (three months prior to the consent expiry date), constituents in the soil at any depth less than 500 mm (below ground level) shall not exceed the standards shown in the following table:

Constituent	Standard
Conductivity	Not greater than 290 mS/m
Chloride	Not greater than 700 mg/kg
Sodium	Not greater than 460 mg/kg
Total Soluble Salts	Not greater than 2500 mg/kg
TPH Fraction	Guideline Value Agricultural Ecological Direct Soil Contact (Fine Sand) From table 5.2
F1 (C6-C10)	210
F2 (>C10-C16)	150
F3 (>C16-C34)	1300
F4 (>C34)	5600
Canadian Council of Ministers of the Environment (CCME), in the document Canada Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale, 2008. Table 5.2	
Soil Type/ Contaminant	Depth of contamination
	Surface (<1m) (mg/kg)
SANDY Silt	
MAHs	
Benzene	1.1
Toluene	82
Ethylbenzene	59
Xylene	59
PAHs	
Naphthalene	7.2
Non-carc (Pyrene)	160
Benzo(a)pyrene	0.027
Table 4.12 SANDY SILT Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999)	

MAHs - benzene, toluene, ethylbenzene, xylenes

PAHs - naphthalene, 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 2034, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

30. This consent may not be surrendered unless the standards in condition 29 have been met.
31. 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.

32. 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 annually until 2020 and every three years thereafter, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 19 April 2017

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

The consent holder's attention is drawn to MPI's "Food safety and animal welfare guidance if spreading rocks and minerals from drilling oil and gas wells on land" (July 2015) which provides guidance to producers and processors of food, including farmers, on how ensure food safety and animal welfare if spreading rocks and minerals from drilling oil and gas wells on land. Should you require further information, please contact Mary Western (MPI, Wellington) or visit <https://www.mpi.govt.nz/document-vault/8698> for the report.

Advice Note (included at the request of DITAG)

The consent holder's attention is drawn to MPI's "New Zealand Code of Practice for the Design and Operation of Farm Dairies (NZCP1) which restricts:

- The discharge of specified wastes to land used for grazing of milking animals; and*
- The use of feed from land which has had specified wastes applied to it.*

Should you require further information, please contact a Dairy Industry Technical Advisory Group (DITAG) representative or visit <http://www.foodsafety.govt.nz/elibrary/industry/dairy-nzcp1-design-code-of-practice/amdt-2.pdf> (specifically section 6.4 Disposal of effluent and other wastes and section 7.8 Purchased Stock Food) or contact an operation dairy processing company regarding conditions of supply.



Total consented area for Waikaikai Landfarm (in yellow) as authorised by consent 5956-2.0

Appendix II

Company supplied annual report



31 August 2020

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

Dear Nathan

RE: Resource Consent 5956 -2.0 - Waikaikai (Wards) – Waikaikai Farms Ltd, 78 Lower Manutahi Road, RD 2, Patea

As required under special condition 12 of resource consent 5956-2.0, please find all relevant information recorded from the operational period 1 July 2019 to 30 June 2020 relating to stockpiling and landspreading activities undertaken at Waste Remediation Services (WRS) Waikaikai disposal site. This is the sixth report completed by WRS for this site, following the previous periods;

2014-15

2015-16

2016-17

2017-18

2018-19

This report is designed to follow on from the previously submitted 2018-19 consent monitoring report and is as such focussed on activities, records and results from the 2019-20 period. This report is structured into six 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 Waikaikai disposal site in 2014, after the original disposal consent 5956-1 was transferred to them by the landowner at the site, following an unsuccessful attempt at operating the disposal site by a different third party operator. Between 2014 and the currently reported on year (2019-20), operations at the site have improved, as reflected in the TRC consent compliance ratings for these years. Similarly to WRS' other site (Manawapou, consent 7795-1) there have been intermittent periods of activity at the site, reflecting fluctuating levels of activity within the local drilling industry. During the 2016-17 period, consent 5956-1.7 was superseded by the current consent, 5956-2.0.

During 2019-20, material from Todd's Mangahewa G drilling campaign continued to be received onsite up until 26 September 2019. This material was spread in area W1911, which was then rehabilitated and sown. Following the completion of area W1911, smaller quantities of waste were received onsite and stockpiled, the details of which are given below in Section 2.

Monitoring of the site undertaken in the 2019-20 year by both the Taranaki Regional Council (TRC) and WRS management has shown the operations undertaken at Waikaikai to be compliant with consent conditions, and no incidents have been recorded against the site in 2019-20.

2. WASTES RECEIVED FOR DISPOSAL

Waste Types and Volumes

WRS' Waikaikai site is consented to dispose of a wider range of wastes than at the Manawapou site, including oily wastes. During the 2019-20 year, a total of 1,889.5m³ of both solid and liquid wastes were received onsite from Todd's Mangahewa G29 and G30 wells, their Kapuni and McKee production facilities, their Mangahewa D site, and Westside's Manutahi D site. Additionally, some material was received from NPDC from the drilling of their Oakura water well. An updated mud register is attached as Appendix C for reference.

Waste Characterisation

Consent 5956-2.0 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 by Hills Laboratories 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 17 of consent 5956-2.0 to ensure the hydrocarbon limit in condition 20 is adhered to. Additionally, consent 5956-2.0 condition 15 requires WRS to present predisposal results to the TRC for any contaminated soil intending for disposal, to assess for suitability on a case-by-case basis. PDF copies of all pre-disposal results are attached to this report as part of Appendix D.

3. DISPOSAL AND REHABILITATION OPERATIONS

In the 2019-20 period spreading/disposal of waste material continued in the spreading area W1911, as indicated on the site map (Appendix B). In late 2018 WRS was engaged by Todd Energy to dispose of all drilling waste liquids and solids generated by their upcoming Mangahewa drilling programme comprising 6 wells located on the Mangahewa G site.

Due to the size and duration of the programme and the progressive well completion programme there was up to 2 weeks delay between finishing a hole and walking the rig to the new cellar. During the entire campaign a balance was maintained between receipt of wastes and live storage capacity by spreading as required to maintain sufficient pit freeboard of approximately 5 days drilling waste. To do this area W1911 was opened up in mid-February 2019 at the southwest corner of the site, opposite area W1504 (Appendix B). The standard method of topsoil removal to windrows around the boundary of the area being prepared was undertaken, followed by cut and fill of the sand dune terrain to produce as near level area as could be achieved with the sand volumes available. This enabled intermittent campaigns of recovering both liquids and solid wastes from pits 1 and 2 and spreading upon the area.

This pattern of waste recovery from the pits and spreading while simultaneously discharging into pits continued successfully throughout the drilling programme. This was completed in October 2019, and then the spreading area was rehabilitated and sown in oats. This process is documented in the photos in Appendix A.

The landspreading processes employed at this site are detailed further 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 2019-20. Photographs of spreading and rehabilitation operations at the Waikaikai 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 5956-2.0. Regular site inspections are also undertaken during periods of inactivity at the site.

Site Inspections – TRC

WRS has received five inspection notices from the TRC for the 2019-20 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 Sampling

Composite soil sampling and groundwater sampling is now undertaken exclusively by TRC field staff, with all samples being sent to RJ Hill Laboratories for the full suite of analyses required under consent 5956-2.0. In the 2019-20 year TRC have taken two composite soil samples (W1 and W2) from spreading area W1911. The results have been supplied to WRS and are summarised in the tables below alongside the relevant standards set out in consent conditions 20 and 26-29:

Table 1 Conditions 20, 26 and 27 - receiving soil results post application, area W1911

Sample	W1	W2	Standard
Constituent			
Conductivity mS/m	20	40	400
Sodium Absorption Ratio (SAR)	N/A*	N/A*	18
Total Petroleum Hydrocarbons mg/kg	4200	5600	20000

*Result not supplied

Table 2 Condition 28 - receiving soil results heavy metals, area W1911

Sample	W1	W2	Standard
Constituent (mg/kg dry weight)			
Total Recoverable Arsenic	< 2	2	17
Barium-Barite	2800	3400	10000
Extractable Barium	N/A*	N/A*	250
Total Recoverable Cadmium	< 0.10	0.1	0.8
Total Recoverable Chromium	11	13	600
Total Recoverable Copper	10	13	100
Total Recoverable Lead	2.9	3.6	160
Total Recoverable Mercury	< 0.10	< 0.10	1
Total Recoverable Nickel	7	8	60
Total Recoverable Zinc	51	65	300

*Result not supplied

The soil sampling results for area W1911 show compliance with the post-application consent conditions (20, 26 and 28) of consent 5956-2.0. Further results are presented below in accordance with condition 29.

Table 3 Condition 29 - W1911 composite soil sample results salinity parameters and hydrocarbons (MAH, PAH, TPH) - surrender limits

Sample	W1	W2	Standard
Constituent			
Conductivity mS/m	20	40	290
Chloride mg/kg	142	270	700
Total Recoverable Sodium mg/kg	470	530	460
Soluble Salts mg/kg	800	1200	2500
Benzene mg/kg	< 0.05	< 0.05	1.1
Toluene mg/kg	< 0.05	< 0.05	68
Ethylbenzene mg/kg	< 0.05	< 0.05	53
m&p-Xylene mg/kg	< 0.10	< 0.10	48
o-Xylene mg/kg	< 0.05	< 0.05	
C7 - C9 mg/kg	860	1,210	120
C10 - C14 mg/kg	3,400	4,400	58
C15 - C36 mg/kg	4,200	5,600	4000
Naphthalene mg/kg	< 0.06	< 0.06	7.2

Sample	W1	W2	Standard
Pyrene mg/kg	< 0.011	< 0.011	160
Benzo[a]pyrene (BAP)	< 0.011	< 0.011	0.027

These results are elevated above surrender criteria for TPH and sodium, but are expected to reduce through biodegradation processes, and at present there is no desire to surrender the consent, so monitoring will continue in the 2020-21 year in this spreading area.

Groundwater results from two sampling runs were supplied to WRS during the monitoring period. The results are presented below in table 4.

Table 4 TRC supplied groundwater results, Waikakai site, all bores 2019-20

Parameter	Bore	GND2290		GND2291		GND2292		GND2293		GND2294	
	Date	22 Jul 2019	05 Dec 2019	22 Jul 2019	05 Dec 2019	22 Jul 2019	05 Dec 2019	22 Jul 2019	05 Dec 2019	22 Jul 2019	05 Dec 2019
LEVEL	m	2.64	2.965	4.41	4.765	4.39	4.88	1.3	2.35	2.06	1.785
TEMP	Deg.C	14.8	15.4	15.4	16	15.6	16.1	15.1	15.6	14.6	15.6
PH	pH Units	6.7	6.7	6.3	6.3	6.3	6.3	6.7	6.7	7.3	7.7
Electrical Conductivity (EC)	mS/m	37.7	27.9	106.3	139.9	205	244	155.9	150.2	34.1	34.1
Chloride	g/m3	32	27	158	260	500	680	400	390	45	46
Total Sodium	g/m3	21	19.9	59	75	230	270	80	75	29	29
Total Dissolved Solids (TDS)	g/m3	300	210	870	1010	1350	1630	1280	1150	230	240
Acid Soluble Barium	g/m3	< 0.11	< 0.11	< 0.11	< 0.11	0.27	0.32	0.26	0.2	< 0.11	< 0.11
Dissolved Barium	g/m3	0.038	0.024	0.013	0.014	0.27	0.33	0.26	0.192	< 0.005	< 0.005
C10 - C14	g/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m3	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
C7 - C9	g/m3	< 0.06	< 0.10	< 0.06	< 0.10	< 0.06	< 0.10	< 0.06	< 0.10	< 0.06	< 0.10
Total hydrocarbons (C7 - C36)	g/m3	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Benzene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Ethylbenzene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m3	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010

The groundwater results show compliance with the groundwater conditions 23-25 of consent 5956-2.0. No hydrocarbons have been detected in any of the samples, salinity is slightly elevated in bores GND2291, 2292 and 2293 but remains well within the consented TDS limit (2500 g/m³) given in condition 23.

WRS have no supplementary receiving environment sample results to submit as part of this Annual Report; however, as noted in the 2018-19 report, surrender sampling has been undertaken at all previous landspreading areas W1407-W1611 as identified in the site map, Appendix B.

5. ADDITIONAL CONSENT REQUIREMENTS

As per condition 3 of consent 5956-2.0, the site management plan has been reviewed and updated and submitted to the TRC as Appendix E of this report. Operations at the Waikaikai 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.

Consent 5956-2.0 condition 6 requires WRS to assess pit liner integrity at regular intervals. The condition of the pits in 2019-20 remained unchanged from the previous monitoring period.

Pasture establishment and ongoing vegetation coverage are monitored by TRC and by WRS in partnership with the landowner at the Waikaikai 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 2019-20 no significant coverage issues were identified.

6. SUMMARY

As in the previous year, there was a reasonable level of activity at the Waikaikai site in 2019-20. Earlier in the operational period, material was received from Mangahewa G site and disposed of via landspreading in area W1911. This area was then rehabilitated and sown in oats. Further waste was received from Todd, Westside and NPDC and stockpiled on site. Historic spreading areas have met surrender criteria, and no incidents/significant issues have been identified at the site during 2019-20.

Waste Remediation Services Ltd

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Post PO Box 7150, New Plymouth 4341, New Zealand

Email: keith@wrsLtd.co.nz

Appendix A Field Photographs



Photographs 1 and 2 Spread mud drying out on area W1911



Photographs 3 and 4 Area W1911 final rehabilitation, topsoil spread, levelled and seed bed prepared and sown with oats



Photographs 5 and 6 Area W1911 oats strike November 2019



Photographs 7 and 8 Area W1911 ground cover after 5 months, dry conditions and 7 months after rehabilitation

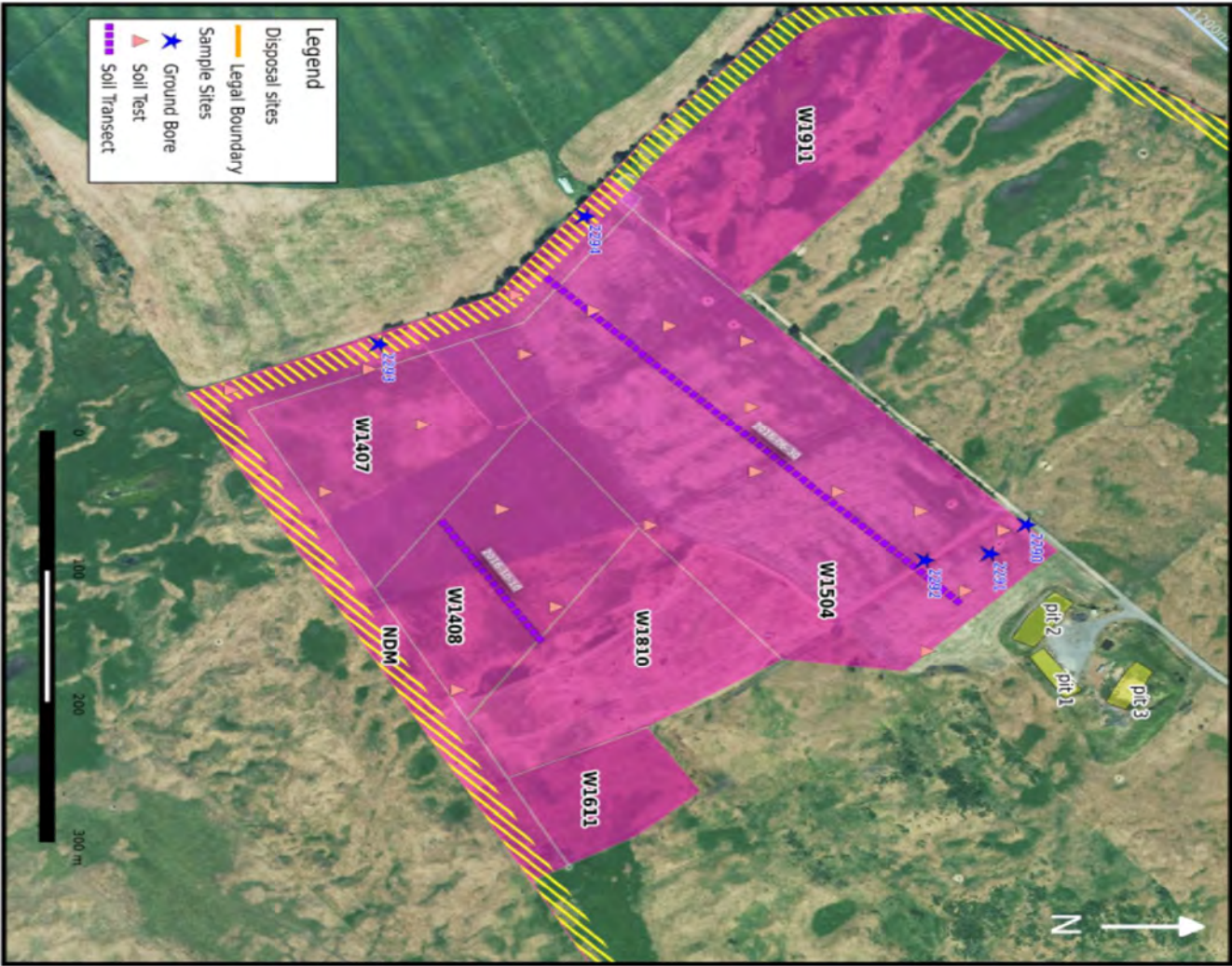
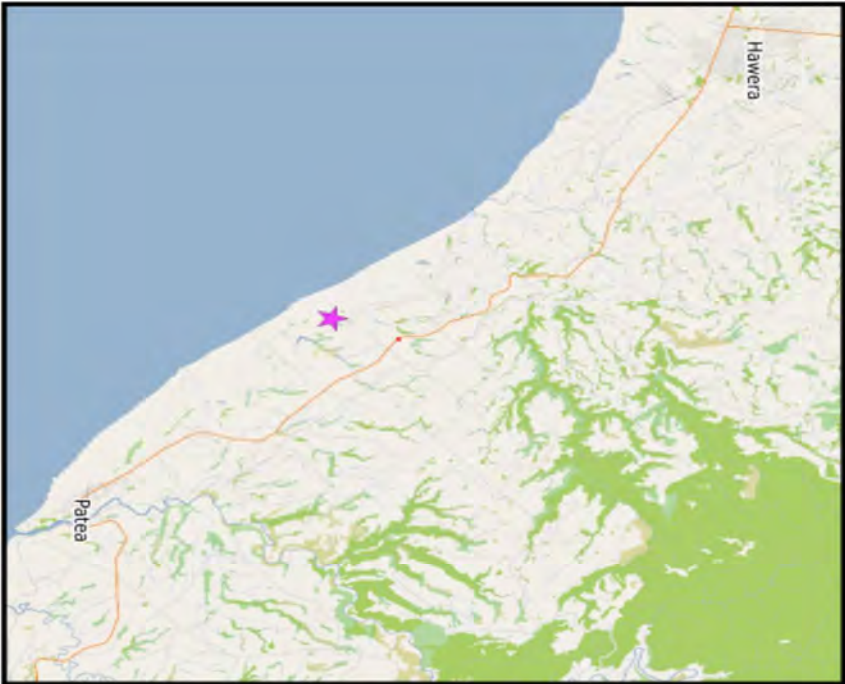


Photograph 9 Area W1911 late June 2020

Appendix B Waikakai Site Map

id	area (ha)	consent no	start date	end date	MUD
NDM	1.73	5956-1			NA
W1407	2.28	5956-1	2014-06-02	2014-07-31	DU/S
W1408	1.9	5956-1	2014-08-01	2014-08-10	DU/S
W1504	5.7	5956-1.7	2015-01-14	2015-04-30	IS
W1611	0.63	5956-1.7	2016-10-11	2016-11-25	DU/S
W1810	1.6	5956-2.0	2018-04-01	2018-10-31	SW/DU/S/IS
W1911	2.24	5956-2.0	2019-02-01		DU/S

Mud Type Codes
SW=Stormwater
DU/S = Drilling Liquids/Solids
IS = Impacted Soils
NA = Not available



Appendix C Mud Register

Date	Source	Customer	Waste material			
			Solid	Liquid	Direct Spread	Total
2-27 July 2019	Mangahewa MHW G-29	Todd	259.2	408.0		667.2
		MHWG-29 TOTAL	259.2	408.0		667.2
27-31 July 2019	Mangahewa MHW G-30	Todd	264.0	78.0		342.0
2-30 Aug 2019	Mangahewa MHW G-30	Todd	240.7	413.2		653.9
5-26 Sept 2019	Mangahewa MHW G-30	Todd	220.0	8.0		228.0
		MHWG-30 TOTAL	504.7	491.2		995.9
19 September 2019	Kapuni Production Station	Todd	-	-	3.0	3.0
18 October 2019	McKee PS	Todd	3.0	-	-	3.0
26 February 2020	Mangahewa D	Todd	-	20.0	-	20.0
3 March 2020	Mangahewa D	Todd	-	36.0	-	36.0
		TODD TOTAL	3.0	56.0	3.0	62.0
12 February 2020	Manutahi D	Westside	6.0	-	-	6.0
16 March 2020	Manutahi D	Westside	14.0	-	-	14.0
		MANUTAH D TOTAL	20.0	-	-	20.0
5-6 March 2020	Oakura Waterwell	NPDC	-	88.4	-	88.4
		OAKURA WATERWELL TOTAL	-	88.4	-	88.4
6-7 May 2020	Mangahewa G	Todd	-	56.0	-	56.0
		TODD TOTAL	-	56.0	-	56.0
		2019-20 ANNUAL TOTAL m3	786.9	1,099.6	3.0	1,889.5

NB: This is a summary table, a full mud register with records of individual deliveries is available upon request.

Appendix D RJ Hill Laboratories Chemical Results



Certificate of Analysis

Page 1 of 2

Client:	Waste Remediation Services Limited (WRS)	Lab No:	2273324	SPv1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	Date Received:	12-Nov-2019	
		Date Reported:	15-Nov-2019	
		Quote No:	80931	
		Order No:	KB 2445 NZ Courier 0053	
		Client Reference:	Waste characterisation	
		Submitted By:	Keith Brodie	

Sample Type: Sludge

Sample Name:	WAI/MHW 29/30 24-Sep-2019 5:00 pm				
Lab Number:	2273324.1				

Individual Tests

Dry Matter	g/100g as rcvd	10.0	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 30	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 30	-	-	-	-

BTEX in Solids by Headspace GC-MS

Benzene	mg/kg dry wt	< 1.0	-	-	-	-
Toluene	mg/kg dry wt	< 1.0	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 1.0	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 2	-	-	-	-
o-Xylene	mg/kg dry wt	< 1.0	-	-	-	-

Polycyclic Aromatic Hydrocarbons Screening in Solids

1-Methylnaphthalene	mg/kg dry wt	< 10	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	< 10	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 10	-	-	-	-
Acenaphthene	mg/kg dry wt	< 10	-	-	-	-
Anthracene	mg/kg dry wt	< 10	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 10	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 10	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 30	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 30	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 10	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	< 10	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 10	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 10	-	-	-	-
Chrysene	mg/kg dry wt	< 10	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 10	-	-	-	-
Fluoranthene	mg/kg dry wt	< 10	-	-	-	-
Fluorene	mg/kg dry wt	< 10	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 10	-	-	-	-
Naphthalene	mg/kg dry wt	< 50	-	-	-	-
Perylene	mg/kg dry wt	< 10	-	-	-	-
Phenanthrene	mg/kg dry wt	< 10	-	-	-	-
Pyrene	mg/kg dry wt	< 10	-	-	-	-



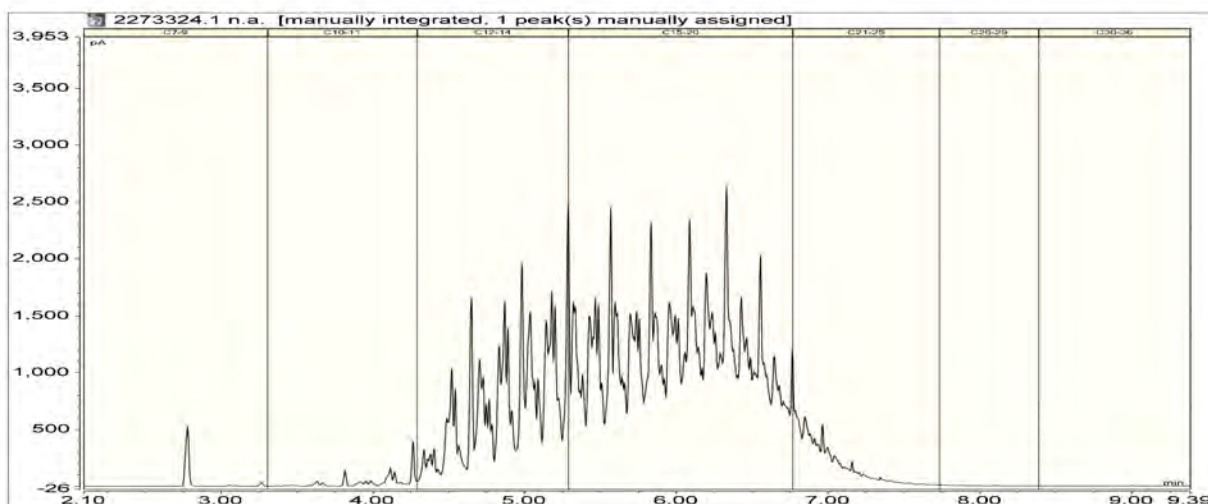
Sample Type: Sludge

Sample Name:		WAI/MHW 29/30 24-Sep-2019 5:00 pm				
Lab Number:		2273324.1				
Total Petroleum Hydrocarbons in Soil As Received						
C7 - C9	mg/kg as rcvd	142 #1	-	-	-	-
C10 - C14	mg/kg as rcvd	48,000	-	-	-	-
C15 - C36	mg/kg as rcvd	116,000	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg as rcvd	164,000	-	-	-	-

2273324.1

WAI/MHW 29/30 24-Sep-2019 5:00 pm

Client Chromatogram for TPH by FID

**Analyst's Comments**

#1 It should be noted that the C7-C9 result for sample 2273324.1 has been adjusted due to the discovery of a laboratory artefact that is produced from the extraction solvent by samples with elevated pH levels.

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. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Total Petroleum Hydrocarbons in Soil As Received	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 as rcvd	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

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.

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Martin Cowell - BSc
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 3

Client:	Waste Remediation Services Limited (WRS)	Lab No:	2343323	SPv1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	Date Received:	18-Mar-2020	
		Date Reported:	25-Mar-2020	
		Quote No:	80931	
		Order No:	KB 2448	
		Client Reference:	Waste characterisation	
		Submitted By:	Keith Brodie	

Sample Type: Aqueous

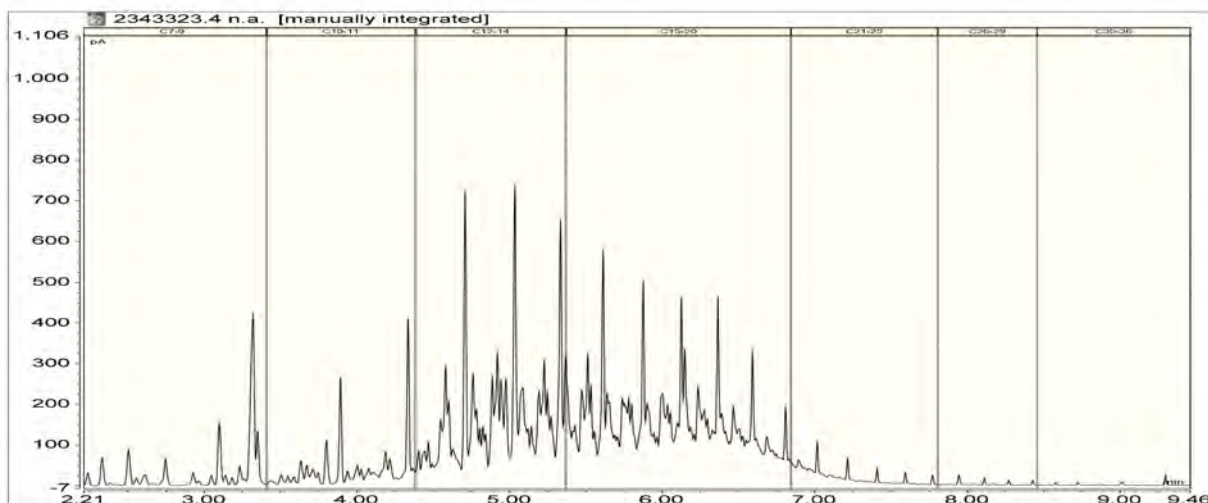
Sample Name:		NPDC Oakura [Aqueous]	Todd MHWD Slops [Aqueous]			
Lab Number:		2343323.3	2343323.4			
Individual Tests						
pH	pH Units	6.1	7.0	-	-	-
Electrical Conductivity (EC)	mS/m	210	4,550	-	-	-
Approx Total Dissolved Salts	g/m ³	1,400	30,000	-	-	-
Total Barium	g/m ³	0.36	1,440	-	-	-
Total Calcium	g/m ³	220	1,490	-	-	-
Total Magnesium	g/m ³	12.6	127	-	-	-
Total Mercury	g/m ³	< 0.0021	< 0.011	-	-	-
Total Potassium	g/m ³	10.5	8,000	-	-	-
Total Sodium	g/m ³	300	6,500	-	-	-
Sodium Absorption Ratio (SAR)*	(mmol/L) ^{0.5}	5.2	43	-	-	-
Chloride	g/m ³	100	1,450	-	-	-
Total Nitrogen	g/m ³	2.8	61	-	-	-
Nitrate-N + Nitrite-N	g/m ³	< 0.10	< 0.10	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	2.8	61	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m ³	< 0.021	< 0.11	-	-	-
Total Cadmium	g/m ³	< 0.0011	< 0.0053	-	-	-
Total Chromium	g/m ³	< 0.011	16.5	-	-	-
Total Copper	g/m ³	0.012	1.88	-	-	-
Total Lead	g/m ³	< 0.0021	0.36	-	-	-
Total Nickel	g/m ³	0.092	1.93	-	-	-
Total Zinc	g/m ³	< 0.021	4.2	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m ³	-	4.4	-	-	-
Toluene	g/m ³	-	11.9	-	-	-
Ethylbenzene	g/m ³	-	1.27	-	-	-
m&p-Xylene	g/m ³	-	9.6	-	-	-
o-Xylene	g/m ³	-	2.9	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	-	1,160	-	-	-
C10 - C14	g/m ³	-	6,700	-	-	-
C15 - C36	g/m ³	-	8,700	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	-	16,600	-	-	-



2343323.4

Todd MHWD Slops [Aqueous]

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

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 23 rd ed. 2017.	0.0011 - 0.021 g/m ³	3-4
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629].	0.0010 - 0.002 g/m ³	4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B / MfE Petroleum Industry Guidelines.	0.10 - 0.7 g/m ³	4
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	3-4
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	3-4
Total Digestion with HCl	Nitric/hydrochloric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	3-4
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. 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. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	3-4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	3-4
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m ³	3-4
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.11 g/m ³	3-4
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	3-4
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	3-4
Total Mercury	Acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.0021 g/m ³	3-4
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	3-4
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	3-4
Sodium Absorption Ratio (Total)*	Calculation; from sodium, calcium and magnesium, as follows; (Na / 23) / [(Ca / 20 + Mg / 12.15)/2] ^{0.5} where the concentrations for these ions (Na, Ca and Mg) are expressed as g/m ³ .	0.2 (mmol/L) ^{0.5}	3-4
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	3-4

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
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	3-4
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser, screen level. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.10 g/m ³	3-4
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) 23 rd ed. 2017.	0.10 g/m ³	3-4

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

Dates of testing are available on request. Please contact the laboratory for more information.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 5

Client:	Waste Remediation Services Limited (WRS)	Lab No:	2164329	SPv1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	Date Received:	20-Apr-2019	
		Date Reported:	13-May-2019	
		Quote No:	80931	
		Order No:	KB 2428	
		Client Reference:	Waste characterisation	
		Submitted By:	Keith Brodie	

Sample Type: Oil

Sample Name:	WAI/MHW - 26 [Oil]				
Lab Number:	2164329.9				
Individual Tests					
Total Arsenic*	mg/kg as rcvd	< 1.0	-	-	-
Total Barium*	mg/kg as rcvd	210	-	-	-
Total Cadmium*	mg/kg as rcvd	< 0.05	-	-	-
Total Calcium*	mg/kg as rcvd	380 #1	-	-	-
Total Chromium*	mg/kg as rcvd	< 1.0	-	-	-
Total Copper*	mg/kg as rcvd	< 1.0	-	-	-
Total Lead*	mg/kg as rcvd	< 0.2	-	-	-
Total Mercury*	µg/kg as rcvd	< 3	-	-	-
Total Nickel*	mg/kg as rcvd	< 1.0 #2	-	-	-
Total Potassium*	mg/kg as rcvd	< 50	-	-	-
Total Zinc*	mg/kg as rcvd	< 5	-	-	-
Chloride*	mg/kg as rcvd	191	-	-	-
Total Nitrogen*	g/100g as rcvd	< 0.12	-	-	-

Sample Type: Aqueous

Sample Name:	WAI/Pre-spread 09-Mar-2019	WAI/Pre-spread 02-Apr-2019	WAI/MHW - 27 11-Apr-2019	WAI/MHW - 25 [Aqueous]	WAI/MHW - 26 [Aqueous]
Lab Number:	2164329.2	2164329.4	2164329.5	2164329.6	2164329.8
Individual Tests					
pH	pH Units	11.8	6.4	11.8	12.6
Electrical Conductivity (EC)	mS/m	2,760	481	1,111	1,730
Approx Total Dissolved Salts	g/m ³	18,500	3,200	7,400	11,600
Total Barium	g/m ³	170	2.6	0.99	30
Total Calcium	g/m ³	2,400	410	930	2,100
Total Magnesium	g/m ³	23	6.0	< 0.42	45
Total Mercury	g/m ³	< 0.0021	< 0.0021	< 0.0021	< 0.0021
Total Potassium	g/m ³	4,800	620	1,540	6,500
Total Sodium	g/m ³	550	91	152	550
Sodium Absorption Ratio (SAR)*	(mmol/L) ^{0.5}	3.1	1.2	1.4	3.2
Chloride	g/m ³	8,900	1,260	2,800	6,100
Total Nitrogen	g/m ³	28	6.6	7.5	73
Nitrate-N + Nitrite-N	g/m ³	0.75	< 0.10	0.28	< 0.10
Total Kjeldahl Nitrogen (TKN)	g/m ³	27	6.6	7.2	73
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m ³	0.051	< 0.021	< 0.021	0.167
Total Cadmium	g/m ³	0.0019	< 0.0011	< 0.0011	0.0064
Total Chromium	g/m ³	0.094	0.013	0.035	0.25
Total Copper	g/m ³	0.49	0.055	0.092	1.04
Total Lead	g/m ³	0.072	0.0125	< 0.0021	0.179



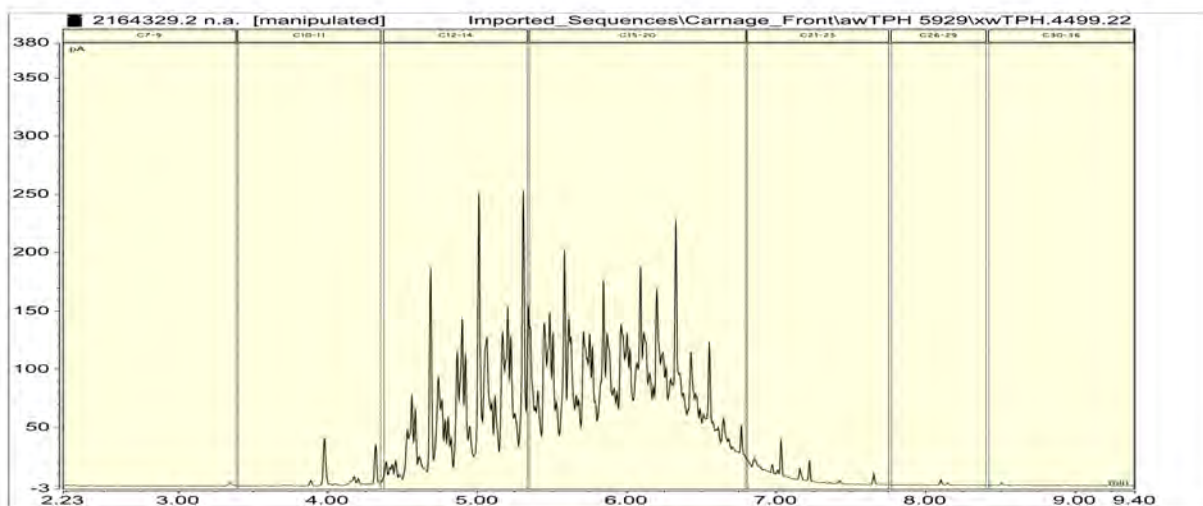
Sample Type: Aqueous

Sample Name:		WAI/Pre-spread 09-Mar-2019	WAI/Pre-spread 02-Apr-2019	WAI/MHW - 27 11-Apr-2019	WAI/MHW - 25 [Aqueous]	WAI/MHW - 26 [Aqueous]
Lab Number:		2164329.2	2164329.4	2164329.5	2164329.6	2164329.8
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Nickel	g/m ³	0.20	0.029	0.035	0.23	0.170
Total Zinc	g/m ³	0.46	0.041	< 0.021	1.10	1.41
BTEX in Water by Headspace GC-MS						
Benzene	g/m ³	< 0.010	0.0041	< 0.0010	< 0.0010	< 0.010
Toluene	g/m ³	< 0.010	0.0044	0.0015	< 0.0010	< 0.010
Ethylbenzene	g/m ³	< 0.010	< 0.0010	< 0.0010	< 0.0010	< 0.010
m&p-Xylene	g/m ³	< 0.02	0.004	< 0.002	< 0.002	< 0.02
o-Xylene	g/m ³	< 0.010	0.0018	< 0.0010	< 0.0010	< 0.010
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	0.7	< 0.06	< 0.06	< 0.06	1.8
C10 - C14	g/m ³	450	22	6.7	1.6	980
C15 - C36	g/m ³	960	27	6	4	1,680
Total hydrocarbons (C7 - C36)	g/m ³	1,410	49	13	6	2,700

2164329.2

WAI/Pre-spread 09-Mar-2019

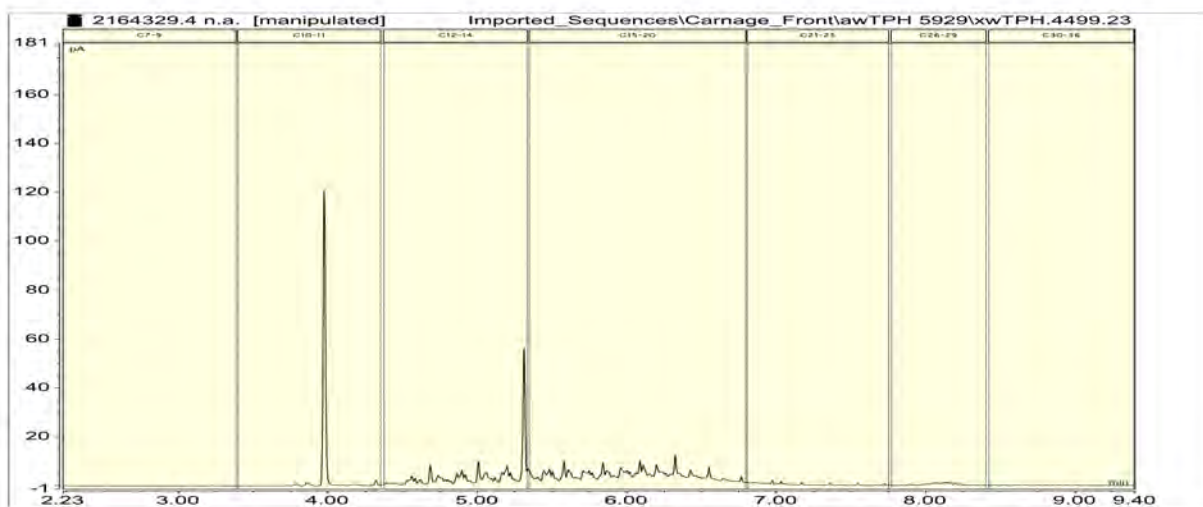
Client Chromatogram for TPH by FID



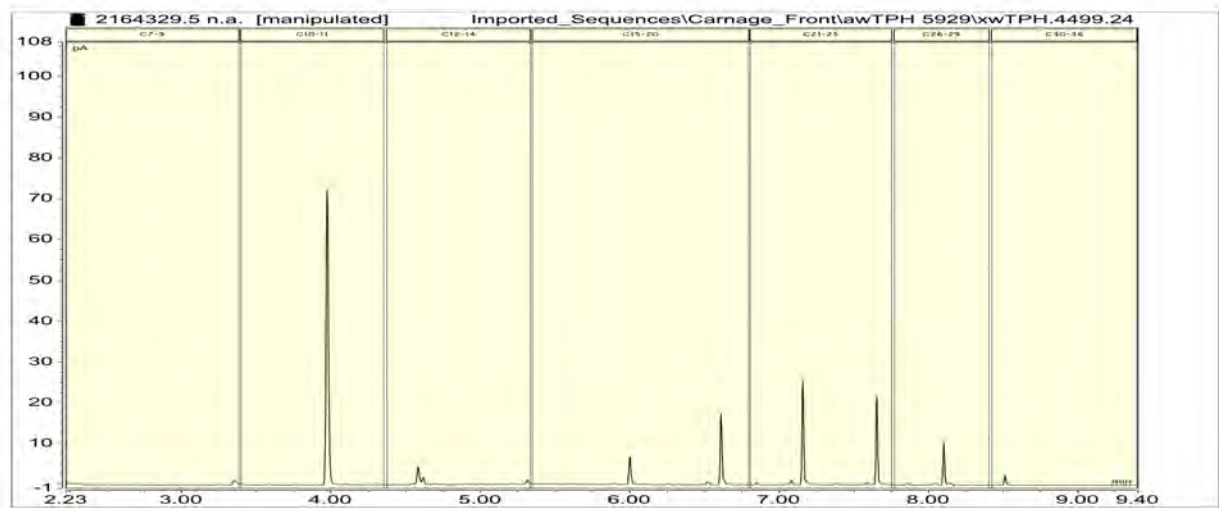
2164329.4

WAI/Pre-spread 02-Apr-2019

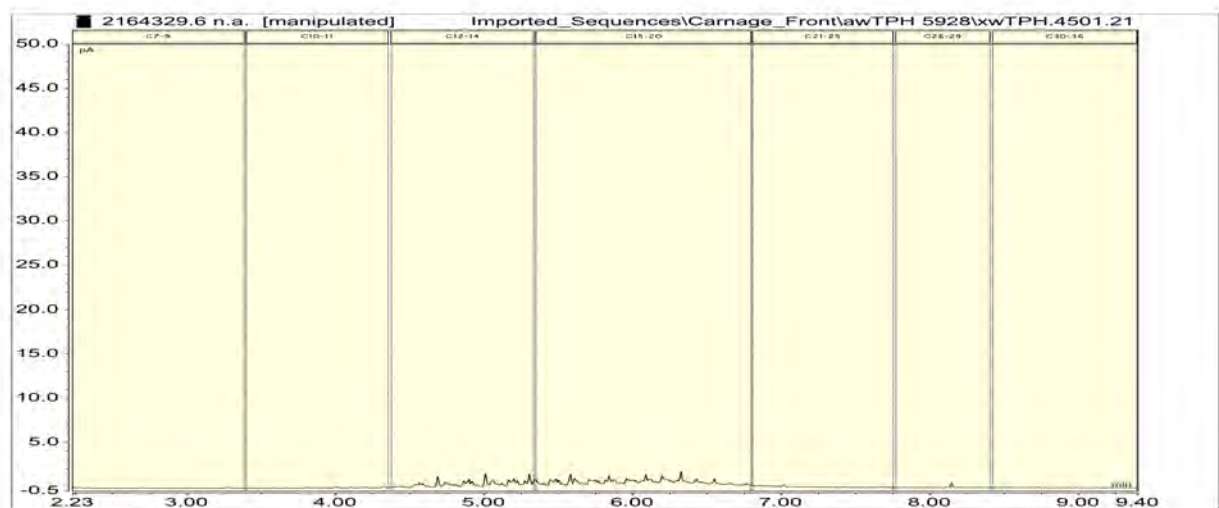
Client Chromatogram for TPH by FID



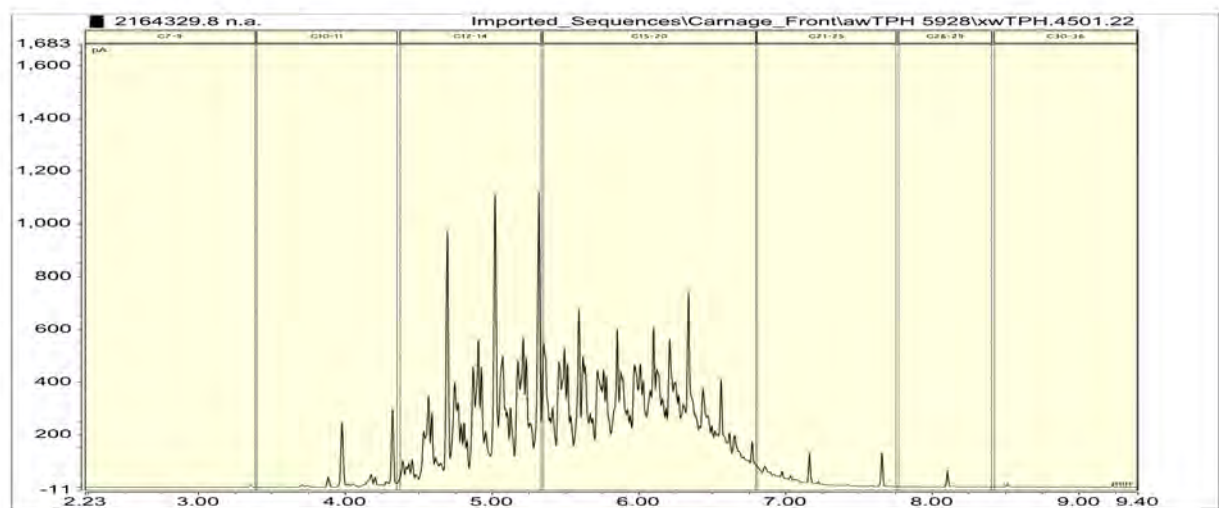
2164329.5
WAI/MHW - 27 11-Apr-2019
Client Chromatogram for TPH by FID



2164329.6
WAI/MHW - 25 [Aqueous]
Client Chromatogram for TPH by FID



2164329.8
WAI/MHW - 26 [Aqueous]
Client Chromatogram for TPH by FID



Analyst's Comments

#1 It should be noted that the blanks contained an elevated level of calcium (115 and 121mg/kg c.f. detection limit of 50mg/kg). This has been corrected for on the sample concentration. This should be kept in mind when interpreting these results.

#2 It should be noted that the blanks contained an elevated level of nickel (1.2 and 1.1mg/kg c.f. detection limit of 1mg/kg). This has been corrected for on the sample concentration. This should be kept in mind when interpreting these results.

Appendix No.1 - IPL Report

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. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Oil			
Test	Method Description	Default Detection Limit	Sample No
Ashing and Aqua Regia digest	Ashing in Muffle furnace, Aqua Regia (HNO ₃ /HCl) digestion.	-	9
Total Arsenic*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9
Total Barium*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	9
Total Cadmium*	Aqua Regia Digestion, ICP-MS.	0.05 mg/kg as rcvd	9
Total Calcium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	9
Total Chromium*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9
Total Copper*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9
Total Lead*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	9
Total Mercury*	Digestion by closed vial (aqua regia) followed by combustion and quantification by hollow cathode absorption spectroscopic analysis. Subcontracted to IPL Ltd. ANC 010 - Closed vial digestion. ANC 011 - Quantification of Hg method.	3 µg/kg as rcvd	9
Total Nickel*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9
Total Potassium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	9
Total Zinc*	Aqua Regia Digestion, ICP-MS.	2 mg/kg as rcvd	9
Chloride in Oil / Water Emulsion*	Extraction of chloride using acid / alcohol mix. Back titration of silver nitrate against potassium thiocyanate. In-House method based on Vogel's Inorganic Analysis.	70 mg/kg as rcvd	9
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g as rcvd	9

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 22 nd ed. 2012.	0.0011 - 0.021 g/m ³	2, 4-6, 8
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m ³	2, 4-6, 8
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	2, 4-6, 8
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	2, 4-6, 8
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	2, 4-6, 8
Total Digestion with HCl	Nitric/hydrochloric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	2, 4-6, 8
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. 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. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	2, 4-6, 8
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	2, 4-6, 8
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m ³	2, 4-6, 8
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.11 g/m ³	2, 4-6, 8
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	2, 4-6, 8
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	2, 4-6, 8

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Mercury	Acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.0021 g/m ³	2, 4-6, 8
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	2, 4-6, 8
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	2, 4-6, 8
Sodium Absorption Ratio (Total)*	Calculation; from sodium, calcium and magnesium, as follows; $(Na / 23) / [(Ca / 20 + Mg / 12.15)/2]^{0.5}$ where the concentrations for these ions (Na, Ca and Mg) are expressed as g/m ³ .	0.2 (mmol/L) ^{0.5}	2, 4-6, 8
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	2, 4-6, 8
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	2, 4-6, 8
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser, screen level. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.10 g/m ³	2, 4-6, 8
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) 23 rd ed. 2017.	0.10 g/m ³	2, 4-6, 8
C7 - C9	Head Space, GCMS analysis.	0.06 g/m ³	2, 4-6, 8

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.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



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



Laboratory Test Report 610891

Customer: Graham Corban**Copy to:**

Address: Hill Laboratories
28 Duke Street
Private Bag 3205
Frankton Hamilton

Purchase Order: 151766**Customer Ref:** 2164329.9**E-Mail:** EnvJobEnquiry@hill-labs.co.nz**Product:** Oil**SAMPLES RECEIVED / WORK COMPLETED**

One vial of oil was received on 6th of May 2019, in a container supplied by Hill Laboratories.

The sample was homogenised and digested by closed vial aqua regia digestion (ANC-010) on 7th of May followed by combustion and quantification by hollow cathode absorption spectroscopic analysis (ANC-011) on 8th of May.

The sample was analysed in duplicate and the averaged result is quoted below.

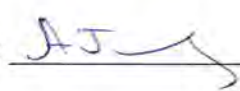
Estimated limit of quantification for this sample is 3 ppb w/w.

RESULTS

Customer Reference	2164329.9
IPL Sequence No.	610891
Mercury Content	<3 µg/kg (ppb w/w)

Work completed and Reported by:  (Steven Fawcett)

Date: 10/05/2019

Checked by:  (Tony Hockings)

Date: 13/05/2019

DISCLAIMERS

This report relates specifically to the samples as received.

The latest issue of the relevant test methods was used unless otherwise stated.

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Appendix E WRS Landfarm Management Plan 2019-20



Waste Remediation Services Ltd (WRS)

Waikaikai (Wards)

&

Manawapou (Symes)

Landfarm Management Plan

2019 - 2020

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Rev	Date	Reason for Issue	Prepared	Checked	Approved
A	May 2014	Issued for review	KMB		
B	Aug 2015		KMB		
C	Aug 2016		KMB		
D	Jun 2017		KMB		
E	Aug 2018		KMB		

F	Jul 2019		KMB		
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This Landfarm Operations Management Plan (OMP) describes the process and procedures/requirements for disposal by land farming of drilling muds and cuttings and production station wastes in accordance with the Taranaki Regional (TRC) and South Taranaki District Councils (STDC) resource and landuse consent conditions and relevant New Zealand guidelines.

1. Safety

Waste Remediation Services Ltd will comply with all current Occupational Safety and Health Legislation in operating the landfarm sites at Waikaikai and Manawapou. The company has the services of an in-house Symons Group dedicated HSEQ Manager and HSEQ Advisor who provide regular input and advice on all site and operational safety matters to identify risks and hazards, record and manage these through site visits and conduct safety meetings with site personnel, contractors and staff and undertake group wide Safety Audits. All visitors to the landfarm sites irrespective of the purpose of their visit are required to sign the visitors log in and out of the site, and comply with all directions and notices displayed at the site. The Operations Manager's contact telephone number is clearly signposted at both landfarm sites should any queries arise

2. Scope

This Landfarm Operations Management Plan sets out the location, parties involved, safety practices and methodologies adopted by the operator to meet all legal requirements, and to minimise the risks and effects of the disposal of oil and gas exploration, production and workover drilling and production station wastes to land.

Management of the landfarm sites involves liaison by Waste Remediation Services Ltd (the Operator) with the landowners (P and K Wards at Waikaikai and A Symes at Manawapou), the Taranaki Regional Council and South Taranaki District Councils (as the consenting authorities), offsite service providers and agents (laboratories, surveyors, couriers..), the exploration/drilling/production station companies supplying the wastes, and contractors involved with the delivery and landfarming of the wastes from time to time.

This liaison particularly with the TRC along with regular site and operations supervision and the keeping of comprehensive and timely records are key components of site management.

The landfarm and each delivery of waste through to disposal needs to be managed to ensure compliance with resource consent conditions and both regional and national guidelines viz the New Zealand guidelines for the safe application of bio solids to land (NZWWA, 2003), guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE, 1999) and the TRC's guidelines for disposal of oilfield wastes by landfarming, and the consents specific to each site viz **Waikaikai 5956-2.0 , Manawapou 7795-1**

Storage Pit Capacities

At July 2019 the following storage capacities currently exist at the two WRS operated facilities

- | | | |
|--------------|---------------------------|---------|
| 1. Waikaikai | 3 pits, combined capacity | 1,200m3 |
|--------------|---------------------------|---------|

2. Manawapou 3 pits, combined capacity 1,100m³

Total available storage 2,300m³

3. Consents

The site is authorised and operated under the following consents;

A) Waikaikai (Wards)

1. TRC: Consent number 5956-2.0 - Issued 19 April 2017, Expiry 1 June 2034,
2. STDC: Landuse Consent RM 010155 Issued 9 January 2002.

B) Manawapou (Symes)

1. TRC : Consent number 7796-1 - Issued 01 May 2012, Expiry 01 June 2028
3. STDC : STDC : Landuse Consent RM

4. Abbreviations

WBM	Water based (drilling) mud
SBM	Synthetic based (drilling) mud
TRC	Taranaki Regional Council
MfE	Ministry for the Environment
NZWWA	New Zealand Water and Wastes Association
STDC	South Taranaki District Council

5. Landfarming Process

Landfarming is the practice of disposing of drilling and production station wastes to land. It comprises collection and delivery to site, storage to allow natural (solar and atmospheric) degradation to occur, and to enable a volume of wastes to accumulate to make ground preparation and spreading practical on a campaign basis, viz > 500 m³.

WRS undertakes this with four distinct earthmoving and agricultural phases resulting in up to the equivalent of 15 machinery ground passes;

- a) **Dewatering** – removal of any storm water from the pits and discharge onto any consented area by vacuum tank removal and discharge spraying. Stormwater is

determined as the “slab” of largely undisturbed, unmixed water overlying the mud in the storage pits.

- b) **Ground Preparation** - stripping existing organic soil horizons and placing this in windrows around the designated spread area, followed by cut and fill earthworks to provide a rolling contour over the spread area/s.
- c) **Waste Spreading** - the waste is then discharged onto land, allowed to dry, spread across the prepared area, incorporated into the soil by tilling and deep ripping down to > 1m depth to remove any likelihood of ponding and to maximize dilution and incorporation into the underlying sand horizons.
- d) **Rehabilitation** - the stripped topsoil is recovered from storage and spread over the entire spread area. This is levelled and further tilled if required. The final rehabilitation step involves final levelling, then cultivating and re-sowing the area to pasture or crop to facilitate natural soil processes to effectively biodegrade, transform and assimilate the waste. This process results in improved soil properties particularly on light, free draining sandy soils resulting in dry matter pasture yields being increased several fold, and the elimination of sand blow holes developing and spreading that result from the persistent prevailing winds very typical of this coastal area in South Taranaki

The overall process involves the following broad steps:

1. Notification to the Taranaki Regional Council (TRC) prior to removal from the wellsite of landfarm site discharge consent number, well site name and well number, waste source, type and volumes, sampling (for hydrocarbon characterization) and assessment of the wastes to be disposed of.
2. Collection of fluids and cuttings from the wellsite and transport to the disposal site in purpose built, sealed units. Fluids are pumped into tankers (also known as “tubes”), and solids are transported by sealed well-side trucks using an excavator to load the material at the wellsite from both in/above ground sumps, cellars and mud tanks.
3. Discharge at the landfarm site of water based muds (WBM) cuttings and fluids, synthetic based mud (SBM) cuttings and fluids, and oily wastes, from transport vehicles to in-ground FPE lined storage pits to allow firstly natural atmospheric degradation and dilution, and until storage volumes are sufficient to allow campaigned final disposal.
4. Preparation of spreading areas by removal and stockpiling of topsoil (A soil horizon) usually into perimeter windrows/stockpiles, re-contouring and levelling the spreading area to improve uniformity, eliminate mud flow/ponding as much as practicable and control of waste application rates. Establishment of spread area margin bunding if required may also occur.
5. Spreading of the cuttings (solids) and thick slurry materials over land at the consented rates using tractor and trailers, digger and/or bulldozer, motor scraper or spray systems (depending on the fluid content of the mud). Fluids are usually distributed onto the disposal area using a tractor drawn effluent vacuum tank with a spray irrigation discharge system.
6. Allowing the cuttings and fluid to dry and degrade sufficiently to enable effective working into the sub-soils (B horizon) to required depths.

7. Levelling the soil surface with a levelling bar or similar to provide an easy grade workable field surface.
8. Replacement of the stockpiled A horizon clay/topsoil to aid stability and assist in grass establishment.
9. Fertilising and sowing either in crop or pasture in consultation with the landowner.
10. Application of fertilizer with or just after seed sowing and again within one year to assist establishment of good ground cover vegetation

6. Wastes Consented for Landfarming

There are only three types of waste able to be disposed of at the Waikaikai Landfarm from exploration and production activities

1. Water Based Mud (WBM) drill cuttings and fluids,
2. Synthetic Based Mud (SBM) drill cuttings and fluids
3. Oily Wastes from wellsites and production facilities .

But only two at the Manawapou Landfarm from exploration and production activities

1. Water Based Mud (WBM) drill cuttings and fluids
2. Synthetic Based Mud (SBM) drill cuttings and fluids

NOTE Unlike some other drilling mud disposal sites in the region both land farms operated by WRS are unable to accept for on-site disposal to ground Produced Water which may have high mineral or salt content associated with the production of oil and gas from reservoirs. This produced water may include water, water that has been injected into the reservoir and any chemicals added during the production/treatment/enhancement process, including hydraulic fracturing.

Produced water can contain residual chemicals from treatment and enhancement; however the definition does not extend to any “flush fluid and/or fluid containing proppant”.

There does not however appear to be any restriction upon WRS from processing stimulation returns on site for onward transport to approved disposal sites.

7. Landfarm Management Process/Activities

This management plan includes, as a minimum:

1. Notification to TRC of receipt of wastes for storage/disposal;
2. Procedures for the receipt and stockpiling of wastes onto the site;
3. Provision to the TRC of each waste types characteristics prior to spreading during each landfarming campaign
4. Methodology for the stripping and recontouring/levelling of area to be land farmed;
5. Methodology for landfarming drilling wastes (including methods of transfer to and from stockpile area/s, methods of spreading, and incorporation into the soil);
6. Methodology for sowing land farmed areas;
7. Contingency procedures;
8. Sampling regime and methodology;
9. Post-landfarming management, monitoring and site reinstatement;

10. Record keeping; and
11. Control of site access and records.

8. Landfarm Management Responsibilities

The following table provides a step-by-step process of landfarm site management.

Table 1 Overview of site management process

Step	What	Who
1	Contact WRS Operations Manager (Ops Mngr) to discuss waste type/volume/sampling/timing of delivery to site Provide WRS Ops. Manager with written notification of source, delivery date, waste type, volume and transporting company. Receive the OK for delivery/disposal of material from WRS Ops Mngr	Client production supervisors/ drilling supervisors/ well services supervisors/mud engineers
2	Receive notification in regard to waste for disposal; - Receive notification of well exploration activities and programme for collection and delivery of waste to land farm site - Ensure all information required by consent is provided by the client ; - Confirm delivery and sample collected point and by who - Record all collection details on WRS/Symons Transport waybills. Assign each 'parcel' of waste a number (Waste Transfer Docket number) to ensure source, transport and storage location are recorded - Collect and submit pre-disposal sample for analysis.	WRS Operations Manager, transporting companies management and truck drivers, clients drilling supervisor
	TRC Notification (delivery for storage): 48 hours prior to delivery for stockpiling on site; including - consent number, name of well/site, type of waste, volume of waste. Planning for delivery/stockpiling: - Arrange and assign storage pit into which the waste consignment is to be discharged taking into account mud type, characteristics and storage volumes available - Ensure delivery driver completes delivery details into WRS Site Delivery Record (used to compile the electronic Mud Register) located in the disposal site shack.	WRS Operations Manager/client's drilling engineer / mud engineer WRS Operations Manager
	Delivery: - Once location for stockpiling at landfarm has been arranged liaise with delivery contractor - Notify WRS of all deliveries to site, providing as much notice as practicable.	Client production supervisors/drilling supervisors/well services supervisors/ mud engineer/ transport companies Dispatch Manager

Step	What	Who
	Managing Stockpiles: - Maintain a record of volumes of wastes in storage pits and ensure freeboard and storage capacities are commensurate with drilling waste volumes as far as is practicable. - If heavy rainfall reduces pit capacity and freeboard removal of excess rainwater by vacuum tanker to suitable land farming areas until land spreading of mud and solids is practical	WRS Operations Manager
	Planning for spreading: - Identify volumes delivered and to be spread - Take sample for analysis, dispatch to lab. and provide results to TRC; - Consider mixing similar waste to provide the appropriate and /or practical soil improvement properties sought by the landowner	WRS Operations Manager
	Resample for pre-disposal results - Calculate loading, area required and spreading rate calculations according to the consent; and - Identify location for disposal site based on area required and separation distances (at least 25 metres away from waterways and un-consented property boundaries, 6m from existing gas pipelines, and 2m from other disposal sites).	WRS Operations Manager
	TRC Notification (spreading): 48 hours prior to spreading advise TRC of date; consent number; well/site; type of waste; volume and location/area it will be spread upon Send sample to laboratory to establish ; concentrations of chloride, nitrogen and TPH.	WRS Operations Manager

9. Pre-Delivery and Storage Waste Characterisation

The consent requires that a representative samples are taken from each type of waste to be delivered to the landfarm for either storage or direct spreading. WRS requires that this is taken at source by the well owner or drilling contractor or other suitably qualified person and forwarded to WRS without delay for analysis or a representative sample is taken from by WRS staff at the point of discharge to storage

The sample containers depend upon the waste type sampled – where practical WRS will make all reasonable endeavors to stipulate and provide the correct sample containers.

10. Pre-Disposal Testing of Wastes

There are no specific numeric limits specified in the consent for any waste type or consignment received for storage, but spreading rates are determined by TPH concentrations and upper limits for heavy metals in the soils after spreading viz

The concentration of heavy metals in the soil over the disposal area shall at all times comply with the MfE NZ Water and Wastes Association Guidelines for the application of Bio solids to land NZ (2003) and the *Resource Management (National Environmental Standard for*

Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, as shown in the following table.

These limits in effect act only as a guide to attaining the required dilution and dispersal to meet heavy metal limits via the spreading rates and mixing/ dilution activities

Similarly, the surrender limits for constituents specified in consent 05956-2.0 Condition 29. below provides guidance for pre-spreading calculation/rates.

Table 1 Pre-surrender analytes and limits – see Condition 29. Consent 05956-2.0

Parameter	Consent Limit (mg/kg unless otherwise stated)	Minimum pre-disposal analysis required
Conductivity	290mS/m (guideline)	
Chloride	700 mg/kg (guideline)	
Sodium	460 mg/kg (guideline)	
Total Soluble Salts	2500mg/kg	
TPH Fraction	Guideline Value Agricultural Ecological Direct Soil Contact (Fine Sand) From table5.2	
F1 (C6-C10)	210	
F2 (>C10-C16)	150	
F3 (>C16-C34)	1300	
F4 (>C34)	5600	
Canadian Council of Ministers of the Environment (CCME), in the document Canada Wide Standard for Petroleum (PHC) in Soil: Scientific Rationale,2008.Table 5.2		
Soil Type Contaminant	Depth of contamination Surface (<1m) (mg/kg)	
Sand Silt MAHs Benzene Toluene Ethylbenzene Xylenes	 1.1 82 59 59	i
PAH (Polycyclic Aromatic Hydrocarbons) Naphthalene Pyrene non-carc Benzo(a)pyrene eq.	 7.2 160 0.027	
Table 4.12 SANDY SILT Guidelines for Assessing and Managing Petroleum Hydrocarbon Contamination Sites in NZ (MfE 1999)		

11. Mixing Waste

It is not practical or necessary to maintain separation of waste types by providing separate sealed pits as during spreading waste types are generally mixed by the spreading and soil incorporation processes. Actual discharge of wastes into the available sealed pits at the site is generally solids into Pit 1 and liquids into Pit 2, 3 and 4, but if capacities are limited spreading of all waste types occurs on the basis of maintaining the maximum free board possible across all pits.

Predisposal assessment of waste will be carried out for each storage pit prior to any decision to spread. Both the combined product volumes and species concentrations of the resultant aggregated waste will be assessed to guide and provide a check on spreading rates prior to spreading occurring.

12. Calculating spreading areas and depth requirements from pre-disposal sample results

The pre-disposal sample results are used for pre-planning of each waste disposal. The consents restrict the thickness that waste can be spread as follows:

- 100mm for wastes with hydrocarbon content less than 50,000mg/kg dry wgt;
- 50mm for wastes with hydrocarbon content greater than 50,000mg/kg dry wgt

Application must be at a rate such that there is no overland flow of liquids; and at a rate such that no ponded liquids remain one hour, after application

To ensure these limits can be met, calculations are based upon results of the pre-disposal sample.

To obtain the minimum area for spreading the calculation is:

a) for TPH < 50,000mg/kg)
 $\text{volume (m}^3\text{)} / \text{depth allowed (0.10m)} = \text{area m}^2$

b) for TPH > 50,000 mg/kg
 $\text{volume (m}^3\text{)} / \text{depth allowed (0.05m)} = \text{area m}^2$

e.g. Volume to be spread is 200 m³

Spread Area= $200/0.05 = 4,000 \text{ sq.} = 0.4\text{Ha}$

13. Monitoring

13.1. Site Inspections

Regular monitoring inspections of the landfarm sites will be undertaken monthly on average as a minimum when sites are inactive, and weekly or more often the site is active to check for:

- Housekeeping of site (rubbish, access tracks, site layout, safety, security, hazards)
- Status of storage pits (volume, contamination, stability, wastes) and signage (wellsite and waste type)
- Land farming (progress, application, depth/area, slopes, separation, reinstatement), and
- Environmental (boundary distances, discharges/spills, water bodies).

13.2. Soil Sampling

TRC has developed a set of guidelines for the disposal of drilling wastes onto and into land that are reflected in the conditions of resource consents.

These guidelines, along with MFE and NZWWA guidelines, set target concentrations of metals, salts and hydrocarbons at all times, and subsequently the levels of hydrocarbons and other species and physical parameters at surrender.

Although there is no specific condition setting consent holder soil sampling frequencies, consent surrender criteria levels form the basis for the type and frequency of monitoring that will be undertaken at the site for specific purposes.

The suite of analytes that are monitored through periodic sampling of the landfarm spreading areas are determined by sampling purpose e.g. if surrender of land farmed areas is to be applied for.

Soil sampling type, methodology and frequency undertaken by WRS also depends upon two key drivers

- 1) Animal Health and Welfare/ Food Security
- 2) Decision/s to Surrender all or any part of the Consent Area

The sampling requirements and reasons are:

1. Pre-spreading - representative sample/s of the wastes to ascertain levels of hydrocarbons to calculate loadings and rates.
2. Heavy Metals - composite, representative soil samples of each disposal area following spreading at approx. one month after spreading, and then periodically, but not more than annually, until consent levels cited in conditions in 5659-2.0 and /or 7795-1.0 are attained; and
3. Surrender -full testing undertaken on part or all disposal areas prior to lodging an application to surrender part of or close the site.

Analyses are normally conducted on a composite sample fraction. The composite is collected from a surveyed transect or representative "W" across the disposal area. Three to five soil cores are taken at each nominated sample points at depths determined by the objective for sampling from 75mm (for annual health and welfare criteria) to 400mm (for environmental sampling required for surrender assessment) From this bulk sample a representative fraction

is submitted for analysis. The sampling methodology provides material from the zone of interest eg exposure of livestock (nominally < 75mm) to the depth the material was applied, plus an additional margin to the depth tilling may have occurred to (nominally 400mm).

All analysis will be provided by R J Hill Laboratories in Hamilton and copies of these analysis results are provided to the TRC by direct electronic transfer simultaneously with receipt by WRS.

Not all parameters are tested at every sample due to cost and practicality – generally a surrogate analytical suite is established in consultation with R J Hills Labs and agreed with the TRC.

Before any consent can be surrendered all parameters will be analysed. The consent cannot be surrendered and the site closed to land farming activities until all species specified in the consent meet the surrender criteria as below for consent 7795-1.0 (Manawapou), or as in Table 1 above for consent 5956-2.0 (Waikaikai).

Table 2 Sampling requirements and consent limits

Parameter	Consent Limit (mg/kg unless otherwise stated)	Typical Sampling requirements for WBM/SBM/Oily Wastes		
		1 month after*	6 months after*	Annual *
Chloride	700 mg/kg (expiry)	/	/	
Sodium (Na)	460 (expiry)			
Conductivity Sodium Absorption Ratio	290 mSm (expiry) 18 (post-app)			
Total soluble salts (g/100g)	2500 (expiry)			i
BTEX Benzene Toluene Ethylbenzene Xylenes PAH Naphthalene Pyrene Benzo(a)pyrene TPH C6-C9 C10-C14 C15-C36	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in [New Zealand MfE 1999]. Tables 4.12 and 4.15, for soil type sand.	/	/	/

13.3. Pasture/Vegetation Monitoring

Pasture/vegetation monitoring will be carried out on a monthly basis in consultation with the landowner/farmer.

Any remedial action will be by agreement with the operator /landowner to enable return to the desired use as soon as practical.

13.4. Photographic Records

Representative photos of the site will be taken before spreading, after spreading and then approx.. 1- 2 months and 12 months post spreading. These will be held by the operator for 5 years and made available to the landowner and TRC upon request.

14. Contingency Procedures - Transport Spills

The primary transport contractor maintains a spill plan that will be implemented should a spill occur during transport of wastes from the rig to the land farm site. A request for a copy of this plan should be made directly to the transporting company –Symons Transport Ltd or any other carrier used by the client from time to time.

15. Site Reinstatement and Closure

When the area consented for landfarming at a particular site has been completed, stockpiling of material on the site will cease and the storage pits and discharge platform area will be reinstated to a standard and conformation compatible with the adjacent land farmed areas.

Monitoring of the site will continue until all spread areas within the site have met consent surrender conditions and guidelines. Typically under the current landfarming methodology this is achieved anywhere from 9-18 months after final rehabilitation

A final campaign of compliance sampling results are required before consents can be surrendered. The final round of sampling will be taken at 100m intervals along parallel transect lines (100m apart) crossing the entire site. This method will treat the site as a whole and provide an overview of waste remediation spatially across the landfarm. This method mirrors the process that the TRC uses to monitor the site on an annual basis.

16. Record Keeping

Records are kept of the following, and provided to the Taranaki Regional Council as required by consent conditions:

- Notifications to TRC for disposal delivery and landfarming; trucking contractor and delivery volumes;
- Wastes from each individual well, including records of additives (only if the client/drilling contractor is able or willing to provide these) used at the wellsite during the drilling process;
- Source descriptors (date collected, waste description, volume, any peculiarities in wastes for example: waxy, high percentage water, stony/sandy etc., cement returns);

- Stockpiling (area, volumes stockpiled, dates and times of commencement and completion);
- Disposal (area (including a survey map and GPS co-ordinates), volumes, dates and times of commencement and completion);
- Composition of material (including conductivity, concentrations of , chloride, sodium, total soluble salts and total hydrocarbons, and C6-C9, C10-C14 and C15-C36 fractions);
- Treatments applied (e.g. fertilisers);
- Site Inspections; and
- Sampling, analysis, and results of monitoring.

Records that are to be kept for 5 years from the date of closure include copies of the TRC monitoring programs, inspection notices, sample forms, sample results and notifications. These will be held on disc and/or in hard copy, all of which are managed by Waste Remediation Services Ltd's Operations Manager.

17. Accountabilities/Responsibilities On and Off Site

These personnel are responsible for the following activities:

Operations Manager	Implementation of this plan, maintaining records of all wastes approved for disposal via land farming, manage landfarm sites, provide notifications and reports to TRC as required by resource consent conditions.
Operations Manager	Liaison with landowners for all land farming matters
Client production supervisors, drilling supervisors, well services supervisors, mud engineers	Provide notification and information on source, nature and volume of wastes to WRS's Operations Manager. Collect sample at source and forward to WRS's Operations Manager Organise transport to the landfarm site.
Civil/Earthworks/Spreading Contractor	Undertake spreading of wastes as instructed by WRS's Operations Manager, and in accordance with TRC consent conditions.

18. Reference Documents

Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Ministry for the Environment, 1999.

Disposal of Hydrocarbon Drilling Wastes near Geary Road, Taranaki Regional Council Report, June 2000.

Public Health Guidelines for the safe use of Sewage Effluent and Sewage Sludge on Land, Department of Health.

Guidelines for the control of disposal of drilling wastes onto and into land, Taranaki Regional Council, July 2003,2005 and 2013.

Review of typical TRC consent conditions to discharge drilling wastes and oily wastes via landfarming

Alberta Energy Et Utilities Board Guide 50: Drilling Waste Management, October 1996
Resource Consents

Consent Monitoring and Compliance Programmes

New Zealand Water and Wastes Association (2003): New Zealand guidelines such as Guidelines for the safe application of bio solids to land.

KMB August 2019

END

Appendix F TRC Inspection Notices

.....END

Inspection Notice

Under section 332 of the Resource Management Act 1991

Consent Number:	R2/5956-2.0	
Consent Name:	Waste - discharge landfarming	
Contact Name:	Waste Remediation Services Limited	
Postal Address:	PO Box 7150, New Plymouth 4341	
Site Location Address:	Lower Manutahi Road, Manutahi (Property owner: Waikaikai Farms Limited)	
Inspection Number:	OBS-2019-64719	
Inspection Type:	Compliance Monitoring Insp.	
Inspection Date:	10 Sep 2019	
Inspection Time:	14:00	
Weather Details:	Rainfall:	None
	Wind Direction:	S
	Wind Strength:	Medium
Samples Taken:	No	
Consent Purpose:	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming	
Conditions Assessed:	32 of 32	
Overall Compliance Status:	Compliance	
Inspection Comments:	No objectionable odours or visible emissions were found during the inspection. All lined pits contained drilling wastes and were quite full, only one pit had visible surface hydrocarbons. Three spreading areas have been exposed, one has had all the muds applied and has been levelled with a dozer and is being left to dry before being incorporated, the other two are still receiving muds, no ponding or run-off occurring from the spreading areas. Historic spreading areas were found to have complete pasture cover, no mud was identified at the surface.	
Further Actions Advice:	Nil	
Signed:		
Council Officer:	John Cooper	
Officer Warrant Number:	174	

Disclaimer: The compliance rating reflects the warranted Officer/s observations at the time of inspection and does not provide a comprehensive assessment of compliance with the consent. Therefore the compliance rating is limited to the exact period during which the inspection was undertaken as well as the specific aspects that were inspected.

Inspection Notice

Under section 332 of the Resource Management Act 1991

Consent Number:	R2/5956-2.0	
Consent Name:	Waste - discharge landfarming	
Contact Name:	Waste Remediation Services Limited	
Postal Address:	PO Box 7150, New Plymouth 4341	
Site Location Address:	Lower Manutahi Road, Manutahi (Property owner: Waikaikai Farms Limited)	
Inspection Number:	OBS-2019-67182	
Inspection Type:	Compliance Monitoring Insp.	
Inspection Date:	19 Nov 2019	
Inspection Time:	14:30	
Weather Details:	Rainfall:	None
	Wind Direction:	W
	Wind Strength:	Light
Samples Taken:	No	
Consent Purpose:	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming	
Conditions Assessed:	0	
Overall Compliance Status:	Compliance	
Inspection Comments:	All land-farmed areas have been worked and pasture has been sown, pasture strike good across all areas and essentially no muds was identified at the surface. All historic spreading areas were found to have complete pasture cover. Two lined pits contain muds and both had available capacity for storm water ingress. Pit 2 liner seriously degraded during mud excavation and will no longer be used.	
Further Actions Advice:	Nil	
Signed:		
Council Officer:	John Cooper	
Officer Warrant Number:	174	

Disclaimer: The compliance rating reflects the warranted Officer/s observations at the time of inspection and does not provide a comprehensive assessment of compliance with the consent. Therefore the compliance rating is limited to the exact period during which the inspection was undertaken as well as the specific aspects that were inspected.

Inspection Notice

Under section 332 of the Resource Management Act 1991

Consent Number: R2/5956-2.0

Consent Name: Waste - discharge landfarming

Contact Name: Waste Remediation Services Limited

Postal Address: PO Box 7150, New Plymouth 4341

Site Location Address: Lower Manutahi Road, Manutahi (Property owner: Waikaikai Farms Limited)

Inspection Number: OBS-2020-69717

Inspection Type: Compliance Monitoring Insp.

Inspection Date: 10 Feb 2020

Inspection Time: 10:35

Weather Details:

Rainfall:	None
Wind Direction:	SW
Wind Strength:	Light

Consent Purpose: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming

Conditions Assessed: 0

Overall Compliance Status: Compliance

Inspection Comments: Two lined storage pits in use to store liquids and muds, impacted gravels currently stored on the edge of the pit with the degraded liner. No recent spreading activities have occurred. The recent spreading areas had very good crop cover but the recent dry spell has browned the areas, very little muds identified around the two paddocks. All historic spreading areas had good pasture cover which appeared healthy.

Further Actions Advice:

Signed:

Council Officer: John Cooper

Officer Warrant Number: 174

Disclaimer: The compliance rating reflects the warranted Officer/s observations at the time of inspection and does not provide a comprehensive assessment of compliance with the consent. Therefore the compliance rating is limited to the exact period during which the inspection was undertaken as well as the specific aspects that were inspected.

Inspection Notice

Under section 332 of the Resource Management Act 1991

Consent Number: R2/5956-2.0
Consent Name: Waste - discharge landfarming
Contact Name: Waste Remediation Services Limited
Postal Address: PO Box 7150, New Plymouth 4341
Site Location Address: Lower Manutahi Road, Manutahi (Property owner: Waikaikai Farms Limited)

Inspection Number: OBS-2019-60530
Inspection Type: Compliance Monitoring Insp.
Inspection Date: 01 Jul 2019
Inspection Time: 11:00

Weather Details:

Rainfall:	None
Wind Direction:	NE
Wind Strength:	Light

Samples Taken: No

Consent Purpose: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming

Conditions Assessed: 32 of 32

Overall Compliance Status: Compliance

Inspection Comments:

No objectionable odour or visible emissions were found during the inspection. Strong mud/hydrocarbon odours present around the current landfarming areas. The two paddocks at the Western corner remain exposed and the muds are weathering well, the material is beginning to break apart easily, topsoil bund remains around the area and the soil was stable. A new area has been exposed and is currently receiving the storm water component of the storage cells, the area has been bunded using topsoil, no ponding or run-off occurring, the area is located at 39.68794S/174.39628E. Pits inspected, all lined pits had available storage capacity, surface hydrocarbons present in two pits, discussed skimming the oil prior to landfarming. No incidents were reported.

Further Actions Advice: Nil

Signed:

Council Officer: John Cooper

Officer Warrant Number: 174

Disclaimer: The compliance rating reflects the warranted Officer/s observations at the time of inspection and does not provide a comprehensive assessment of compliance with the consent. Therefore the compliance rating is limited to the exact period during which the inspection was undertaken as well as the specific aspects that were inspected.

Inspection Notice

Under section 332 of the Resource Management Act 1991

Consent Number:	R2/5956-2.0	
Consent Name:	Waste - discharge landfarming	
Contact Name:	Waste Remediation Services Limited	
Postal Address:	PO Box 7150, New Plymouth 4341	
Site Location Address:	Lower Manutahi Road, Manutahi (Property owner: Waikaikai Farms Limited)	
Inspection Number:	OBS-2020-68297	
Inspection Type:	Compliance Monitoring Insp.	
Inspection Date:	06 Jan 2020	
Inspection Time:	12:15	
Weather Details:	Rainfall:	None
	Wind Direction:	W
	Wind Strength:	Medium
Samples Taken:	No	
Consent Purpose:	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming	
Conditions Assessed:	32 of 32	
Overall Compliance Status:	Compliance	
Inspection Comments:	No recent mud deliveries appear to have occurred. Two lined pits in use for mud storage, which also contained storm water; storage capacity available for storm water ingress. The pit with the degraded liner contains residual muds also. Spreading areas inspected, pasture strike excellent across all recent spreading areas, essentially no mud was identified at the surface and the pasture appeared healthy. All previous spreading areas had good pasture cover which also appeared healthy.	
Further Actions Advice:	Nil	
Signed:		
Council Officer:	John Cooper	
Officer Warrant Number:	174	

Disclaimer: The compliance rating reflects the warranted Officer/s observations at the time of inspection and does not provide a comprehensive assessment of compliance with the consent. Therefore the compliance rating is limited to the exact period during which the inspection was undertaken as well as the specific aspects that were inspected.