Waste Remediation Services Ltd
Waikaikai Landfarm
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-41

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Executive summary

Waste Remediation Services Ltd (WRS) 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 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess WRS's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of their activities.

WRS holds one resource consent, which includes a total of 32 conditions setting out the requirements that they must satisfy.

In this monitoring period a small amount of material was landfarmed. This material comprised the stored drilling material within the last unlined drilling storage cell in Taranaki. The site also acted as contingency storage for the consent holder's other landfarm at Symes, Manawapou.

All landfarmed areas were submitted for surrender analysis at the end of the monitoring period. The resultant analysis indicated that the areas utilised for the practice of landfarming had generally met their conditional limit for surrender with only one parameter above the surrender limit. Sodium concentrations within the soil were elevated above the conditional surrender limit of 460 mg/kg, with the most elevated concentration at 550 mg/kg. All other analytes were below their limit as specified by the consent.

The rationale for allowing the areas to be surrendered, despite the elevated sodium concentrations, was due to the observations undertaken by the Council of the long term analysis of the sodium absorption ratio (SAR). The long term record indicated that the SAR had remained stable below four (<4) SAR for the soil samples collected since 2012. The consent limit was set at 18 SAR.

In order for these areas to be recognised as surrendered by consent, the consent holder would be required to submit the analysis to the Council.

Stormwater management will require additional mitigation in the upcoming period, as the currently stored material has the potential to flow overland into surrender assessed areas of the site during intense rainfall. This could adversely affect the remediated areas if left unresolved.

Monitoring indicated that saline impacts are still apparent in the groundwater in the immediate vicinity of the storage cells. One monitoring well, in similarity to last monitoring year, remained above its conditional limit of 2,500 g/m^3 total dissolved salts, however it is reducing. The removal of the unlined cell is likely to have resulted in a corresponding reduction in the saline concentration observed in the specific impacted well.

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

The Council's monitoring programme for the year under review included seven inspections, 20 water samples and two soil samples collected for physicochemical analysis. Twenty additional soil samples were collected at the request of the consent holder and were submitted for surrender analysis.

During the year, WRS demonstrated a Good level of environmental and a High level of administrative performance with the resource consents.

For reference, in the 2016-2017 year 74% of consent holders in Taranaki, monitored through compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 21% demonstrated a good level of environmental performance and compliance with their consents.

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

This report includes recommendations for the 2017-2018 year.

Table of contents

List of tables

List of figures

List of photos

1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Waste Remediation Services Ltd (WRS). WRS 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 WRS that relate to 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 programs and reports the results of the programmes jointly. This report discusses the environmental effects of WRS's use of land. It is the fifth annual report by the Council for Waikaikai Landfarm and the third report with WRS as consent holders.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the WRS 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 2017-2018 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 WRS, 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 WRS's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

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

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

For example:

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

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

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

Administrative performance

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

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

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

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

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved..

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 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 Waikaikai 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

WRS 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 features are presented in Figure 1.

Figure 1 WRS Waikaikai Landfarm with regional inset

Summary of site data is presented 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 backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian/alluvial deposits
Drainage class:	Free/well draining

1.4 Resource consents

1.4.1 Discharges of wastes to land

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

WRS holds discharge permit **5956-2.0** to cover the discharge of drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites and contaminated soil onto and into land via landfarming. This permit was originally issued by the Council on 22 March 2002. The consent was transferred to WRS in November 2014. On the 19 April 2017 under Section 87(e) of the RMA, it was renewed. It is due to expire on 1 June 2034.

- Condition 1 sets out definitions;
- Condition 2 states the location of the activities;
- Condition 3 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects;
- Condition 4 requires the consent holder to install a minimum of three groundwater monitoring wells;
- Condition 5 stipulates that all storage cells utilised for the storage of material shall be lined with a fit for purpose synthetic liner;
- Condition 6 requires the consent holder to check the integrity of the storage pits/cell liners within a 24 month period;
- Condition 7 requires the site to be operated in accordance with a Management Plan;
- Conditions 8 to 12 set out the requirements for notifications, monitoring and reporting;
- Condition 13 to 22 stipulates the discharge limits;
- Conditions 23 to 25 stipulate the receiving environmental limits with respect to water;
- Conditions 26 to 30 detail the receiving environmental limits for soil and the surrender criteria;
- Condition 31 concerns archaeological remains; and
- Condition 32 is an amendment and review condition.

The permit is attached to this report in Appendix I.

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

1.5 Monitoring programme

1.5.1 Introduction

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

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

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

1.5.2 Programme liaison and management

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

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

1.5.3 Site inspections

The WRS Waikaikai site was inspected four times during the monitoring period. Additional inspections were also undertaken during sampling runs. Inspections focused on the following aspects:

- observable and/or ongoing effects upon soil and groundwater quality associated with the land disposal process;
- effective incorporation of material, application rates and associated earthworks;
- integrity and management of storage facilities ;
- dust and odour effects in proximity of the site boundaries;
- housekeeping and site management and;
- the neighbourhood was surveyed for environmental effects.

Please see Section 2.1 for the inspections undertaken in this monitoring period.

1.5.4 Chemical sampling

Compliance Monitoring

Waikaikai landfarm consent 5956-2.0 contains specific conditions relating to allowable material, waste analysis, notifications and sampling requirements, monitoring and reporting, discharge limits, receiving environment limit for groundwater, receiving environment limit for soil and surrender limits. This consent stipulates the requirements to be met by the consent holder for this activity.

To enable the Council to monitor the state of the landfarming process and the remediation programme with respect to possible surrender sampling. Samples of soil and groundwater are collected.

Soil sampling is undertaken to monitor the quality of the landfarming undertaken in the first instance. It also serves as a marker for the degree of remediation undertaken in the landfarming process at the time of sample collection. These samples are collected annually. From a compliance perspective it allows the Council to quantify the quality of the process and it allows for comparison to any consent holder provided data.

The methodology utilised by the Council for collecting soil samples across the land farmed 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 meters 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

In this monitoring period two soil samples were collected. The analysis criteria had been modified in the previous period through the inclusion of total recoverable heavy metal testing after discussion with the consent holder. Specifically, the concentration of heavy metals within the receiving environment must not exceed the following concentration: (Condition 28 of consent 5956-2.0).

Condition 28 of consent 5956-2.0

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)	

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; 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.

These 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 sampling is 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 10% for three consecutive readings.

Groundwater analysis parameters

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

Surrender Sampling

Surrender is the term utilised by the Council to distinguish a parcel of land which may be considered as remediated. For a parcel of land to be surrendered the Council would need to review all the analysis data undertaken by the consent holder and compare it to the Council's data. In some cases there may be a data gap and as such additional samples and analysis may be required.

A compliance monitoring programme including sampling was agreed by WRS and the Council to provide for surrender requirements.

Specifically in order to be considered for surrender assessment the following analysis must be met, as stated below in condition 29 from consent 5956-2.0.

Condition 29 of consent 5956-2.0

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 that 290 mS/m
Chloride	Not greater than 700 mg/kg
Sodium	Not greater than 460 mg/kg
Total Soluble Salts	Not greater than 2,500 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)	1,300
F4 (>C34)	5,600
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 - napthalene, non-carc. (pyrene), benzo(a)pyrene eq.
TPH - total petroleum hydrocarbons (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36})

The requirement to meet these standards shall not apply if, before 1 March 2034, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

1.5.5 Review of consent holder data

In accordance with consent 5956-2.0, and specifically conditions 11 and 12 of the consent WRS must provide the Council with an annual report. This report contains the information required in condition 11 and 12 of the consent.

A copy of this report was provided by the consent holder and is attached in Appendix II.

2 Results

2.1 Inspections

29 September 2016

At the time of inspection the following was observed. The wind was westerly with a speed of, speed 3 m/s, No objectionable odours or visible emissions were found during the inspection.

No recent storage of muds or other hydrocarbon type materials had occurred at the site. The storage pit liners appeared in good repair and essentially no surface hydrocarbons were present, the liquid inside appeared to be storm water. The unlined storage pit had a digger working inside to remove some of the mud. At the time plenty of material was yet to be excavated from the pit.

The spreading area approximately 180m south of the storage area was inspected. Contouring works prior to application looked good and the material was well blended in the soil profile. Very little hydrocarbon odour was noted and the material broke apart easily. Contouring works continuing around the spreading area to remove a small hill prior to having more muds applied. Previous spreading areas were found to have stable pasture cover which appeared healthy.

15 November 2016

At the time of inspection the following as observed. The wind was northerly at a speed 5 m/s. No objectionable odours or visible emissions were found during the inspection.

No recent mud deliveries had occurred. The pit liners appeared in good repair and the pits were quite full of stormwater. The un-lined pit had been completely emptied of mud and scraped clean. Recent mud application in the adjacent paddock was inspected. The top soil remained stockpiled at the fringes of the spreading area and the mud remained at the surface weathering. Topsoil was to be replaced prior to the area being sown when conditions would allow.

Historic spreading areas were inspected. Earlier spreading areas had good pasture cover, the more recent spreading areas down gradient closer to the sea had quite brown pasture and the land-owner outlined the grass in the area was not as responsive as other spreading areas. Impacted soils spreading areas have rocks continuing to migrate to the surface. No incidents were reported.

22 February 2017

At the time of inspection the wind was westerly with a speed 2 m/s. No objectionable odours or visible emissions were found during the inspection. No recent storage activities have occurred. Two lined pits at the site contained stormwater which was free of hydrocarbons. The oily waste pit had some waxy crude on the surface, and the unlined pit was empty. All liners appeared in good repair. All areas where muds had been spread were found to of had good pasture cover and the pasture appeared healthy. Recent spreading area was inspected and found to have very good pasture cover; no muds were found at the surface. No recent spreading activities have occurred. No incidents were reported.

28 April 2017

At the time of inspection the following was observed. The wind was northerly with a speed of 3 m/s. No objectionable odours or visible emissions were found during the inspection. All pits at the site contained stormwater only. A contractor was on-site pumping out the stormwater to make room for impending mud deliveries due to space constraints at the Symes site. Water was being pumped onto the most recent spreading area, which is south of the storage pits. The oily waste pit was found to have some residual surface hydrocarbons. All historic spreading areas had good pasture cover which appeared healthy.

01 May 2017

At the time of inspection the following was observed. The wind was westerly with a speed of 3 m/s. No objectionable odours or visible emissions were found during the inspection.

All lined pits contained stormwater only, pit 3 was empty. Contractors, on-site at the time, were emptying pit 1's storm water. The liquid was being discharged onto recent spread areas at the south of the site. No ponding or overland flow was observed. The pits were being emptied in preparation to receive muds. The liners appeared in good repair. Historic spreading areas had good pasture cover which appeared healthy. No muds were identified at the surface. No incidents were reported.

14 June 2017

During the inspection, the wind was from the southwest at a speed 4 m/s. No objectionable odours or visible emissions were found.

Pits 1 and 2 contained drilling muds. No surface hydrocarbons were present. Pit 1 was draining into pit 2 through a balance pipe. Pit 2 had plenty of capacity to receive future storm water. Pit 3 which is unlined was empty. Pit 4 contained storm water only. The recent spreading area where storm water had been applied was inspected. The pasture growth looked well and was complete across the entire area. The historic application areas had good pasture cover. No muds were identified at the surface.

22 June 2017

The inspection was conducted in conjunction with groundwater sampling in fine conditions with a light North wind.

The site was occupied by a contractor removing stormwater from storage pits and spreading it to land, in anticipation of arrival of muds from TAG.

No odour or dust was noted offsite.

Five groundwater bores were sampled. No odour, sheen or foaming was encountered in any well. The officer was accompanied by landowner. High conductivity readings were encountered in GND2292 downgradient of the old pit area.

Surrender soil sampling was to be carried out the following day.

23 June 2017

Surrender sampling undertaken at the Waikaikai Landfarm at request of the consent holder, WRS. Twenty soil samples were collected, these samples were comprised of 20 soil transects collected across four landfarmed areas, F1, A1, A2 and B1. All transects were GPS marked. All samples were sent to RJ Hill Laboratory in Hamilton for surrender analysis.

2.2 Results

2.2.1 Groundwater sampling

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. The intention of these wells is to assess the groundwater in the immediate vicinity of the storage cells. The remaining two wells are situated on the south western boundary of the landfarm to assess for any potential of offsite migration. Analysis of the site specific monitoring wells is provided in the following Tables 1 to 5.

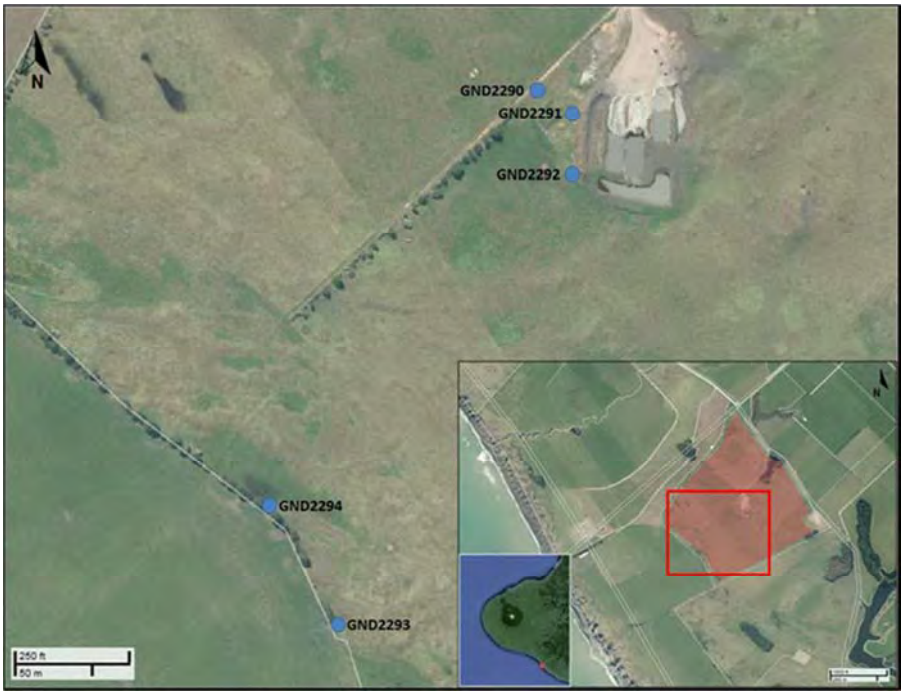

Figure 2 WRS Waikaikai groundwater monitoring well locations

Table 1 GND2290 2016-2017 monitoring results

GND2290	Site	GND2290	GND2290	GND2290	GND2290
	Collected	13 Sep 2016	09 Dec 2016	15 Mar 2017	22 May 2017
Parameter	Time	13:20	11:30	10:40	13:15
Barium Acid Soluble	g/m^3	0.029	0.028	0.03	0.036
Barium (dissolved)	g/m^3	0.029	0.028	0.03	0.034
Chloride	g/m^3	11.2	11.6	18.3	35.2
Conductivity	mS/m@20°C	30	26.6	26.7	30.8
Sodium	g/m^3	26.4	25.6	23.2	23.7
pH	pH	6.8	6.7	6.8	6.9
Temperature	°C	14.6	15.8	15.8	15.6
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C7-C9 TPH	g/m^3	< 0.10	< 0.10	< 0.10	< 0.06
C9-C15 TPH	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 TPH	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
C7- C36 TPH	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Xylene M	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
Xylene O	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Dissolved Salts	g/m^3	232.1	205.8	206.6	238.3

Table 2 GND2291 2016-2017 monitoring results

GND2291	Site	GND2291	GND2291	GND2291	GND2291
	Collected	13 Sep 2016	09 Dec 2016	15 Mar 2017	22 May 2017
Parameter	Time	12:45	10:30	10:20	12:40
Barium Acid Soluble	g/m^3	0.02	0.017	0.02	0.022
Barium (dissolved)	g/m^3	0.02	0.017	0.015	0.021
Chloride	g/m^3	387	368	328	302
Conductivity	mS/m@20°C	150	132	123	127
Sodium	g/m^3	60.4	55	58.7	53.7
pH	pH	6	6	6.2	6.4
Temperature	°C	15.3	16.5	15.4	15.5
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C7-C9 TPH	g/m^3	< 0.10	< 0.10	< 0.10	< 0.06
C9-C15 TPH	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 TPH	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
C7- C36 TPH	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Xylene M	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
Xylene O	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Dissolved Salts	g/m^3	1,160.6	1,021.3	951.7	982.6

Table 3 GND2292 2016-2017 monitoring results

GND2292	Site	GND2292	GND2292	GND2292	GND2292
	Collected	13 Sep 2016	09 Dec 2016	15 Mar 2017	22 May 2017
Parameter	Time	12:15	10:15	09:55	11:55
Barium Acid Soluble	g/m^3	0.61	0.54	0.67	0.22
Barium (dissolved)	g/m^3	0.6	0.49	0.52	0.22
Chloride	g/m^3	1,840	1,200	1,190	1,230
Conductivity	mS/m@20°C	562	367	366	390
Sodium	g/m^3	635	439	442	87.2
pH	pH	6	6.1	6.3	6.4
Temperature	°C	15.3	16.1	16.3	15.5
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C7-C9 TPH	g/m^3	< 0.10	< 0.10	< 0.10	< 0.06
C9-C15 TPH	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 TPH	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
C7- C36 TPH	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Xylene M	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
Xylene O	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Dissolved Salts	g/m^3	**4,348.3**	**2,839.5**	**2,831.8**	**3,017.5**

Table 4 GND2293 2016-2017 monitoring results

GND2293	Site	GND2293	GND2293	GND2293	GND2293
	Collected	13 Sep 2016	09 Dec 2016	15 Mar 2017	22 May 2017
Parameter	Time	11:10	09:15	08:55	10:55
Barium Acid Soluble	g/m^3	0.19	0.21	0.2	0.022
Barium (dissolved)	g/m^3	0.18	0.2	0.16	NA
Chloride	g/m^3	468	385	361	357
Conductivity	mS/m@20°C	171	146	137	142
Sodium	g/m^3	94.4	85.5	77.4	509
pH	pH	6.6	6.8	7	7
Temperature	°C	15.1	16.4	15.8	15.2
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C7-C9 TPH	g/m^3	< 0.10	< 0.10	< 0.10	< 0.06
C9-C15 TPH	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 TPH	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
C7- C36 TPH	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Xylene M	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
Xylene O	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Dissolved Salts	g/m^3	1,323	1,129.6	1,060	1,098.7

Table 5 GND2294 2016-2017 monitoring results

GND2294	Site	GND2294	GND2294	GND2294	GND2294
	Collected	13 Sep 2016	09 Dec 2016	15 Mar 2017	22 May 2017
Parameter	Time	11:40	09:45	09:25	11:20
Barium (Acid Soluble)	g/m^3	0.007	0.008	0.009	0.013
Barium (dissolved)	g/m^3	0.007	0.007	0.007	0.012
Chloride	g/m^3	45.2	46.3	46.8	46.8
Conductivity	mS/m@20°C	30.6	30.8	31.7	33.6
Sodium	g/m^3	29.9	31	31.3	30.3
pH	pH	7.5	7.2	7.2	7.2
Temperature	°C	14.7	15.5	15.1	14.5
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
C7-C9 TPH	g/m^3	< 0.10	< 0.10	< 0.10	< 0.06
C9-C15 TPH	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 TPH	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
C7- C36 TPH	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Xylene M	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
Xylene O	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Dissolved Salts	g/m^3	236.8	238.3	245.3	260

Groundwater monitoring of the Waikaikai Landfarm in the 2016-2017 monitoring period detailed the following:

- Total Petroleum Hydrocarbon (TPH, all chains) concentrations were all below the limit of detection for these analytes across all five wells.

- In similarity the concentrations of benzene, toluene, ethylene and xylenes (BTEX) were also below the limit of detection in all wells.
- Total dissolved salts remained above the conditional limit set by the consent of 2,500 g/m^3 in monitoring well GND2292 which ranged from 2,381-4,348 g/m^3, with the final concentration collected in May of 3,017 g/m^3. The remaining four wells ranged from 205 g/m^3 (lowest concentration) in well GND2291 (December 2016) to 1,323 g/m^3 (highest TDS concentration below consented obligation limit of 2,500 g/m^3) in well GND2293 (December 2016).
- In similarity, chloride concentrations were also elevated in well GND2292, ranging from 1,190-1,840 g/m^3. GND2293 detailed the next highest concentration, ranging from 357-468 g/m^3.
- Sodium concentrations followed a similar theme, with the highest concentration found at GND2292 635 g/m^3 in September 2016. The second highest concentration was found at GND2293, 509 g/m^3 in May 2017. This is the most elevated concentration found at this monitoring location to date, eclipsing its previously elevated concentration of 450 g/m^3, recorded at GND2293 in May 2014. However, this concentration of sodium is below the consented maximum concentration allowable by consent which is a combined total dissolved salt of 2,500 g/m^3.
- Groundwater conductivity followed a similar theme to the salt concentrations, with GND2292 the highest, ranging from 562-366 mS/m@20°C.
- Groundwater pH values ranged from pH 6 (GND2292, 2291) to pH 7.5 (GND2294).
- Temperature in the groundwater remained quite steady throughout the year, ranging from 14.5°C (lowest, GND2294, May 2017) to 16.5°C (highest, GND2291, December 2016).
- Barium, both acid soluble and dissolved, ranged from 0.02 g/m^3 acid soluble (GND2291, September 2016) and 0.02 g/m^3 dissolved (also GND2292, September 2016) to 0.61 g/m^3 acid soluble (GND2292, September 2016) and dissolved with a highest concentration of 0.49 g/m^3 (also GND2292, December 2016).

2.2.2 Soil sampling

The Council collected two composite soil samples this monitoring period. This was decreased from six composite samples collected in the previous period to reflect the lag in land farmable material cited by the consent holder. Also, in addition the consent holder applied for surrender sampling, which is discussed in more detail in the following Section 2.3

Table 6 Waikaikai Landfarm soil sample results 2016-2017 monitoring period

Soil sampling	Site		SOL000187	SOL000187
	Collected		15-Mar-17	15-Mar-17
Parameter	Time	Consent limit 5956-2.0	8:30	9:15
Conductivity	mS/m@20C	400	49.9	39.2
Calcium	mg/kg	-	27.2	32
Chloride	mg/kg	700	51.4	27.3
Moisture Factor	nil	-	1.028	1.032
Potassium	mg/kg	-	55.5	35.1
Magnesium	mg/kg	-	6.2	6.2
Sodium	mg/kg	460	33.9	28.9
pH	pH	-	6.6	6.6
Total Petroleum Hydrocarbons	mg/kg	Requires additional testing	247	566
Sodium Absorption Ratio	None	18	1.52608	1.22481
Total Soluble Salts	mg/kg	2,500	390.5	306.8
TR Arsenic	mg/kg dry wt	17	< 2	3
TR Cadmium	mg/kg dry wt	0.8	< 0.10	0.11
TR Chromium	mg/kg dry wt	600	13	16

Soil sampling	Site		SOL000187	SOL000187
	Collected		15-Mar-17	15-Mar-17
Parameter	Time	Consent limit 5956-2.0	8:30	9:15
TR Copper	mg/kg dry wt	100	37	53
TR Mercury	mg/kg dry wt	1	< 0.10	< 0.10
TR Nickel	mg/kg dry wt	60	7	6
TR Lead	mg/kg dry wt	160	5.3	8.3
TR Zinc	mg/kg dry wt	300	63	63
Ammonia	mgN/kg	-	2.89	1.94
Nitrite/Nitrate Nitrogen	mgN/kg	-	3.08	1.96
TR= Total Recoverable				

The soil analysis undertaken in the 2016-2017 monitoring period is provided above in Table 6. The table contains the specific consented concentrations (consent 5956-2.0) which must not be exceeded to allow the reader to compare with results.

When compared to the consented analysis concentrations (Table 6) the resultant analysis detailed no exceedance.

2.3 Surrender Sampling

As stipulated by consent 5956-2.0, specifically condition 29, if a consent holder would seek to surrender an area utilised for the practice of landfarming they must undertake or submit a specific analysis of the soils to be assessed by the Council. The additional analysis is detailed under this consent condition.

2.3.1 Methodology for surrender sampling

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

The consent holder had requested that all areas provided in Figure 3 be submitted for surrender sampling.

Area F1: This area was farmed between January 2015 and April 2015. Area F1 has an approximate length length of 350 m and a width of up to 180 m. The area is approximately 55,000 m^2. This area has been compliance sampled by the Council since the application date. However surrender related analysis has been omitted by the consent holder until the recent request. Heavy metal analysis has only recently been included in the Council compliance sampling at the request of the consent holder.

Area A1: Landfarming was completed in July 2014. Area A 1 has a length of 150 m, a width of up to 150m and an area of approximately 15,750 m^2.

Area A2: Landfarming was completed in August 2014. Area A2 has a length of 176 m, a width of up to 110 m (longest) and a total area of approximately 16,400 m^2.

Area B1: Landfarming was undertaken at the end of 2016. Area B1 has a length of 100 m and a width of up to 86 m and total area of approximately 6,670m^2.

The number of transects and soil cores required was calculated as follows:

Total landfarmed area: 94,000 m^2 (rounded up).

Sample requirements: One transect per 5,000m^2. (94,000/5,000)= 18.8.

Total number of samples required: **18.8 transects or 19 transects.**

Note: Total 190 soil cores. This was rounded up to 200 cores/ 20 soil samples in the field.

2.3.1.1 Field observations

Observations by the Council's officer, with the responsibility of collecting the compliance soil core samples throughout the year, found that the soil cores had been homogenous in nature. Thus with this observation the requirement for spot sampling was omitted from the surrender sampling plan.

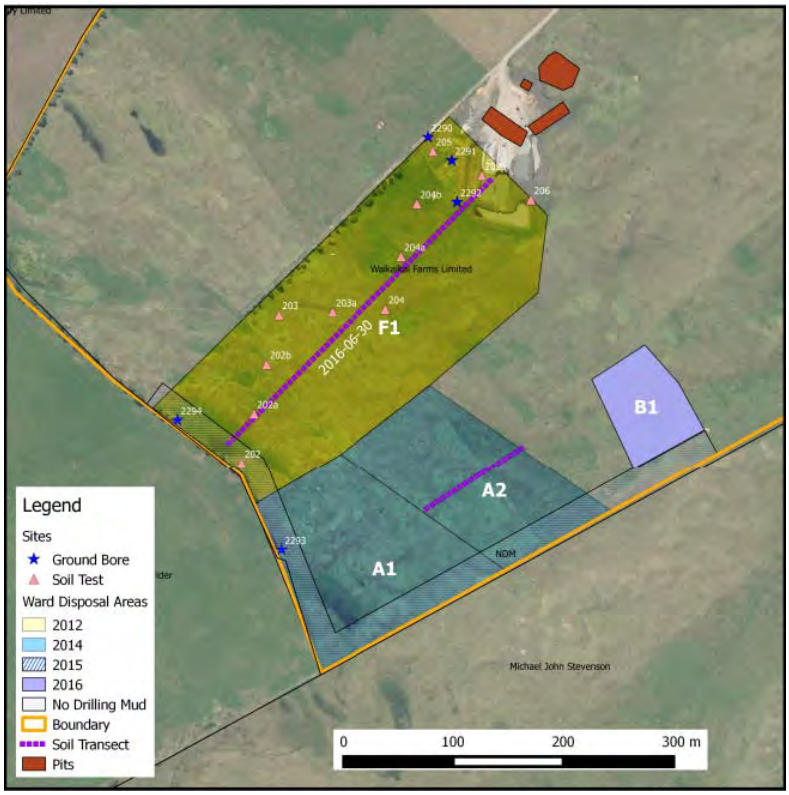

Figure 3 WRS Waikaikai landfarm surrender locations

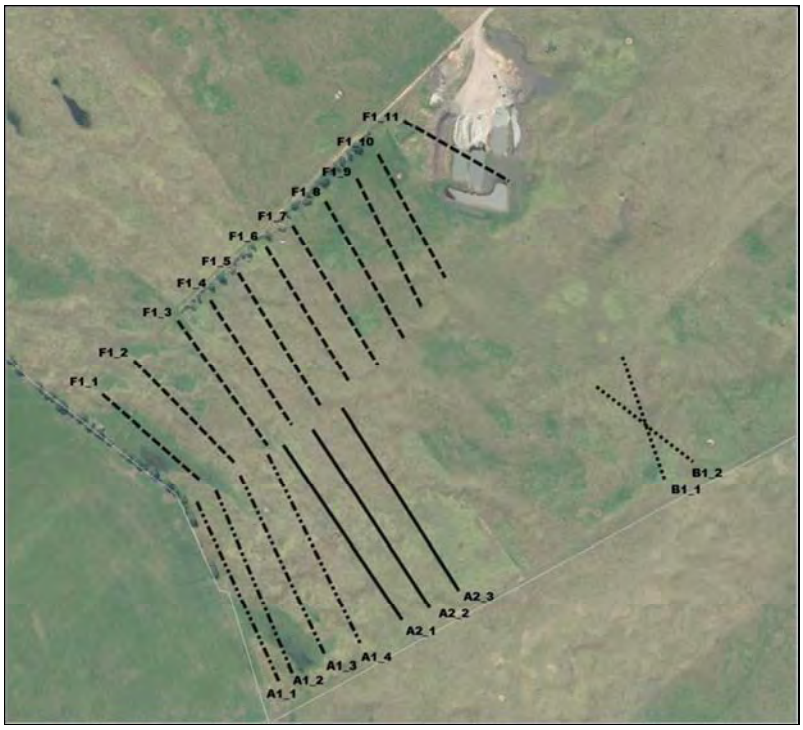

Figure 4 Council surrender soil sample transects

Table 7 WRS surrender soil analysis areas A1- A2 inclusive

Sample Type: Soil	Sample Name:	conditions surrender in	A1_1_230517 23-May-2017 12:35 pm	A1_2_230517 23-May-2017 12:45 pm	A1_3_230517 23-May-2017 12:50 pm	A1_4_230517 23-May-2017 1:00 pm	A2_1_230517 23-May-2017 1:10 pm	A2_2_230517 23-May-2017 1:20 pm	A2_3_230517 23-May-2017 1:30 pm
	Lab Number:		1781257	1781257	1781257	1781258	1781258	1781258	1781258
Dry Matter	g/100g as rcvd		91	90	91	91	89	90	89
Total Recoverable Barium	mg/kg dry wt	10,000	39	230	179	250	260	118	119
Total Recoverable Sodium	mg/kg dry wt	460	460	490	530	470	520	460	390
Chloride	mg/kg dry wt	700	< 3	5	< 3	26	39	37	30
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt		< 0.06	< 0.06	< 0.06	< 0.06	< 0.07	< 0.07	< 0.06
Heavy Metals with Mercury, Screen Level									
Total Recoverable Arsenic	mg/kg dry wt	17	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	0.8	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	600	14	13	10	15	13	16	16
Total Recoverable Copper	mg/kg dry wt	100	10	10	9	10	10	11	10
Total Recoverable Lead	mg/kg dry wt	160	1.1	1.3	1.3	1.7	1.4	1.4	1.4
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	7	7	6	7	7	8	8

Sample Type: Soil	Sample Name:	conditions surrender in	A1_1_230517 23-May-2017 12:35 pm	A1_2_230517 23-May-2017 12:45 pm	A1_3_230517 23-May-2017 12:50 pm	A1_4_230517 23-May-2017 1:00 pm	A2_1_230517 23-May-2017 1:10 pm	A2_2_230517 23-May-2017 1:20 pm	A2_3_230517 23-May-2017 1:30 pm
	Lab Number:		1781257	1781257	1781257	1781258	1781258	1781258	1781258
Total Recoverable Zinc	mg/kg dry wt	300	56	57	45	63	56	65	65
BTEX in Soil by Headspace GC-MS									
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	82	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil									
Acenaphthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	7.2	< 0.12	< 0.12	< 0.12	< 0.13	< 0.13	< 0.13	< 0.12
Phenanthrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	mg/kg dry wt	160	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total Petroleum Hydrocarbons in Soil									
C7 - C9	mg/kg dry wt	210	< 8	< 8	< 8	< 8	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	150	< 20	< 20	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	1,300	< 40	< 40	< 40	< 40	< 40	< 40	< 40

Sample Type: Soil	Sample Name:	conditions surrender in	A1_1_230517 23-May-2017 12:35 pm	A1_2_230517 23-May-2017 12:45 pm	A1_3_230517 23-May-2017 12:50 pm	A1_4_230517 23-May-2017 1:00 pm	A2_1_230517 23-May-2017 1:10 pm	A2_2_230517 23-May-2017 1:20 pm	A2_3_230517 23-May-2017 1:30 pm
	Lab Number:		1781257	1781257	1781257	1781258	1781258	1781258	1781258
Total hydrocarbons (C7 - C36)	mg/kg dry wt	n/a	< 70	< 70	< 70	< 70	< 70	< 70	< 70
Soluble Salts (Field)	%	0.25%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm		< 0.01	< 0.01	< 0.01	0.03	0.01	0.02	0.01

Table 8 WRS surrender soil analysis areas B1_1- F1_5

Sample Type: S oil	Sample Name:	Consent limit surrender mg/kg	B1_1_230517 23-May-2017 1:40 pm	B1_2_230517 23-May-2017 1:50 pm	F1_1_230517 23-May-2017 10:28 am	F1_2_230517 23-May-2017 10:40 am	F1_3_230517 23-May-2017 10:50 am	F1_4_230517 23-May-2017 10:55 am	F1_5_230517 23-May-2017 11:05 am
	Lab Number:		1781258	1781257	1781257	1781257	1781257	1781257	1781257
Dry Matter	g/100g as rcvd		91	90	85	86	86	81	85
Total Recoverable Barium	mg/kg dry wt	10,000	128	148	95	123	360	380	290
Total Recoverable Sodium	mg/kg dry wt	460	430	340	480	490	540	520	540
Chloride	mg/kg dry wt	700	4	4	6	19	20	45	34
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt		< 0.06	< 0.06	< 0.07	< 0.06	< 0.07	< 0.07	< 0.07
Heavy Metals with Mercury, Screen Level									
Total Recoverable Arsenic	mg/kg dry wt	17	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	0.8	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	600	14	15	12	15	14	14	14
Total Recoverable Copper	mg/kg dry wt	100	11	10	16	17	15	19	19
Total Recoverable Lead	mg/kg dry wt	160	1.3	1.3	2.2	2.4	3.2	3.8	3.6
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	6	8	6	7	7	7	7
Total Recoverable Zinc	mg/kg dry wt	300	57	60	51	57	60	64	63
BTEX in Soil by Headspace GC-MS									
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	82	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Sample Type: S oil	Sample Name:	Consent limit surrender mg/kg	B1_1_230517 23-May-2017 1:40 pm	B1_2_230517 23-May-2017 1:50 pm	F1_1_230517 23-May-2017 10:28 am	F1_2_230517 23-May-2017 10:40 am	F1_3_230517 23-May-2017 10:50 am	F1_4_230517 23-May-2017 10:55 am	F1_5_230517 23-May-2017 11:05 am
	Lab Number:		1781258	1781257	1781257	1781257	1781257	1781257	1781257
	dry wt								
Polycyclic Aromatic Hydrocarbons Screening in Soil									
Acenaphthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	7.2	< 0.13	< 0.12	< 0.13	< 0.13	< 0.13	< 0.14	< 0.13
Phenanthrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	mg/kg dry wt	160	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total Petroleum Hydrocarbons in Soil									
C7 - C9	mg/kg dry wt	210	< 8	< 8	< 8	< 8	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	150	< 20	< 20	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	1,300	< 40	< 40	< 40	< 40	78	77	137
Total hydrocarbons (C7 - C36)	mg/kg dry wt		< 70	< 70	< 70	< 70	78	77	137
Soluble Salts (Field)	%	0.25 %	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm		0.01	0.01	< 0.01	0.01	0.1	0.06	0.06

Table 9 WRS Waikaikai surrender soil analysis F1_6-F1_11

Sample Type: Soil	Sample Name:	Consent limit surrender mg/kg	F1_6_230517 23-May-2017 11:30 am	F1_7_230517 23-May-2017 12:05 pm	F1_8_230517 23-May-2017 11:40 am	F1_9_230517 23-May-2017 12:10 pm	F1_10_230517 23-May-2017 12:22 pm	F1_11_230517 23-May-2017 2:05 pm
	Lab Number:		1781257	1781257	1781257	1781257	1781257	1781257.1
Dry Matter	g/100g as rcvd		84	88	82	83	86	85
Total Recoverable Barium	mg/kg dry wt	10,000	230	140	940	1,360	700	1,140
Total Recoverable Sodium	mg/kg dry wt	460	550	480	540	520	420	500
Chloride	mg/kg dry wt	700	57	7	12	41	4	5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt		< 0.07	< 0.06	< 0.07	< 0.07	< 0.07	< 0.06
Heavy Metals with Mercury, Screen Level								
Total Recoverable Arsenic	mg/kg dry wt	17	< 2	< 2	< 2	< 2	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	0.8	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	600	13	13	17	17	17	18
Total Recoverable Copper	mg/kg dry wt	100	20	12	29	28	19	26
Total Recoverable Lead	mg/kg dry wt	160	3.9	2	5.1	7.5	4.5	4.7
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	7	7	7	7	8	7
Total Recoverable Zinc	mg/kg dry wt	300	59	56	57	63	58	53
BTEX in Soil by Headspace GC-MS								
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	82	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	59	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil								
Acenaphthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Sample Type: Soil	Sample Name:	Consent limit surrender mg/kg	F1_6_230517 23-May-2017 11:30 am	F1_7_230517 23-May-2017 12:05 pm	F1_8_230517 23-May-2017 11:40 am	F1_9_230517 23-May-2017 12:10 pm	F1_10_230517 23-May-2017 12:22 pm	F1_11_230517 23-May-2017 2:05 pm
	Lab Number:		1781257	1781257	1781257	1781257	1781257	1781257.1
Benzo[a]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	7.2	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Phenanthrene	mg/kg dry wt		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	mg/kg dry wt	160	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total Petroleum Hydrocarbons in Soil								
C7 - C9	mg/kg dry wt	210	< 8	< 8	< 8	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	150	< 20	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	1,300	139	< 40	330	420	121	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt		139	< 70	330	420	121	< 70
Soluble Salts (Field)	%	0.25%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EC (in 1:5 Extract)	mS/cm		0.07	< 0.01	0.05	0.07	0.06	0.03

Surrender soil sampling undertaken on the Waikaikai Landfarm in the 2016-2017 monitoring year is provided in the above Tables 7-9. The specific analysis concentrations related to surrender sampling is provided where applicable for each analyte. A brief synopsis per analyte is provided below.

- Total Recoverable (TR) Barium ranged from 39-1,360 mg/kg, note the limit is 10,000 mg/kg.
- TR Sodium ranged from 340-550 mg/kg, note the limit is 460 mg/kg. Note there were exceedances in this parameter in 15 of 20 samples submitted.
- Chloride ranged from 4-57 mg/kg, note the limit is 700 mg/kg.

- TR Arsenic concentrations were all below the limit of detection (LOD) for this analyte, <2 mg/kg.
- TR Cadmium were similarly below the LOD for this analyte, <0.10 mg/kg.
- TR Chromium ranged from 10-18 mg/kg, the limit is 600 mg/kg.
- TR Copper ranged from 9-29 mg/kg, the limit is 100 mg/kg.
- TR Lead ranged from 1.1-7.5 mg/kg, the limit is 160 mg/kg.
- TR Mercury concentrations were all below the LOD for this analyte which is set at <0.10 mg/kg.
- TR Nickel concentration ranged from 6-8 mg/kg, limit is set at 60 mg/kg.
- TR Zinc ranged from 45-65 mg/kg with a limit of 300 mg/kg.
- Benzene, toluene, ethylene and xylenes (m&p and o) (BTEX) concentrations were below the limit of detections for these analytes. These limits of detection are <0.05, <0.05, <0.05, <0.10 and <0.05 mg/kg respectively.
- Polycyclic Aromatic Hydrocarbon (PAH) concentrations were all below the limits of detection for these analytes. Specifically relating to the consent, the PAH's of concern are as follows, Naphthalene, Pyrene and Benzo (a) Pyrene (BaP).
- Total petroleum hydrocarbon speciation will be assessed per chain.
    - C_7-C_9 concentrations were all below the LOD for this analyte, 8 mg/kg.
    - C_{10}-C_{14} concentrations were below the LOD for this analyte, 20 mg/kg.
    - C_{15}-C_{26} concentrations were observed in seven samples of twenty, it ranged from 420 mg/kg to 77 mg/kg. Note the limit for surrender is set at 1,300 mg/kg.

Overall, the results of the surrender sampling undertaken on the Waikaikai landfarm indicated compliance with consent condition. There were exceedances (15 of 20) with respect to Sodium concentrations (>460 mg/kg Sodium), though the highest value in exceedance of the stated value was 550 mg/kg Sodium.

Despite the exceedance with respect to Sodium values, the Council was willing to accept these results for the surrender of these areas. However an agreement between the landowner and the consent holder was required, which was supplied in the WRS annual report (Appendix II).

The rationale for allowing the areas to be surrendered, despite the elevated sodium concentrations, was due to the observations undertaken by the Council of the long term analysis of the sodium absorption ratio (SAR) analysed in the Council's compliance soil sampling. The long term record of SAR recorded by the Council at the Waikaikai Landfarm is provided in the following Figure 5. Specifically, Figure 5 indicated that SAR had been below four (<4) SAR for the soil samples collected by the Council over this tenure. The risk of elevated sodium in soils is the development of sodic soils which is likely to occur at a SAR greater than 13.

The consent holder would also be required to submit these results for surrender to have these areas recognised by the consent; this has yet to be undertaken.

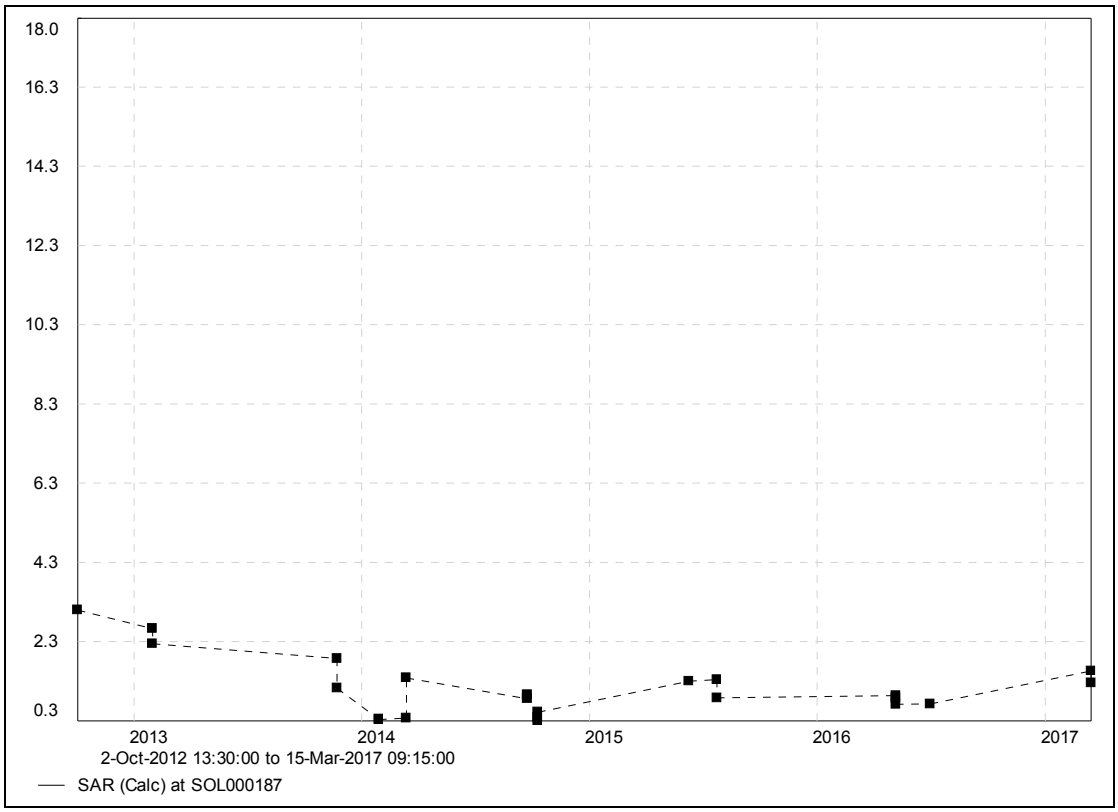

Figure 5 Sodium absorption ratio (SAR) in soil samples Waikaikai Landfarm 2012-2017

2.4 Provision of consent holder data

The consent holder provides information pertaining to consented obligations which must be provided to the Council each year in the form of an annual report, the Waikaikai WRS annual report is attached in Appendix II.

In addition to the requirement for an annual report, the consent holder must also notify the Council as to planned landfarming operations, and provided various data on material, including analysis results.

Conditions 9-12 of the consent specify the requirements.

2.4.1.1 Delivery Record

The two recorded deliveries this monitoring year were from TAG's drilling operations, the associated names relate to a TAG wellsite. The subsequent analysis of these sources is provided Appendix II.

Table 10 WRS Waikaikai delivery record

Site origin	Date	Volume
A-2	20/05/2017-16/06/2017	207 m^3
E-8	28/04/2017-12/05/2017	219 m^3
Total		**426 m^3**

2.4.1.2 Spreading Records

Only one landfarming operation was undertaken this monitoring period at the Waikaikai Landfarm. 550 m^3 of material was farmed from the emptying and removal of the former unlined storage cell. This was undertaken in November 2016.

2.5 Investigations, interventions, and incidents

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

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

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

In the 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with WRS's conditions in their resource consent or provisions in Regional Plans.

3 Discussion

3.1 Discussion of site performance

The main performance items undertaken by the consent holder this year were the removal of the final unlined storage cell in Taranaki and the submission of landfarmed areas for surrender sampling.

The unlined cell 'contingency cell', contained in excess of 50 m^3 of drilling material and as it was unlined contravened the consent condition which stipulated that any pit to be utilised for the storage of solid or liquid wastes shall be lined. The process began in September 2016 and was completed in November 2016.

The consent holder requested the Council to undertake the surrender sampling of the landfarmed areas of Waikaikai landfarm at the end of the monitoring period. This was undertaken with the resultant analysis finding all consent analytes (bar Sodium) were within there conditional limit for surrender. Sodium concentrations were found to be above the conditional limit 460 mg/kg, with a maximum concentration returned of 550 mg/kg. However, the Council were willing to allow these areas to be surrendered[1] if the consent holder gained agreement from the landowner and submitted these areas for surrender. The Council understands that agreement has been reached between the consent holder and landowner (WRS 2016-2017 annual report).

To date all landfarmed areas (Areas F1, A1, A2, and B1) at the Waikaikai landfarm have met their conditional limit of surrender. However, contained within the facility is over 400m^3 of drilling related material which will require management moving forward, this was delivered from TAG's operations this monitoring period. The facility stormwater management system will require additional mitigation moving forward as the areas surrendered are in the likely flow path for stormwater (inspections observed Section 2.1) and as such the option to discharge this fluid component will need to be addressed moving forward.

Overall, notifications have been received when required, as have associated analysis. The consent holder was prompt in providing their annual report information.

3.2 Environmental effects of exercise of consents

In the previous monitoring period the main environmental effect as a result exercise of the storage and landfarming activities were centred on saline impacts observed in the groundwater in the immediate vicinity of storage cells. At the time, the site contained an unlined storage cell which was utilised for storing drilling mud. During this monitoring period, between September and November 2016, the cell was removed and the material landfarmed.

Routine groundwater monitoring of the saline impacted groundwater monitoring well, GND2292 (Table 3) indicated a decrease in concentration in terms of total dissolved salts (TDS) between September 2016 and December 2016, from 4,348 g/m^3 TDS to 2,839 g/m^3 TDS in December 2016, before rising slightly in the final monitoring round for the year to 3,017 g/m^3. This concentration remains elevated above the conditional

[1] The areas with elevated Sodium concentrations were allowed to be surrendered due to the long term record of sodium absorption ratio (SAR) results which indicated a SAR below 4, Figure 5, 2012-2017 soil samples Waikaikai Landfarm.

limit set by the consent which details that the concentration of TDS in the groundwater should not exceed 2,500 g/m^3. It should be noted while there are localised saline impacts in the groundwater in close proximity to the storage cells; the overall effect is negligible. The elevated concentrations of TDS are marginally within the acceptable range for irrigation (1,001-3,500 g/m^3) and within range for stock watering[2] (3,501-8,000 g/m^3)

Surrender sampling was requested by the consent holder this monitoring period. This was undertaken to allow the consent holder to begin returning landfarmed areas to their original purpose. The resultant analysis indicated that the areas of Waikaikai Landfarm utilised for the practice of landfarming had met their conditional limit for surrender. Sodium concentrations as stated remained above their limit for surrender.

The landfarmed areas have been revegetated to a high standard with a solid vegetation cover across all areas.

The rationale for allowing the areas to be surrendered, despite the elevated sodium concentrations, was due to the observations undertaken by the Council of the long term analysis of the sodium absorption ratio (SAR) analysed in the Council's compliance soil sampling. The long term record of SAR recorded by the Council at the Waikaikai Landfarm is provided in the following Figure 5. Specifically, Figure 5 indicated that SAR had been below four (<4) SAR for the soil samples collected by the Council over this tenure. The risk of elevated sodium in soils is the development of sodic soils which is likely to occur at a SAR greater than 13.

[2] Table 5.1- Range of acceptable total dissolved solids concentrations for potential uses of groundwater. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Module 5 – Tier 1 Groundwater Acceptance Criteria

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 11.

Table 11 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 wellsites, 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
4. Groundwater monitoring well installation	Inspections and sampling	Yes
5. Cell lined with fit for purpose liner	Inspections, unlined cell and contents removed between Sep and Nov 2016	Yes
6. Storage cell integrity check every 24 months	To be undertaken within the next 24 months	Yes
7. Operation in accordance with management plan		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	Yes
12. Annual Report	Provided	Yes
13. No discharge within 25 meters of	Inspections	Yes

Purpose: 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*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
surface water or property boundaries		
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	Not assessed this year as no contaminated soil was requested to be brought to the site.	NA
16. All waste brought to site must be landfarmed as soon as practicable but no later than 24 months after delivery date	Ongoing	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	Inspections	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 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	One monitoring well currently above this limit, >2,500 g/m^3	No
24. Consent shall not lead or be liable to lead to contaminants entering a surface water body		Yes
25. Shall not result in any adverse impacts on groundwater and or surface water	Elevated saline concentration in locality of storage cells	No
26. Conductivity must be less than 400 mSm^{-1}. If background soil has an conductivity greater than 400 mSm^{-1}, then conductivity	Inspections and sampling	Yes

Purpose: 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*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
after disposal shall not exceed original conductivity by more than 100 mSm^{-1}		
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
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	Surrender sampling recently undertaken, all parameters bar sodium within surrender concentrations as stipulated by this condition, sodium absorption ratio (SAR) indicated low SAR, below 4 across all soil samples collected (2012-2017)	Yes
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		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**

N/A = not applicable

Table 12 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	
2014-2015	5956-1.7		1		
2016-2017	5956-2.0		1		
Totals		0	2	1	2

During the year, WRS demonstrated a Good level of environmental and High level of administrative performance with their resource consent as defined in Section 1.1.4. Note consent was transferred to WRS in November 2014, the 2014-2015 monitoring period. .

Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. That the monitoring of consented activities at the Waikaikai Landfarm in the 2016-2017 year be slightly augmented in terms of the required number of soil samples to be collected. This number will be reduced from six to two soil samples. The remainder of the monitoring programme will continue unchanged in similarity to the previous monitoring period.

In this monitoring period only two complaince soil samples were collected. As recommended.

3.4 Alterations to monitoring programmes for 2017-2018

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

- the extent of information made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor discharges and effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2017-2018 that the monitoring programme remains unchanged from the programme implemented in this monitoring period.

3.5 Exercise of optional review of consent

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

4 Recommendations

1. THAT monitoring of consented activities at Waikaikai Landfarm in the 2017-2018 year continue at the same level as in 2016-2017 (or) unless the site begins to stockpile and landfarm whereby the option for additional soil samples (four additional) to be added to the programme will be exercised.
2. THAT the option for a review of resource consent in June 2018, as set out in condition 32 of the consent, not be exercised, on the grounds that conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent.

Glossary of common terms and abbreviations

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

As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
Bund	A wall around a tank to contain its contents in the case of a leak.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1}).
DO	Dissolved oxygen.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
$g/m^2/day$	Grams/$metre^2$/day.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.

O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
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 the Council’s laboratory.

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Appendix I

Resource consents held by WRS

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

Discharge Permit

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

Name of Consent Holder:	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 Pan' 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 (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.

    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 gm^3.

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)	

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 that 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 - napthalene, non-carc. (pyrene), benzo(a)pyrene eq.
TPH - total petroleum hydrocarbons (C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36})

The requirement to meet these standards shall not apply if, before 1 March 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

WRS annual report

27 June 2017

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 Lwr Manutahi Rd, RD 2, Patea 4598

As required under special condition 10 of resource consent 5956-1/1.7, and condition 12 of consent 5956-2.0 please find information that WRS, as the operator of the site, have recorded from the 1 July 2016 to the 30th June 2017.

This report and record of activities is presented largely on a change basis, that is only changes from the previous annual report will be described.

1. The site has been inactive for nine months of the monitoring period with two short periods of activity; late September to late November 2016 and June 2017.
2. The only import of waste for storage was produced fluid in June 2017. This remains in storage.
3. Pit 3 was cleaned of residual mud that had covered part of the floor of Pit 3 from April 2014. A digger and tractor and trailers was used for the clean out of aged bentonite mud along with scrapping of in situ clay from the pit floor and lower walls . These were landfarmed in a small especially prepared area W1611 in the 4th quarter of calendar 2016 and re-sown to pasture. Good ground cover was quickly

achieved by early summer and the oats /rye blend bailed for hay in early 2017. This area W1611 was soil samples in May 2017 with the intention of surrendering the block. Sampling showed surrender criteria have been meet after only 6 months; a formal surrender application is underway.

During the latter second half of the monitoring period the TRC in their role as "regulator in waiting" proposed a methodology they would undertake to establish whether an area meet the consent criteria required to demonstrate remediation of contaminants had been achieved, surrender criteria had been meet and surrender possible. Although the South Taranaki District Council (STDC) is currently the regulator charged with determining when any area deemed contaminated under the current National Environmental Standard for Contaminated Soils is sufficiently remediated to enable this area to be excised from the land farming consent and returned to use not requiring a consent, the STDC has tacitly approved the TRC's methodology and mandate – see TRC document # 1838210, 22/03/2017 .

Following a discussion in early 2016 with the TRC it was agreed that they would undertake all soil sampling during the 2016-17 monitoring period as there remained differing purposes and opinions as to the objective and therefore the type of sampling to be undertaken prior to any decision by the consent holder to seek surrender of any areas landfarmed to date. The soil sampling undertaken during May 2017 was to the operator's knowledge the only soil sampling completed during the monitoring period.

WRS on site management activities have been limited to regular site visits (approx.. monthly) by the Operations Manager and periodic liaison with the land owner. Minor maintenance and some photography were undertaken during these visits.

At the commencement of the monitoring year 1 July 2016 all three pits were approximately 75% full largely with storm water with minor drilling mud and cuttings that had been placed in storage over the previous year. The minor drilling wastes are those left in lined pits when pit emptying occurs to ensure the synthetic liner is not disturbed and to prevent wind shear across an empty pit causing the liner to flog and become damaged.
No further deliveries were made to the site until produced water from TAG's A-2 production well was undergoing a workover in May 2017. Receipt at Waikaikai from TAG's activities is not the norm, but as all pits at Manawapou were nearing capacity due to a larger volume of mud than forecasted, the decision was made to place TAG waste in storage at Waikaikai . Prior to receipt stormwater was removed and spread upon previously land farmed areas. Between 20 May and 16 June 2017, 207 m3 of produced fluids and drilling waste was delivered to the site. At 30 June 2017 this remains in storage pending a decision re final disposal location. Detail of the received waste is provided in in the attached Mud Register.

As seen in previous years pit water levels are determined by rainfall versus losses by ablation and evaporation – at no time during the year was the standing water level in Pit 1 and 2 observed to reduce the freeboard to less than approx. 100mm. As seen in previous years an equilibrium water balance appears to be maintained as the storage volume per mm rise increases rapidly with pit wall taper and similarly wind shear and evaporative loss increases as fetch across the water surface both increase.

With the sustained depression of world oil prices from the spring of 2014 showing no signs of sustained recovery the cessation of exploration and sustaining production drilling has continued and thus there has been little drilling mud generated of any volume requiring disposal.

For the second year in a row the Waikaikai landfarm has essentially been under Care and Maintenance for most of the 2016-2017 monitoring year with the effects as minimal and near to steady state as possible.

Information pertaining to resource consent 5956-1/1.7 up until 19th April 2017, and thereafter 5956-2.0 is provided under the following headings

1. Delivery Record - see separate document 'Mud Register'

The Mud Register is a WRS master electronic record of all waste received by the company at both sites. It is generated from both sites' Record of Delivery, transport manifests, and client's waste records; it records deliveries received at site for storage or spreading of each well/delivery campaign notified by email to the TRC as required by Condition 5 (5956-1.7) and 8 (5956-2.0)

During July 2016 to 28 April 2017 there were no deliveries of industry wastes into the site; in late April mud from TAG's 2017 drilling programme was diverted to Waikaikai from Manawapou as storage capacity was nearing a maximum there. To enable this, stormwater from both Pits 1 and 2 was disposed of onto previously spread areas. From 28 April to 6th June small volumes of mud from E-8 and produced water from A-2 was placed in storage at Waikaikai as shown in the Mud Register. This waste will remain in storage until drilling activity necessitates additional storage is required or the two year storage time limit is reached.

2. Spread Areas and Events during 2016/17

Area M1611 was specifically prepared to tidy up an area of existing clay borrow workings undertaken by the landowner to enable the clean out of Pit 3 muds and clay to be completed. Earthmoving equipment was bought to site on 22 September 2016 and over the next few weeks, as operator availability allowed, Pit 3 was scrapped clean of all residual mud and approx. a 200mm flitch of in situ clay from the lower walls and pit bottom. This was transported by tractor and trailer to the spread area, discharged, allowed to dry out for approx. 4 weeks and then deep ripped and tilled into the underlying sand horizons. Top soil was recovered from storage in the perimeter windrow, spread, levelled and sown with a mixture of ryegrass and oats. These final stages of rehab occurred on the 25th October were filmed by Showdown Productions film/TV company for inclusion in a 10 min clip on land Farming by TVNZ's Rural Delivery programme.

See Appendix B

3. Spreading Records

No virgin drilling mud or waste was spread at Waikaikai during the reporting period, however a small quantity (approx.. 50m3) of 3+ year old mud remaining in the bottom of Pit 3 , along with approximately 500m3 of lower pit side wall and pit floor clay was removed as part of the Pit 3 clean up. This was spread over area W1611 at the standard <50,000 ppm hydrocarbon rate of 100mm average thickness, tilled in the subsoil, covered with topsoil and re-sown as previously described.

4. Liner Integrity

As both lined pits at Waikaikai, Pits 1 and 2 remained greater than 75% full for all but a few hours during the year there was no opportunity to inspect the liners in any detail.

The liners will be inspected when they are next emptied within the next 2 years.

4. Field Photographs – see Appendix A

5. Composition of Wastes/Pre Disposal Analysis -

Nil

6. TRC Inspection Notices

The consent holder has copies of inspections, however it is not known if this is a complete record of all the inspections undertaken. Entries in the Site Visitors log indicate that it is.

7. Operations Management Plan –see separate document

Operations at the Waikaikai land farm are all undertaken generally in accordance with the WRS Landfarm Management Plan. The document applies to both the Waikaikai and Manawapou land farms is a live document and is constantly reviewed and updated as necessary (most recently June 2017) to reflect current operational requirements and practices at both the sites operated by WRS.

8. MONITORING

1. **Consent Holder** - although there is no specific consent requirement for the consent holder to undertake routine programmed monitoring, there are numeric conditions that must be complied with in respect to conductivity Cond.25, SAR Cond.26 and heavy metals Cond.27 consent # 5956-1.7 At the end of the 2016 monitoring year all spread areas had attained or very near surrender criteria and regular further monitoring of the above parameters was deemed unnecessary and not undertaken. This assessment was based upon the soil sampling undertaken at the end of June 2016 as described in the 2015-16 reporting period as below , viz

   "one round of environmental soil sampling of the most recently spread (Jan – May 2015) area FI on 30 June 2016.
   A 400 m transect running from roughly E-W through the centre and parallel to the areas long dimension was sampled at 10m intervals –a single 250-350 deep soil core was taken at each interval and aggregated into a single sample.
   On a second 100 m transect, environmental samples were taken on the same heading, intervals and methodology from area A2.

   The samples were sent to Hills Labs for analysis. Only sodium exceeded the surrender criteria of Cond.28, namely 600 and 490 mg/kg compared to the surrender limit of 460 mg/kg, all other analytes were well below surrender criteria."

2. **Regulator –** a programme of compliance monitoring was undertaken during the year 2016-17 monitoring year by the TRC. This programme was a slightly reduced programme compared to that undertaken during the equivalent 2015-16 year reflecting the fact that the site was under care and maintenance for that period. Following discussions with the TRC in Q4/16 and Q1/17, WRS requested a proposal to undertake surrender sampling and assessment of all areas land farmed at Waikaikai at 1 January 2017. Their proposal was accepted and the soil sampling required by the National Environmental Standards for Contaminated Soils (NESCS) was undertaken on 23 May 2017. Analysis by RJ Hills Labs was completed on the 2 June and forwarded to WRS with comments and conclusions from the TRC on 6th June 2107 by email as below;

   "In short the results suggest that the areas sampled, which had been utilised for the practice of landfarming, have now met there conditional limit for surrender.

   There are a couple of exceedances (14 of 20) with respect to elevated sodium values which are above the conditional limit of 460 mg/kg, the highest returned value of 550mg/kg (Transect F1_6_230517) sodium.

   However, chloride and total soluble field salts remained at low concentrations compared to their consent conditions.

   In this regard and if the landowner is happy with the elevated sodium you may submit these results for surrender of these areas.

   I would require acknowledgement from the landowner."

   These minor elevated values for Na were accepted by the landowner by email on 20 June 2017 and a formal application to excise the areas from consent 5956-2.0 is underway.

TO SUMMARISE

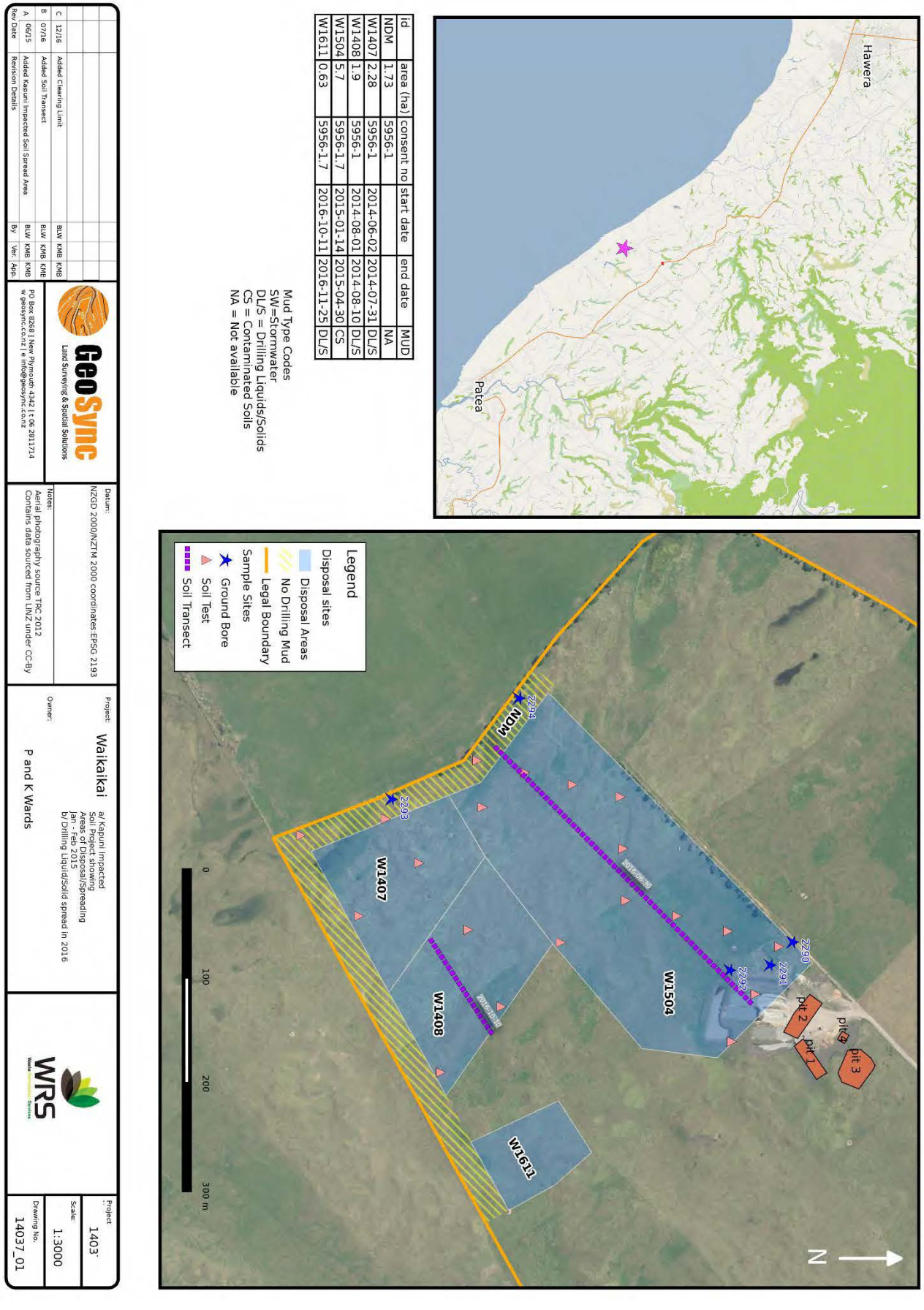
A year with minor clean up of Pit 3 and land farming of this, followed by the emptying of Pit 1 and 2 of stormwater and receipt of approx.. 200 m3 of mixed drilling mud and produced water from E-8 and A-2 that remained in storage and the end of the reporting year.

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

APPENDIX A

Pit 3 Scraping, Spreading, Revegetation

Appendix B Waikaikai 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	DL/S
W1408	1.9	5956-1	2014-08-01	2014-08-10	DL/S
W1504	5.7	5956-1.7	2015-01-14	2015-04-30	CS
W1611	0.63	5956-1.7	2016-10-11	2016-11-25	DL/S

Mud Type Codes
SW=Stormwater
DL/S = Drilling Liquids/Solids
CS = Contaminated Soils
NA = Not available

Rev	Date	Revision Details	By	Ver.	App.
A	06/15	Added Kapuni Impacted Soil Spread Area	BLW	KMB	KMB
B	07/16	Added Soil Transect	BLW	KMB	KME
C	12/16	Added Clearing Limit	BLW	KMB	KMB

GeoSync Land Surveying & Spatial Solutions
PO Box 8268 | New Plymouth 4342 | t 06 2811714
w geosync.co.nz | e info@geosync.co.nz

Datum: NZGD 2000/NZTM 2000 coordinates:EPSG 2193

Notes: Aerial photography source TRC 2012
Contains data sourced from LINZ under CC-By

Project: Waikaikai

a/ Kapuni Impacted Soil Project showing Area of Disposal/Spreading Jan - Feb 2015
b/ Drilling Liquid/Solid spread in 2016

Owner: P and K Wards

WRS Waste Resource Services

Project No. 1403
Scale: 1:3000
Drawing No. 14037_01

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ANALYSIS REPORT

Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1751246 SPv1
Contact:	Keith Brodie	**Date Received:**	01-Apr-2017
	PO Box 77	**Date Reported:**	21-Apr-2017
	Oakura 4345	**Quote No:**	80931
	TARANAKI	**Order No:**	KB1911
		Client Reference:	Waste characterisation Sludge
		Submitted By:	Keith Brodie

Sample Type: Sludge

Sample Name:		Supplejack A2 x2 06-07/03/17 15:00				
Lab Number:		1751246.1				
Individual Tests						
Dry Matter	g/100g as rcvd	75	-	-	-	-
Approx Total Dissolved Salts	g/m³	1,900	-	-	-	-
Electrical Conductivity (EC)*	mS/m	283 #1	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	22	-	-	-	-
Total Recoverable Calcium	mg/kg dry wt	8,600	-	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	6,600	-	-	-	-
Total Recoverable Potassium	mg/kg dry wt	8,100	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	1,080	-	-	-	-
Chloride*	mg/kg dry wt	10,000	-	-	-	-
pH*	pH Units	9.7	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	7	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	43	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	12	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	14.1	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	22	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	50	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	-	-	-	-
Toluene	mg/kg dry wt	< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.11	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-

Sample Type: Sludge						
Sample Name:		Supplejack A2 x2 06-07/03/17 15:00				
Lab Number:		1751246.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.15	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

Analyst's Comments

#1 Electrical Conductivity: Undertaken using as received sample as requested; used during the extraction.

SUMMARY OF METHODS

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

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.010 - 60 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esICextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m^3	1
Electrical Conductivity (EC)*	Electrical Conductivity measured in 1:5 Solid:Water extract.	0.1 mS/m	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Calcium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Magnesium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Potassium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Chloride*	Ion Chromatography determination of a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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ANALYSIS REPORT

Client:	Waste Remediation Services Limited (WRS)	**Lab No:**	1807369	SPv1
Contact:	Keith Brodie	**Date Received:**	12-Jul-2017	
	PO Box 77	**Date Reported:**	27-Jul-2017	
	Oakura 4345	**Quote No:**	80931	
	TARANAKI	**Order No:**	KB 1924	
		Client Reference:	Waste characterisation	
		Submitted By:	Keith Brodie	

Sample Type: Sludge

Sample Name:		E-8 Manawapou 02-May-2017 12:00 pm				
Lab Number:		1807369.1				
Individual Tests						
Dry Matter	g/100g as rcvd	75	-	-	-	-
Approx Total Dissolved Salts	g/m³	2,300	-	-	-	-
Electrical Conductivity (EC)*	mS/m	341	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	21	-	-	-	-
Total Recoverable Calcium	mg/kg dry wt	8,100	-	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	6,600	-	-	-	-
Total Recoverable Potassium	mg/kg dry wt	8,100	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	1,030	-	-	-	-
Chloride*	mg/kg dry wt	5,400	-	-	-	-
pH	pH Units	9.3	-	-	-	-
Total Nitrogen*	g/100g dry wt	0.07	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	6	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	43	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	13	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	14.0	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	24	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	58	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	-	-	-	-
Toluene	mg/kg dry wt	< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.12	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	< 0.013	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	< 0.013	-	-	-	-
Perylene	mg/kg dry wt	0.014	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.013	-	-	-	-
Acenaphthene	mg/kg dry wt	< 0.013	-	-	-	-
Anthracene	mg/kg dry wt	< 0.013	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.013	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.013	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.013	-	-	-	-

Sample Type: Sludge						
Sample Name:		E-8 Manawapou 02-May-2017 12:00 pm				
Lab Number:		1807369.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Benzo[e]pyrene	mg/kg dry wt	< 0.013	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.013	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.013	-	-	-	-
Chrysene	mg/kg dry wt	< 0.013	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.013	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.013	-	-	-	-
Fluorene	mg/kg dry wt	< 0.013	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.013	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.07	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.013	-	-	-	-
Pyrene	mg/kg dry wt	< 0.013	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

SUMMARY OF METHODS

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

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.010 - 60 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1
esICextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m^3	1
Electrical Conductivity (EC)*	Electrical Conductivity measured in 1:5 Solid:Water extract.	0.1 mS/m	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Calcium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Magnesium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Total Recoverable Potassium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1

Sample Type: Sludge			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1
pH	1:2 v/v soil:water slurry after 16±2hrs, pH meter. APHA 4500-H^+ B 22nd ed. 2012.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1
1-Methylnaphthalene	Sonication extraction, SPE cleanup, GC-MS SIM analysis. Modified US EPA 8270.	0.010 mg/kg dry wt	1
2-Methylnaphthalene	Sonication extraction, SPE cleanup, GC-MS SIM analysis. Modified US EPA 8270.	0.010 mg/kg dry wt	1
Perylene	Sonication extraction, SPE cleanup, GC-MS SIM analysis. Modified US EPA 8270.	0.010 mg/kg dry wt	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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix III
WRS Landfarm Management Plan

Waste Remediation Services Ltd (WRS)

Waikaikai (Wards)

&

Manawapou (Symes)

Landfarm Management Plan

2017 - 2018

Table of contents

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		

This landfarm Operations Management Plan 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 dedicated Safety Supervisor 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. All visitors to the site 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.

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 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 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.

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. Overview of the 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, viz > 500 m3. This is followed by stripping existing organic soil horizons and cut and fill earthworks to provide a rolling contour over the spread and adjoining areas. The waste is then spread onto land, allowed to dry, spread across the prepared area, incorporated into the soil by tilling (dilution), the stripped topsoil replaced and further tilled if required. The final rehabilitation step involves 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 to be increased several folds and the elimination of sand blow holes developing and spreading resulting from the persistent prevailing winds

The 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, and solids are transported by sealed well-side trucks using an excavator to load the material from wellsite in ground sumps/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 lined storage pits to allow natural atmospheric degradation and dilution until volumes are sufficient to allow campaigned spreading.

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.
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 spray irrigation 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.

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

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

7. Landfarm Management Process

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
	• Identify wastes types, characterisation and volumes for disposal, there are three possible types of waste: • Water based muds; • Synthetic based muds. • Oily wastes	Client production supervisors/, drilling supervisors/ well services supervisors
	Contact WRS Operations Manager 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 OK for delivery/disposal of material from WRS	Client production supervisors/ drilling supervisors/ well services supervisors
	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 • Record all collection details on WRS/Symons Transport waybills. Assign each 'parcel' of waste a number (sample #) to ensure source, transport and storage location are recorded if required ;and • Collect and submit pre-disposal sample for analysis.	WRS Operations Manager, transporting companies management and truck drivers, clients drilling supervisor

Step	What	Who
	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 WRS Operations Manager
	Delivery: • Once location for stockpiling at landfarm has been arranged organize with a contractor for delivery; and • Notify WRS of all deliveries to site, providing as much notice as practicable.	Client production supervisors/drilling supervisors/well services supervisors/ transport companies Dispatch Manager
	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 notify TRC of need to use contingency storage and removal of excess rainwater by effluent tanker to suitable land farming areas until land spreading of mud and solids is practicable	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 weight; 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.

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 or disposal, but there are however 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 therefore in effect act only as a guide to attaining the required dilution and dispersal to meet heavy metal limits via the spreading rates

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 Ethylbenzen e 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. 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 (oily wastes into Pit 4 Waikaikai only), but if capacities are limited disposal 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 the actual composite, 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, the following calculations are required, using information from the pre-disposal sample.

To obtain the minimum area for spreading the calculation is:

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

b) for TPH > 50,000 mg/kg
volume (m^3)/ depth allowed (0.05m) = area m2

e.g. Volume to be spread is 200 cu.m / m3

Spread Area= 200/0.05 = 4,000 sq. = 0.4Ha

13. Monitoring

13.1. Site Inspections

Regular monitoring inspections of the landfarm sites will be undertaken (monthly on average as a minimum) 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 requiring consent holder soil sampling these levels form the basis for the monitoring that will be undertaken at the site.

It is these analytes that are monitored through periodic sampling of the landfarm spreading areas as required for a specific purpose e.g. assessing analyte concentrations if excise and 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 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 annually or as requested.

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 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)			

Parameter	Consent Limit (mg/kg unless otherwise stated)	Typical Sampling requirements for WBM/SBM/Oily Wastes		
Conductivity Sodium Absorption Ratio	290 mSm (expiry) 18 (post-app)			
Total soluble salts (g/100g)	2500 (expiry)			i
BTEX Benzene Toluene Ethylbenzen e Xylenes PAH Napthalene Pyrene Benzo(a)pyrene TPH C6-C9 C10-C14	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, immediately after spreading and then at 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. 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.);
- Stockpiling (area, volumes stockpiled, dates and times of commencement and completion);
- Disposal (area (including a 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

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	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.