Remediation NZ Limited Drilling Waste Disposal Monitoring Programme Annual Report 2012-2013

Technical Report 2013-67

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Executive summary

Remediation (NZ) Limited operates a drilling waste landfarm located on Manawapou Road at Manutahi in the Manawapou catchment. Disposal activities commenced at this site during the 2012-2013 monitoring year. This report for the 2012-2013 period describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

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

The Council's monitoring programme for the year under review included 12 inspections, the collection of two soil samples and ten groundwater samples, and the review of monitoring data received from the Company.

The monitoring indicated that there appears to be no adverse environmental effects due to activities at the site. Concentrations of contaminants in the surface soil meet the required consent conditions and surface and groundwater results indicate no adverse impacts from stockpiling or spreading at this site. Ongoing monitoring of the site will ensure that any consent limits that apply at the time of surrender, are satisfied at that time. There were three Unauthorised Incident/s (UI/s) recording non-compliance in respect of this consent holder during the period under review.

During the year, the Company demonstrated a poor level of compliance with various consent conditions, and improvement is desirable. No significant environmental impacts were observed but there were some operational issues which required additional investigation and enforcement.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendation for the 2013-2014 year.

Table of contents

			Page
1.	Introduction		1
	1.1	Compliance monitoring programme reports and the Resource Management Act 1991	1
		1.1.1 Introduction	1
		1.1.2 Structure of this report	1
		1.1.3 The Resource Management Act (1991) and monitoring	1
		1.1.4 Evaluation of environmental and consent performance	2
	1.2	Process descriptions	3
		1.1.1 Drilling waste	3
		1.1.2 Landfarming	4
	1.2	Site location and description	5
	1.3	Resource consents	6
	1.4	Monitoring programme	7
		1.4.1 Introduction	7
		1.4.2 Programme liaison and management	7
		1.4.3 Site inspections	8
		1.4.4 Chemical sampling	8
		1.4.5 Review of analytical results	8
2.	Results		9
	2.1	Inspections	9
		2.1.1 Results of discharge monitoring	12
		2.1.2 Provision of company data	13
		2.1.3 Results of receiving environment monitoring	13
		2.1.3.1 TRC Soil results	13
		2.1.3.2 TRC Groundwater results	14
		2.1.3.3 Remediation supplied soil results	16
	2.2	Investigations, interventions, and incidents	16
3.	Discussion		19
	3.1	Discussion of site performance	19
	3.2	Environmental effects of exercise of consents	19
	3.3	Evaluation of performance	19
	3.4	Alterations to monitoring programmes for 2013-2014	22
4.	Recommendations		23
Glossary of common terms and abbreviations			24
Bibliography and references			27
Appendix I	Resource consent held by Remediation NZ Limited		
Appendix II	Supplied annual report		

Appendix III Abatement and Infringement notices

Appendix IV Monitoring well schematics

Appendix V AgKnowledge landfarm review report

List of tables

Table 1	2012-2013 TRC soil sample results, Remediation Landfarm	13
Table 2	TRC Groundwater results for monitoring wells GND 2300 and 2301, Remediation landfarm	14
Table 3	Groundwater results for monitoring wells GND 2302 and 2303, Remediation landfarm	15
Table 4	Summary of performance for Consent 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	19

List of figures

Figure 1	Aerial photograph showing the location and extent of the Remediation Landfarm and approximate regional location (inset)	6
Figure 2	Site activity photos from June 2013 inspection	12
Figure 3	Supplied spreading map showing areas S1 and S2, Remediation Landfarm	13
Figure 4	Groundwater monitoring site locations, Remediation landfarm with site map and regional map (inset)	16

List of photos

Photo 1	Drilling mud discharge around the pit	18
Photo 2	Ponding muds in spreading area S2 as observed on 29 January 2013	18

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2012 - June 2013 by the Taranaki Regional Council describing the monitoring programmes associated with resource consents held by Remediation NZ Limited (Remediation). Remediation operates a drilling waste landfarm situated on Manawapou Road at Manutahi. Remediation also operates composting/vermicomposting sites in Brixton and Uruti. The Uruti site receives and processes drilling waste as part of their composting operation.

The Remediation site became operational in September 2012. At the time of exercise of the consent, the storage area had been developed with a secure lined pit system, and groundwater monitoring was initiated shortly after initial stockpiling of material.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Remediation NZ Limited, to discharge drilling waste onto and into land via landfarming. This is the first Annual Report, to be prepared by the Taranaki Regional Council to cover the Company's 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 Resource Management Act and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by Remediation, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Company's Manawapou landfarm 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 2013-2014 monitoring year.

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

1.1.3 The Resource Management Act (1991) and monitoring

The Resource Management Act 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 a discharger, and may include cultural and social-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
(d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic):
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on exiting permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, (covering both activity and impact) monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management. 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 consent 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 an overall rating. The categories used by the Council, and their interpretation, are as follows:

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.

- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, 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, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and any inconsequential non compliances with conditions were resolved positively, co-operatively, and quickly.

- **improvement desirable (environmental)** or **improvement desirable (administrative compliance)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there were matters that required

urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.

- **poor performance (environmental)** or **poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process descriptions

1.1.1 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.

1.1.2 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 $3-4000/ha to $30-40,000/ha (2013). The full report is attached in Appendix IV.

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

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 utilized at the Remediation 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 continue to be used for grazing following stabilisation and re-grassing.

1.2 Site location and description

The Remediation (NZ) Landfarm is located on Manawapou Road at Manutahi. This site is located 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 1023 mm (taken from the nearby 'Duffy' monitoring station). As with the other South Taranaki coastal sites, the Remediation 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:	1023 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
Land use:	Remediation farming livestock / grazing cattle

Table 1 Bore construction data

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

Bore	*Depth (m)*	*Drilling Formation*
	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

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

1.3 Resource consents

Remediation 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 issued by the Taranaki Regional Council on 1 May 2012 to Remediation, as a resource consent under Section 87(e) of the Resource Management Act. This resource consent is due to expire on 1 June 2028.

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.

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the Resource Management Act sets out obligation/s upon the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

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

The monitoring programme for the Remediation landfarm consisted of four primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application:

- in discussion over monitoring requirements
- preparation for any reviews
- renewals
- new consents
- advice on the Council's environmental management strategies and content of regional plans and
- consultation on associated matters.

1.4.3 Site inspections

A total of twelve inspections were made of the Remediation landfarm site during the monitoring period with regard to the consent for the discharge of drilling waste. Inspections focussed 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.

1.4.4 Chemical sampling

During the monitoring period the Council collected two composite soil samples from both spreading areas S1 and S2 at the Remediation site. For each sample, 12-15 cores were taken from a diagonal transect at 10m intervals to a depth of 250mm, and composited in the field. The samples were analysed for chloride, conductivity, hydrocarbons, moisture factor, pH, sodium and total soluble salts.

At the Remediation site four bores were constructed and sampled three times over the monitoring year. Samples were analysed for barium, chloride, conductivity, nitrate, pH, total dissolved salts BTEX, and TPH.

1.4.5 Review of analytical results

The Council reviewed soil sampling results and the annual reports provided by the Company in respect of the site. The Company collected representative pre-disposal samples from individual waste streams prior to disposal, and receiving environment soil samples from all spreading areas post waste application. These samples were sent to an independent IANZ accredited laboratory for analysis for a wider range of contaminants. Chemical parameters tested were (all solid/sludge samples):

- pH
- chlorides
- potassium
- sodium
- total nitrogen
- barium
- heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)
- BTEX
- PAHs
- TPH (and individual hydrocarbon fractions C7-C9, C10-C14, C15-C36)

Receiving environment soil samples were also tested for electrical conductivity and sodium absorption ratio (SAR).

2. Results

2.1 Inspections

There were a total of twelve inspections of the Remediation site during the monitoring period. Of these, four were scheduled, two were non-compliance follow-up inspections, and six were conducted in conjunction with physicochemical monitoring. Incidents are further discussed in Section 2.2 of this report. Summaries of compliance inspection and follow-up inspections are provided below.

9 October 2012
An inspection was conducted in conjunction with routine groundwater sampling. No spreading had yet commenced and pit one was observed to be reasonably full. All appeared to be in order.

6 November 2012
An inspection was conducted in conjunction with routine groundwater sampling. Upon inspection it was observed that pit one was reaching capacity. In addition, two new pits were now constructed and lined on site and no material had yet been farmed. The site looked reasonably well managed and all was found to be in order.

7 January 2013
Upon inspection no objectionable odours or emissions were detected. Three pits were now noted on site, all with high-grade synthetic liners. Pits one and two were reaching capacity. Some material had been farmed in an area adjacent to the pits. This farmed material had ponded slightly at one end of the spreading area. This ponding was attributed to the slight slope across the spreading area. The ponding at this site could be indicative of a future problem as it is considerably more undulating than neighbouring sites, and would need close monitoring by the consent holder during future spreading operations.

17 January 2013
Upon inspection no objectionable odours or visible emissions were detected beyond the site boundary. Three pits were on-site, all of which were lined and appeared to be intact. The southern most pit was full and essentially no freeboard was available. It appeared that the southern wall had been built up to contain the liquid. Some evidence of rabbit burrowing was noticed around the southern wall also. The liquids in all pits appeared free of surface oils and some landfarming had occurred to the north of the storage area. The farmed mud appeared to be well blended into the soil matrix. No pasture strike was evident, yet topsoil bunds appeared to be helping prevent wind destabilisation. It was also observed that no signage was present around the pit area.

22 January 2013
An inspection was conducted in conjunction with routine soil sampling. Upon inspection no objectionable odours or visible emissions were detected. Pit one was observed to be at capacity and liquid had begun to pond around the side of the pit where the liner had clearly been overtopped and was no longer visible. It was outlined that the contents of this pit would need to be farmed shortly, however as Remediation had begun spreading, it was presumed that this would be done as a part of that process. Cattle were observed within the spreading area, which had recently been spread yet had not yet been tilled or sown. While there was no current consent

conditions regarding keeping stock out of active spreading areas, it was noted and discussed with the Company.

23 January 2013
No objectionable odours or visible emissions were detected upon inspection. An inspection was initiated after a delivery of what appeared to be WBM was discharged by 'Redback'. Material had been stored in the southern most pit, which was beyond capacity. Further investigation revealed the levels to be at least 8 inches above the liner level on the southern side and a bund wall along the southern side had a clear 'wet tide-line' indicative that the pit was not sealed above the liner. The liquid appeared to be encroaching into the paddock onto the western side of the pit and some of the truck washings were also discharged onto the unsealed surface before the pit rather than into the pit itself. One of the other pits had a baffle pipe inside. The level of the liquid within the pit was to the top of the pipe and some material appeared to have discharged into it. The third pit at the site was acceptable and the muds in the pits appeared free of surface oils. In addition, cattle were being used to further remediate the area where muds had recently been applied, more earthworks had occurred in preparation to receive further muds. It was outlined that no more material was to be put into the already full pits, which were above the liner level and to ensure all washings were discharged into the lined pits. An incident was registered, the details of which are given in Section 2.2.

29 January 2013
No objectionable odours or visible emissions were detected during the inspection. The holding pit that had been identified during the previous inspection as being too full had since had the level lowered and was discharging the liquid portions of the mud into the western pit. Areas where muds had recently been applied showed some ponding. Some of the ponded liquid was migrating to the lower end of the application site. An earthen bund had been constructed at this end of the spreading area and appeared to have contained the material effectively. It was outlined to the contractors that the consent requires the application of all muds in a manner where no ponded liquid remains after one hour of it being applied, and that applied material must be incorporated into the soil as soon as is practical.

30 January 2013
No objectionable odours or visible emissions were detected upon inspection. Work had been undertaken to incorporate ponded liquid into the soil profile, however some areas of liquid ponding still remained at the northern end of the site. Some washings were discharged to land adjacent to the pits and some surface oils were present on the turbid wash liquid which was ponded in tyre ruts. The pits were inspected and found to be satisfactory. It was outlined to site staff that they must incorporate all remaining muds into the soil profile and ensure no surface ponding occurs one hour after muds are spread. Staff were also reminded to ensure washings are discharged into the pits.

11 February 2013
An inspection was conducted in conjunction with routine groundwater sampling. At the time of inspection mud was being spread, the liquid portion of the waste was being pumped into the solids pit and agitated to create a slurry which was then being dispersed over the contoured area. No ponding or issues were observed and the spreading area looked in order.

2 April 2013

No objectionable odours or visible emissions were detected beyond the site boundary upon inspection, however distinct sulphur odours were noted directly downwind of storage pits. All pits were found to have plenty of freeboard available. The liquid inside all of the pits was dark with very little visible surface oiling. The area where muds had previously been applied had since been disced and had been sown, but no pasture was visible. Muds were observed to be generally well mixed into the soil profile.

23 April 2013

Upon inspection no objectionable odours or visible emissions were detected. Three lined pits were found onsite, all of which were observed to have plenty of available freeboard and the liners appeared in good order. Very little surface oil was visible in the pits and the area where muds had been applied was fenced off from stock. Pasture strike looked good throughout and appeared to be healthy. The ponded water in the low points from recent heavy rain was clear and free of hydrocarbon sheen.

4 June 2013

Upon inspection no objectionable odours or visible emissions were detected. All pits on site were found to have plenty of freeboard and the material contained within was essentially free of surface oils and hydrocarbon sheen. It was observed that one liner was found to have a small tear near the top which is above the lowest point of the pit wall, the hole will need to be repaired to prevent wind deteriorating it further. A small pile (approximately $1m^3$) of gravel/metal was stockpiled adjacent to the pits, no hydrocarbon contamination was found, but it was outlined that if the material originated at a well site it must be stored within the pit. Another pile of concrete and cuttings was observed on the edge of one pit adjacent to the small shed. The area where muds had previously been applied was found to have good pasture coverage and had recently been lightly grazed. Cattle had caused pugging in the soft soil, yet very little mud was identifiable within the soil profile (except in one 2 m^2 patch which had essentially no pasture strike). Another low point (where the spreading area drains adjacent to the groundwater monitoring bore) had little pasture growth due to the ponding, yet the liquid was free of hydrocarbon sheen and odour. It was outlined to site staff to repair the small hole in the liner and ensure all materials originating from well sites are stored within the pits.

Figure 2 Site activity photos from June 2013 Inspection, clockwise from top left: spreading area S1 looking north, lined pit 1 with cuttings/cement piled outside pit, lined pit 2, area S1 looking inland

2.1.1 Results of discharge monitoring

During the monitoring year there were four disposals totalling 2,500 m^3 consisting of primarily water/synthetic based cuttings and fluids, with smaller quantities of contaminated water and soil. The waste spread was sourced from the Arakamu (1 and 2), Waitapu (1 and 2), Wairere 1, Copper Moki (2, 3 and 4), Douglas, and Cheal (A9, A10, A11, A12, B5, B6, B7, C3 and C4) wellsites. On the basis of average TPH concentrations the waste was spread at the 100 mm application rate over an area of 5,000 m^2 (area S1 and S2, Figure 3, below). As per the consent conditions, the Company is required to supply pre-disposal results of material to be discharged prior to discharge for the Council to review.

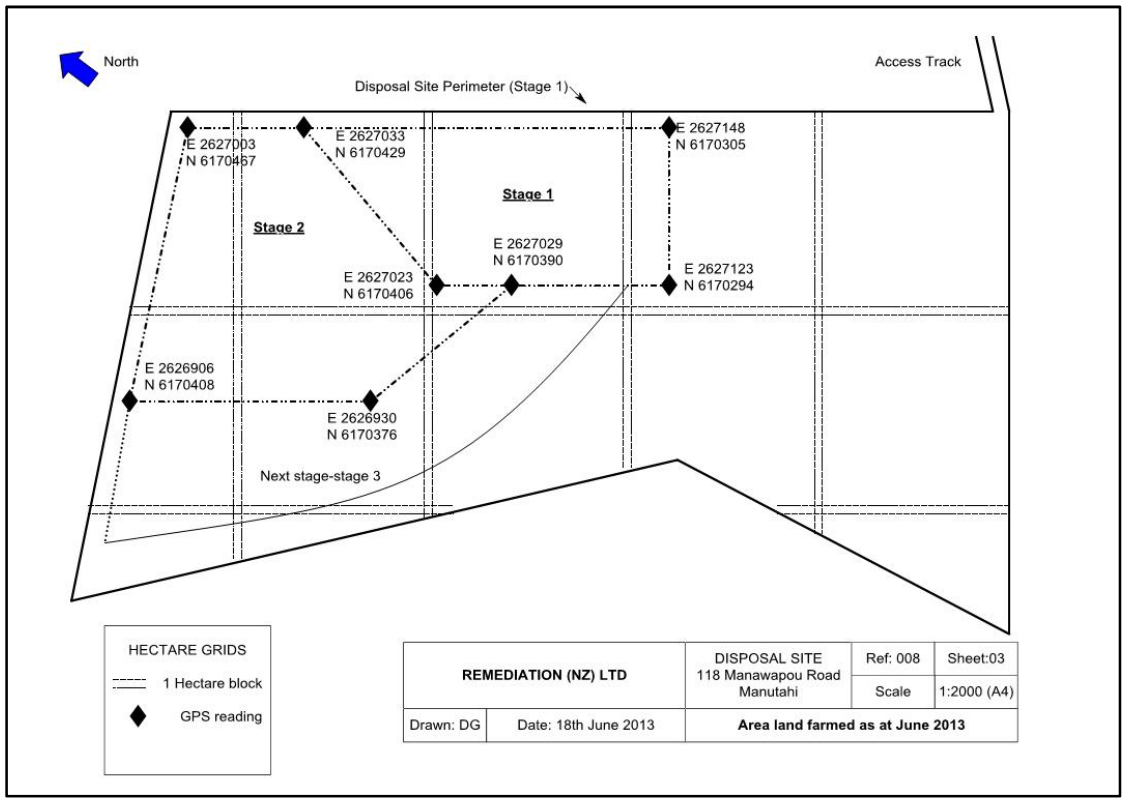


Figure 3 Supplied spreading map showing areas S1 and S2, Remediation Landfarm

2.1.2 Provision of company data

The Company provides data recording stockpiling, discharges to land via landfarming, predisposal results and receiving environment soil sample results to the Council throughout the monitoring year. The Company also supplies this data for review annually as a report as per the consent requirement. The 2012-2013 supplied annual report for this site was received late following a request from the Council, but met the consent requirements in terms of content, with the exception of post spreading receiving soil results, which were unavailable at the time of reporting. The full supplied report is attached in Appendix II.

2.1.3 Results of receiving environment monitoring

2.1.3.1 TRC Soil results

During the monitoring year, two spreading areas had been completed. Therefore, two composite soil samples were collected by sub-sampling to a depth of 250mm in landfarmed areas S1 and S2. The results of this sampling are presented in Table 2, along with baseline pre-spreading results for comparison.

Table 2 2012-2013 TRC soil sample results, Remediation Landfarm

Parameter	Unit	S1	S2	S1 Baseline*	S2 Baseline*	Consent limit
		10-Jun-13	10-Jun-13			
Calcium	mg/kg	122	167	43	23	-
Chloride	mg/kg DW	177	268	9	9	700
Conductivity	mS/m@20C	166	229	80	50	400

Parameter	Unit	S1	S2	S1 Baseline*	S2 Baseline*	Consent limit
Hydrocarbons	mg/kg DW	29	26	<70	<70	50,000 (application)
Moisture factor	nil	1.019	1.021	-	-	-
Magnesium	mg/kg	16	17	18	9	-
Sodium	mg/kg	37	44	44	31	460
pH	pH	7.4	7.5	-	-	-
Sodium absorption ratio	None	0.84	0.87	1.4	1.4	18
Total soluble salts	mg/kg	1299	1792	528	310	2500

Bold type indicates non-compliance
*Company supplied results

The Council soil samples for areas S1 and S2 demonstrate compliance with all of the limits stipulated in the conditions of consent 7795-1. The levels of hydrocarbons detected are relatively low. Total soluble salts and chlorides have increased but at these levels are unlikely to have any detrimental effects on soil structure and biota, or groundwater quality.

2.1.3.2 TRC Groundwater results

A total of ten groundwater samples were taken over three occasions from the four monitoring wells during the monitoring period. The monitoring well locations are shown in Figure 4, and the well schematics are attached in Appendix IV. The results are presented in Tables 3 and 4 below.

Table 3 TRC Groundwater results for monitoring wells GND 2300 and 2301, Remediation landfarm

Parameter	Unit	GND2300		GND2301	
		09-Oct-12	11-Feb-13	09-Oct-12	11-Feb-13
Barium	g/m3	0.07	0.18	-	0.057
Benzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	276	87.8	52.3	59.5
Conductivity	mS/m@20C	93.5	42.8	38.2	32.9
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon	g/m3	<0.7	<0.7	<0.7	<0.7
Nitrate	g/m3 N	0.35	12	-	3.09
pH	pH	6.4	6.4	6.5	6.6
Total dissolved salts	g/m3	723.4	331.1	295.6	254.6
Toluene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m3	<0.0010	<0.002	<0.0010	<0.002
ortha-Xylene	g/m3	<0.002	<0.0010	<0.002	<0.0010

Table 4 Groundwater results for monitoring wells GND 2302 and 2303, Remediation landfarm

Parameter	Unit	GND2302			GND2303		
		09-Oct-12	11-Feb-13	10-Jun-13	09-Oct-12	11-Feb-13	10-Jun-13
Barium	g/m3	-	0.068	0.26	-	0.108	0.69
Benzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	73.4	68.5	69.2	89.6	69.1	137
Conductivity	mS/m@20C	37.7	37	37.5	45.6	36.5	36
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon	g/m3	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Nitrate	g/m3 N	-	4.11	3.66	-	0.52	0.4
pH	pH	6.6	6.6	6.6	6.5	6.6	6.16
Total Dissolved Salts	g/m3	291.7	286.3	290.1	352.8	282.4	287.8
Toluene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m3	<0.0010	<0.002	<0.002	<0.0010	<0.002	<0.002
ortha-Xylene	g/m3	<0.002	<0.0010	<0.0010	<0.002	<0.0010	<0.0010

No hydrocarbons were detected in any of the groundwater samples taken during the monitoring period. Chloride was slightly elevated in bore GND2300 in the October 2012 sample; however, it was within the range of chloride concentrations seen in bores at the other coastal sites, where chloride is naturally elevated. No adverse environmental effects are anticipated from slightly elevated salts in non-consumptive coastal groundwater. Barium was also slightly elevated in some of the samples taken. As has become apparent from groundwater monitoring at some of the landfarm sites, barium levels may appear elevated above what would be considered 'background'. However, review of analytical methods for barium in water indicates that the methodology utilized by the Council (acid soluble barium) may give a less representative (and higher) result than the methodology utilized by RJ Hill Laboratories (dissolved barium through filtration). It is therefore recommended that the Council adopt the dissolved barium through filtration method of assessing barium levels in all subsequent water samples for this site.

Figure 4 Groundwater monitoring site locations, Remediation landfarm with site map and regional map (inset)

2.1.3.3 Remediation supplied soil results

At the time of reporting only baseline soil (pre-spreading) and pre-disposal (waste) results have been received from the Company.

The Company has been informed that results must be supplied to the Council as soon as they are available to confirm compliance with special conditions 14, 20, 21 and 22 of resource consent 7795-1. Council officers were continuing to address this matter at the end of the period under review.

2.2 Investigations, interventions, and incidents

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

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

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

In the 2012-2013 period, it was necessary for the Council to undertake significant additional investigations and interventions, or record incidents, in association with Remediation's conditions in resource consents or provisions in Regional Plans in relation to the Company's activities during the monitoring period.

Three incidents were recorded against the landfarm site during the monitoring period. These incidents are summarised below.

Abatement 11870 – 11 September 2012

An abatement notice was issued to the consent holder regarding drilling muds which had been stockpiled at the site prior to the installation of groundwater monitoring bores. This contravened special condition 4 of Resource Consent 7795-1 which states, a minimum of three groundwater monitoring boreholes must be installed prior to the exercise of the consent. This was a technical consent breach with no associated adverse environmental effects (as the storage pits were fully lined). The Company was quick to respond and rectify the situation; monitoring wells were installed under Council supervision and sampled as per the consent requirements.

A copy of the abatement notice is attached in Appendix III.

Incident 23308 – 23 January 2013

During routine compliance monitoring it was discovered that a lined pit used to contain water based drilling mud had been filled above the level of the liner and that washings from a recent truck delivery had also been discharged onto the unsealed surface around the pit rather than into the pit itself. The findings of the inspection were immediately outlined to the resource consent holder who agreed to have the level of the pit lowered the following day when spreading activities were to commence, and operators were to be made aware that all washings have to be discharged into the pits.

Photo 1 Drilling mud discharge around the pit

Incident 23331 – 29 January 2013

During routine compliance monitoring it was discovered that on the area where muds had been applied, ponded liquid had remained on the surface more than one hour after it was spread. Re-inspection the following day found that although works had been undertaken to incorporate the material into the soil profile, ponded liquid was still present in some areas. A letter requesting an explanation for the consent non-compliance was sent, a letter of explanation was then received, and an infringement notice was issued to the consent holder. A copy of the infringement notice is attached in Appendix III.

Photo 2 Ponding muds in spreading area S2 as observed on 29 January 2013

3. Discussion

3.1 Discussion of site performance

The Company was generally competent with the physical aspects of the landfarming processes and achieved decent results with spreading procedures and pasture establishment. However, there were some operational incidents recorded against the site, and the supply of information (notifications, reporting formats, transporting records and map supply) requires improvement.

The incidents recorded against the Company were largely related to substandard storage (overfilling) and spreading (ponding) activities. There were no observable environmental effects detected from these non compliances, however, to avoid any potential future effects it will be necessary for the Company to review some of its practices and clearly communicate with transporting and earthworks contractors.

In the following monitoring period it will be necessary for the Council to work with the Company to ensure that the data supply (reporting) methodology utilised by the Company is of an improved standard. A recommendation to this effect is given in Section 4.

3.2 Environmental effects of exercise of consents

Monitoring indicates that there appears to be no adverse environmental effects due to activities at the site. Levels of contaminants in the surface soil meet the required consent conditions in the Council samples. At the time of reporting, the Company receiving environment results had yet to be supplied. Groundwater results have not indicated that there are any significant impacts on groundwater resources from activities conducted at this site. Further monitoring of the site will be undertaken to ensure that compliance with all consent limits is demonstrated prior to surrender. Due to the location of the sites and the significant distance to any neighbours no air monitoring was undertaken as effects are known to be minimal.

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 5.

Table 5 Summary of performance for Consent 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

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	**Not consistently**
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

Condition requirement	Means of monitoring during period under review	Compliance achieved?
4. Install groundwater monitoring wells prior to exercise of consent	Notifications received	**No**
5. Notify TRC 48 hrs prior to stockpiling	Notifications received	**Requires improvement**
6. Notify TRC 48 hrs prior to landfarming	Notifications received	**Requires improvement**
7. The consent holder shall sample for the following: a. Total petroleum hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes
8. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
9. Report on records in condition 6 to Council by 31 August each year	Report received	**Received late**
10. Discharges made only within area as specified by submitted application	Inspection	Yes
11. No discharge within 25m of a water body, 10m from any property boundary and 50m from the QEII covenant Key Native Ecosystems	Inspection	Yes
12. Maximum application thickness for wastes: a) 100 mm TPH <5% b) 50 mm TPH >5% c) No ponded liquids 1 hr after application	Company records and inspection	**Mostly (ponding observed on 1 occasion)**
13. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes
14. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
15. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	Yes
16. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 2500g/m^3	Sampling	Yes
19. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling	Yes
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	**Requires confirmation**
23. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mSm^{-1} b. chloride, 700 g/m^3 c. dissolved salts, 2500 g/m^3 d. sodium, 460 g/m^3	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		**Poor (compliance and administrative)**

*TRC results only. Company results required to confirm

The Company's consent compliance was poor during the period under review, and an improvement is desirable. During the year under review there were three incidents recorded against the site and one infringement notice and one abatement notice issued to the Company for operational consent condition non-compliances.

3.4 Alterations to monitoring programmes for 2013-2014

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

It is proposed that for 2013-2014 the monitoring programme for the Remediation NZ Limited site remains generally unchanged from that for the 2012-2013 monitoring year. However, if spreading activities continue into the larger 'stage 2' area, it should be assessed as to whether additional groundwater bores are required in this area.

A recommendation to this effect is attached to this report.

4. Recommendations

1. THAT the monitoring programme for the Remediation NZ Limited site in the 2013-2014 year, remain unchanged from that for 2012-2013.

2. THAT the Company reviews their reporting and notification formatting with input from Council scientific staff.

3. THAT prior to the utilisation of the southern 'Stage 2' spreading zone, the Council reviews whether the installation of additional monitoring wells is required in this area.

Glossary of common terms and abbreviations

The following abbreviations and terms are 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
BTEX	MAH's benzene, toluene, ethylbenzene and xylene
bund	a wall around a tank to contain its contents in the case of a leak
CBOD	carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate
cfu	colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample
COD	chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction
Condy	conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m
Cu*	copper
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1})
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
E.coli	*escherichia coli*, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Ent	enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample
F	fluoride
FC	faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
fresh	elevated flow in a stream, such as after heavy rainfall
g/m^3	grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
IANZ	International Accreditation New Zealand
Incident	an event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred
intervention	action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring
investigation	action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident
l/s	litres per second

MAHs	Monocyclic aromatic hydrocarbons, molecules consist of a single six-sided hydrocarbon ring
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point
NH_4	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH_3	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
NO_3	nitrate, normally expressed in terms of the mass of nitrogen (N)
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water
O&G	oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons)
OW	Oily waste
PAHs	Polycyclic aromatic hydrocarbons, molecules consist of more than two six-sided hydrocarbon rings
Pb*	lead
pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5
Physicochemical	measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
PM_{10}	relatively fine airborne particles (less than 10 micrometre diameter)
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and including all subsequent amendments
SBM	Synthetic based mud
SS	suspended solids
SQMCI	semi quantitative macroinvertebrate community index;
Temp	temperature, measured in °C (degrees Celsius)
TPH	Total petroleum hydrocarbons
Turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
WBM	Water based mud
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

Department of Health 1992: Public health guidelines for the safe use of sewage effluent and sewage sludge on land. Department of Health.

Ministry for the Environment 1999: Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand, Ministry for the Environment.

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

Appendix I

Resource consent held by Remediation NZ Limited

Discharge Permit

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

Name of Consent Holder:	Remediation (NZ) Limited P O Box 8045 NEW PLYMOUTH 4342
Decision Date:	1 May 2012
Commencement Date:	1 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 at or about (NZTM) 1717244E-5608736N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	156 Manawapou Road, Manutahi
Legal Description:	Lot 1 DP 7324 (Discharge site)
Catchment:	Manawapou

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

General condition

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

Special conditions

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

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

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

Requirements prior to exercise of consent

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

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

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

Notifications, monitoring and reporting

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

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

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

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

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

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

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

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

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

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

Discharge limits

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

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

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

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

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

    prior to incorporation into the soil.

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

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

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

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

Operational requirements

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

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

Receiving environment limits - water

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

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

Receiving environment limits - soil

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

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

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

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

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

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

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

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

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

Archaeological remains

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

Lapse and review

26. This consent shall lapse on 30 June 2017, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

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

Signed at Stratford on 1 May 2012

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Supplied annual report

PROPOSED DISPOSAL SITE

N

Pipeline Corridor

MANAWAPOU ROAD

TANGAH_E ROA

MUGGERIDGE

TANGAH_E R_A

L_VER TA_MAHA ROAD

MANAWAPOU ROAD

STAGE 1
9.776 Ha

Bunding around perimeter of site

Access Track

Storage Area & Pond

Tasman Sea

STAGE 2

LOWER TAUMAHA ROAD

GEARY ROAD

Disposal Site Area - Stage 1

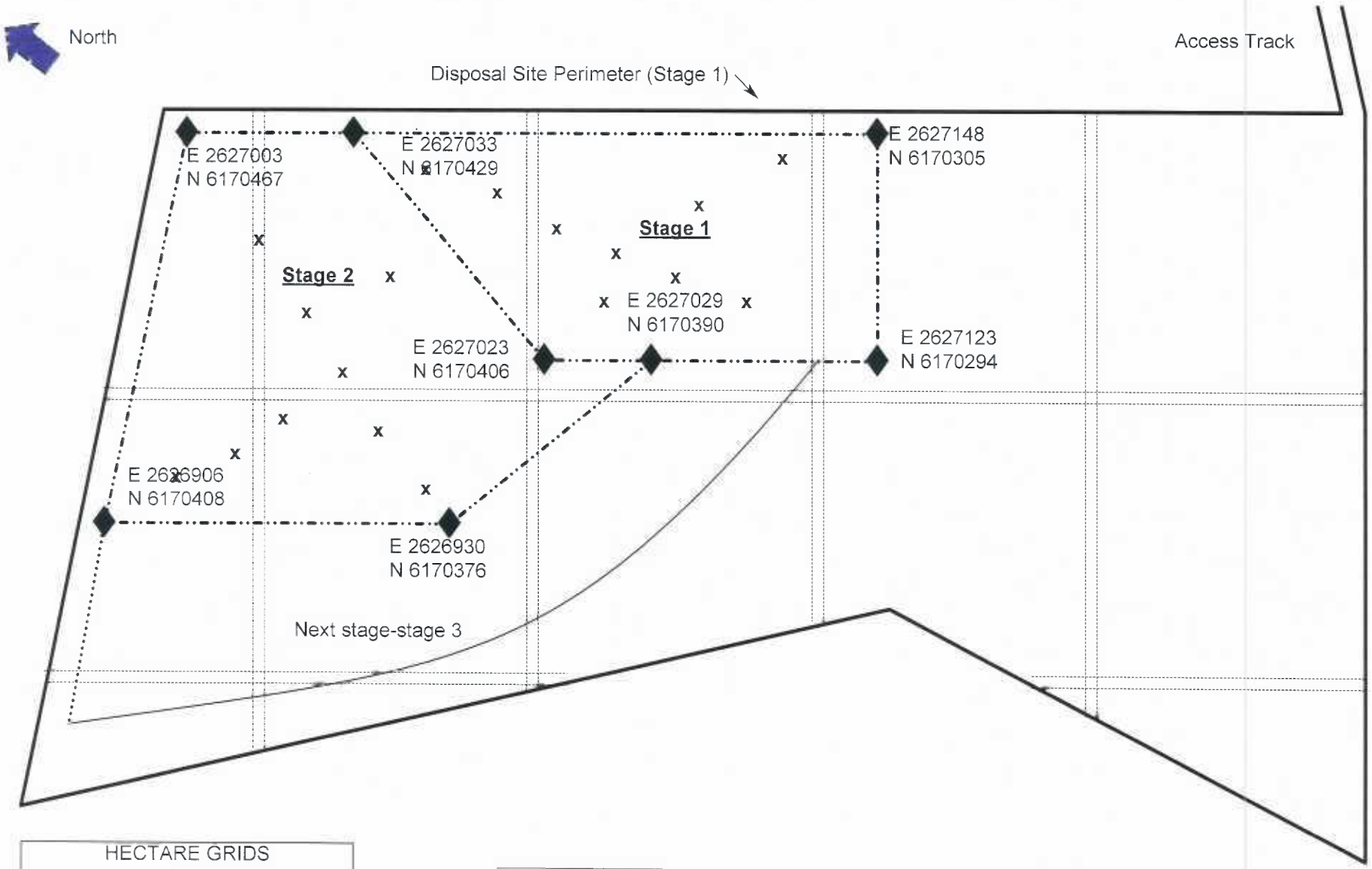
Disposal Site Area - Stage 2

DIANE SOBYE
Drafting Services
Ph 06 751 2881
Mob 027 634 3788

REMEDIATION NZ LTD
PROPOSED DISPOSAL SITE

DISPOSAL SITE
118 Manawapou Road
MANUTAHI

REF.	SHEET
008	01
SCALE	1:10 000 (A3)
DATE	25 March 2011



HECTARE GRIDS

1 Hectare block

GPS reading

x Soil Sampling Site

REMEDIATION (NZ) LTD		DISPOSAL SITE 118 Manawapou Road Manutahi	Ref: 008	Sheet:03
			Scale	1:2000 (A4)
Drawn: DG	Date: 25 September 2013	**Area land farmed as at June 2013**		

Calculations for Spreading Area & Depth

Manutahi Site Consent No 7795-1

Spreading

Waste to be spread = WBM

Volume to be spread = 500m3

Hydrocarbon Content = 1580 mg/kg

Spreading Depth = 100mm

500m3/ .100 = 5000m2

Loading

(1580 mg/kg x 100mm) / 250mm = 632mg/kg (0.0632% hydrocarbons in top 250mm of soil)

Drilling Waste New Zealand Energy September 12

Date	Product	Manifest No	Site	Transporter	Volume
4/09/2012	WBM	2117	Waitapu One	McCann	17
4/09/2012	WBM	2118	Waitapu One	McCann	13
4/09/2012	WBM	2507	Waitapu One	Redback	6
5/09/2012	WBM	2119	Waitapu One	Redback	18
5/09/2012	WBM	2508	Waitapu One	Redback	13
5/09/2012	WBM	2509	Waitapu One	Redback	13
5/09/2012	WBM	2510	Waitapu One	Redback	6
5/09/2012	WBM	2511	Waitapu One	Redback	6
7/09/2012	WBM	2120	Waitapu One	McCann	16
7/09/2012	WBM	2515	Waitapu One	Redback	6
7/09/2012	WBM	2516	Waitapu One	Redback	13
15/09/2012	WBM	2123	Waitapu One	McCann	16
17/09/2012	WBM	2951	Waitapu One	McCann	17
17/09/2012	WBM	2953	Waitapu One	Redback	12
17/09/2012	WBM	2954	Waitapu One	Redback	12
18/09/2012	WBM	2955	Waitapu One	McCann	17
18/09/2012	WBM	2956	Waitapu One	Redback	10
19/09/2012	WBM	2957	Waitapu One	McCann	16
19/09/2012	WBM	2958	Waitapu One	Redback	10
20/09/2012	WBM	2343	Waitapu One	Redback	10
21/09/2012	WBM	2959	Waitapu One	McCann	15
22/09/2012	WBM	2960	Waitapu One	McCann	14
23/09/2012	WBM	2961	Waitapu One	Redback	12
24/09/2012	WBM	2347	Waitapu One	Redback	12
25/09/2012	WBM	2962	Waitapu One	McCann	16
25/09/2012	WBM	2348	Waitapu One	Redback	9
28/09/2012	WBM	2965	Waitapu One	Redback	13
28/09/2012	WBM	2966	Waitapu One	McCann	11
29/09/2012	WBM	2967	Waitapu One	McCann	15
29/09/2012	WBM	2968	Waitapu One	Redback	15
30/09/2012	WBM	2969	Waitapu One	McCann	20
30/09/2012	WBM	2970	Waitapu One	McCann	9
					408

Drilling Waste New Zealand Energy Corp October 2012

Date	Product	Site& Manifest No	Transporter	Volume
1/10/2012	WBM	Waitapu One 2971	Redback	16
1/10/2012	WBM	Waitapu One 2972	Redback	13
1/10/2012	WBM	Waitapu One 2973	Redback	10
1/10/2012	WBM	Waitapu One 2974	Redback	16
2/10/2012	WBM	Waitapu One 2975	Redback	16
2/10/2012	WBM	Waitapu One 2976	Redback	13
4/10/2012	WBM	Waitapu One 2787	Redback	13
5/10/2012	WBM	Waitapu One 3074	Redback	16
5/10/2012	WBM	Waitapu One 2788	Redback	13
8/10/2012	WBM	Waitapu One 2978	Redback	13
8/10/2012	WBM	Waitapu One 2789	Redback	7
8/10/2012	WBM	Waitapu One 2793	Redback	6
11/10/2012	WBM	Waitap[u One 2979	McCann	10
13/10/2012	WBM	Waitapu 2 2980	McCann	8
13/10/2012	WBM	Waitapu 2 2356	Redback	10
14/10/2012	WBM	Waitapu 2 2981	McCann	17
14/10/2012	WBM	Waitapu 2 2978	Redback	10
14/10/2012	WBM	Waitapu 2	Redback	10
15/10/2012	WBM	Waitapu 2 2982	McCann	17
15/10/2012	WBM	Waitapu 2 2984	Redback	10
16/10/2012	WBM	W 2 2985	McCann	17
16/10/2012	WBM	W 2 2986	Redback	15
17/10/2012	WBM	W 2 2987	McCann	17
17/10/2012	WBM	W 2 2988	Redback	10
17/10/2012	WBM	W 2 2989	Redback	10
18/10/2012	WBM	W 2 2990	Redback	10
18/10/2012	WBM	W 2 2991	McCann	17
18/10/2012	WBM	W 2 2992	Redback	10
21/10/2012	WBM	W 2 2993	Redback	10
23/10/2012	WBM	W 2 2994	Redback	10
23/10/2012	WBM	W 2 2995	Redback	22
25/10/2012	WBM	W 2 2996	McCann	17
25/10/2012	WBM	W 2 2997	Redback	10
25/10/2012	WBM	W 2 3048	Redback	8
25/10/2012	WBM	W 2 2998	McCann	17
25/10/2012	WBM	W 2 2999	Redback	12
25/10/2012	WBM	W 2 3000	Redback	12.5
26/10/2012	WBM	W 2 3401	McCann	6
26/10/2012	WBM	W 2 3402	Redback	6
29/10/2012	WBM	ARK 1 2126	McCann	11
29/10/2012	WBM	W 1 2368	Redback	12
29/10/2012	WBM	W 1 & 2 2370	Redback	12
30/10/2012	WBM	ARK 2127	McCann	17
30/10/2012	WBM	W 2 2371	Redback	6
31/10/2012	WBM	W 1 3404	McCann	4
31/10/2012	WBM	ARK 2128	McCann	12
31/10/2012	WBM	W 2 2374	Redback	12
31/10/2012	WBM	W 2 3358	Redback	22
				645.5

Drilling Muds NZEC November 2012

Date	*Product*	*Manifest No*	*Transporter*	*Volume*
1/11/2012	WBM	W 2 3405	Red Back	12
1/11/2012	WBM	ARK 2129	Red Back	7
1/11/2012	WBM	W 2 3406	Red Back	12
1/11/2012	WBM	W 2 3407	Red Back	12
1/11/2012	WBM	W 2 3408	Red Back	12
2/11/2012	WBM	W 2 3409	Red Back	13
2/11/2012	WBM	W 2 3410	Red Back	8
2/11/2012	WBM	ARK 1 2130	Red Back	6
2/11/2012	WBM	ARK 1 2130	Red Back	12
3/11/2012	WBM	ARK 1 2131	Red Back	14
3/11/2012	WBM	ARK 1 2377	Red Back	14
3/11/2012	WBM	ARK 1 2378	Red Back	12
3/11/2012	WBM	ARK 1 3305	Red Back	14
3/11/2012	WBM	ARK 1 2379	Red Back	12
5/11/2012	WBM	W 2 2381	Red Back	12
7/11/2012	WBM	W 2 2132	Red Back	6
12/11/2012	WBM	ARK 2 3701	Red Back	14
12/11/2012	WBM	ARK 2 3702	Red Back	9
12/11/2012	WBM	ARK 2 3703	Red Back	11
12/11/2012	WBM	ARK 2 3704/2	Red Back	17
13/11/2012	WBM	ARK 2 3704/3	Red Back	17
13/11/2012	WBM	ARK 2 3705	Red Back	17
14/11/2012	WBM	ARK 2 3706	Red Back	10
14/11/2012	WBM	ARK 2 3707/5	Red Back	16
15/11/2012	WBM	ARK 2 3709	Red Back	14
15/11/2012	WBM	ARK 2 3710	Red Back	14
15/11/2012	WBM	ARK 2 3711	Red Back	14
16/11/2012	WBM	ARK 2 3712	Red Back	14
16/11/2012	WBM	ARK 2 3713	Red Back	14
16/11/2012	WBM	ARK 2 3714	Red Back	14
17/11/2012	WBM	ARK 2 3716	Red Back	14
18/11/2012	WBM	ARK 2 3715/6	Red Back	17
18/11/2012	WBM	ARK 2 3718	Red Back	14
19/11/2012	WBM	ARK 2 3719	Red Back	10
19/11/2012	WBM	ARK 2 3717/7	Red Back	17
19/11/2012	WBM	ARK 2 3720	Red Back	14
20/11/2012	WBM	ARK 2 3721	Red Back	10
21/11/2012	WBM	ARK n2 3722#8	McCann	17
23/11/2012	WBM	ARK 2 3723#9	McCann	6
26/11/2012	WBM	ARK 2 3724	Red Back	14
26/11/2012	WBM	ARK 2 3725	Red Back	14
26/11/2012	WBM	ARK 2 3726#10	McCann	18
26/11/2012	WBM	ARK 2 3727	Red Back	6
27/11/2012	WBM	ARK 2 3728#11	McCann	9
28/11/2012	WBM	ARK 2 3411	Red Back	20
30/11/2012	WBM	ARK 2 3729#12	McCann	17
				740.98

Drilling Waste NZEC December 2012

Date	Product	Site& Manifest No	Transporter	Volume
2/12/2012	WBM	Arakamu Two 3735	Redback	22
2/12/2012	WBM	Arakamu Two 3732	Redback	22
2/12/2012	WBM	Arakamu Two 3734	Redback	14
2/12/2012	WBM	Arakamu Two 3733#3	McCann	12
2/12/2012	WBM	Arakamu Two 3731	Redback	14
1/12/2012	WBM	Arakamu One 3730	Redback	14
5/12/2012	WBM	Arakamu Two 3737	Redback	22
5/12/2012	WBM	Arakamu One 3738	Redback	16
5/12/2012	WBM	Arakamu One 3739	Redback	14
5/12/2012	WBM	Arakamu Two 3740	Redback	22
5/12/2012	WBM	Arakamu One 3741	Redback	16
5/12/2012	WBM	Arakamu Two 3742	Redback	14
5/12/2012	WBM	Arakamu Two 3743	Redback	22
6/12/2012	WBM	Arakamu Two 3744	Redback	22
6/12/2012	WBM	Arakamu One 3745	Redback	16
6/12/2012	WBM	Arakamu One 3746	Redback	14
6/12/2012	WBM	Arakamu One 3747	Redback	12
6/12/2012	WBM	Arakamu One 3748	Redback	22
6/12/2012	WBM	Arakamu One 3749	Redback	14
6/12/2012	WBM	Arakamu Two 3750	Redback	12
6/12/2012	WBM	Arakamu One 3412	Redback	22
6/12/2012	WBM	Arakamu Two 3413	Redback	14
6/12/2012	WBM	Arakamu Two 3414	Redback	14
7/12/2012	WBM	Arakamu Two 3415	Redback	13
7/12/2012	WBM	Arakamu One 3416	Redback	16
7/12/2012	WBM	Arakamu Two 3417	Redback	14
10/12/2012	WBM	Arakamu Two 3418	Redback	22
10/12/2012	WBM	Arakamu Two 3419	Redback	22
10/12/2012	WBM	Arakamu One 3420	Redback	14
10/12/2012	WBM	Arakamu Two 3421	Redback	22
11/12/2012	WBM	Arakamu Two 3422	Redback	14
22/12/2012	WBM	Arakamu One 3423	Redback	14
22/12/2012	WBM	Arakamu One 3424	Redback	20
23/12/2012	WBM	Arakamu One 3425#1	McCann	7
24/12/2012	WBM	Arakamu One 3426	Redback	20
24/12/2012	WBM	Arakamu One 3427#2	McCann	7
24/12/2012	WBM	Arakamu One 3428	Redback	16
25/12/2012	WBM	Arakamu One 3429#3	McCann	17
25/12/2012	WBM	Arakamu 3430#2#3	Redback	22
26/12/2012	WBM	Arakamu One 3432	Redback	14
26/12/2012	WBM	Arakamu One 3431#4	McCann	17
27/12/2012	WBM	Arakamu One 3433	Redback	20
27/12/2012	WBM	CMST 3434	Redback	22
27/12/2012	WBM	CMST 3435	Redback	26
28/12/2012	WBM	Arakamu One 3436#5	McCann	17
28/12/2012	WBM	Arakamu Two 3437	Redback	12
28/12/2012	WBM	CMST 3437	Redback	10
28/12/2012	WBM	CMST 3438	Redback	26
28/12/2012	WBM	CMST 3439	Redback	13
28/12/2012	WBM	CMST 3440	Redback	17
28/12/2012	WBM	Arakamu One 3440	Redback	5
29/12/2012	WBM	Arakamu One 3441#6	McCann	17
30/12/2012	WBM	Arakamu One 3442	Redback	20
30/12/2012	WBM	Arakamu One 3443#7	McCann	17
31/12/2012	WBM	Arakamu One 3444	Redback	22
31/12/2012	WBM	CMST 3445	Redback	22
				971.82

Drilling Waste Remediation NZEC January 13

Date	*Product*	*Site& Manifest No*	*Transporter*	*Volume*
1/01/2013	WBM	Arakamu One 3446#8	McCann	17
1/01/2013	WBM	Arakamu One 3447	Redback	22
2/01/2013	WBM	Arakamu One 3449	Redback	22
3/01/2013	WBM	Arakamu One 5060#9	McCann	16
3/01/2013	WBM	Arakamu 1A 5061	Redback	20
4/01/2013	WBM	Arakamu One 5063#10	McCann	16
7/01/2013	WBM	Arakamu One 2852	Redback	13
10/01/2013	WBM	Arakamu One 53608	GJ Sole	12
10/01/2013	WBM	Arakamu One 5064#11	McCann	6
11/01/2013	WBM	Arakamu One 5065#12	McCann	15
11/01/2013	WBM	Arakamu One 5066	Redback	13
11/01/2013	WBM	Arakamu One 5067	Redback	13
11/01/2013	WBM	Arakamu One 5068	Redback	13
11/01/2013	WBM	Arakamu One 5069#13	McCann	12
11/01/2013	WBM	Arakamu One 5070	Redback	13
12/01/2013	WBM	Arakamu One 5071	Redback	13
12/01/2013	WBM	Arakamu One 5072	Redback	13
15/01/2013	WBM	Arakamu One 5073	Redback	9
19/01/2013	WBM	Wairere One 2853	Redback	14
21/01/2013	WBM	Wairere One 2854#1	McCann	16
21/01/2013	WBM	Wairere One 2855	Redback	14
21/01/2013	WBM	Wairere One 2856	Redback	14
21/01/2013	WBM	Wairere One 2857	Redback	10
21/01/2013	WBM	Arakamu One 2858	Redback	12
22/01/2013	WBM	Wairere One 2859#2	McCann	16
22/01/2013	WBM	Wairere One 2860	Redback	14
22/01/2013	WBM	Wairere One 2861	Redback	16
22/01/2013	WBM	Wairere One 2862	Redback	22
22/01/2013	WBM	Wairere One 2863#3	McCann	12
22/01/2013	WBM	Wairere One 2864	Redback	14
22/01/2013	WBM	Wairere One 2865	Redback	16
22/01/2013	WBM	Wairere One 2866	Redback	22
22/01/2013	WBM	Wairere One 2867	Redback	14
23/01/2013	WBM	Wairere One 2868	Redback	22
24/01/2013	WBM	Wairere One 2869	Redback	11
24/01/2013	WBM	Wairere One 2870	Redback	14
25/01/2013	WBM	Wairere One 2874#5	McCann	17
25/01/2013	WBM	Wairere One 2874#6	McCann	17
25/01/2013	WBM	Wairere One 2875	Redback	10
26/01/2013	WBM	Wairere One 2876#7	McCann	17
26/01/2013	WBM	Wairere One 2876#8	McCann	17
27/01/2013	WBM	Wairere One 2877#9	McCann	16
28/01/2013	WBM	Wairere One 2878	Redback	10
28/01/2013	WBM	Wairere One 2879	Redback	22
28/01/2013	WBM	Wairere One 2880	Redback	12
28/01/2013	WBM	Warere One 2881#10	McCann	16
29/01/2013	WBM	Wairere One 2882	Redback	12
29/01/2013	WBM	Wairere One 2883	Redback	19
30/01/2013	WBM	Wairere One 2884#11	McCann	15
30/01/2013	WBM	Wairere One 2885	Redback	16
				901.5

Remediation (NZ) Ltd.
Think of it as a State of the Art Fertiliser Production Facility

PO Box 8045, New Plymouth 4342
96 Waitara Road, Brixton, New Plymouth
Ph: 06 754 4151 Fax: 06 754 3161

Revital Fertilisers

TRC Consent 7795-1 Annual Report

Landfarming Events for Year Ended 30th June 2013

Landfarming Liquids

12 December 2012 500m3; Water Based Fluid Stage 1

29th January 2013 600m3; Water Based Fluid Stage 1

21st February 2013 800m3; Water Based Fluid Stage 2

Landfarming Solids

21st February 2013 600m3; Water Based Mud Stage 2

Sowing

20th March 2013 Stages 1&2 Sown

Treatments

Fertiliser

10th May 2013 5 tonne of Revital 50/50 spread on Stages 1&2 at 2.5 tonnes per hectare.

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Remediation (NZ) Ltd	**Lab No:**	1142807	SPv1
Contact:	Kerry O'Neill	**Date Registered:**	06-Jun-2013	
	C/- Remediation (NZ) Ltd	**Date Reported:**	17-Jun-2013	
	Brixton Organic Centre	**Quote No:**	55240	
	PO Box 8045	**Order No:**		
	NEW PLYMOUTH 4342	**Client Reference:**	Baseline Sample	
		Submitted By:	Kerry O'Neill	

Sample Type: Soil

Sample Name:		Manutahi Section 1	Manutahi Section 2			
Lab Number:		1142807.1	1142807.2			
Individual Tests						
Dry Matter	g/100g as rcvd	91	83	-	-	-
Total Recoverable Barium	mg/kg dry wt	33	24	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	< 20	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	187	195	-	-	-
Chloride*	mg/kg dry wt	9	9	-	-	-
Total Nitrogen*	g/100g dry wt	0.19	0.18	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.12	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	15	16	-	-	-
Total Recoverable Copper	mg/kg dry wt	14	10	-	-	-
Total Recoverable Lead	mg/kg dry wt	2.0	1.6	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt	7	6	-	-	-
Total Recoverable Zinc	mg/kg dry wt	66	64	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Toluene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	-	-	-
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Anthracene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Chrysene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Fluoranthene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Fluorene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Naphthalene	mg/kg dry wt	< 0.12	< 0.14	-	-	-

Sample Type: Soil						
Sample Name:		Manutahi Section 1	Manutahi Section 2			
Lab Number:		1142807.1	1142807.2			
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Phenanthrene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Pyrene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	-	-	-

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
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
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-2
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	-	1-2
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	-	1-2
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]	-	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
esICextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1-2
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-2
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-2
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1-2
Total Recoverable Vanadium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1-2
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

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.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

Appendix III

Abatement and Infringement notices

Document: 1155922

31 January 2013

Remediation (NZ) Limited
PO Box 8045
New Plymouth 4342

Attention: Mr K Oneill

Non-compliance with special condition 12 of Resource Consent 7795-1

On Tuesday, 29 January 2013 an inspection of the landfarm site at Manutahi Road, authorised by Resource Consent 7795-1 was undertaken by Investigating Officer John Cooper. He found that the site was not operating within the special conditions of Resource Consent 7795-1.

It was discovered that ponded liquids were present around the area where drilling muds had been applied more than one hour prior to the inspection. Photographs were taken.

Special condition 12 of resource consent 7795-1 states:

For the purposes of landfarming, drilling wastes shall be applied to land in a manner 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 or greater than 50,000 mg/kg dry weight; and
c) in a manner such that no ponded liquids remain after one hour, for all wastes;

prior to incorporation into the soil.

On Wednesday, 30 January 2013 a re-inspection was undertaken by Investigating Officer John Cooper. He found that although works had been undertaken to incorporate the mud material into the soil profile, ponded liquids still remained on the surface in several areas. Photographs were taken.

Such discharges as those discovered on 29 and 30th January 2013 is in breach of Resource Consent No. 7795-1 and therefore breaches Section 15 (1)(d) of the Resource Management Act 1991.

Council treats such non-compliant discharges as very serious.

You are therefore given the opportunity to write in, stating the circumstances relating to the non-compliance, and giving sufficient reason why enforcement action under the Resource

Management Act 1991 should not be considered in this instance, such correspondence to be received at this council within fourteen (14) days.

Yours faithfully
B G Chamberlain
Chief Executive

per: BE Pope
Compliance Manager

INFRINGEMENT NOTICE **NOTICE NUMBER 328**

(Issued under the authority of section 343C of the Resource Management Act 1991)

ENFORCEMENT AUTHORITY	ENFORCEMENT OFFICER IDENTIFICATION
Taranaki Regional Council	**19**
47 Cloten Road, Stratford	
Private Bag 713, Stratford	
Phone: 06 765 7127	
Fax: 06 765 5097	

TO: Remediation (NZ) Limited of

PO Box 8045, New Plymouth 4342

You are alleged to have committed an infringement offence against the Resource Management Act 1991, as follows:

Details of Alleged Infringement Offence

Section of Resource Management Act 1991 contravened: Section 15(1)(b)

Nature of infringement: Discharge of contaminant, namely drilling muds, onto or into land in circumstances which may have resulted in that contaminant entering water, when the discharge was not expressly allowed by a national environmental standard, or other regulations, a rule in a regional plan, or a resource consent.

Location: 156 Manawapou Road, Manutahi

Date: 29 January 2013 Approximate time: 1.00pm

THE FEE FOR THIS INFRINGEMENT IS $750.00

Payment of Infringement Fee

The infringement fee is payable to the enforcement authority within 28 days after 19 February 2013.

The infringement fee is payable to the enforcement authority at: **47 Cloten Road, Stratford, or Private Bag 713, Stratford**

The contact details of the Taranaki Regional Council are as follows: 47 Cloten Road, Stratford. Private Bag 713, Stratford. Phone: 06 765 7127 Fax: 06 765 5097.

Payments by cheque should be crossed "Not Transferable".

……

Signature of Enforcement Officer

IMPORTANT

PLEASE READ SUMMARY OF RIGHTS PRINTED OVERLEAF

Document No: 1163447

SUMMARY OF RIGHTS

Note: If, after reading this summary, you do not understand anything in it, you should consult a lawyer immediately.

Payment

1 If you pay the infringement fee within 28 days after the service of this notice, no further action will be taken against you in respect of this infringement offence. Payments should be made to the enforcement authority at the address shown on the front of this notice.

Note: If, under section 21(3A) or (3C)(a) of the Summary Proceedings Act 1957, you enter or have entered into a time to pay arrangement with an informant in respect of an infringement fee payable by you, paragraphs 3 and 4 below do not apply and you are not entitled either to request a hearing to deny liability or to ask the Court to consider any submissions (as to penalty or otherwise) in respect of the infringement.

Further Action

2 If you wish to raise any matter relating to circumstances of the alleged offence, you should do so by writing a letter and delivering it to the enforcement authority at the address shown on the front of this notice within 28 days after the service of a reminder notice in respect of the offence.

3 If you deny liability and wish to request a hearing in the District Court in respect of the alleged offence, you must, within 28 days after the service of a reminder notice in respect of the offence, deliver to the enforcement authority at the address shown on the front page of this notice a letter requesting a Court hearing in respect of the offence. The enforcement authority will then, if it decides to commence court proceedings in respect of the offence, serve you with a notice of hearing setting out the place and time at which the matter will be heard by the Court.

Note: If the Court finds you guilty of the offence, costs will be imposed in addition to any penalty.

4 If you admit liability in respect of the alleged offence but wish to have the Court consider submissions as to penalty or otherwise, you must, within 28 days after the service of a reminder notice in respect of the offence, deliver to the enforcement authority at the address shown on the front page of this notice a letter requesting a hearing in respect of the offence AND in the same letter admit liability in respect of the offence AND set out the submissions that you would wish to be considered by the Court. The enforcement authority will then, if it decides to commence court proceedings in respect of the offence, file your letter with the Court. There is no provision for an oral hearing before the Court if you follow this course of action.

Note: Costs will be imposed in addition to any penalty.

Non-payment of Fee

5 If you do not pay the infringement fee and do not deliver a letter requesting a hearing within 28 days after the service of this notice, you will be served with a reminder notice (unless the enforcement authority decides otherwise).

6 If you do not pay the infringement fee and do not deliver a letter requesting a hearing in respect of the alleged infringement offence within 28 days after the service of the reminder notice, you will become liable to pay COSTS IN ADDITION TO THE INFRINGEMENT FEE (unless the enforcement authority decides not to commence court proceedings against you).

Defence

7 You will have a complete defence against proceedings relating to the alleged offence if the infringement fee is paid to the enforcement authority at the address

shown on the front page of this notice within 28 days after the service of a reminder notice in respect of the offence. Late payment or payment made to any other address will not constitute a defence to proceedings in respect of the alleged offence.

8 (1) This paragraph describes a defence additional to the one described in paragraph 7. This defence is available if you are charged with an infringement offence against any of sections 9, 12, 13, 14, and 15 of the Resource Management Act 1991.

(2) You must prove either of the following to have the defence:

(a) that—

(i) the action or event to which the infringement notice relates was necessary for the purposes of saving or protecting life or health, or preventing serious damage to property, or avoiding an actual or likely adverse effect on the environment; and

(ii) your conduct was reasonable in the circumstances; and

(iii) you adequately mitigated or remedied the effects of the action or event after it occurred; or

(b) that—

(i) the action or event to which the infringement notice relates was due to an event beyond your control, including natural disaster, mechanical failure, or sabotage; and

(ii) you could not reasonably have foreseen or provided against the action or event; and

(iii) you adequately mitigated or remedied the effects of the action or event after it occurred.

(3) Subparagraph (2) does not apply unless—

(a) you deliver a written notice to the enforcement agency; and

(b) in the notice, you—

(i) state that you intend to rely on subparagraph (2)(a) or (b); and

(ii) specify the facts that support your reliance on subparagraph (2)(a) or (b); and

(c) you deliver the notice—

(i) within 7 days after you receive the infringement notice; or

(ii) within a longer period allowed by a District Court.

(4) If you do not comply with subparagraph (3), you may ask the District Court to give you leave to rely on subparagraph (2)(a) or (b).

8A (1) This paragraph describes a defence additional to those described in paragraphs 7 and 8. This defence is available if—

(a) you are—

(i) a principal; or

(ii) an employer; or

(iii) the owner of a ship; and

(b) you may be liable for an offence alleged to have been committed by—

(i) your agent; or

(ii) your employee; or

(iii) the person in charge of your ship.

(2) If you are a natural person, including a partner in a firm, you must prove either of the following to have the defence:

(a) that you—

(i) did not know, and could not reasonably be expected to have known, that the offence was to be, or was being, committed; and

(ii) took all reasonable steps to remedy any effects of the act or omission giving rise to the offence; or

(b) that you took all reasonable steps to—

(i) prevent the commission of the offence; and

(ii) remedy any effects of the act or omission giving rise to the offence.

(3) If you are not a natural person (for example, you are a body corporate), you must prove either of the following to have the defence:

(a) that—

(i) neither the directors (if any) nor any person involved in your management knew, or could reasonably be expected to have known, that the offence was to be, or was being, committed; and

(ii) you took all reasonable steps to remedy any effects of the act or omission giving rise to the offence; or

(b) that you took all reasonable steps to—

(i) prevent the commission of the offence; and

(ii) remedy any effects of the act or omission giving rise to the offence.

8B (1) This paragraph describes a defence additional to the defences described in paragraphs 7, 8, and 8A. This defence is available if you are charged with an infringement offence against section 15A(1)(a) of the Resource Management Act 1991 (relating to dumping waste or other matter in the coastal marine area from a ship, aircraft, or offshore installation).

(2) In order to have the defence, you must prove all of the following in relation to the act or omission that is alleged to constitute the offence:

(a) that the act or omission was necessary—

(i) to save or prevent danger to human life; or

(ii) to avert a serious threat to any ship, aircraft, or offshore installation; or

(iii) in the case of ***force majeure*** caused by stress of weather, to secure the safety of any ship, aircraft, or offshore installation; and

(b) that the act or omission was a reasonable step to take in all the circumstances; and

(c) that the act or omission was likely to result in less damage than would otherwise have occurred; and

(d) that the act or omission was taken or omitted in such a way that the likelihood of damage to human or marine life was minimised.

8C (1) This paragraph describes a defence additional to the defences described in paragraphs 7, 8, 8A, and 8B. This defence is available if you are charged with an infringement offence against section 15B(1) or (2) of the Resource Management Act 1991 (relating to certain discharges of a harmful substance, a contaminant, or water in the coastal marine area from a ship or offshore installation).

(2) You must prove either of the following to have the defence:

(a) that the harmful substance, contaminant, or water was discharged for the purpose of securing the safety of a ship or an offshore installation, or for the purpose of saving life and that the discharge was a reasonable step to effect that purpose; or

(b) that the harmful substance, contaminant, or water escaped as a consequence of damage to a ship or its equipment or to an offshore installation or its equipment, and—

(i) such damage occurred without your negligence or deliberate act; and

(ii) as soon as practicable after that damage occurred, all reasonable steps were taken to prevent the escape of the harmful substance, contaminant, or water or, if any such escape could not be prevented, to minimise any escape.

Queries/Correspondence

9 When writing or making payment of an infringement fee, please indicate—

(a) The date of the infringement offence; AND

(b) The infringement notice number; AND

(c) The identifying number of each alleged offence and the course of action you are taking in respect of it (if this notice sets out more than 1 offence and you are not paying all the infringement fees for all the alleged offences); AND

(d) Your full address for replies (if you are not paying all the infringement fees for all the alleged offences).

FULL DETAILS OF YOUR RIGHTS AND OBLIGATIONS ARE SET OUT IN SECTIONS 340 TO 343D OF THE RESOURCE MANAGEMENT ACT 1991 AND SECTION 21 OF THE SUMMARY PROCEEDINGS ACT 1957.

NOTE: ALL PAYMENTS, ALL QUERIES, AND ALL CORRESPONDENCE REGARDING THIS INFRINGEMENT MUST BE DIRECTED TO THE ENFORCEMENT AUTHORITY AT THE ADDRESS SHOWN.

No. 11870
Document: 1101916

ABATEMENT NOTICE UNDER SECTIONS 322 & 324 OF THE RESOURCE MANAGEMENT ACT 1991

To: Remediation (NZ) Limited
PO Box 8045
New Plymouth 4342

Taranaki Regional Council gives notice that you must take the following action:

1. Install a minimum of three groundwater monitoring bores satisfactory to the Chief Executive, Taranaki Regional Council to ensure compliance with Resource Consent 7795-1.

The location to which this abatement notice applies is:

118-156 Manawapou Road, Hawera
LOTS 1 & 2 DP 7324 BLK XIV HAWERA SD
1717244E 5608736N

You must comply with this abatement notice within the following period:

28 October 2013.

You must continue to comply with this abatement notice after that date.

This notice is issued under:

Section 322(1)(b)(ii) of the Resource Management Act 1991, which states that:

(1) An abatement notice may be served on any person by an enforcement officer—

(b) Requiring that person to do something that, in the opinion of the enforcement officer, is necessary to ensure compliance by or on behalf of that person with this Act, any regulations, a rule in a plan or a proposed plan, or a resource consent, and also necessary to avoid, remedy, or mitigate any actual or likely adverse effect on the environment—

(ii) Relating to any land of which the person is the owner or occupier.

The reasons for this notice are:

2. Scientific Officer, David Olson visited the property on 11 September 2012 and found that:
    - Drilling muds had been stockpiled at the site prior to the installation of groundwater monitoring bores which were to the satisfaction of the Chief Executive, Taranaki Regional Council.

3. Special condition 4 of Resource Consent 7795-1 states:

    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.

4. At the time of inspection special condition 4 of Resource Consent 7795-1 was being contravened.

5. Section 15(1)(b) of the Resource Management Act 1991 prohibits the discharge of contaminants onto or into land in circumstances which may result in that contaminant entering water unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan, or a resource consent.

6. The discharge of drilling mud, discovered on 11 September 2012 was not allowed by Resource Consent 7795-1 and therefore contravened section 15(1)(b) of the Resource Management Act 1991.

7. Contravention of section 15(1)(b) of the Resource Management Act 1991 is an offence under section 338(1)(a) of the Resource Management Act 1991.

8. This notice has been issued to you to require you to take the action as set out in clause 1 because in the opinion of the enforcement officer that issued this notice, this action is necessary to ensure compliance by you/on your behalf with section 15(1)(b) of the Resource Management Act 1991/regulations/a rule in a plan/a proposed plan/a resource consent and also necessary to avoid/remedy/mitigate any actual/likely adverse effect on the environment relating to any land of which you are the owner/occupier.

If you do not comply with this notice, you may be prosecuted under section 338 of the Resource Management Act 1991 (unless you appeal and the notice is stayed as explained below), or an infringement notice may be served on you under section 343C of the Resource Management Act 1991.

You have the right to appeal to the Environment Court against the whole or any part of this notice. If you wish to appeal, you must lodge a notice of appeal in form 49 with the Environment Court within 15 working days of being served with this notice.

An appeal does not automatically stay the notice and so you must continue to comply with it unless you also apply for a stay from an Environment Judge under section 325(3A) of the Resource Management Act 1991 (*see* form 50). To obtain a stay, you must lodge both an appeal and a stay with the Environment Court.

You also have the right to apply in writing to Taranaki Regional Council to change or cancel this notice in accordance with section 325A of the Resource Management Act 1991.

The Taranaki Regional Council authorised the enforcement officer who issued this notice. Its address is:

Taranaki Regional Council
Private Bag 713
Stratford 4352

Phone: (06) 765 7127
Facsimile: (06) 765 5097

The enforcement officer is acting under the following authorisation:

A warrant of authority issued by the Taranaki Regional Council, pursuant to section 38 of the Resource Management Act 1991, authorising the officer to carry out specified functions and powers as an enforcement officer under the Resource Management Act 1991 including issue of abatement notices.

…….
John Cooper
Enforcement Officer
Taranaki Regional Council
Warrant No. 174

28 September 2012

Appendix IV

Monitoring well schematics

Remediation NZ Manutahi Land Farm

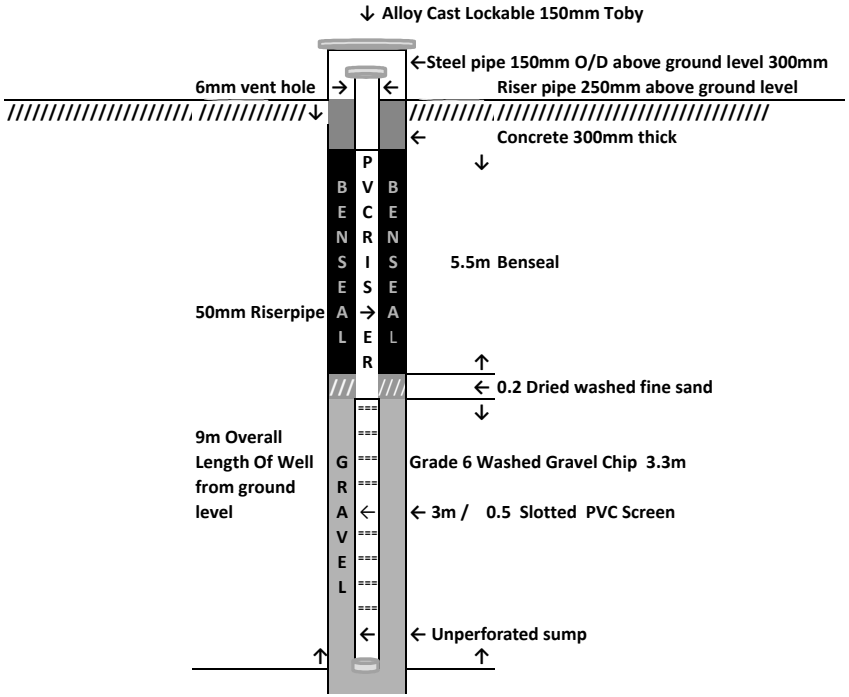
Construction Diagram Of Monitoring Well MW1 GND 2300

Date: 4-10-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm flighted augers

TRC on site observing formation layers & drill cuttings

Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 04/10/2012

Drilling Formations

0 to 0.5 sandy topsoil
0.5 to 1m sandy clay
1m to 5.5m light brown/orange clay-fine-soft-sticky
5.5 to 10.5 sandy/clay /loose sand increasing moisture

Tagged bottom of screen 8.9 top of riser pipe
SWL Water Table @ 7.275m dipped by TRC @ 1035am on 9-10-2012

Remediation NZ Manutahi Land Farm

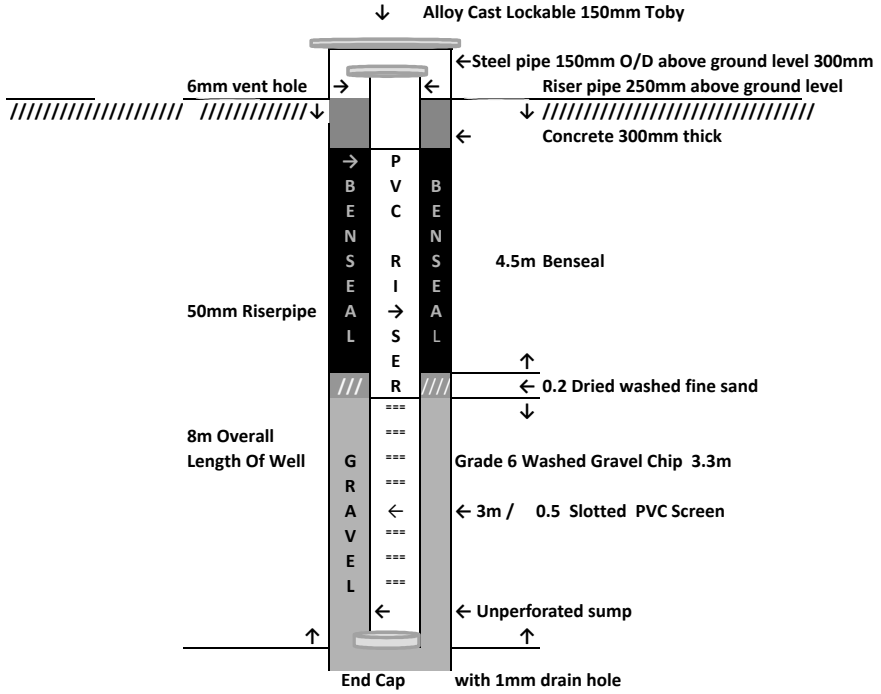
Construction Diagram Of Monitoring Wells MW2 GND 2301

Date: 4-10-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm flighted augers

TRC on site observing formation layers & drill cuttings

Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 4 -10- 2012

Drilling Formations

0 - 0.5 sandy top soil
0.5 to 2.5 fine gravel/black sands
2.5 to 3.5 lit brown/orange clays /fine
3.5 to 4.0 yellow clays/very fine/stick moust
4.0 to 6.5 sandy clay
6.5 to 9.0 tight dark clay with peat

Tagged bottom of screen 8.82 top of riser pipe
Water Table @ 6.5m dipped by TRC @ 1325 on 9-10-2012

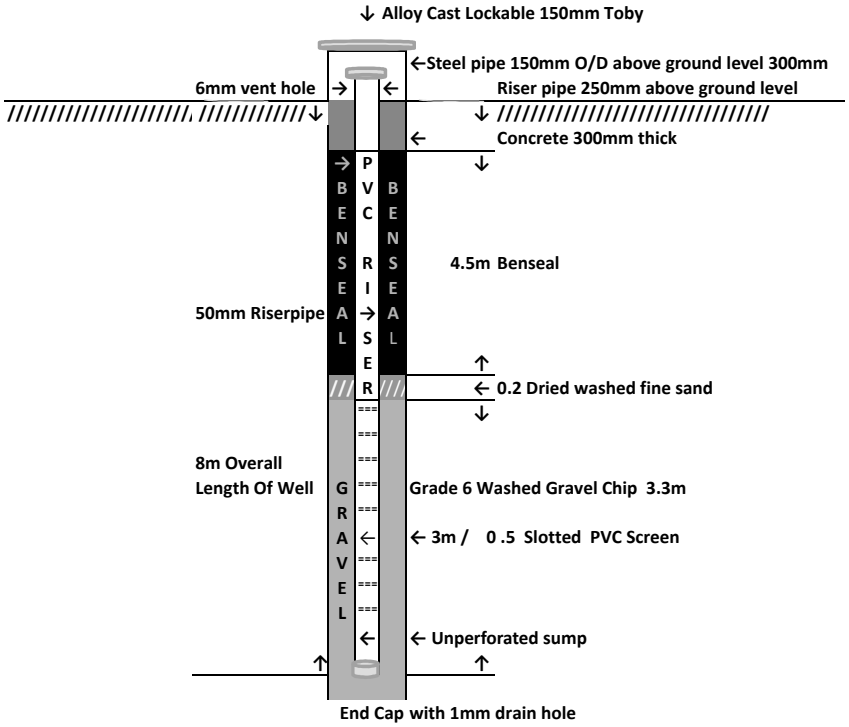
Remediation NZ Manutahi Land Farm

Construction Diagram Of Monitoring Wells

MW2 GND 2302

Date: 4-10-2012

Hole Drilled With Tractor Rig From 0 to 8m with 100mm flighted augers
TRC on site observing formation layers & drill cuttings
Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd ########

Drilling Formations

0 - 2m black fine gravel/sand
2m to 8m light brown/orange clay
8.0m to 9.0m grey sandy clay moisture loose
9.0m to 10m grey sandy clay/tight/compact

Tagged bottom of screen 8.3m top of riser pipe
Water Table @ 8.078 dipped by TRC on 9-10-2012

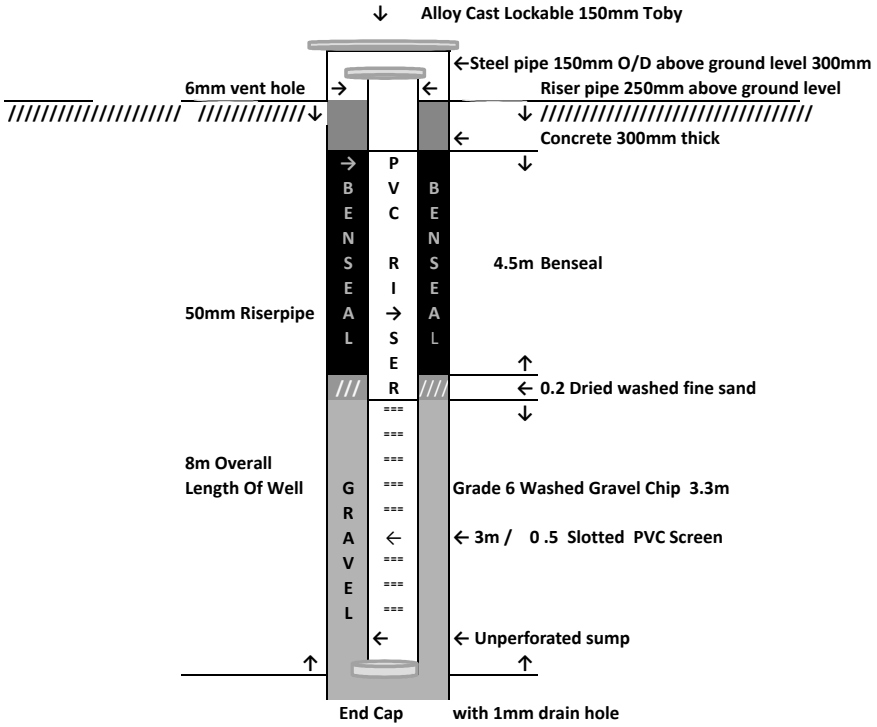
Remediation NZ Manutahi Land Farm

Construction Diagram Of Monitoring Wells

MW2 GND 2303

Date: 4-10-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm flighted augers
TRC on site observing formation layers & drill cuttings
Note: BTW to survey in ground elevations & GPS well locations



Drilling Formations

0 - 0.5 dark brown sandy soil
0.5 - 2.0 light brown/orange clay- loose -sticky-moist
2.0 to 3.0 light brown /orange clay tight
3.0 to 5.0 light brown / orange sandy clay saturated/soft
5.0 to 7.0 dark brown peaty clay/brow orange clay saturated
7.0 to 7.5 loose saturated sands
7.5 to 10m tight dark grey sands/dry /tight
Tagged bottom of screen 8.8 top of riser pipe
Water Table 5.404@ dipped by TRC on 9-10-2012

Appendix V

AgKnowledge landfarm review report

The Taranaki Landfarms

are they

"Fit for Purpose"

A report

Commissioned by Taranaki Regional Council

Undertaken by

Dr D C Edmeades
agKnowledge Ltd
PO Box 9147, Hamilton, 3240.

September 2013

EXECUTIVE SUMMARY

1. Waste products (rock cuttings and drilling muds) from the oil exploration industry in Taranaki are being incorporated into re-contoured formed sand dunes and re-sown back to pasture (a process referred to as Landfarming). This process is controlled by resource consents issued by the Taranaki Regional Council. Three Landfarms have been completed to date and are now being farmed commercially (2 under irrigation).

2. The drilling muds contain potential contaminants: petrochemical residues, barium, heavy metals and salts. The question arises: are these reformed soils 'fit-for-purpose' - in this case pastoral farming and especially dairy farming.

3. As required by the consents regular soil samples were collected and analysed during the disposal process. These results were summarised and examined relative to the permitted limits for the various potential contaminants.

4. The completed sites were visited and the pasture and soils inspected. Soil and pasture samples were collected and analysed for all potential contaminants. These results were compared to the properties of normal New Zealand pastorals soils.

5. It is concluded from this body of evidence that these modified soils are 'fit –for-purpose". The concentrations of: nutrients (macro and micro), heavy metals and soluble salts in these soils and pasture are similar to normal New Zealand soils. The form of barium present is as environmentally benign barite, and there is no evidence of accumulation of petrochemical residues.

6. The process of Landfarming these otherwise very poor soils, together with appropriate management (irrigation, fertiliser and improved pastures) has increased the agronomic value of the land from about $3-5000/ha to $30-40,000/ha.

BRIEF

1. The Taranaki Regional Council (TRC) has consented several oil exploration companies to dispose of 'drilling muds' at several sites on coastal sands around the region.

2. The drilling muds are initially stored at the sites and, after the sand dunes have been levelled, this material is applied to the surface (at < 100mm thick) and then incorporated into the re-contoured sandy soils (at a minimum depth of 250mm depth). Once this process is completed the modified soils are fertilised (not more the 200 kg N/ha) and sown down to clover–based pasture. This whole process is controlled by criteria set out in resource consents.

3. Three sites (referred to as landfarms) have been completed to date and are currently being used for pastoral farming. One site (Browns, commenced 2006, completed 2011) is not irrigated and runs dry stock. The other 2 sites (Schrider, commenced 2004, completed 2010, and Geary, commenced 2001, completed 2006) are under pivot irrigation and used for dairy farming. Note there is a small area at the Geary site, which is not irrigated.

4. The TRC has retained agKnowledge Ltd to determine whether these landfarms are "fit for purpose", in this case fit for pastoral farming and in particular dairying.

5. Specifically this brief excludes any consideration as to the off-site effects of the landfarms (possible movement of contaminants via runoff or leaching) and does not consider whether the compliance criteria set out in the consents were met or otherwise.

METHODOLOGY

6. Drilling muds consist of a) the cuttings (mainly solid) of the underlying strata of rocks from the drill bit b) drilling fluids (bentonite based mud and slurry including proprietary additives used to either lubricate the drilling process or to control the in-well pressure and conditions. This includes barium sulphate which is used as a wetting and weighting agent and c) drilling wastes (liquid) containing well water and petrochemical residues. There are 3 classes of drilling fluids: water-based, (WBM), oil based (OBM) and synthetic (SBM) (Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1).

7. Given the general composition of the drilling muds, this report investigates the following aspects of the completed landfarms:

    a. What is the current soil fertility of the modified soils with respect to growing clover-based pasture for ruminants and in particular dairy cows?

b. What are the heavy metal and barium concentrations in the soils and pastures and are there any implications for soil, pasture and animal health and production?
c. Are there any petrochemical residues in the soils and pasture, which may affect soil, plant and animal health?

8. Two sites, Geary and Schrider, were visited on July 4 2013 and soils samples (0-75mm – the standard depth for determining soil fertility) and mixed-pasture samples were collected for an initial investigation, using the standard sampling protocols.

9. The 3 completed landfarms were visited on 5 August 2013 and on this occasion two sets of soil (0-75mm) and mixed pasture samples were collected from the following sites: Schrider (irrigated), Geary (irrigated and non-irrigated) and Brown (non-irrigated). One set were sealed in clip-tight plastic bags for analysis of petroleum hydrocarbon (PCH) residues and the other set were used to determine the concentrations of the full suit of elements including the macro, micro and heavy metals plus barium.

10. The TRC provided the full records of the soil tests (0-250mm) undertaken as per the consents, during the process of disposal of the drilling muds, at each site. This data was summarized.

11. Throughout this the report the criteria for the safe disposal of heavy metals, barium and petroleum hydrocarbons (as set down by a number of authorities) are used as part (other matters are also considered) of the assessment process. In applying these criteria it is assumed that they have been set at levels to ensure the protection of soil, pasture, animal and human health.

RESULTS

Pasture Assessment

At the time of the second site visit (5 August 2013) the pastures were assessed as follows:

Table 1: Visual assessment of the pastures at the three sites.

Site	Assessment	Rating
Schrider (irrigated)	Ryegrass dominant pasture, vigorous. Very little clover some showing signs of potassium deficiency. Excreta patches obvious. Some flats weeds and poor pasture grasses.	6/10
Geary (irrigated)	Vigorous ryegrass pasture with about 20% clover. Excreta patches not apparent. Very few weeds.	8/10
Geary (non-irrigated)	Assorted weeds abundant, excreta patches prominent, Some low value browntop and Yorkshire fog. Ryegrass and clover only in excreta patches.	2/10
Brown (non-irrigated)	Assorted weeds abundant, excreta patches prominent, Ryegrass and clover only in excreta patches.	2/10

Importantly, there were abundant earthworm casts on all sites indicating considerable soil biological activity. The earthworm can be regarded as the 'canary in the mine' with respect to soil biological activity.

Soil Properties

The general properties of the modified soils (0-75mm, the standard depth for soil fertility assessment) are given in Table 2 and indicate low levels of cation exchange capacity (CEC), anion storage capacity (ASC), organic matter (OM) and organic nitrogen (ON), reflecting their sandy nature and past history (low quality pasture). The amounts of soluble salts (SS) and the exchangeable sodium percentage (referred to in the documentation incorrectly as the sodium absorption, SAR) are low and the soil calcium (Ca) and sodium (Na) levels are consistent with the normal levels found in pastoral soils.

Table 2: Soil chemical properties (0-75mm) at the three landfarms sites.

Site	CEC (me/100 gm)	ASC (%)	OM (%)	ON (%)	SS (%)	Ca (MAF units)	Na (MAF units)	SAR (%)
Schrider	9	11	2.6	0.13	0.01	7	7	1.1
Geary Irrigated	7	11	2.2	0.16	0.02	5	10	2.0
Geary Non irrigated	9	16	3.5	0.21	0.02	6	7	1.2
Brown	9	34	3.4	0.14	0.01	6	4	0.6
Typical	*10-30*	*20-80*	*5-20*	*0.1-0.4*	*0.05-0.30*	*5-20*	*3-10*	*1-2*

As required by the consent agreements, routine soil testing (0-250mm) was undertaken on all three sites during the process of disposal of the drilling muds. The results for each site are summarized in Tables 3 a,b,c:

Table 3a. Chemical characteristics of the soil (0-250mm) at the Schrider site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1] & units	No. over limit
Conductivity (disposal)	51	32 <0.02	0.13	<0.02	400 mS/m	0
Conductivity (expiry)	53	44 < 0.02	1.3	<0.02	290 mS/m	0
Soluble salts	53	43 <0.05	0.46	<0.05	0.25 %	2
SAR	47	1.1	3.1	0.3	18	0
Sodium	31	482	790	310	460 g/m3	14
Chloride	50	145	1360	4	700g/m3	3

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

Table 3b. Chemical characteristics of the soil (0-250mm) at the Geary site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1]& units	No. over limit
Conductivity (disposal)	33	30 <0.02	0.37	<0.02	400 mS/m	0
Conductivity (expiry)	33	29 <0.02	0.37	<0.02	290 mS/m	0
Soluble salts	33	32 <0.05	0.13	<0.05	0.25 %	0
SAR	38	1.0	3.7	0.1	18	0

Sodium	13	481	600	310	460 g/m3	7
Chloride	36	28	356	4	700 g/m3	0

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

Table 3c. Chemical characteristics of the soil (0-250mm) at the Brown site during disposal.

Soil Property	No. samples	Average	Max	Min	Limit[1]& units	No. over limit
Conductivity (disposal)		No given			400 mS/m	0
Conductivity (expiry)		No given			290 mS/m	0
Soluble salts	5	all < 0.05	<0.05	-	0.25 %	0
SAR	17	2.4	18	0.3	18	0
Sodium	17	80	530	7	460 g/m3	7?
Chloride	31	98	550	5.9	700 g/m3	0

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

The soil property which most frequently exceeded the limit was the soil Na concentrations. The limit of 460 gm/m^3 soil, is (assuming a soil bulk density of about 1) equivalent to a MAF soil Na reading of about 20. Thus, while some elevated soil Na levels were recorded during the disposal process the current levels (0-75 mm) are normal (Table 2). This is also apparent in the SAR levels. The likely reason for this is that Na (and the same applies to chloride) are very mobile and will readily leach out of soils, especially sandy soils with a good rainfall and under irrigation, noting that in the New Zealand situation Na and Cl are environmentally benign.

In any case note that the problems that occur when soil Na levels are elevated (loss of soil structure and impeded drainage together with plant sensitivity to salinity) normally arise on heavy soils in arid climates. Furthermore, higher than normal soil Na levels and hence better than normal pasture Na concentration (see later) can only be beneficial to animal health in the New Zealand setting.

Soil Fertility

Soils

The soil tests (Table 4) indicate that, in terms of optimizing production from clover-based pastures, the sites are deficient with respect to potassium (K) and sulphur (S). The site with the best overall soil fertility is 'Geary irrigated' and this is reflected in the superior pasture on this site (Table 1). The poor pasture on the 2 non-irrigated sites (Brown, Geary non-irrigated) can be explained by the lack of irrigation resulting in moisture stress together with the poor underlying soil fertility.

Table 4: Soil nutrient levels (0-75mm) at the three landfarms sites (units are as used in the standard MAF soil testing protocol)

Site	pH	Olsen P	K	Sulphate S	Organic S	Mg
Schrider	6.0	24	2	4	3	23
Geary Irrigated	6.3	28	5	12	3	37
Geary Non irrigated	6.2	38	7	6	3	22

Brown	6.6	22	2	8	4	13
Optimal[1]	*5.8-6.0*	*35-40*	*7-10*	*10-12*	*10-12*	*8-10*

Notes 1) assuming a high producing dairy farm

Pasture

The concentrations of macro (Table 5a) and micro (Table 5b) nutrients in the mixed-pasture samples from the 4 sites are given below. Mixed-pasture analysis provides information relating to the nutrient value of the pastures for, in this case, ruminants.

Table 5a: Macronutrient concentrations (%) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	**Pasture macronutrient concentration (%)**						
	N	**P**	**K**	**S**	**Mg**	**Ca**	**Na**
Schrider	4.43 (2.66)	0.44 (0.43)	2.51 (1.69	0.37 (0.40)	0.29 (0.38)	0.57 (0.64)	0.79 (1.11)
Geary Irrigated	4.44	0.47	3.59	0.40	0.33	0.38	0.55
Geary non-irrigated	3.92 (4.11)	0.46 (0.45)	3.62 (2.73)	0.37 (0.41)	0.30 (0.31)	0.39 (0.39)	0.54 (0.45)
Brown	4.15	0.40	3.51	0.36	0.24	0.64	0.47
Typical	*4.5-5.5*	*0.30-0.40*	*2.0-4.00*	*0.25-0.35*	*0.15-0.22*	*0.25-0.50*	*0.1-0.3*

Table 5b: Micronutrient concentrations (ppm) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	**Pasture micronutrient concentrations (ppm)**							
	Mn	**Zn**	**Cu**	**Fe**	**Co**	**Mo**	**Se**	**B**
Schrider	54 (58)	31 (33)	6.4 (6.3)	230 (818)	0.16 (0.27)	0.34 (<0.05)	0.31 (0.48)	6.0 (7.3
Geary Irrigated	86	32	7.6	2057	0.87	0.59	0.14	9.7
Geary non-irrigated	79 (84)	28 (34)	9.2 (10.9)	1124 (930)	0.46 (0.23)	0.46 (0.41)	0.02 (0.02)	7.7 (7.5)
Brown	65	31	9.3	351	0.18	2.38	<0.01	6.9
Typical	*20-50*	*10-20*	*5-10*	*45-65*	*0.04-0.10*	*0.1-1.0*	*>0.03*	*13-16*

These results indicate that the nutrient levels in the pastures from these landfarm sites are typical of New Zealand pastures except that:

a) The pasture sodium (Na) levels are elevated due to enrichment from the soils either from sea sprays or from the drilling muds. Either way this is of no consequence and can only be a benefit to animal health.
b) The manganese (Mn) and zinc (Zn) levels appear to the greater than normal but are nevertheless not sufficiently high to give rise to animal health problems.
c) The iron (Fe) levels are elevated. This is most likely due to contamination from the soil as frequently occurs on 'normal' soils and in any case is of little practical consequence.
d) The cobalt (Co) and molybdenum (Mo) are above the minimum levels for optimal health.

e) The selenium (Se) levels on 2 sites are below the minimum level for optimal animal production as is frequently the case for many New Zealand soils. This can be readily corrected with fertiliser Se.

The combined soil and pasture results suggest that there is nothing unusual about the soils and pastures at these landfarms, relative to normal conditions, which occur routinely throughout New Zealand. Furthermore, they indicate that providing the soil fertility is optimised and there is little moisture stress (i.e. they are irrigated), high quality productive and healthy clover-based pastures can be grown on these landfarms.

If the constraints (soil fertility and moisture) were removed it should be possible to grow at least 15 tonnes DM/ha annually, and assuming they are used for dairying, would put the value of the landfarms at about $30-40,000/ha. In their natural state (i.e. before land farming) they were growing low-quality feed and used for dry-stock farming only. There original value would be about $3-4000/ha.

Heavy Metals

Soil (Routine Sampling 0-250mm)

The results from the monitoring of the soils (0-250mm) during the process of disposal of the drilling muds, as required under the consents, are summarized for each site in Table 6 a, b, c:

In all cases the heavy metal concentrations were well below the guideline limits set by the Ministry for the Environment (2003) for the disposal of biosolids.

Table 6a: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Schrider site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	47	46 < 2[2]	4	< 2	20
Cd	47	all < 0.10[2]	< 0.10	-	1
Cr	50	15	23	8	600
Cu	50	13	25	9	100
Pb	50	3	23	1	300
Ni	50	8	11	5	60
Zn	50	71	100	33	300
Hg	41	all < 0.01[2]	< 0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

Table 6b: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Geary site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	33	all < 2[2]	<2	-	20
Cd	33	all < 0.1[2]	<0.10	-	1
Cr	33	15	20	8	600
Cu	33	17	32	7	100
Pb	33	14	48	1	300
Ni	33	7	11	5	60
Zn	33	72	113	33	300
Hg	33	all < 0.1[2]	<0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

Table 6c: Summary of heavy metal concentrations (ppm) in the soil (0-250mm) at the Brown site.

Element	No. samples	Average	Max.	Min.	Limit[1]
As	24	17 < 2[2]	5	< 2	20
Cd	24	22 < 0.10[2]	0.27	< 0.10	1
Cr	24	11	19	7	600
Cu	24	21	41	15	100
Pb	24	3	8	1	300
Ni	24	6	10	4	60
Zn	24	74	120	49	300
Hg	24	all < 0.01[2]	<0.10	-	1

Note 1) from the Ministry for the Environment 2003
2) for some elements and on some occasions the results were reported at being less than a given limit. It is not realistic in such cases to give an arithmetic mean and hence some indication of the distribution of the results is recorded.

The heavy metal concentrations in the soils (0-250mm), as measured during the process of disposal, were all much less than the set limits, at all three sites.

Soil (normal pastoral soil levels)

The heavy metal concentrations in soils (0-100mm) from surveys conducted from various regions of New Zealand under pasture and non-farmed land uses are summarized in Appendix 1. The Table below (Table 7) compares these typical concentrations (0-100mm) with those found at the three landfarm sites (0-75mm).

Table 7: Comparison of the heavy metal concentrations (ppm) in typical New Zealand pastoral and non-farmed soils (0-100mm) and in the soils (0-75mm) at the three sites; Schrider, Geary and Brown.

Element	Range in mean/median values in NZ farmed or (non-farmed) soils)[1]	Site					
		Schrider		Geary			Brown[2]
		Sample 1[2]	Sample 2[2]	Sample 1[2]	Sample 2[2]		Sample 1
				Non-irrigated	Non irrigated	Irrigated	
Arsenic (As)	3-9 (3-5)	<2	<2	<2	<2	<2	2
Cadmium (Cd)	0.1-0.8 (0.1-0.14)	<0.1	0.11	<0.1	<0.1	<0.1	<0.1
Chromium (Cr)	8-18 (12-18)	nd	11	nd	11	11	8
Copper (Cu)	10-20 (10-16)	nd	11	nd	20	13	21
Lead (Pb)	6-16 (9-16)	1.6	1.8	3.2	3	1.4	3.6
Nickel (Ni)	4-14 (4-14)	nd	5	nd	5	5	4
Zinc (Zn)	7-79 (28-66)	nd	55	nd	53	57	57
Mercury (Hg)	0.07-0.20 (0.11-0.19)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Notes 1) from Appendix 1.
2) samples 1 collected 4 July 2013, samples 2 collected 8 August 2013.

The samples collected on the three landfarms (Schrider, Geary and Brown), were from the depth 0-75mm (the normal depth for testing soil nutrients). The range in the median and mean above, from the surveys, are for soils to a depth of 0-100mm. Data from Waikato survey (Waikato Regional Council 2011) shows that top-soils (0-100mm) are enriched relative to the sub-soils (100-200mm) for Cd, Cr, Cu, Ni but not for the other heavy metals. Thus, the results above for the landfarms (0-75mm) are likely to be elevated to some extend relative to the typical ranges given in Table 7.

These results indicate that the soil heavy metal concentrations are at the low end of the ranges for both farmed (dairying) and non-farmed soils (referred to in the respective reports as either native, indigenous and background).

Pasture (normal levels)

The available information on the heavy metal concentrations in pastures in New Zealand is summarized in Appendix 2.

Table 8: Heavy metal concentrations (ppm) in mixed-pasture from the three sites for samples collected 5 August 2013 (Figures in parenthesis are from samples collected 4 July 2013).

Site	Pasture heavy metal and barium concentrations (ppm)						
	As	**Cd**	**Hg**	**Pb**	**Cr**	**Ni**	**Ba**
Schrider	<0.1 (<0.1)	0.022 (0.033)	0.013 (0.028)	0.039 (0.079)	0.460 (<0.1)	<1 (<1)	42 (33)
Geary Irrigated	<0.1	0.011	<0.01	0.072	0.750	<1	74
Geary non-irrigated	<0.1 (<0.10)	0.025 (0.027)	0.011 (0.029)	0.102 (0.112)	0.600 (0.160)	<1 (<1)	>100 (97)
Brown	<0.1	0.073	0.011	0.104	0.520	<1	71
***Typical*[1]**	*0.07-0.24*	*0.03-0.29*	*na*	*0.10-1.8*	*0.31-0.49*	*0.10-0.20*	*na*

Note 1) see Appendix 2

Consistent with the soil data, these results indicate that there is nothing unusual about the heavy metal concentrations in the pastures from these landfarms relative to normal levels reported for New Zealand pastures.

Barium

Barium sulphate (Barite) is used during the drilling process (Alberta Environment 2009), as noted. This chemical form of barium is practically insoluble and therefore environmentally benign, unlike other barium salts (e.g. barium chloride and nitrate) (Menzies et al 2008). There are currently no guidelines in New Zealand for the disposal of biosolids containing barite. The Canadian Authorities (Alberta Environment 2009) have set remediation guidelines for agricultural land at 10,000 ppm (Barite containing sites) and 750 ppm (non-barite sites).

Table 9 summarizes the soil barium (Ba) data (0-250mm) collected during the disposal phase for the three sites.

Table 9: Total barium (Ba) concentrations (ppm) in the soils (0-250mm) at the three sites during the disposal phase.

Site	No. samples	Average	Max	Min	Limit[1]	No. over limit
Schrider	54	528	5500	17	750 ppm	6
Geary	39	1265	5400	90	750 ppm	11
Brown	15	1860	3200	40	750 ppm	13

Note 1) Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1.

This data suggests that the Ba limit (assuming a non-barite source of Ba) was exceeded at some times, however none of the sites reached levels of 10,000 ppm the guideline for barite sites.

The Alberta Environment (2009) guidelines specify a simple procedure to determine whether barite is present at a specific site. If the extractable Ba (in 0.1M Calcium chloride at a 1:10 ratio) exceeds 250 ppm then it is assumed it is a non-barite site. The results below show that the extractable Ba levels are well below the 250-ppm limit leading to the conclusion that the only source of Ba at these sites is the environmentally benign barite form.

Table 10. The concentrations of extractable and total barium (Ba) in soils and in pastures at the 3 landfarm sites

Site	Extractable Ba (ppm)	Total Ba (ppm)	Pasture Ba (ppm)
Schrider	24	7800	42 (33)
Geary (irrigated)	36	760	74
Geary (non-irrigated)	46	2400	>100 (97)
Brown	31	930	71

This being so, the limit for safe disposal (viz. < 10,000 ppm) applies and this was never exceeded during the disposal process. This is consistent with the measured Ba concentrations in the pastures (Table 8) which indicate levels in the ppm range and not in the percent (%) range as might be expected for a divalent cation such as calcium (Ca) or magnesium (Mg) (c.f. table 5a and 8). This is consistent with the view that barite is not considered bioavailable (Alberta Environment 2009).

Petroleum Hydrocarbons

Soils

The guidelines for the management of petrochemical hydrocarbons (PHC) (Ministry for the Environment 2011) require the monitoring of 3 representative types of PHCs:

a) TPH (Total Petroleum Hydrocarbons) in three classes: C7-C9, C10-C14 and C15-36.
b) BTEX: which includes benzene, toluene, ethyl-benzene and xylene.
c) PAH (Polycyclic aromatic hydrocarbons).

Levels of each PHC are set for screening purposes, meaning that if these levels are exceeded, further investigation is recommended.

The measured concentrations of these classes of PHC in the soil (0-250mm) collected during the disposal process for each site are given in tables 11a,b,c below:

Table 11a. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Schrider site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	55	50< 8	12	<8	120	0
	C10-C14	55	44< 20	5020	<10	58	3
	C15-C36	55	21<30	19000	<30	4000	4
BTEX	Benzene	43	13<0.05	0.26	<0.03	1.1	0
	Toluene	43	35<0.06	3.23	<0.03	68	0
	Ethylbenzene	43	35<0.05	1.93	<0.03	53	0
	o-xylene	43	23<0.05	4.68	<0.03	48	0
	m&p-xylene	43	31<0.09	13	<0.05	48	0
PAH	Benzo[a]pyrene	37	12<0.02	0.07	<0.02	0.027	1
	Napthelene	37	13<0.10	7.1	<0.10	7.2	0
	Pyrene	37	30<0.09	0.72	<0.02	160	0

Note 1) screening limit set by Ministry for the Environment 2011

Table 11b. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Geary site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	32	all<8	<8	-	120	0
	C10-C14	32	29<20	49	<10	58	0
	C15-C36	32	17<30	1400	<30	4000	0
BTEX	Benzene	28	25<0.05	0.20	<0.05	1.1	0
	Toluene	28	25<0.06	0.20	<0.05	68	0
	Ethylbenzene	28	25<0.05	0.20	<0.05	53	0
	o-xylene	28	21<0.05	0.13	<0.02	48	0
	m&p-xylene	28	25<0.09	<0.20	<0.05	48	0
PAH	Benzo[a]pyrene	19	16<0.02	0.40	<0.02	0.027	1
	Napthelene	19	18<0.10	0.12	<0.02	7.2	1
	Pyrene	19	18<0.09	0.19	<0.02	160	0

Note 1) screening limit set by Ministry for the Environment 2011

Table 11c. Concentrations of various petroleum hydrocarbons (PHC) in the soils (0-250mm) at the Brown site.

PHC		No. samples	Average	Max.	Min	Limit[1]	No. over limit
TPH	C7-C9	57	36<8	16	<8	120	0
	C10-C14	57	28<20	5500	<20	58	23
	C15-C36	57	5<30	13500	<30	4000	14
BTEX	Benzene	26	16<0.05	0.08	<0.05	1.1	0
	Toluene	26	16<0.06	0.08	<0.05	68	0
	Ethylbenzene	26	16<0.05	0.16	<0.05	53	0
	xylene	26	14<0.10	0.24	<0.10	48	0
PAH	Benzo[a]pyrene	26	8<0.025	0.028	<0.025	0.027	2
	Napthelene	26	8<0.12	0.30	<0.12	7.2	0
	Pyrene	26	23<0.09	0.28	<0.09	160	0

Note 1) screening limit set by Ministry for the Environment 2011

During the process of disposal there were some occasions when the limits, particularly of TPHs, and particularly on the Brown site, were exceeded. Despite this the BTEX and PAH screening limits were rarely exceeded.

Petrochemical hydrocarbons are biodegradable (Ministry for the Environment 2011) under aerobic soil conditions (as is the case on these sandy soils) and it is likely that the higher rate of exceedances on the Brown site is because this is the most recently completed site. It is anticipated that with time these levels will decline noting that the numerous earthworm casts at all sites indicated an active biomass. This is confirmed by the fact that the TPH concentrations (0-75mm) measured in August 2013 (Table 12) were below the levels of detection on all sites (Table 12).

Table 12: Concentrations of total petrochemical hydrocarbons (TPH) in the soils (0-75mm) at the three landfarm sites (samples collected 5 Aug 2013).

Site	Total Petrochemical Hydrocarbon[1] (TPH) (ppm)			
	C7-C9	C10-C14	C15-C36	Total (C7-C36)
Schrider	<8	<20	<40	<70
Geary Irrigated	<10	<20	<40	<70
Geary non-irrigated	<8	<20	<40	<70
Brown	<8	<20	<40	<70

Note 1) see Appendix 3 for the full results including BTEX and PAH.

The possibility that the TPH levels in these topsoils (0-75mm) underestimate the concentrations in the full profile (i.e. 0-250mm), either due to uneven placement of the drilling wastes in the profile, or their movement down the profile, can be set aside because of the method of disposal required under the consents (surface applied not more than 100mm and incorporated to a depth > 250 mm) and the fact that TPHs are not water soluble.

Pasture

The measured concentrations of these classes of PHCs in the pasture from each site are given in table 13 below:

Table 13: Concentrations of total petrochemical hydrocarbons (TPH) in the pastures at the three landfarm sites (samples collected 5 Aug 2013).

Site	Total Petrochemical Hydrocarbon[1] (TPH) (ppm)			
	C7-C9	C10-C14	C15-C36	Total (C7-C36)
Schrider	<8	<20	58	58
Geary Irrigated	<8	<20	86	86
Geary non-irrigated	<8	<20	71	71
Brown	<8	<20	81	81

1) see Appendix 3 for the full results including BTEX and PAH.

Once again the levels of C7-C9 and C10-C14 TPHs are below the detection limits, as for the soils, but there are higher order TPHs (C15-C36) in the pasture, which

are not present in the soil. The likely explanation for this is that plants manufacture waxes, which are represented in the C15-C36 group of TPH (*pers. comm*. Jo Cavanagh, Landcare Research Ltd)

The concentrations of individual PAHs in the pasture are given in Appendix 3 and for most, the levels are below the detection limit. Plants do not manufacture these compounds and hence any levels above the limit of detection are likely due to plant uptake. However the levels are so low that it is unlikely they would cause a problem in terms of pasture growth, animal health or food quality.

This is consistent with the results from monitoring the concentrations of these compounds in milk from these farms. None have been found (*pers. com*. Mr Andy Fowler, Fonterra, Hamilton).

CONCLUSIONS

Based on the available evidence it is concluded that the Taranaki 'Landfarms' are 'fit for purpose' in terms of pastoral farming and particular dairy farming. This conclusion is based on considering the concentrations of nutrients (both macro and micro), heavy metals, barium and petrochemical hydrocarbons residues in both the soils and pastures at 3 sites.

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 $3-4000/ha to $30-40,000/ha.

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Appendix 1a: Heavy metal concentrations (ppm) in non-farmed soils (0-100mm).

Heavy metal	Source of data			
	Rural Auckland[1] (indigenous)	Waikato[2] (background)	Wellington[3] (native)	Range in mean/median values
Arsenic (As)	3.3	5.1 (1-25)	3 (<2-10)	3-5
Cadmium (Cd)	0.14	0.11 (0.03-0.30)	0.10 (<0.1-0.30)	0.10-0.14
Chromium (Cr)	12.5	18 (1-50)	12 (6-18)	12-18
Copper (Cu)	10.1	16 (4-55)	12 (6-22)	10-16
Lead (Pb)	15.8	11 (3-32)	9 (3-15)	9-16
Nickel (Ni)	4.8	3.9 (0.56-21)	14 (16-2-22)	4-14
Zinc (Zn)	40.2	28 (11-58)	66 (40-104)	28-66
Mercury (Hg)	0.11	0.19 (0.19-0.5)	ng	0.11-0.19

Notes 1) Concentrations of Selected Trace Elements for Various Land Uses and Soil Orders within Rural Auckland. Auckland Council Technical Report 2012/021

2) Soil Quality and Trace Element Monitoring in the Waikato Region. Waikato Regional Council Technical Report 2011/13

3) Soil quality and stability in the Wellington Region. State and Trends. Great Wellington Regional Council. 2012

Appendix 1b: Heavy metal concentrations (ppm) in dairy or farmed soils (0-100mm).

Heavy metal	Source of data					
	Auckland (dairying) [1]	Bay of Plenty (dairying) [2]	Waikato[3] (farmed)	Wellington[4] (dairying)	Malborough [6] (dairying)	Range in mean/ median values
Arsenic (As)	3.3	4.9 (SE 1.2)	8.6 (0.70-94)	4 (<2-30)	5.1	3-9
Cadmium (Cd)	0.59	0.75 (SE 0.09)	0.71 (0.10-2.0)	0.5 (0.23-1.3)	0.42	0.1-0.8
Chromium (Cr)	13.1	7.6 (SE 0.8)	14 (1-220)	17 (9.8 – 50)	27	8-18
Copper (Cu)	16	16.1 (SE 3.7)	24 (3-250)	13 (6.8-35)	20	10-20
Lead (Pb)	14.7	5.6 (SE 0.6)	16 (3-95)	16 (7.3-32)	15	6-16
Nickel (Ni)	5.5	6.1 (SE 1.0)	6 (1-34)	12 (4-24)	13	4-14
Zinc (Zn)	43.1	72 (SE 17.8)	62 (1-258)	79 (33-120)	81	7-79
Mercury (Hg)	0.2	0.07 (SE 0.01)	0.16 (0.03-0.5)	ng	ng	0.07-0.20

Appendix 2: Heavy metal concentrations (ppm) in pasture reported in the literature and the Maximum Permissible Levels (MPL) in complete rations.

Heavy metal	**Longhurst[1]**	**Quin[2]**	**Typical**	**MPL[3]**
As	0.07-0.24	ng[4]	0.07-0.24	2
Cd	0.03-0.29	0.05 – 0.08	0.03-0.29	1
Cr	ng	0.34-0.46	0.31-0.49	ng
Cu	9-14	5.4-11.7	5.4-14	ng
Pb	0.10-0.35	0.76-1.80	0.10-1.8	5
Ni	ng	< 0.10-0.20	0.10-0.20	ng
Zn	6.5-40	22-37	6.5-37	ng
Hg	ng	ng	ng	0.10

Notes
1) Longhurst et. al. 2004. Range in mean concentrations across soil groups and plant species
2) Quin and Syers 1978. Range in values for control treatment
3) Maximum permitted levels in complete rations for ruminants (Suttle N. F. 2010)
4) ng = not given

Appendix 3: Laboratory results showing the concentrations of all petrochemical hydrocarbons in 4 soils samples and 4 pasture samples.

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Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Eurofins NZ Laboratory Services Ltd	**Lab No:**	1168389	SPv2
Contact:	S Stiles-Jones	**Date Registered:**	17-Aug-2013	
	C/- Eurofins NZ Laboratory Services Ltd	**Date Reported:**	29-Aug-2013	
	PO Box 281	**Quote No:**	56330	
	HAMILTON 3240	**Order No:**	168833HM	
		Client Reference:	3256047	
		Submitted By:	S Stiles-Jones	

Amended Report

This report replaces an earlier report issued on the 26 Aug 2013 at 1:33 pm
Sample IDs have been amended at the client's request.

Sample Type: Soil

		Sample Name:	13508240 (Brown) 09-Aug-2013	13508241 (Geary Unirrig) 09-Aug-2013	13508242 (Geary irrig) 09-Aug-2013	13508243 (Schrider) 09-Aug-2013	
		Lab Number:	1168389.1	1168389.2	1168389.3	1168389.4	
Individual Tests							
Dry Matter	g/100g as rcvd		80	84	75	84	-
BTEX in Soil by Headspace GC-MS							
Benzene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Toluene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Ethylbenzene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
m&p-Xylene	mg/kg dry wt		< 0.10	< 0.10	< 0.12	< 0.10	-
o-Xylene	mg/kg dry wt		< 0.05	< 0.05	< 0.06	< 0.05	-
Polycyclic Aromatic Hydrocarbons Screening in Soil							
Acenaphthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Acenaphthylene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[a]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Chrysene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Fluoranthene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Fluorene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Naphthalene	mg/kg dry wt		< 0.14	< 0.14	< 0.16	< 0.13	-
Phenanthrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Pyrene	mg/kg dry wt		< 0.03	< 0.03	< 0.04	< 0.03	-
Total Petroleum Hydrocarbons in Soil							
C7 - C9	mg/kg dry wt		< 8	< 8	< 10	< 8	-
C10 - C14	mg/kg dry wt		< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt		< 40	< 40	< 40	< 40	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt		< 70	< 70	< 70	< 70	-

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	-	1-4
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	1-4

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.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

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ANALYSIS REPORT

Client:	Eurofins NZ Laboratory Services Ltd	**Lab No:**	1165426	SPv1
Contact:	K Rhodes	**Date Registered:**	09-Aug-2013	
	C/- Eurofins NZ Laboratory Services Ltd	**Date Reported:**	23-Aug-2013	
	PO Box 281	**Quote No:**		
	HAMILTON 3240	**Order No:**	168833HM	
		Client Reference:	9640618	
		Submitted By:	K Rhodes	

Sample Type: Plant Material

Sample Name:		13P02588	13P02589	13P02590	13P02591	
Lab Number:		1165426.1	1165426.2	1165426.3	1165426.4	
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene	mg/kg	0.0009	0.0007	0.0006	0.0010	-
Acenaphthylene	mg/kg	< 0.0005	< 0.0005	< 0.0005	0.0006	-
Anthracene	mg/kg	0.0009	0.0023	0.0005	0.0014	-
Benzo[a]anthracene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Benzo[a]pyrene (BAP)	mg/kg	0.0003	< 0.0002	0.0003	< 0.0002	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg	0.0004	0.0003	0.0003	0.0002	-
Benzo[g,h,i]perylene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Benzo[k]fluoranthene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Chrysene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Dibenzo[a,h]anthracene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Fluoranthene	mg/kg	0.0008	0.0004	0.0004	0.0004	-
Fluorene	mg/kg	0.0014	0.0013	0.0010	0.0015	-
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Naphthalene	mg/kg	0.006	0.007	0.005	0.011	-
Phenanthrene	mg/kg	0.0028	0.0021	0.0016	0.0018	-
Pyrene	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-
Total Petroleum Hydrocarbons in Biota						
C7 - C9	mg/kg as rcvd	< 8	< 8	< 8	< 8	-
C10 - C14	mg/kg as rcvd	< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg as rcvd	81	71	86	58	-
Total hydrocarbons (C7 - C36)	mg/kg as rcvd	81	71	86	< 60	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - 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: Plant Material

Test	Method Description	Default Detection Limit	Samples
Homogenisation of Biological samples for Organics Tests	Mincing, chopping, or blending of sample to form homogenous sample fraction.	-	1-4
Polycyclic Aromatic Hydrocarbons in Biomatter		-	1-4
Total Petroleum Hydrocarbons in Biota	Sonication extraction, Alumina cleanup, GC-FID analysis	-	1-4

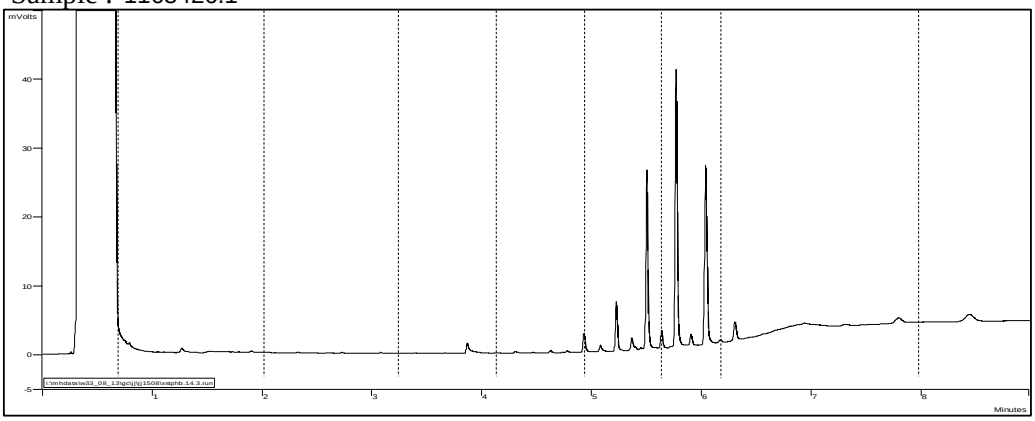
Sample Type: Plant Material			
Test	**Method Description**	**Default Detection Limit**	**Samples**
TPH in Biota extraction by Sonication (Instrument Vial)	Sonication extraction, Silica cleanup, GC-FID analysis.	-	1-4
TPH in Biota extraction by Sonication (Storage Vial)	Sonication extraction, Silica cleanup, GC-FID analysis.	-	1-4

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

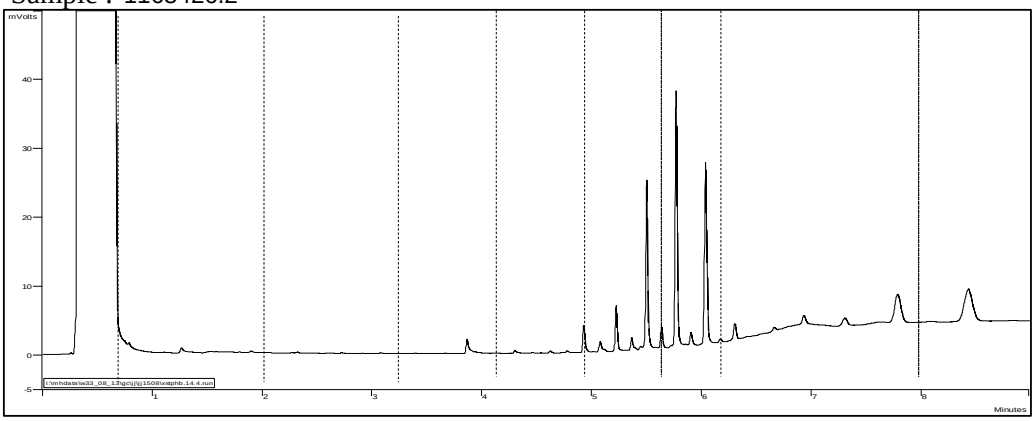
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

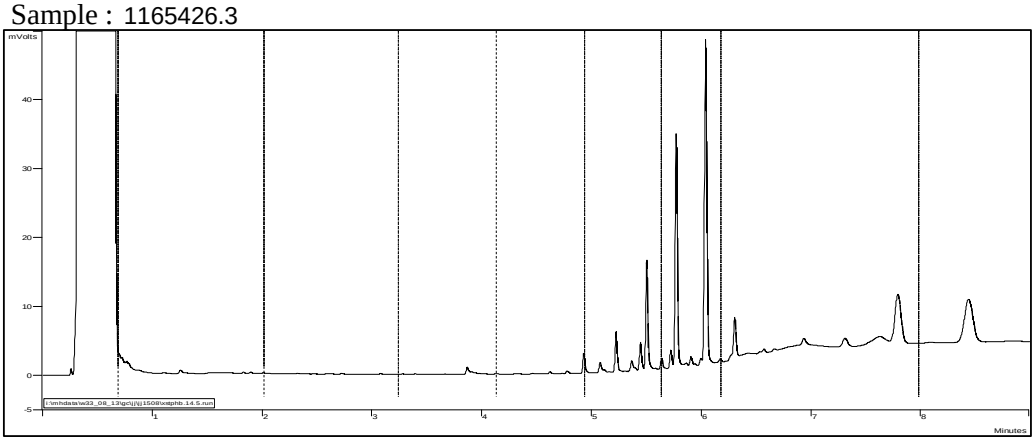
Sample : 1165426.1



Sample : 1165426.2

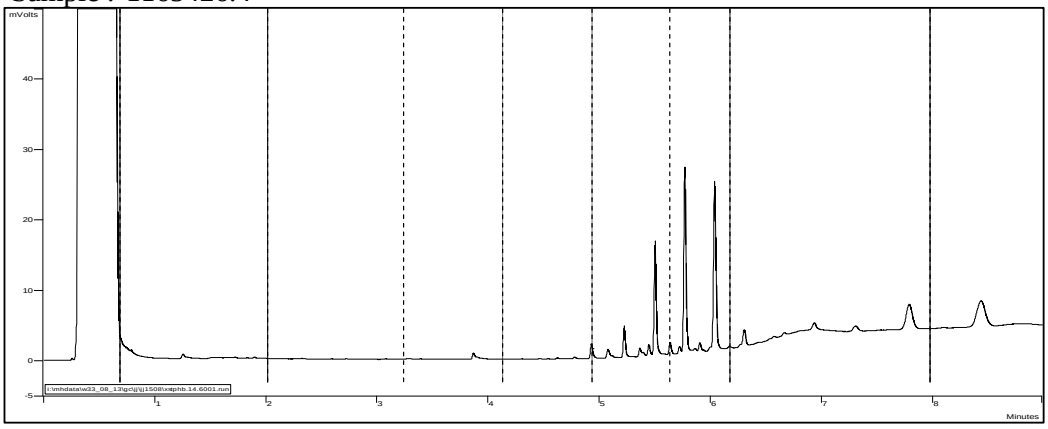


Sample : 1165426.3



C7 C10 C15 C20 C25 C30 C34 C44

Sample : 1165426.4



C7 C10 C15 C20 C25 C30 C34 C44