

Waste Remediation Services Limited  
(WRS)  
Symes Manawapou Landfarm  
Monitoring Programme  
Annual Report  
2014-2015

Technical Report 2015-77

ISSN: 1178-1467 (Online)  
Document: 1564921 (Word)  
Document: 1624610 (Pdf)

Taranaki Regional Council  
Private Bag 713  
STRATFORD

March 2016



## Executive summary

Waste Remediation Services Limited (WRS) (The Company) operates a landfarm located on Manawapou Road near Manutahi (the Site), South Taranaki. Disposal activities have been carried out by the Company at this site since June 2014. It was previously operated by Remediation NZ who relinquished control to the Company in June 2014, whereby the original resource consent was granted in May 2012.

This report for the period July 2014 – June 2015 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's administrative and environmental performance during the period under review, and the results and environmental effects of the site activities.

The facility encompasses three lined storage cells which are utilised to store water based and synthetic based drilling muds (WBM and SBM) prior to landfarming on the designated landfarm area. The site also has four groundwater monitoring wells, two of which are situated in close proximity to the storage cells and two which are located on the Northern and North Eastern boundary of the site, closest to the nearest potential receptor.

The Company holds one resource consent, this includes a total of 27 conditions setting out the requirements that they must satisfy.

**During the monitoring period, the Company demonstrated a good level of environmental performance and a good level of administrative performance.**

The Council's monitoring programme for the year under review included six scheduled inspections, 16 groundwater samples, and eight soil samples, in addition to a review of monitoring data received from the Company .

The annual monitoring showed that the Company managed the site in an acceptable manner, there were limited measurable environmental effects as a result of the exercise of this Consent. The Company was able to demonstrate a good level of environmental performance. The installation of a groundwater monitoring well network during was beneficial to the site in as much as it enabled the Council to identify groundwater impacts in the vicinity of the storage cells. During the year, the Company demonstrated a good level of environmental and administrative performance with the resource consent.

During the year under review there were zero Unauthorised Incidents (UIs) recording non-compliance in respect of the consent holder during the period under review.

For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.



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# **1. Introduction**

## **1.1 Compliance monitoring programme reports and the Resource Management Act 1991**

### **1.1.1 Introduction**

This report is for the monitoring period July 2014 – June 2015, it is prepared by the Council, and it describes the monitoring programme associated with resource consent held by Waste Remediation Services Limited (WRS), hereafter the Company. The Company operates a landfarm situated on Manawapou Road, near Manutahi, South Taranaki.

Disposal activities undertaken by the Company commenced at this site during the 2013-2014 monitoring year. The original consent was granted 1 May 2012 to Remediation NZ limited, and the site became operational in September 2012. The present owners took control of the site in June 2014.

During the 2014-2015 monitoring period, there were disposals of approximately 1170 m<sup>3</sup> of water-based and synthetic-based cuttings and fluids from the TAG OIL (NZ) Ltd Cheal E wellsite. These disposals commenced on 12 December 2014 through to 20 December 2014, across the consented area, spreading area A (Figure 2). Stormwater from the storage pits was also spread onto this area on two occasions prior to the disposal of solid wastes.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to discharges of drilling wastes from hydrocarbon exploration and production activities, onto and into land, via landfarming. This is the third annual report to be prepared by the Council to cover the discharges and their effects.

### **1.1.2 Structure of this report**

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by the Company, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at the Site.

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 2014-2015 monitoring year.

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

### 1.1.3 The Resource Management Act 1991 and monitoring

The 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);
- (e) risks to the neighbourhood or environment.

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

### 1.1.4 Evaluation of environmental and administrative performance

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

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

Events that were beyond the control of the consent holder and unforeseeable (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 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2 Process description

### 1.2.1 Drilling waste

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

#### Drilling fluids

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

## **1.2.2 Landfarming**

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

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

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

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



**Photo 1** Landfarm post application and reinstatement North West Projection



**Photo 2** Pasture cover establishment South East Projection

### 1.3 Site location and description

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

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

### Site data

#### Location

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



**Figure 1** Aerial photograph showing the location and approximate extent of the Symes Manawapou Landfarm and approximate regional location (inset)

## **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.

The Company holds discharge permit 7795-1 to discharge drilling wastes [consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds], from hydrocarbon exploration and production activities, onto and into land via landfarming. This permit was initially issued by the Council on 1 May 2012 to Remediation NZ, as a resource consent under Section 87(e) of the Resource Management Act. This resource consent is due to expire on 1 June 2028. It was transferred to the new consent holder WRS in June 2014.

Condition 1 sets out definitions, and condition 2 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects.

Condition 3 sets out the requirements for a management plan, while condition 4 sets out the requirements for the installation of groundwater monitoring bores prior to the exercise of the consent.

Conditions 5 to 9 set out the requirements for a management plan, notifications, monitoring and reporting.

Conditions 10, 12, 13, 14 and 15 specify discharge limits, locations and loading rates.

Condition 11 requires a buffer zone between areas of disposal and surface water bodies, property boundaries, and QEII Key Native Ecosystems.

Conditions 16 and 17 regard operational requirements, while conditions 18 to 24 specify receiving environment limits for both soil and water

Condition 25 concerns archaeological remains, while conditions 26 and 27 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

## **1.5 Monitoring programme**

### **1.5.1 Introduction**

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

The 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 reviews;
- renewals;
- new consents;
- advice on the Council's environmental management strategies and content of regional plans and;
- consultation on associated matters.

### **1.5.3 Site inspections**

A total of six scheduled inspections were made of the site during the monitoring period, with regard to the consents for the discharge of drilling waste. An additional seven inspections were conducted at the site during chemical 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
- the neighbourhood was surveyed for environmental effects.

### **1.5.4 Chemical sampling**

During the monitoring period the Council collected six composite soil samples from the site. The samples were analysed for chloride, conductivity, hydrocarbons, pH, sodium absorption ratio (SAR) and total soluble salts.

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), whereby a soil corer is inserted to a depth of 500 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 a soil core is provided in Photo 3.



**Photo 3** Soil core collected from the Symes Manawapou Landfarm

The Council also undertook analysis of the groundwater by sampling the purpose built groundwater monitoring wells which are located at specific areas on the site Figure 4. The four monitoring wells were each sampled four times. Samples were analysed for pH, temperature, conductivity, chloride, total dissolved solids, sodium, barium, TPH and BTEX.

### 1.5.5 Review of analytical results

In line with the consented requirements the Company must supply the Council with representative analytical results of the material they intend to apply to land at this facility. They undertook this by providing the Council with analytical results of the material which was analyzed by an International Accreditation New Zealand (IANZ) laboratory, Hills Laboratory, Hamilton. Chemical parameters tested are as follows:

- pH
- chlorides
- potassium
- sodium
- total nitrogen
- total barium
- heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg)
- BTEX
- PAH
- TPH ( including speciation analysis C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>)

The company must also provide the Council with a representative post spreading soil sample of the areas which were utilised for the application of material. The rationale for this post spread sample is to ascertain the consent specified application rates have been achieved.

In this monitoring period the Company did not supply the Council with a post spread sample of material.

## **2. Results**

### **2.1 Inspections**

#### **3 July 2014**

No objectionable odours or visible emissions were found during the inspection. The three lined cells in the storage area were observed to contain drilling muds. The western cell liner which had been repaired was inspected and the repair appeared to be satisfactory. Recent heavy rains had brought the fluid level up to the repair. Surface oils were observed to have wind blown to the eastern side of the cell. The north western cell was perceived to contain mainly storm water with a small volume of emulsified surface oils. The north eastern cell seemed to have plenty of free-board available and a small volume of surface oils at the eastern end, the liner appeared in good shape.

No recent spreading had occurred, decent pasture cover was observed across most of the historic spreading area although some muds could be identified in patches at the surface where no pasture strike had occurred. Test pits identified mud clumps within the soil profile, no hydrocarbon odours were noted.

#### **18 July 2014**

No objectionable odour or visible emissions were observed during the inspection. No traffic movements or recent deliveries of mud appeared to have occurred. All lined cells at the site contained material and plenty of free-board was available. The western cell level was slightly below the level of the liner repair, surface oils were wind-blow to the western end. The other two lined cells contained very little surface oils. The northern cell appeared to be mainly clear liquid.

The spreading area's top soil had been stripped back to form a perimeter bund. Contouring of land looked acceptable, however, the lowest point at the north west corner was approximately 4m lower than the highest central point within the spreading area. The north east corner was approximately 2 m lower. The stripped topsoil along the northern perimeter had exposed some muds from previous applications which indicated the areas had overlapped slightly. Pasture cover across previous spreading areas appeared healthy, muds were evident within the soil profile within test pits; the material was still quite sticky and found in small clumps.

#### **On 22 July 2014**

The inspection was conducted in conjunction with scheduled groundwater sampling at the site. Contouring of the pre landfarm area had been undertaken, however no spreading had occurred as the site operator had predisposal results pending from RJ Hill Laboratories. The site looked generally tidy, pasture cover on the previously spread areas was good, and the contouring looked reasonably well done.

Material was secure in the cells and the samples taken from three of the bores had no odour, foam or sheen. Bore 2301 had a slight odour and appeared slightly foamy, but no obvious hydrocarbons were present. It will be necessary to discuss with the site operators about site security and signage, which is currently largely absent.

The following action was undertaken: Officer contacted site operator about signage and fencing, site operator required to supply predisposal results prior to commencing of spreading.

### **7 August 2014**

No objectionable odours or visible emissions were found during the inspection. No activity on-site. The equipment utilised for spreading the liquid portion of wastes was present. Lined cells had been lowered. Some surface oils were present in all cells. Liner repair holding and the fluid level was well below the repair.

Stripped topsoil bund remained stable and the spreading area looked good. Historic application area had good pasture which appeared healthy, mud identified within the soil profile, no hydrocarbon odours noted.

### **10 October 2014**

A site inspection was conducted in conjunction with soil sampling. Two composite samples were collected from stage 2 and 3 areas. Some mud was visible in the samples. A large area in the centre of the site (appears to be new Area 'A' on the supplied map) remains opened up with exposed sand. The consent holder was contacted and explained that this site has not received any land farmable muds as of yet.

The stockpiling area lacked adequate signage and security fencing. The consent holder advised they had purchased signs and gates and intends to install them the following week. Otherwise, no issues were noted.

### **3 November 2014**

No objectionable odours or visible emissions were found beyond the site boundary during the inspection. The three lined cells contained material, plenty of capacity available and the liners appeared to be coping with weather events, repairs were observed to be holding, some surface oils were present in all storage cells.

Spreading area had been fenced off, some material had been applied, stripped topsoil remained stable. Historic application areas inspected, pasture cover complete across all areas. Muds identified within the soil profile in all dug test cells. Some hydrocarbon/mud odours noted and the material broke apart easily, most recent established pasture mainly clover.

### **26 November 2014**

Inspection was conducted in conjunction with groundwater sampling. All four bores were sampled at the site. Bore GND2301 had prominent odours emanating from the bore. All cells in the stockpiling area had received additional drilling waste. Cell 1 was observed to be discharging into Cell 2. Spreading Area A was still open (stockpiled topsoil had abundant pasture growth) and a semi-permanent fence had been erected around its perimeter. A gate with lock had been installed at the entrance to the site with appropriate signage.

### **9 January 2015**

No objectionable odours or visible emissions were noted during the inspection. No site activity observed to have occurred, the gates were locked. Cells 1 and 3 had mud removed but residues remained. Some surface hydrocarbons were present in both cells. Muds were present on the grass area on the southern side of Cell 1 which appeared to

of occurred while cell emptying was in progress. The cell liners appeared in good repair. Cell 2 appeared to contain liquid with a minor amount of surface hydrocarbons.

The recently spread area on the northern side of the storage area was inspected and looked good; muds were well incorporated into the soil profile. Some natural migration to the surface had occurred; the material was dry and broke apart easily. No works to sow pasture had occurred as yet. Historic application areas had essentially complete pasture cover which appeared healthy; muds were identifiable within the soil profile.

#### **19 January 2015**

The inspection was conducted in conjunction with groundwater sampling. The Company site manager was on site and observed the groundwater sampling procedure. Bailers were utilised (groundwater >7 m depth) in bore GND2301 and a slight odour and foaming was observed. GND2300 also had a slight odour. Area A had been recently spread the previous month, it remained bare following recent work, the perimeter fence had now been removed, and the surrounding pasture growth had well advanced.

#### **27 March 2015**

This inspection was conducted in conjunction with soil sampling, accompanied by Scientific Officer Nathan Crook for training and observation purposes. Two composited transects were collected across the spreading Area A, as well as two additional spot samples to be analysed for hydrocarbon only. The main rationale was to compare the spot sample concentration with composited samples. Pasture had established well. Spreading area was to be reworked and sown by landowner in the coming month (via. phone conversation with K. Brodie 26 Feb 2015).

#### **On 28 April 2015**

This inspection was conducted in conjunction with groundwater sampling. All four groundwater bores were sampled, a slight foam and odour were encountered in GND2301.

Spreading Area A had been recently reworked and weed which had covered the area had been removed. All three storage cells contained stormwater and some residual muds; a slight odour was emanating from the cells. The storage cells contained plenty of freeboard. There was no evidence to suggest stock had accessed the site.

#### **On 9 June 2015**

The previously land-farmed areas had been resown and good pasture strike across the entire area was observed. The only exposed areas were where no drilling mud had been applied. These areas remained as wind exposed ridges on the southern side of the application area; topsoil appeared stable during the inspection.

The three lined cells in the storage area were filled with storm water, the level of fluid in Cell 1 was observed to be close to the balance pipe above liner repairs, plenty of capacity was available in Cell 2. Some surface hydrocarbons were present in Cell 3 from residual muds present in the cell.

## 2.2 Results of discharge monitoring

### 2.2.1 Material received

During the monitoring period under review the site received material from TAG OIL's Cheal wellsite's. The material had been delivered from the Cheal E6 and Cheal E7 well sites and was divided into solid and liquid waste. Material was transported to the site by a registered tanker and then discharged into a set, lined, storage cell (Photo 1), of which there are three on this site.

The volume delivered is detailed in Table 1. An expanded version of Table 1 is available in Appendix II.



**Photo 4** Lined storage cell

**Table 1** Mud delivery register

Delivery dates	Product	Site	Volume m <sup>3</sup>
05/11/2014-26/11/2014	Liquid	TAG OIL Cheal E6	346
05/11/2014-26/11/2014	Solid	TAG OIL Cheal E6	195
30/11/2014-20/12/2014	Solid	TAG OIL Cheal E7	336
30/11/2014-20/12/2014	Liquid	TAG OIL Cheal E7	464
Total liquid			810
Total solid			531
Total combined			1341





**Figure 2** The Company supplied map detailing previously spread areas RNZ1, 2 & 3 and Spread Area A1 from the 2014/2015 monitoring period

## 2.3 Provision of company data

The Company provides notification to the Council when they receive deliveries of landfarmable material; these notifications contain information pertaining to the source of the material and the quantity.

The Consent holder also undertook analytical sampling of the each individual stream of material brought on to site, this is in line with consent conditions<sup>1</sup>. Analysis of the pre spreading samples is provided in the Company's annual report; this is attached in Appendix II. During the year the site received 810 m<sup>3</sup> of liquid-related material and 531 m<sup>3</sup> of solid material.

## 2.4 Results of receiving environment monitoring

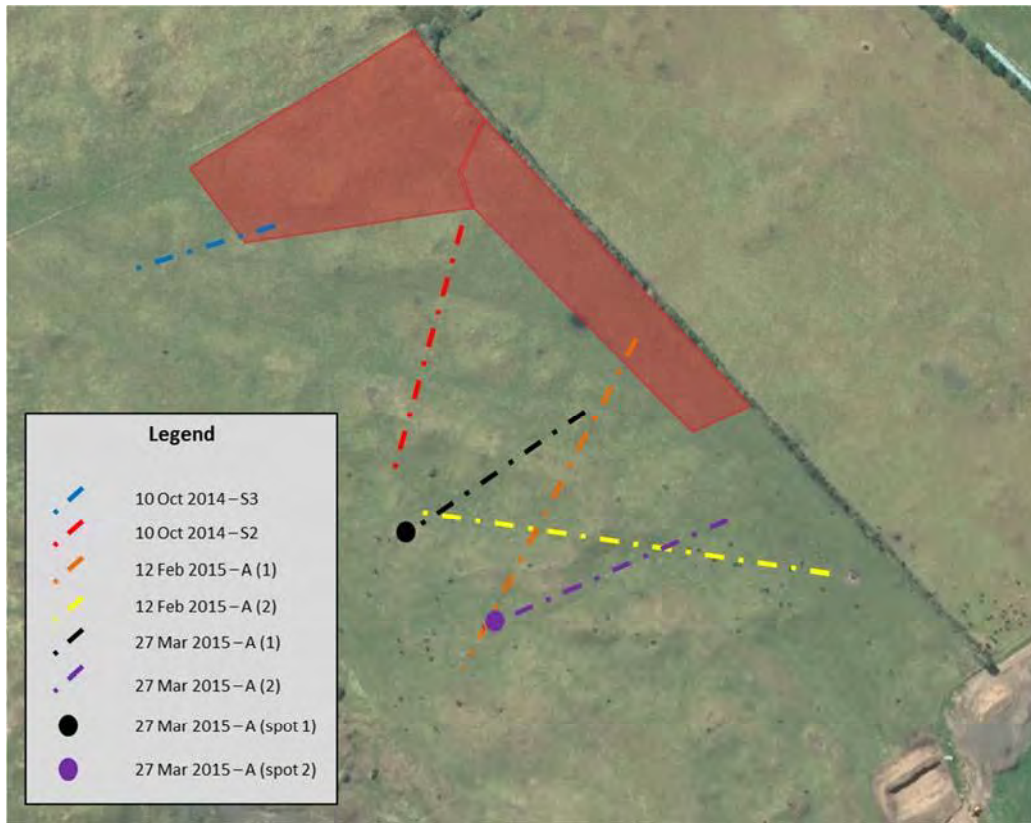
### 2.4.1 Council soil sampling results

The Council carries out soil sampling throughout the monitoring period to ascertain the concentrations of certain parameters within the soil profile. During the monitoring period the Council collected six composite soil samples and two additional spot samples. The soil samples were collected by compositing ten individual soil cores

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<sup>1</sup> Consent 7795-1 Condition 7. Appendix I

across a 100 metre transect from a maximum depth of 500 mm (Photo 3). The soil sampling methodology is discussed in Section 1.5.4.



**Figure 3** Location of composite soil samples at the Symes Manawapou Landfarm

**Table 2** Council soil sampling results for the 2014-15 monitoring period

Parameter	Unit	10 Oct 2014	10 Oct 2014	12 Feb 2015	12 Feb 2015	27 Mar 2015	27 Mar 2015
		S3	S2	A (1 of 2)	A (2 of 2)	A (1 of 2)	A (2 of 2)
Calcium	mg/kg	91.3	29.2	106	137	28	200
Chloride	mg/kg DW	10.1	8.6	493	607	183	675
Conductivity	mS/m@20C	50	23.8	273	341	141	353
Hydrocarbons	mg/kg DW	1629	1312	148	16	15	20
Magnesium	mg/kg	5.7	3.6	10	9	5.3	15.1
Moisture factor	Nil	1.086	1.093	1.055	1.06	1.052	1.069
pH	pH	7.8	7.1	7.5	7.8	6.2	7.1
Sodium absorption ratio	None	0.228	0.404	1.645	1.737	2.293	1.778
Sodium	mg/kg	8.3	8.7	66.2	77.7	50.4	96.8
Total soluble salts	mg/kg	391	186	2139	2665	1104	2761

Soil sample analysis undertaken by the Council through out the 2014-15 monitoring period detailed two minor exceedances. These two exceedances were the concentration of Total Soluble Salts (>2500 mg/kg) and Conductivity (290 mS/m). These parameters are currently over the surrender criteria stipulated in the conditions of the consent.



## 2.4.2 Council Groundwater Results

During the 2014-2015 monitoring period the Council undertook groundwater sampling of the operational monitoring bore network. The network, which is a conditional requirement of the consent, was installed to quantify the quality of the groundwater in the locality of the storage cells. The intent of this monitoring was to specifically understand if any effects were permeating from the storage cells and/or the spreading areas. A description of the corresponding bore logs undertaken during the construction of the groundwater monitoring wells is provided in Appendix III.

Two of these groundwater monitoring wells are situated in close proximity to the drilling mud storage cells, while the additional two wells are situated on the northern and north eastern perimeter of the landspread areas (Figure 4).

The Council assesses these monitoring wells four times a year. Disposable groundwater sampling bailers are utilised for sampling due to the fact that the average static groundwater level is below 7 m depth which inhibits the use of a peristaltic low-flow pump.

Each bore is purged a minimum of three casing volumes of water or until certain in-situ parameters (pH, conductivity and dissolved oxygen) have reached a constant ( $\pm 10\%$ ), with the hydrocarbon samples collected first. A summary of analysis for each bore is provided in Tables 3 to 6.



**Figure 4** Groundwater monitoring well locations

**Table 3** Groundwater monitoring result for bore GND 2300

Parameter	Unit	22 Jul 2014	26 Nov 2014	19 Jan 2015	28 Apr 2015
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m <sup>3</sup>	0.06	0.73	0.1	0.1
Barium (dissolved)	g/m <sup>3</sup>	0.01	-	0.06	0.015
Chloride	g/m <sup>3</sup>	81.9	94.4	138	157
Conductivity	mS/m@20°C	43	46.9	60.5	64.6
pH	pH	6.7	6.6	6.5	6.6
Sodium	g/m <sup>3</sup>	45.9	56.3	57.7	61.8
Static water level	m	7.433	6.893	7.302	7.357
Temperature	°C	14	14.5	15.2	14.3
Total dissolved solids	g/m <sup>3</sup>	332.7	-	468.1	499.8

**Table 4** Groundwater monitoring results for bore GND 2301

Parameter	Unit	22 Jul 2014	26 Nov 2014	19 Jan 2015	28 Apr 2015
Benzene	g/m <sup>3</sup>	0.0011	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7	2.2	<0.7
C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m <sup>3</sup>	<0.2	<0.2	1.4	0.2
C15-C36	g/m <sup>3</sup>	<0.4	<0.4	0.8	<0.4
Barium (acid soluble)	g/m <sup>3</sup>	8.2	0.77	5.2	6.1
Barium (dissolved)	g/m <sup>3</sup>	7.2	-	4.6	5.8
Chloride	g/m <sup>3</sup>	3900	420	2420	2160
Conductivity	mS/m@20°C	1190	186	744	694
pH	pH	6.5	6.5	6.2	6.4
Sodium	g/m <sup>3</sup>	740	135	437	406
Static water level	m	7.44	6.946	7.276	7.169
Temperature	°C	15.3	16	17.6	15.6
Total dissolved solids	g/m <sup>3</sup>	9207	-	5756	5370

**Table 5** Groundwater monitoring results for bore GND 2302

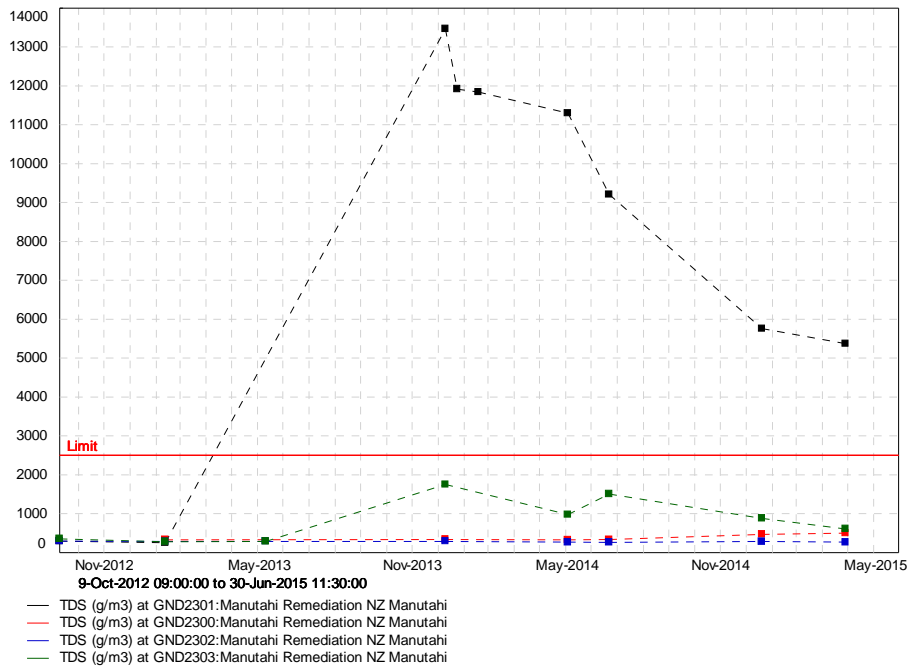
Parameter	Unit	22 Jul 2014	26 Nov 2014	19 Jan 2015	28 Apr 2015
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m <sup>3</sup>	<0.10	<0.1	<0.10	<0.10
C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m <sup>3</sup>	0.057	0.066	0.05	0.08
Barium (dissolved)	g/m <sup>3</sup>	0.014	-	0.018	0.014
Chloride	g/m <sup>3</sup>	62.3	60.4	62.9	58.9
Conductivity	mS/m@20°C	34.3	36.2	36.6	34.4
pH	pH	6.8	6.7	6.6	6.5
Sodium	g/m <sup>3</sup>	40	158	40	41.2
Static water level	m	7.682	7.467	7.563	7.607
Temperature	°C	14.3	14.9	16.2	14.8
Total dissolved solids	g/m <sup>3</sup>	265.4	-	283.2	266.2

**Table 6** Groundwater monitoring results for bore GND 2303

Parameter	Unit	22 Jul 2014	26 Nov 2014	19 Jan 2015	28 Apr 2015
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m <sup>3</sup>	0.7	0.52	0.37	0.4
Barium (dissolved)	g/m <sup>3</sup>	0.19	-	0.13	0.058
Chloride	g/m <sup>3</sup>	614	435	340	213
Conductivity	mS/m@20°C	195	140	114	79.1
pH	pH	6.5	6.4	6.3	6.4
Sodium	g/m <sup>3</sup>	193	44	119	78.4
Static water level	m	5.203	4.829	5.124	5.099
Temperature	°C	13.6	14.8	15.5	14.4
Total dissolved solids	g/m <sup>3</sup>	1509	-	882	612

Groundwater analysis undertaken by the Council through out the 2014-15 monitoring period detailed one ongoing exceedance. This was in the concentration of Total Dissolved Salts (TDS) ( $>2500 \text{ g/m}^3$ ) in groundwater bore GND2301. This was a breach of special condition 18<sup>2</sup>, Figure 5.

The rationale for the exceedance observed in groundwater bore GND2301 which is situated in the locality of the storage cell area was due to a rip in the liner of cell one which compromised its integrity. This was identified in early 2014 by Council's Investigating Officer. Repairs were undertaken in mid 2014, and as a result the concentration of TDS has shown a decreasing trend since the repair, Figure 5.



**Figure 5** Historic Total Dissolved Salt Concentration by monitoring well location

Groundwater monitoring bores GND2302 and 2303 are located on the site boundary (Figure 4) to detect any potential offsite migration. Neither of these bores to date has shown any evidence to suggest possible groundwater contamination. As the groundwater analysis at the boundary of the site did not suggest any adverse effects from the exercise of the consent the annual surface water sample of the unnamed lake to the north of the facility was deemed unnecessary.

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

<sup>2</sup> Consent 7795-1 Condition 18: The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding  $2500 \text{ g/m}^3$

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 (IR) 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 2014-15 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

### **3. Discussion**

#### **3.1 Discussion of site performance**

Under the previous management regime there were several administrative issues which centred on the supply of information, housekeeping, and site security. The physical landfarming operations also required some improvement in terms of record keeping of the areas which had been utilised for the application of material. This resulted in a slight overlap in terms of material being overlaid on a previous spread area, this is discussed in more detail in the following section.

The current site management took full control of the facility in June 2014, as such they inherited a poor rating from the previous owner due to the fact they had taken ownership during the 2013-14 monitoring period.

However, this monitoring period 2014-2015 marked the first full year in which the site was managed by the Company. Observations throughout the year detailed that the issues outlined in 2013-14 year had been addressed with the new ownership, with an improved performance rating in both environmental and administrative areas, including the addition of site security measures and improved safety signage.

In terms of the operations which have occurred at the facility during this monitoring period; one area was landfarmed, this area is detailed as Area A (Figure 2). Notifications were made to the Council regarding the transfer of wastes to site and landfarming activities. Inspections did not identify any issues of concern.

The Consent holder did not undertake any soil sampling as per requirement of the exercise of the consent, however, these are to be undertaken and reported during the 2015-16 monitoring period. While the Council accepts this, it is not inline with the consent conditional requirement.

#### **3.2 Environmental effects of exercise of consents**

In terms of environmental effects associated with the exercise of the consent, a minor legacy issue remains. During the 2013-14 monitoring year a small tear was identified by the Council's Inspectorate Officer in the liner of one of the storage cells. This was subsequently repaired, however, due to the nature of the tear; an increase in the concentrations of total dissolved salts (TDS) was identified within the groundwater monitoring well GND 2301. The historic increase in TDS concentration is detailed in Figure 5.

While the issue had been rectified through the careful repair of the storage liner, the legacy still remains and the Council will continue to monitor this location until it is below the consented requirement of TDS below 2500 g/m<sup>3</sup>. Monitoring of the three remaining groundwater wells indicated that there appears to be no more than minor environmental effects due to activities at the site.

Levels of potential contaminants in the surface soil as a result of the application meet the required consent conditions, with no application areas exceeding stipulated criteria. The Company would not be able to surrender spread Area A1 due to the fact that the

concentrations of salt within the soil profile do not meet surrender criteria, as detailed by the consent.

In reviewing the data provided by the Company and specifically the map which indicated the location of the newly spread area (Figure 2), it is possible to discern that that the application of material to land in this period (Area A1) slightly overlapped a previous application area. This was identified by the Council's Investigating Officer, and the Company will be mindful to not allow this to occur in the future as it would constitute a breach in one of the consent conditions<sup>3</sup>. In this instance as the double layering only occurred over a small area, the operator was warned to be mindful of previously spread locations. However, the Council appreciates the transparency of the Company in providing this accurate depiction of the overlap.

The Council was notified prior to the site receiving landfarmable material and pre-application screening analysis of the material was undertaken by the Consent holder and this information is provided in Appendix II which includes the Consent holder's annual report.

Due to the location of the site and the significant distance to any neighbours, no air monitoring was undertaken as effects on air quality are known to be minimal. The Council staff whom undertake the site inspections have been trained to acknowledge the presence of odours and they have been minimal during this period of reporting, refer to Section 2.1 Inspections.

### 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 7.

**Table 7** Summary of performance for Consent 7795-1 to discharge drilling wastes via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	N/A	N/A
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. The consent holder shall provide a stockpiling and landfarming management plan prior to the exercise of the consent	Management plan received and approved	Yes
4. Install groundwater monitoring wells prior to exercise of consent	Inspections and site records	Yes
5. Notify TRC 48 hrs prior to stockpiling	Notifications received	Yes
6. Notify TRC 48 hrs prior to landfarming	Notifications received	Yes

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<sup>3</sup> Consent 7795-1, Condition 15: An area of land utilised for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. The consent holder shall sample for the following: <ul style="list-style-type: none"> <li>a. Total petroleum hydrocarbons</li> <li>b. Benzene, toluene, ethylbenzene, xylenes</li> <li>c. Polycyclic aromatic hydrocarbons</li> <li>d. Chloride, nitrogen, pH, potassium, sodium</li> </ul>	Sampling	No soil samples received
8. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
9. Report on records in condition 6 to Council by 31 August each year	Report received	Yes
10. Discharges made only within area as specified by submitted application	Inspection	Mostly, slight overlap
11. No discharge within 25 m of a water body, 10 m from any property boundary and 50 m from the QEII covenant Key Native Ecosystems	Inspection	Yes
12. Maximum application thickness for wastes: <ul style="list-style-type: none"> <li>a) 100 mm TPH &lt;5%</li> <li>b) 50 mm TPH &gt;5%</li> <li>c) No ponded liquids 1 hr after application</li> </ul>	Company records and inspection	Yes
13. Incorporation into soil as soon as practicable to a depth of at least 250 mm	Inspection and sampling	Yes
14. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
15. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	Mostly, slight overlap.
16. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
17. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
18. Total dissolved salts in any fresh water body shall not exceed 2500 g/m <sup>3</sup>	Legacy issue associated with torn storage cell liner from 2013-14 year. TDS above 2500 g/m <sup>3</sup>	No



Condition requirement	Means of monitoring during period under review	Compliance achieved?
19. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling, see above note.	No
20. Conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Yes
21. Sodium absorption ratio [SAR] must be less than 18.02, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
22. Concentrations of heavy metals in the soil shall at all times comply with MFE guidelines	Sampling	Yes
23. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mS <sup>m</sup> <sup>-1</sup> b. chloride, 700 g/m <sup>3</sup> c. dissolved salts, 2500 g/m <sup>3</sup> d. sodium, 460 g/m <sup>3</sup>	Not applicable - sampling prior to surrender of consent	N/A
24. If condition 23 is not met, consent cannot be surrendered	Not applicable - sampling prior to surrender of consent	N/A
25. Notification of discovery of archaeological remains	Not applicable – none found	N/A
26. Consent shall lapse on 30 June 2017	Not applicable – consent exercised	N/A
27. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		Good

N/A = not applicable

During the year, the Company demonstrated a good level of environmental and good level of administrative performance with the resource consents as defined in Section 1.1.4. During the year under review there were 36 deliveries of drilling waste to the site and one disposal of material to land via landfarming.

Soil and groundwater sampling undertaken by the Council showed minor environmental effects as a result of the storage and disposal of drilling wastes. The Company did not undertake any sampling in this monitoring period (as required by special condition 7) and while justification for this was provided by the consent holder, it has contributed to an overall environmental and administration performance rating of good. Ratings are as defined in Section 1.1.4

### **3.4 Recommendations from the 2013-2014 Annual Report**

In the 2013-2014 Annual Report, it was recommended:

1. THAT the monitoring programme for the Site in the 2014-2015 year, remain unchanged from that for 2013-2014 monitoring period.
2. THAT the consent holder improves administrative compliance with the Consent required conditions.

During the monitoring period under review, the Company provided detailed and timely records of drilling waste deliveries and notified the Council before both delivery and disposal of muds.

### **3.5 Alterations to monitoring programmes for 2015-2016**

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

It is proposed that for 2015-2016 the monitoring programme for the Symes Manawapou Landfarm site remains unchanged from that for the 2014-2015 monitoring period. A recommendation to this effect is attached to this report.

#### **4. Recommendations**

1. THAT monitoring of consented activities at Symes Manawapou Landfarm in the 2015-2016 year continues at the same level as in 2014-2015.
2. THAT the consent holder continues to provide timely administrative and environmental compliance with the Consent required conditions, including soil samples.

## Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m <sup>3</sup> s <sup>-1</sup> ).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
g/m <sup>2</sup> /day	grams/metre <sup>2</sup> /day.
g/m <sup>3</sup>	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.
IR	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 <sup>2</sup>	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.
NH <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act</i> 1991 and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
Zn*	Zinc.

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

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

## **Bibliography and references**

Ministry for the Environment 2003: Guidelines for the safe application of biosolids to land in New Zealand, Ministry for the Environment.

Taranaki Regional Council 2013: Remediation NZ Limited Drilling Waste Disposal Monitoring Programme Annual Report 2012-2013. Technical report 2013-67.

Taranaki Regional Council 2014: Waste Remediation Services (WRS) Limited Symes Manawapou Landfarm Monitoring Programme Annual Report 2013-2014. Technical Report 2014-118.

## **Appendix I**

**Resource consent held by  
Waste Remediation Services (WRS)**  
(For a copy of the resource consent  
please contact the TRC consent department)





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

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

Decision Date: 01 May 2012

Commencement Date: 01 May 2012

**Conditions of Consent**

Consent Granted: To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming

Expiry Date: 01 June 2028

Review Date(s): June 2016, June 2022

Site Location: 156 Manawapou Road, Manutahi

Legal Description: Lot 1 DP 7324 (Discharge site)

Grid Reference (NZTM) 1717244E-5608736N

Catchment: Manawapou

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

### **General condition**

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

### **Special conditions**

1. For the purposes of this consent the following definitions shall apply:
  - a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land for the purpose of interim storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours; and
  - b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.
2. The consent holder shall adopt the best practicable option (as defined section 2 of the Resource Management Act 1991) to prevent or minimise any actual or potential effects on the environment arising from the discharge.

### **Requirements prior to exercise of consent**

3. Prior to the exercise of this consent, the consent holder shall provide a stockpiling and landfarming management plan that, to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council, demonstrates the activity can and will be conducted to comply with all of the conditions of this consent. The management plan shall be reviewed annually (on or about the anniversary of the date of issue of this consent) and shall include as a minimum:
  - a) procedures for notification to Council of disposal activities;
  - b) procedures for the receipt and stockpiling of drilling wastes onto the site;
  - c) methods used for the mixing and testing of different waste types;
  - d) procedures for site preparation;
  - e) procedures for landfarming drilling wastes (including means of transfer from stockpiling area, means of spreading, and incorporation into the soil);
  - f) procedures for sowing landfarmed areas, post-landfarming management, monitoring and site reinstatement;
  - g) contingency procedures;
  - h) sampling regime and methodology;
  - i) control of site access; and
  - j) documentation for all the procedures and methods listed above.
4. Prior to the exercise of this consent, the consent holder shall after consultation with the Chief Executive, Taranaki Regional Council, install a minimum of three groundwater monitoring bores. The bores shall be at locations and to depths, that enable monitoring to determine any change in groundwater quality resulting from the exercise of this consent. The bores shall be installed in accordance with NZS 4411:2001 and all associated costs shall be met by the consent holder.

## Notifications, monitoring and reporting

5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz)) at least 48 hours prior to permitting drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:
  - a) the consent number;
  - b) the name of the well(s) from which the waste was generated;
  - c) the type of waste to be stockpiled; and
  - d) the volume of waste to be stockpiled.
6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz)) at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:
  - a) the consent number;
  - b) the name of the well(s) from which the waste was generated;
  - c) the type of waste to be landfarmed;
  - d) the volume and weight (or density) of the waste to be landfarmed;
  - e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
  - f) the specific location and area over which the waste will be landfarmed.
7. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
  - a) total petroleum hydrocarbons (C<sub>6</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>);
  - b) benzene, toluene, ethylbenzene, and xylenes;
  - c) polycyclic aromatic hydrocarbons screening; and
  - d) chloride, nitrogen, pH, potassium, and sodium.
8. The consent holder shall keep records of the following:
  - a) wastes from each individual well;
  - b) composition of wastes (in accordance with condition 5);
  - c) stockpiling area(s);
  - d) volumes of material stockpiled;
  - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates;
  - f) volumes and weights of wastes landfarmed;
  - g) dates of commencement and completion of stockpiling and landfarming events;
  - h) dates of sowing landfarmed areas;
  - i) treatments applied; and
  - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;and shall make the records available to the Chief Executive, Taranaki Regional Council.
9. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, by 31 August of each year, a report on all records required to be kept in accordance with condition 6, for the period of the previous 12 months, 1 July to 30 June.

### **Discharge limits**

10. The discharge shall only occur on the disposal sites shown in the Drawing entitled 'Remediation NZ Ltd Proposed Disposal Site' submitted with the application and attached to this consent.
11. There shall be no discharge within buffer zone, being:
  - 25 metres of the Manawapou River;
  - 25 metres of the unnamed tributary;
  - 10 metres from any property boundary; and
  - 50 metres from the QE II covenant Key Native Ecosystem areas.
12. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:
  - a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight;
  - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
  - c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;prior to incorporation into the soil.
13. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.
14. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:
  - a) liquid waste has been discharged; or
  - b) solid waste has been discharged and incorporated into the soil.
15. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

### **Operational requirements**

16. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
17. As soon as practicable following landfarming, areas shall be sown into pasture (or into crop). The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

### **Receiving environment limits - water**

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

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

#### Receiving environment limits - soil

20. The conductivity of the soil/waste layer after landfarming shall be less than 400 mS/m, or alternatively, if the background soil conductivity exceeds 400 S/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.
21. The sodium adsorption ratio (SAR) of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.
22. The concentration of heavy metals in the soil over the disposal area shall at all times comply with the Ministry for the Environment and New Zealand Water & Wastes Association's Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:

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

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

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

MAHs - benzene, toluene, ethylbenzene, xylenes  
 PAHs - naphthalene, non-carc. (pyrene), benzo(a)pyrene eq.  
 TPH - total petroleum hydrocarbons (C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>)

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

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

### **Archaeological remains**

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

### **Lapse and review**

26. This consent shall lapse on 30 June 2017, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
27. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 3 June 2014

For and on behalf of  
Taranaki Regional Council

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A D McLay  
**Director - Resource Management**

## **Appendix II**

### **Company Supplied Annual Report**





20<sup>th</sup> August 2015

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

Attention Nathan Crook

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

Dear Nathan,

As required under special condition 9 of resource consent 7795-1, please find information that WRS, as the new operator of the site, have recorded from the 1 July 2014 to the 30<sup>th</sup> June 2015. WRS took over operation of the site from 30 May 2014. At that time all three pits were approximately 80% full largely with storm water with solidified cement returns, waste trash screen hardware, miscellaneous steel and some minor drilling mud and cuttings that had been placed in storage over the previous months from what WRS understood to be a variety of sources. No records were provided by Remediation NZ Ltd (RNZ) of the quantities or source of wastes stored in the pits in spite of repeated requests for these. From July 2014 WRS has records of drilling mud wastes placed into storage in the three lined pits ( approx. 500m<sup>3</sup> each ). At the close of the reporting period on 30 June 2015 all three pits had practically no drilling wastes as all drilling solids and liquids were been spread in December 2015. No further drilling wastes have been received for storage from that time to the end of the reporting period. A very dry first quarter of 2015 was followed by significant rain through to the end of June 15 resulting in the pits now largely containing storm water.. Any residual drilling wastes are now highly diluted.

In the spring of 2014 world oil prices were showing a steady downward trend. Returns were rapidly eroded especially for small field operators such as those operating in

Taranaki. Exploratory oil and gas, and production support drilling was ceased by all junior exploration companies operating in the province. This hiatus has continued to the end of the 2015 reporting period with no new wells spudded in the region. Some development and completion rig operations continue, but the generation of drilling muds and solids for disposal within the province by landfarming has effectively ceased.

For this reason WRS has not received any drilling waste for storage and disposal since Dec 2014. The disposal site at Manawapou has been inactive through to the close of the reporting period (30 June 2015) apart from rehabilitation in April 2015 of the area spread in Dec 2014..

Information pertaining to resource consent 7795-1 is provided under the following headings

### **1) Delivery Record -attached 'Mud Register'**

The mud register contains the record of deliveries for storage, for each well/delivery campaign as notified by email to the TRC; as required by Condition 5.

### **2) Spread Areas and Events during 2014/15 –attached Diagramme**

Site map showing Area A spread between 29 /10 - 22/12/2014 and rehabilitated in April 2015

- a) Disposal of storm water by slurry tanker 04-09 August 2014
- b) Disposal of storm water by slurry tanker 29-30 October 2014
- c) Spreading of drilling mud and solids 12-22 December 2014
- Total volume drilling wastes spread 1170m3

### **3) Spreading Records**

All spreading campaigns were notified by email as required by Condition 6 at least 48hrs before "landfarming "commenced. As all the pits at a site are emptied to a practical minimum during spreading campaigns the "Mud Register" contains a comprehensive

record of the waste to be spread, viz delivery date, source of the wastes, type, volumes (densities are not measured as this is impractical and varies hugely with time and drilling history). Key parameters are determined by analysis by RJ Hills Labs and spread location by the supplied diagramme .

#### **4) Field Photographs - attached**

As attached. Spread Area A had just been reinstated at the end of May 2015. Pasture had just struck but growth stalled by cooler ground temperatures.

#### **5) Composition of Wastes/Pre Disposal Analysis - attached**

Analytical results from RJ Hill Laboratories Ltd of sampling undertaken during the period.

#### **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 as there are no identifiers that would show this.

#### **7) Operations Management Plan –attached**

Operations at the Manawapou land farm are all undertaken generally in accordance with the Landfarm Management Plan. The document is a live document and is constantly reviewed and updated as necessary (most recently July 2015) to reflect operational requirements and practices.

## **To summarise**

-Material stockpiled on the site is sampled prior to arrival on site. The sample can at best be considered as representative of the waste stream at a point in time in the drilling and completion cycle of a well and not the entire waste volume. Once wastes are mixed with other material in the storage pits individual consignments can no longer be identified or characterised if required.

When a sufficient volume of material has been stockpiled requiring spreading to land, an assessment is made of all predisposal results to determine whether a composite sample needs to be taken. If hydrocarbon levels can be estimated without the need for a composite sample, the spread area is designated and landfarming commences.

Monitoring of the landfarm area begins within three months of topsoil being re-applied and pasture planted. As spreading and rehabilitation was completed late in the reporting period no post disposal/spreading sampling was undertaken. Monitoring will be undertaken in the 2015-16 reporting period

Specific landfarmed and sampling locations areas are set out and surveyed in by fixed station or hand held GPS methods. These co-ordinates are contained within the Manawapou (Symes) site records which are updated as spreading and any other works are undertaken.

## **Methods:**

All sampling is undertaken as per standard Hill Laboratories sampling protocols. Representative samples are collected from a number of surveyed points and these are aggregated to produce the representative sample that is sent to the laboratory for analysis. Typically samples are retrieved from approximately 75mm depth with an industry standard plug sampler, but sampling depths can vary depending on the location of the waste layer and the depth of waste disposal.

Keith Brodie  
Waste Remediation Services (WRS) Ltd  
PO Box 7150,



## ANALYSIS REPORT

Page 1 of 1

<b>Client:</b>	Waste Remediation Services Ltd (WRS)	<b>Lab No:</b>	1300854	SPv1
<b>Contact:</b>	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	<b>Date Registered:</b>	19-Jul-2014	
		<b>Date Reported:</b>	23-Jul-2014	
		<b>Quote No:</b>		
		<b>Order No:</b>		
		<b>Client Reference:</b>		
		<b>Submitted By:</b>	Keith Brodie	

### Sample Type: Aqueous

Sample Name:	Waikakai Pre Disp 31 17-Jul-2014 4:30 pm	Manawapou Pre Disp 1 17-Jul-2014 5:00 pm	Manawapou Pre Disp 2 17-Jul-2014 5:05 pm		
Lab Number:	1300854.1	1300854.2	1300854.3		
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	< 0.15	4.4	< 0.15	-
C10 - C14	g/m <sup>3</sup>	< 0.4	16.1	< 0.4	-
C15 - C36	g/m <sup>3</sup>	< 0.8	8	< 0.8	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	< 1.4	28	< 1.4	-

### Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

## SUMMARY OF METHODS

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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MIE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m <sup>3</sup>	1-3

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

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

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

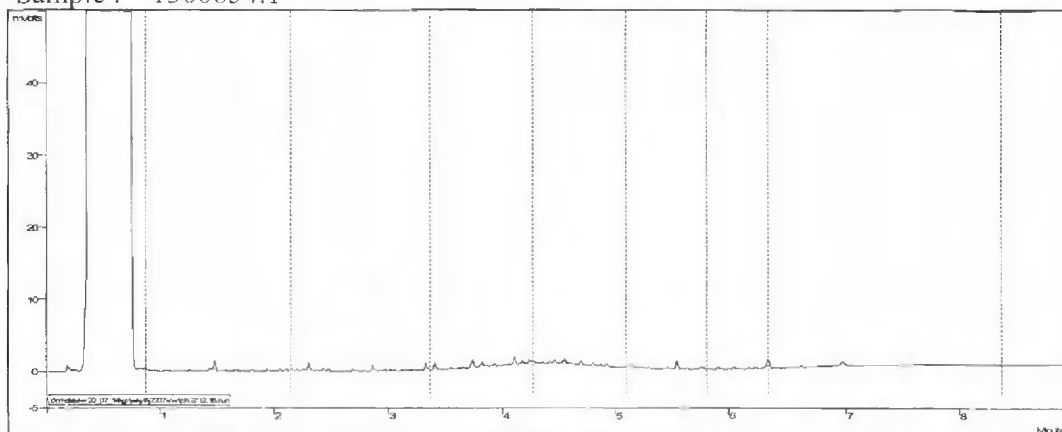
Ara Heron BSc (Tech)  
Client Services Manager - Environmental Division



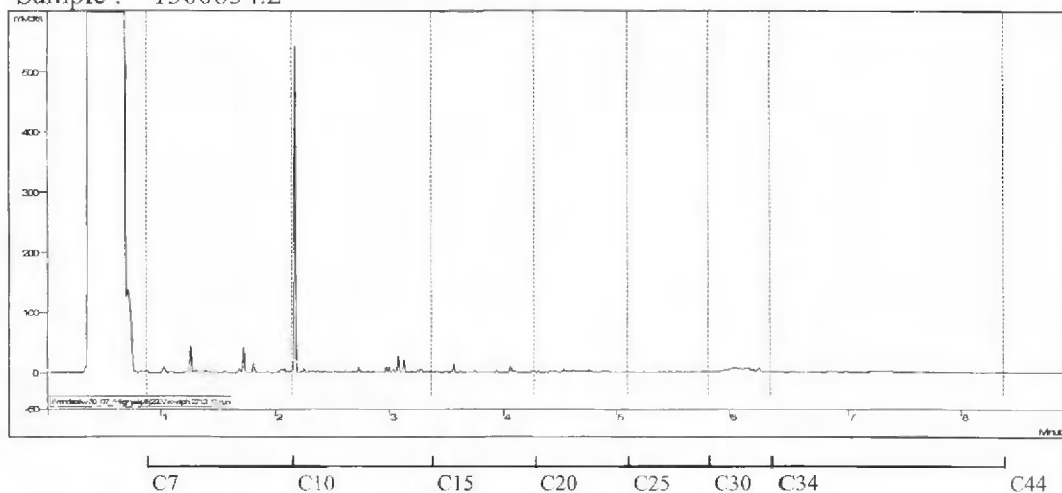
This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.

The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked \*, which are not accredited.

Sample : 1300854.1



Sample : 1300854.2







## ANALYSIS REPORT

Page 1 of 3

<b>Client:</b>	Waste Remediation Services Ltd (WRS)	<b>Lab No:</b>	1311210	SP:1
<b>Contact:</b>	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	<b>Date Registered:</b>	14-Aug-2014	
		<b>Date Reported:</b>	28-Aug-2014	
		<b>Quote No:</b>	60824	
		<b>Order No:</b>		
		<b>Client Reference:</b>	WAI Pre-Disp Liquid/ MAN Pre-Disp Liquid	
		<b>Submitted By:</b>	Keith Brodie	

### Sample Type: Aqueous

Sample Name:		Waikikai Pre Disp 3-2 13-Aug-2014 2:30 pm	Manawapou Pre Disp 1-2 13-Aug-2014 2:00 pm			
Lab Number:		1311210.1	1311210.2			
Individual Tests						
pH	pH Units	8.6	8.8	-	-	-
Total Barium	g/m <sup>3</sup>	170	0.37	-	-	-
Total Boron	g/m <sup>3</sup>	2.5	0.41	-	-	-
Total Calcium	g/m <sup>3</sup>	1,010	42	-	-	-
Hexavalent Chromium	g/m <sup>3</sup>	< 0.02 #1	< 0.010	-	-	-
Total Magnesium	g/m <sup>3</sup>	410	3.8	-	-	-
Total Mercury	g/m <sup>3</sup>	< 0.011	< 0.0021	-	-	-
Total Potassium	g/m <sup>3</sup>	9,400	990	-	-	-
Total Sodium	g/m <sup>3</sup>	1,260	173	-	-	-
Total Vanadium	g/m <sup>3</sup>	1.91	< 0.021	-	-	-
Chloride	g/m <sup>3</sup>	6,800	1,260	-	-	-
Total Nitrogen	g/m <sup>3</sup>	185	9.5	-	-	-
Nitrate-N + Nitrite-N	g/m <sup>3</sup>	0.40	0.03	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m <sup>3</sup>	185	9.5	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m <sup>3</sup>	0.34	< 0.021	-	-	-
Total Cadmium	g/m <sup>3</sup>	< 0.0053	< 0.0011	-	-	-
Total Chromium	g/m <sup>3</sup>	2.2	< 0.011	-	-	-
Total Copper	g/m <sup>3</sup>	1.30	0.018	-	-	-
Total Lead	g/m <sup>3</sup>	1.23	< 0.0021	-	-	-
Total Nickel	g/m <sup>3</sup>	1.84	< 0.011	-	-	-
Total Zinc	g/m <sup>3</sup>	4.6	0.025	-	-	-
Ethylene Glycol in Water						
Ethylene glycol*	g/m <sup>3</sup>	13	< 4	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol*	g/m <sup>3</sup>	< 2	< 2	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m <sup>3</sup>	0.048	< 0.0010	-	-	-
Toluene	g/m <sup>3</sup>	0.190	< 0.0010	-	-	-
Ethylbenzene	g/m <sup>3</sup>	0.022	< 0.0010	-	-	-
m&p-Xylene	g/m <sup>3</sup>	0.16	< 0.002	-	-	-
o-Xylene	g/m <sup>3</sup>	0.057	< 0.0010	-	-	-
Glutaraldehyde in Water by DNPH & LCMSMS						
Glutaraldehyde*	g/m <sup>3</sup>	< 0.3	< 0.3	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.  
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked \*, which are not accredited.

Sample Type: Aqueous					
Sample Name:		Waikakai Pre Disp 3-2 13-Aug-2014 2:30 pm	Manawapou Pre Disp 1-2 13-Aug-2014 2:00 pm		
Lab Number:		1311210.1	1311210.2		
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq					
Acenaphthene	g/m <sup>3</sup>	< 0.0007	< 0.00010	-	-
Acenaphthylene	g/m <sup>3</sup>	< 0.0007	< 0.00010	-	-
Anthracene	g/m <sup>3</sup>	0.0023	< 0.00010	-	-
Benzo[a]anthracene	g/m <sup>3</sup>	0.0026	< 0.00010	-	-
Benzo[a]pyrene (BAP)	g/m <sup>3</sup>	0.0008	< 0.00010	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m <sup>3</sup>	0.0017	< 0.00010	-	-
Benzo[g,h,i]perylene	g/m <sup>3</sup>	0.0007	< 0.00010	-	-
Benzo[k]fluoranthene	g/m <sup>3</sup>	0.0008	< 0.00010	-	-
Chrysene	g/m <sup>3</sup>	0.0029	< 0.00010	-	-
Dibenzo[a,h]anthracene	g/m <sup>3</sup>	< 0.0007	< 0.00010	-	-
Fluoranthene	g/m <sup>3</sup>	0.0040	< 0.00010	-	-
Fluorene	g/m <sup>3</sup>	0.026	< 0.0002	-	-
Indeno[1,2,3-c,d]pyrene	g/m <sup>3</sup>	< 0.0007	< 0.00010	-	-
Naphthalene	g/m <sup>3</sup>	0.191	< 0.0005	-	-
Phenanthrene	g/m <sup>3</sup>	0.052	< 0.0004	-	-
Pyrene	g/m <sup>3</sup>	0.0087	< 0.0002	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m <sup>3</sup>	0.8	< 0.4	-	-
C10 - C14	g/m <sup>3</sup>	39	< 1.0	-	-
C15 - C36	g/m <sup>3</sup>	90	< 2	-	-
Total hydrocarbons (C7 - C36)	g/m <sup>3</sup>	130	< 4	-	-

### Analyst's Comments

#1 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the Cr6S analysis.

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

## SUMMARY OF METHODS

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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Acetaldehyde and Glutaraldehyde in Water extraction, Trace*	DNPH derivatisation, extraction, HPLC.	-	1-2
Heavy metals, totals, screen As, Cd, Cr, Cu, Ni, Pb, Zn	Nitric acid digestion, ICP-MS, screen level	0.0011 - 0.021 g/m <sup>3</sup>	1-2
Ethylene Glycol in Water*	Direct injection, dual column GC-FID	4 g/m <sup>3</sup>	1-2
Methanol in Water - Aqueous Solvents*	Direct injection, dual column GC-FID	1.0 g/m <sup>3</sup>	1-2
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m <sup>3</sup>	1-2
Glutaraldehyde in Water by DNPH & LCMSMS*	DNPH derivatisation, extraction, LCMSMS	0.03 g/m <sup>3</sup>	1-2
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m <sup>3</sup>	1-2
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/M/E Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m <sup>3</sup>	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 22 <sup>nd</sup> ed. 2012 (modified).	-	1-2
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-2
pH	pH meter. APHA 4500-H <sup>+</sup> B 22 <sup>nd</sup> ed. 2012.	0.1 pH Units	1-2
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.0021 g/m <sup>3</sup>	1-2



Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Boron	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.11 g/m <sup>3</sup>	1-2
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	1.1 g/m <sup>3</sup>	1-2
Hexavalent Chromium	Diphenylcarbazide colorimetry. Discrete Analyser. APHA 3500 Cr B (modified from manual analysis) 22 <sup>nd</sup> ed. 2012.	0.010 g/m <sup>3</sup>	1-2
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.42 g/m <sup>3</sup>	1-2
Total Mercury	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.0021 g/m <sup>3</sup>	1-2
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	1.1 g/m <sup>3</sup>	1-2
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.42 g/m <sup>3</sup>	1-2
Total Vanadium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 <sup>nd</sup> ed. 2012.	0.021 g/m <sup>3</sup>	1-2
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl <sup>-</sup> E (modified from continuous flow analysis) 22 <sup>nd</sup> ed. 2012.	0.5 g/m <sup>3</sup>	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m <sup>3</sup> is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m <sup>3</sup> , the Default Detection Limit for Total Nitrogen will be 0.11 g/m <sup>3</sup> .	0.05 g/m <sup>3</sup>	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO <sub>3</sub> -I 22 <sup>nd</sup> ed. 2012.	0.002 g/m <sup>3</sup>	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N <sub>org</sub> D. (modified) 4500 NH <sub>3</sub> F (modified) 22 <sup>nd</sup> ed. 2012.	0.10 g/m <sup>3</sup>	1-2

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

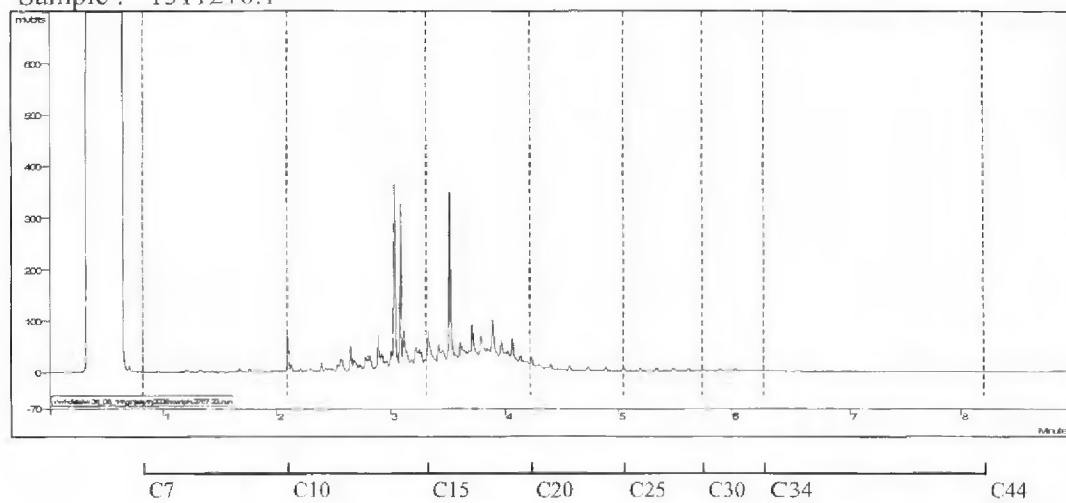
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Client Services Manager - Environmental Division

Sample : 1311210.1





## ANALYSIS REPORT

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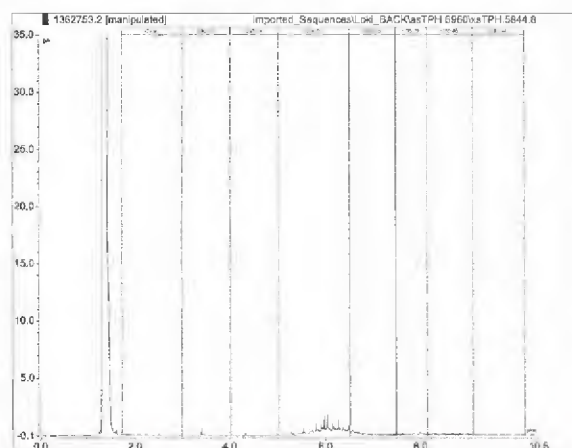
<b>Client:</b>	Waste Remediation Services Ltd (WRS)	<b>Lab No:</b>	1362753	SPv1
<b>Contact:</b>	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	<b>Date Registered:</b>	10-Dec-2014	
		<b>Date Reported:</b>	24-Dec-2014	
		<b>Quote No:</b>		
		<b>Order No:</b>		
		<b>Client Reference:</b>	Manawapo Pre-Spread 1 & 2	
		<b>Submitted By:</b>	Keith Brodie	

Sample Type: Sludge					
<b>Sample Name:</b>		Manawapo Pre-Spread Solids B 09-Dec-2014	Manawapo Pre-Disposal Liquid 09-Dec-2014		
<b>Lab Number:</b>		1362753.1	1362753.2		
Individual Tests					
Dry Matter	g/100g as rcvd	73	6.3	-	-
Chloride*	mg/kg dry wt	20,000	240,000	-	-
Total Nitrogen*	g/100g dry wt	< 0.13	0.25	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 9	< 300	-	-
C10 - C14	mg/kg dry wt	< 20	< 500	-	-
C15 - C36	mg/kg dry wt	< 40	1,020	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 1,600	-	-

1362753.2

Manawapo Pre-Disposal Liquid 09-Dec-2014

Client Chromatogram for TPH by FID



## SUMMARY OF METHODS

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

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-2



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.  
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked \*, which are not accredited.

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MIE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1-2
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	1-2
esICexIn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1-2
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1-2
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-2

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Client Services Manager - Environmental Division



## ANALYSIS REPORT

Page 1 of 1

<b>Client:</b>	Waste Remediation Services Ltd (WRS)	<b>Lab No:</b>	1362536	SPv1
<b>Contact:</b>	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	<b>Date Registered:</b>	10-Dec-2014	
		<b>Date Reported:</b>	12-Dec-2014	
		<b>Quote No:</b>	65793	
		<b>Order No:</b>		
		<b>Client Reference:</b>	Manawapo Pre-spread 1 & 2	
		<b>Submitted By:</b>	Keith Brodie	

### Sample Type: Sludge

<b>Sample Name:</b>	Manawapo Pre-spread Solids A 09-Dec-2014 11:30 am				
<b>Lab Number:</b>	1362536.1				
Individual Tests					
Dry Matter	g/100g as rcvd	61	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 11	-	-	-
C10 - C14	mg/kg dry wt	< 30	-	-	-
C15 - C36	mg/kg dry wt	< 50	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	-	-	-

## 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
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
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

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

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


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Client Services Manager - Environmental Division




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[illegible]

 WBM  
 Grey Water  
 Black Water  
 Solid  
 Ball Road  
 multiple loads per docket  
 Query  
 Invoiced



[illegible] WBM

☐ Grey Water

Black Water  
Solid  
Ball Road

x 2 loads per docket

Query



**Appendix III**  
**Groundwater Monitoring Well Log**



Bore	Depth (m)	Drilling Formation
GND2300	0.00 – 0.50	Sandy topsoil
	0.50 – 1.00	Sandy clay
	1.00 – 5.50	Light brown / orange fine-soft-sticky-clay
	5.50 – 10.50	Sandy / clay / loose sand, increasing moisture
GND2301	0.00 – 0.50	Sandy top soil
	0.50 – 2.50	Fine gravel / black sands
	2.50 – 3.50	Lit brown / orange clays / fine
	3.50 – 4.00	Yellow clays / very fine / sticky
	4.00 – 6.50	Sandy clay
	6.50 – 9.00	Tight dark clay with peat
GND2302	0.00 – 2.00	Black fine gravel / sand
	2.00 – 8.00	Light brown / orange clay
	8.00 – 9.00	Grey sandy clay moisture loose
	9.00 – 10.00	Grey sandy clay / tight / compact
GND2303	0.00 – 0.50	Dark brown sandy soil
	0.50 – 2.00	Light brown / orange clay-loose-sticky-moist
	2.00 – 3.00	Light brown / orange clay tight
	3.00 – 5.00	Light brown / orange sandy clay saturated / soft
	5.00 – 7.00	Dark brown peaty clay / brown orange clay saturated
	7.00 – 7.50	Loose saturated sands
	7.50 – 10.00	Tight dark grey sands / dry / tight