

TAG Oil (NZ) Limited
Vanner Landfarm
Monitoring Programme
Annual Report
2014-2015

Technical Report 2015-63

ISSN: 1178-1467 (Online)
Document:1598827 (Word)
Document:1599125 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

February 2016

Executive summary

BTW Company Limited (BTW) manages a drilling waste landfarm on behalf of consent holder TAG Oil (NZ) Limited (The Company). Vanner Landfarm is located on Lower Ball Road, Kakaramea, in the Mangaroa catchment. It has been operated at this location since November 2012. During the 2013-14 monitoring period, the resource consent was transferred from BTW Company Limited to the Company. BTW have continued to manage this facility on behalf of the Company, whereby they landfarmed material which was exclusive to the Company's operations.

This report for the period July 2014 to June 2015 describes the monitoring programme implemented by the Taranaki Regional Council (the 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, this includes a total of 26 conditions setting out the requirements that the Company must satisfy.

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

The Council's monitoring programme for the year under review included ten inspections, ten water samples and six soil samples collected for physicochemical analysis.

The annual monitoring indicated that the site had continued to be operated to a high level and no adverse environmental effects had been detected. As in previous years, the monitoring indicated soil and water resources were not adversely affected from site activities, house keeping, record keeping and reporting were all to a high standard.

The only remaining issue associated with this facility moving forward in the 2015-16 monitoring year will be the re-vegetation of the final application areas. These areas had been subject to wind blown erosion which detrimentally affected the pasture growth. There was zero 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 high level of both environmental and administrative performance with the resource consent 7942-1.1.

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

This report includes recommendations for the 2015-2016 year.

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	2
1.1.4 Evaluation of environmental and administrative performance	2
1.2 Process description	4
1.2.1 Drilling waste	4
1.2.2 Landfarming	5
1.3 Site location and description	6
1.4 Resource consents	7
1.4.1 Discharges of wastes to land	7
1.5 Monitoring programme	8
1.5.1 Introduction	8
1.5.2 Programme liaison and management	8
1.5.3 Site inspections	9
1.5.4 Chemical sampling	9
1.5.5 Review of analytical results	9
2. Results	11
2.1 Inspections	11
2.2 Results of discharge monitoring	13
2.3 Results of receiving environment monitoring	14
2.3.1 Council soil results	14
2.3.2 Council groundwater results	15
2.3.3 Council surface water results	17
2.4 Review of analytical results	18
2.5 Investigations, interventions, and incidents	18
3. Discussion	20
3.1 Discussion of site performance	20
3.2 Environmental effects of exercise of consents	20
3.3 Evaluation of performance	22
3.4 Recommendations from the 2013-2014 Annual Report	24
3.5 Alterations to monitoring programmes for 2015-2016	24
3.6 Exercise of optional review of consent	25
4. Recommendations	26
Glossary of common terms and abbreviations	27

Bibliography and references 29

Appendix I Resource consents held by TAG Oil (NZ) Limited

Appendix II BTW Annual Report

List of tables

Table 1	Material application table	14
Table 2	2014-2015 The Council's soil sample results Vanner landfarm	14
Table 3	Groundwater monitoring results from bore GND 2316 at the Vanner landfarm during the 2014-2015 period	16
Table 4	Groundwater monitoring results from bore GND 2317 at the Vanner landfarm during the 2014-2015 period	16
Table 5	Council surface water samples of the Mangaroa Stream	17
Table 6	Summary of performance for Consent 7942-1.1	22

List of figures

Figure 1	Site map of the Vanner landfarm with application areas, dates and BTW sample transects	13
Figure 2	Council soil sampling transect locations, areas F6 to F10 2014-15 monitoring period	15
Figure 3	Location of groundwater monitoring wells and stream samples from the Mangaroa Stream, Vanner landfarm	15

List of photos

Photo 1	TAG Vanner landfarm location map with regional location (inset)	7
Photo 2	Vanner landfarm area F8 March 2015	21
Photo 3	Vanner landfarm area F8 November 2015	21
Photo 4	Vanner landfarm area F9 and F10 November 2015	22

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2014-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by TAG Oil (NZ) Limited (the Company). BTW (on behalf of TAG Oil) operates a landfarm (Vanner Landfarm) situated on Lower Ball Road at Kakaramea, in the Mangaroa catchment.

The Vanner site became operational during the 2011-2012 monitoring period, when there was a single disposal of 1390 m³ of primarily water/synthetic based cuttings and fluids, with smaller quantities of contaminated water and soil. The waste spread in 2012-2013 was sourced from the Mangahewa C and D, Sidewinder, Puka and KA-1 wellsites and Cheal production station. On 30 July 2013 consent 7942-1 was transferred from BTW to the Company and the site began exclusively disposing of the Company's mud. The site remained under BTW management and had continued to stockpile and landfarm muds and cuttings for the remainder of the 2013-2014 monitoring period.

During this monitoring period, 2014-2015, one area was landfarmed on site, this is described as area F10, and it represented the final parcel of land of the Northern portion of the landfarm. This material consisted of water based drilling cuttings and fluids, exclusively from the Company's operations at their Waitangi 1 well site.

Post application and re-instatement, the site is now inactive, with the Company providing the Council with sufficient information to allow for a partial surrender of the portions of land which had historically been utilised for the practice of landfarming.

Of note, the southern portion of the landfarm is still consented should the Company require additional areas to re-commence the landfarming process.

This report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by the Company, to discharge drilling waste onto and into land via landfarming. This is the third annual report to be prepared by the Council to cover the discharges to land and their effects at the Vanner landfarm site.

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

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by

the Company in the Mangaroa catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Company's site/catchment.

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

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

Section 4 presents recommendations to be implemented in the 2015-2016 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

- (a) the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects;
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- (d) natural and physical resources having special significance (for example recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.
- **Good:** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.
- **Improvement required:** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.
- **Poor:** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self

reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

- **High:** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.
- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.
- **Improvement required:** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.
- **Poor:** Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

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

1.2 Process description

1.2.1 Drilling waste

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

1.2.1.2 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 avoid 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.

1.2.1.3 Cuttings

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

1.2.2 Landfarming

The landfarming process has typically been used in the Taranaki region to assist the conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about \$3-4000/ha to \$30-40,000/ha (2013).

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

1. Drilling waste is transported from wellsites by truck (cuttings) or tanker (liquids). It may be discharged directly to land or placed in a dedicated storage pit.
2. The required area is prepared by scraping back and stockpiling existing pasture/topsoil and leveling out uneven ground.

3. Waste is transferred to the prepared area by excavator and truck and spread out with a bulldozer. Liquids may be discharged by tanker or a spray system.
4. Waste is allowed to dry sufficiently before being tilled into the soil to the required depth with a tractor and discs.
5. The disposal area is leveled with chains or harrows.
6. Stockpiled or brought in topsoil/clay is applied to aid stability and assist in grass establishment.
7. Fertiliser may be applied and the area is sown in crop or pasture at a suitable time of year.

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

In this period the Company provided the Council with sufficient information to allow for the partial surrender of the Vanner site.

1.3 Site location and description

The Vanner landfarm is located on Lower Ball Road at Kakaramea, flanked by Origin Energy Ltd's former Spence Road landfarm to the south. These sites are located on marginal coastal farm land situated on reworked dune fields. An extensive (50-150 m) foredune is located seaward of the consented site, it remained undisturbed by site activities. The foredune provides a considerable natural buffer from prevailing onshore winds.

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 deep water table (especially in the proximity of the storage areas). Test bores were augured to 10 m in the pit area, mostly through coarse sand without intercepting significant soil moisture. Pit construction revealed mostly coarse sand at the pit bases (approximately 3-4 m below surface).

Average annual rainfall for the site is 1,043 mm (taken from the nearby Patea monitoring station). As with the other South Taranaki coastal sites, the Vanner site is subject to strong winds predominantly from the N-NW at average speeds of 10-20 knots (taken from Hawera automated weather station).

The Mangaroa Stream runs through the northern extent of the site separating the stockpiling facilities and some of the available spreading area from the main spreading area at the southern end of the site. Prior to any spreading activities the Company were required to install a culvert across the stream to prevent unauthorised discharges and stream bed damage from earthworks and transporting processes.

Site data

Location

Word descriptor:	Lower Ball Road, Kakaramea, Taranaki
Map reference:	E 1720685
(NZTM)	N 5602731
Mean annual rainfall:	1,043 mm

Mean annual soil temperature:	~15.1°C
Mean annual soil moisture:	~32.9%
Elevation:	~25 m asl
Geomorphic position:	Cliffed / dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining
Land use:	Active disposal



Photo 1 TAG Vanner landfarm location map with regional location (inset)

1.4 Resource consents

1.4.1 Discharges of wastes to land

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

The Company holds discharge permit **7942-1.1** to discharge waste (consisting of drilling cuttings and drilling fluids from the drilling operations with water based muds and synthetic based muds) onto and into land via landfarming. This permit was issued by the Council on 21 October 2011 under Section 87(e) of the RMA. It is due to expire on 1 June 2028.

Condition 1 sets out definitions.

Condition 2 requires the consent holder to adopt the best practicable option to minimise any environmental effects.

Conditions 3 to 7 require the notification and the provision of information and analytical data prior to receipt of wastes on site for stockpiling, and prior to discharge.

Condition 8 stipulates the discharge area.

Condition 9 requires a buffer zone between areas of disposal and surface water bodies and property boundaries.

Conditions 10 to 13 stipulate the manner and dispersal of wastes and discharge limits.

Conditions 14 and 15 specify further site management requirements.

Conditions 16 to 23 specify receiving environment limits for both soil and water.

Condition 24 concerns archaeological remains.

Conditions 25 and 26 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

1.5 Monitoring programme

1.5.1 Introduction

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

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

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

1.5.2 Programme liaison and management

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

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

- consultation on associated matters.

1.5.3 Site inspections

A total of four scheduled inspections were conducted during the monitoring period, these were undertaken the Council's Inspectorate Officer. Six further inspections were carried out during chemical sampling runs. The 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.

1.5.4 Chemical sampling

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

During the monitoring period, two monitoring wells were each sampled four times. Samples were analysed for pH, temperature, conductivity, chloride, total dissolved solids, sodium, barium, TPH and BTEX.

The Mangaroa Stream was sampled twice at two sites (upstream and downstream) for standard surface water quality parameters and hydrocarbons.

1.5.5 Review of analytical results

The Council reviewed soil sampling results and the annual reports provided by the Company in respect of the landfarm 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 IACC 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, sodium absorption ratio (SAR) and total soluble salts (TSS).

The Company also supplied surface water sample results from the Mangaroa Stream for review.

2. Results

2.1 Inspections

07 July 2014

There was a westerly breeze noted at the time of the site visit. No objectionable odours or visible emissions were found during the inspection. All pits found to contain muds and plenty of free-board available. The liners appeared in good repair. Thick HDPE covers were in place at the tipping areas to protect the liner integrity. A digger was on-site to assist with emptying the muds from the delivering trailer as the material had separated during transport, impacting on its removal from the trailer. All washings were directed to the northern pit which appeared to contain only fluids.

No surface hydrocarbons were present in any of the pits. The site surface was observed to suffer from heavy vehicle movements especially during wet periods. Previous spreading areas were inspected. It was noted that young stocks were present. Areas of bare pasture were present throughout the spreading area. Test pitting identified mud easily in the soil profile, it was well blended with the sandy soils, no hydrocarbons odours were noted. Hay bales were placed along the culvert to retain the sandy soil, hay bales were also installed around the western perimeter low point to retain the topsoil. No recent spreading had occurred. No incidents were reported.

14 July 2014

A site inspection was undertaken in conjunction with groundwater and surface water sampling. Weather conditions were poor, but the site looked in good state. Recent farming and topsoil re-application had occurred in the F9 area near the pits. This area looked good, no issues were observed. Previous spreading areas were also observed to be in good order, with a few areas of patchy vegetation cover. The surface water samples were clear and odourless, there was no sign of any impacts on the stream from site activities. The groundwater samples were turbid and orange from naturally occurring iron oxide. BTW staff turned up on-site for a regular inspection, and a brief discussion on the state of the site was held. Everything appeared well managed, with increased signage and fencing in the stockpiling area following the recent erroneous delivery of mud scheduled for a different site.

03 November 2014

There was a light westerly breeze noted at the time of the site visit. No objectionable odours or visible emissions were found during the inspection. All pit liners appeared in good repair with plenty of capacity available within the pits. Some surface oils were noted in pit B. No recent spreading activities had occurred, operations were expected to begin the following week and the site was to be closed following completion. The areas which had been previously inspected were observed to have been badly affected by the wind which had killed the pasture, which resulting in bare land. The area would require more topsoil applied when the spreading activities were to occur and the area would thereafter have to be resown. Some muds were observed to have migrated to the surface in places, it was well weathered and it broke apart easily. No hydrocarbon odours were noted.

18 November 2014

The inspection was conducted in conjunction with groundwater and surface water sampling. Contractors were on site excavating pit A and spreading to area F9 (coastal

side - inland side already had topsoil reapplied as per communication from BTW). Pasture establishment looked good, some barren patches.

12 December 2014

The inspection was conducted in conjunction with soil sampling of spreading area F6. The pasture establishment was observed to be in good order, although some barren patches were evident throughout the spreading area. The site was inactive at the time of inspection.

22 December 2014

The inspection was conducted in conjunction with soil sampling of spreading area F7. Pasture establishment was generally good, although some barren patches with drilling mud in the cores were evident. GJ Sole tanker was onsite at the time of inspection and appeared to be sucking out Pit C. No new mud or landspreading activity was evident.

08 January 2015

There was a light southerly breeze at the time of inspection. No objectionable odours or visible emissions were noted. No site activity was occurring at the time of the inspection. Work had been undertaken to landfarm the contents of cells, only one lined pit remained at the site and contained a black liquid with a hydrocarbon/mud odour. The liner appeared in good repair although some tears were sighted at the south west top corner. All other pits had been emptied, liners removed and the pit areas re-contoured. The area to the north of the remaining pit had also had muds incorporated, some visible at the surface. These areas were yet to be sown into pasture; some natural weed growth had occurred across this area. The topsoil was essentially stable and very little dust appeared to be generated from the large areas of exposed soil. The historic application areas detailed exposed soil where pasture struggled to establish due to wind erosion. The muds were identifiable within the soil profile and appeared to be weathering well and the pasture appeared healthy.

10 February 2015

The inspection was conducted in conjunction with groundwater monitoring. The site had recently (within the last two weeks) been made inactive by BTW. Mud storage pits and bunding had been removed and levelled. Gravel was stockpiled nearby; this was to be removed later. Topsoil was to be reapplied and sown, post-drought. Groundwater bores were sampled through the use of a bailer. The sample from bore GND2316 was turbid and bright orange with a slight odour. The pasture establishment in spreading area F8 was observed to be inconsistent.

13 March 2015

There was a variable northerly breeze at the time of inspection. No objectionable odours emissions were found during the inspection. No muds were stockpiled at the site as the storage pits had been removed and land reinstated. The recently spread area was inspected, natural coastal weeds were observed growing throughout the area, the seed was yet to be sown. Some muds had migrated to the surface, it was well weathered with very little odour and material broke apart easily. The spreading areas F8-10 detailed hard mud pans in places across the wind exposed contour. No pasture growth had occurred in these areas. The earliest application areas, situated at the southern end of the site had good pasture cover and very little mud was identified at the surface or within the soil profile.

In the inspection notice it was requested that: Additional site work would have to be undertaken to sow the recently spread areas while patches of hard pan mud in earlier application areas would need to be ripped to incorporate material and then resown.

18 March 2015

An inspection was conducted in conjunction with groundwater and soil sampling. Both bores were sampled with a bailer, some foaming and turbidity was observed. Spreading areas F8 and F10 were sampled using a composite of 15 cores each. Drilling muds were encountered in each transect, between 200-300 mm depth. Spreading areas F8 and F7 appeared to have been recently reworked and sown with early stages of pasture emergence. The wind was strong and cattle were observed in the spreading area at time of inspection. It was evident that channel erosion was responsible for stripping topsoil away and exposing a mud layer near bore GND2316. Area F10 had been levelled and sown, but wind damage to establishing pasture had prevented stabilisation of topsoil.

2.2 Results of discharge monitoring

Throughout the monitoring year under review the Company landfarmed one area of the site, area F10. The size of F10 was 1.47 ha and the material originated from TAG Oil’s operations at the Waitangi 1 wellsite. The material was composed of water based muds and cuttings with a volume of 886 m³. Note that the area F10 was the final portion of land which was intended to be utilised by the Company during this period, which was undertaken in November 2014 (**Figure 1**). Further information is provided in Table 1.

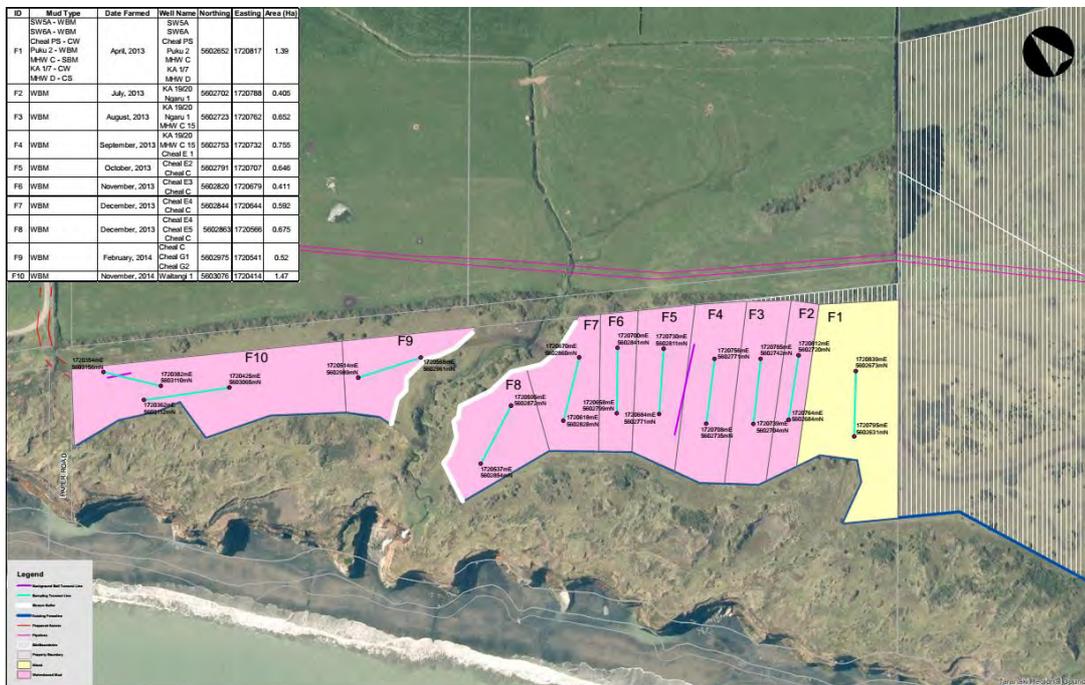


Figure 1 Site map of the Vanner landfarm with application areas, dates and BTW sample transects

Table 1 Material application table

Location	Material Type	Date Landfarmed	Area of Cover (ha)	Thickness of material (mm)	Volume landfarmed (m ³)
F10	WBM	November 2014	1.47	100 mm	886

2.3 Results of receiving environment monitoring

2.3.1 Council soil results

During the monitoring year the Council collected six composite soil samples. These soil samples were collected via a soil corer which was inserted to a nominal depth of 300 mm +/- bgl to encapsulate the zone of application. The procedure for soil sample collection is adapted from the Safe Application of Biosolids to land New Zealand (2003), whereby ten soil cores are collected at 10 m intervals across a spread area and then composted to gain one representative sample of the area of application. The areas which were sampled by the Council during this monitoring period were F6, F7, F8, F9 and F10 respectively. The results of the Council sample results are provided in Table 2. The location of the soil transects undertaken by the Council is provided in Figure 2.

Table 2 2014-2015 The Council's soil sample results Vanner landfarm

	TRC ID	TRC1412285	TRC1412336	TRC150667	TRC150668	TRC151746	TRC151747
	Soil ID	SOL000186	SOL000186	SOL000186	SOL000186	SOL000186	SOL000186
	Location	F6	F7	F8	F9	F8	F10
	Date	12-Dec-14	22-Dec-14	11-Feb-15	11-Feb-15	18-May-15	18-May-15
	Time	13:40	9:45	12:15	12:45	12:45	13:30
Calcium	mg/kg	37	89.7	107	121.1	49.6	83.1
Chloride	mg/kg	169	209.9	537.7	99	5	6.5
Conductivity	mS/m@20C	17.7	136.3	63.4	150.8	7.6	74
Total Hydrocarbon	mg/kg	34	358	2748	74	16	61
Potassium	mg/kg	239.5	439.3	678.4	221.1	49	135.5
Moisture factor	nil	1.1	1.002	1.061	1.005	1.068	1.007
Magnesium	mg/kg	5.9	6.8	6.5	8	6.9	9.2
Sodium	mg/kg	43.1	57.8	122.6	41.7	8.8	11.5
Ammonical Nitrogen	mgN/kg	1.26	0.16	2.43	7.74	2.22	1.95
Nitrate/ Nitrite Nitrogen	mgN/kg	1.21	0.4	0.3	4.92	0.6	0.96
PH	pH	7	8	8.1	7.5	7.3	7.8
Sodium Absorption Ratio	None	1.73634	1.58455	3.11187	0.99098	0.31035	0.31948
Total Soluble Salts	mg/kg	701.2	1066.7	2493.4	1180.2	298.2	579.1

The Council soil sample results show compliance with all consent limits. Of note, the reported concentrations for area F8 during the February sample run were close to the surrender limit in terms of hydrocarbons and total soluble salts¹. However, follow up analysis of the same area in May of the same year found that these had suitably remediated and were reported below the requisite surrender criteria stipulated by the resource consent.

¹ Consent 7942-1.1, Condition 22, Appendix I



Figure 2 Council soil sampling transect locations, areas F6 to F10 2014-15 monitoring period

2.3.2 Council groundwater results

During the monitoring year the Council undertook quarterly sampling of the groundwater monitoring bore network. There are two groundwater monitoring bores installed on the Vanner landfarm site. The location of the monitoring wells is displayed in Figure 3.



Figure 3 Location of groundwater monitoring wells and stream samples from the Mangaroo Stream, Vanner landfarm

Table 3 Groundwater monitoring results from bore GND 2316 at the Vanner landfarm during the 2014-2015 period

	TRC ID	TRC1410811	TRC1411945	TRC150641	TRC151748
	Location	GND2316	GND2316	GND2316	GND2316
	Date	14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:35	9:40	10:50	12:00
Acid soluble barium	g/m3	0.1	0.125	0.15	0.05
Dissolved barium	g/m3	0.07	0.043	0.045	0.037
Benzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	221	123	120	106
Conductivity	mS/m@20C	97.3	60.4	68.7	57.8
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m3	<0.10	<0.7	<0.10	<0.7
HC C7-C9	g/m3	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m3	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m3	<0.4	<0.4	<0.4	<0.4
LEVEL	m	8.923	8.97	9.122	8.687
Sodium	g/m3	117	61	60.2	44.2
PH	pH	6.2	6.4	6.4	6.1
Total dissolved salts	g/m3	752.8	467.3	531.5	447.2
Temperature	Deg.C	14.9	No result	15.6	16.9
Toluene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m3	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m3	<0.0010	<0.0010	<0.0010	<0.0010

Table 4 Groundwater monitoring results from bore GND 2317 at the Vanner landfarm during the 2014-2015 period

TRC ID		TRC1410812	TRC1411946	TRC150642	TRC151749
Location		GND2317	GND2317	GND2317	GND2317
Date		14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:55	10:20	11:40	11:30
Acid soluble barium	g/m3	0.14	0.122	0.11	0.13
Dissolved barium	g/m3	0.1	0.083	0.08	0.093
Benzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	213	200	191	220
Conductivity	mS/m@20°C	87.9	73.7	83.4	83.2
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m3	<0.4	<0.7	<0.7	<0.4
HC C7-C9	g/m3	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m3	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m3	<0.4	<0.4	<0.4	<0.4
Static water level	m	7.485	7.685	7.902	7.313
Sodium	g/m3	70.4	67	69.4	74.1
PH	pH	6.7	6.6	6.6	6.5
Total dissolved salts	g/m3	680.1	570.2	645.3	643.7

TRC ID		TRC1410812	TRC1411946	TRC150642	TRC151749
Location		GND2317	GND2317	GND2317	GND2317
Date		14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:55	10:20	11:40	11:30
Temperature	°C	14.5	No result	15.6	15
Toluene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m3	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m3	<0.0010	<0.0010	<0.0010	<0.0010

The results of the annual groundwater monitoring, undertaken at the Vanner Landfarm by the Council are provided in Tables 3 and 4. During the year under review the Council sampled the two site wells quarterly, this was undertaken to encapsulate seasonal variation. The results, as echoed by the previous monitoring years' result detailed no exceedance in terms of consent conditions. Measured salinity parameters are within the typical range for coastal groundwater. To date, no hydrocarbons have been detected at any stage in either monitoring bore.

2.3.3 Council surface water results

The Mangaroa Stream which flows through the Vanner landfarm site was sampled twice during the monitoring period at two sampling sites, one upstream (MAN000020) and one downstream (MAN000010). The sample collection sites are identified in Figure 3. The samples were analysed to a similar suite of parameters as assessed under the groundwater analysis discussed previously. Results are provided in Table 5.

Table 5 Council surface water samples of the Mangaroa Stream

TRC ID		TRC1410813	TRC1410814	TRC1411947	TRC1411948
Location		MAN000010	MAN000020	MAN000010	MAN000020
Location		MG Stream D/S	MG Stream U/S	MG Stream D/S	MG Stream U/S
Date		14-Aug-14	14-Aug-14	18-Nov-14	18-Nov-14
Parameter	Time	11:50	11:30	11:30	11:15
Acid soluble barium	g/m ³	0.015	0.013	0.011	0.011
Dissolved barium	g/m ³	0.009	0.009	No result	No result
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m ³	65.3	63.7	71.9	67.2
Conductivity	mS/m@20°C	38.6	38.4	38.3	38.3
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Total Hydrocarbon	g/m ³	<0.10	<0.7	<0.4	<0.10
HC C6-C9	g/m ³	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4
Sodium	g/m ³	38.5	38.3	38.1	37.7
PH	pH	7.6	7.8	7.6	7.6
Total dissolved salts	g/m3	298.7	297.1	296.3	296.3
Temperature	°C	9.9	9.8	No result	No result
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010

TRC ID		TRC1410813	TRC1410814	TRC1411947	TRC1411948
Location		MAN000010	MAN000020	MAN000010	MAN000020
Location		MG Stream D/S	MG Stream U/S	MG Stream D/S	MG Stream U/S
Date		14-Aug-14	14-Aug-14	18-Nov-14	18-Nov-14
Parameter	Time	11:50	11:30	11:30	11:15
XYLENE-M	g/m ³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010

The biannual surface water sampling of the Managaroa Stream indicated no adverse environmental effects on this body of water as a result of the activities of the Vanner landfarm. Water quality parameters measured during this monitoring period are within typical ranges for the coastal streams in Taranaki. Both the upstream and downstream sample locations detailed little or no variation when compared with each other. As the upstream sample location (MAN000020) is situated upstream of the site, any adverse effects permeating from the facility would result in a difference between the two sample sites. To date there has been little in the way of variation across all parameters.

2.4 Review of analytical results

BTW (acting on behalf of the Company) supplied pre-screening analysis of the material which was brought to site prior to disposal to land. This is a conditional requirement. This information is provided in Appendix II.

During this monitoring period BTW applied for a partial surrender of the site. They did so by providing the Council with justification through analytical sample results of the soil (their sampling methodology is outlined in their supplied annual report, Appendix II), that the areas of the site which had been utilised for the application of landfarmable material had met the conditional requirement for surrender.

The results also indicated that area F10 which was the final portion of the site to be utilised for the application of water based drilling mud was also within the consented requirement for surrender, as such the site was processed for a partial surrender.

As well as satisfying the Council with receiving soil results, the Company also undertook stream samples of the Mangaroa Stream. Two sample sites were analysed, in similar fashion to the Council's surface water samples, an upstream and downstream surface water sample were collected. As previously discussed in Section 2.3.3, the results indicated little variation between the upstream and downstream samples, and no result of concern was noted. The analytical results of the BTW analysis of the Mangaroa Stream are provided in the supplied BTW report Appendix II.

2.5 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual

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

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

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

In the 2014-2015 period, the Council was not required to undertake any significant additional investigations, interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Discussion of site performance

The site performance of the Vanner landfarm throughout the 2014-2015 monitoring period has continued to a high standard. This was discussed in the 2013-2014 monitoring period and the Company has continued to undertake operations in a clear and concise manner. There is pride in the management of this facility and it is echoed in the supplied annual report.

The Company provided pre-screening analysis of the material delivered from the Waitangi 1 wellsite; this is in the supplied annual report Appendix II. The work notification pertaining to when the application of material to land via landfarming was to occur was submitted and received by the Council.

In March of this year the Company provided the Council with analytical evidence to support the decision to surrender the portions of the site which had met the conditional requirement. Sufficient evidence in the form of analytical soil results of each parcel of land (areas F1-F10 inclusive) was provided, a copy of this analysis is provided in the supplied annual report, Appendix II. This resulted in a change of the consent conditions whereby no more future discharges of material may occur on the locations (F1-F10 inclusive) of previous applications.

During this monitoring period the Company removed the lined site storage cells as well as the wash down pit; the land was reinstated and re-contoured. The Company also undertook soil stabilisation measures in the central portions of the site (F8 and F7) to address revegetation issues (Photo 2 and 3), coupled with the sowing of the final applications areas of the site, areas F9 and F10. While these areas have since suffered from erosion issues (F9-F10), the Company has recently engaged Agriseeds and Osflo to address the re-vegetation issue in these specific areas. This indicates that the Company is proactive with the site, keen to meet the consented conditions and to satisfy the landowner.

3.2 Environmental effects of exercise of consents

The only slight environmental issue which remains with this facility, as already discussed, is the re-vegetation of the final portions of the site. There had been issues with re-vegetation in the central portions of the site earlier in the year (Photo 2), however careful management had mitigated the erosion issue and pasture has been established (Photo 3). Although, while pasture had initially been established on the final application areas, areas F9 and F10, heavy weather in September of this year, which is outside of the monitoring period of this report, stripped the topsoil and associated vegetation (Photo 4).

As the site is located in South Taranaki, very close to the coastal cliff line, it is exposed to wind blown erosion; this has been an issue throughout the life cycle of this facility.

The Company is aware of the issue and is working closely with the land owner to cultivate the area which is prone to erosion. As already discussed they will engage Agriseed and Osflo to mitigate this erosion problem. In doing so they will satisfy the conditional requirement 15 of the resource consent which states:

'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. '

The Council will continue to monitor the re-vegetation of the remaining areas (F9 and F10) of the site through out the coming year 2015-2016.



Photo 2 Vanner landfarm area F8 March 2015



Photo 3 Vanner landfarm area F8 November 2015



Photo 4 Vanner landfarm area F9 and F10 November 2015

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 6.

Table 6 Summary of performance for Consent 7942-1.1

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. Notify TRC 48 hrs prior to stockpiling	Notifications received	Yes
4. Notify TRC 48 hrs prior to landfarming	Notifications received	Yes
5. 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
6. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
7. Report on records in condition 6 to Council by 31 August each year	Report received 18 August 2014	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
8. The discharge shall only occur on the area East of area F1 as shown in Drawing No 13314-109-GIS Rev 0	Inspection	N/A in this monitoring period
9. No discharge within 25 m of a water body or property boundary	Inspection	Yes
10. Discharge depth limited to 100mm for waste with hydrocarbons <5%, or 50mm for waste with hydrocarbons >5%	Company records and inspection	Yes
11. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes
12. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
13. 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
14. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
15. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Mostly
16. Total dissolved salts in any fresh water body shall not exceed 2,500 g/m ³	Sampling	Yes
17. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling	Yes
18. Disposal of waste shall not result in any significant adverse environmental effects on the Mangaroa Stream	Inspection and sampling	Yes
19. Soil 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
20. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
21. Concentrations of heavy metals in the soil shall at all times comply with MFE guidelines	Sampling	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
22. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 400 mS/m b. chloride, 700 g/m ³ c. dissolved salts, 2,500 g/m ³ d. sodium, 460 g/m ³ e. PAHs, MAHs and TPH, Tables 4.12 and 4.15, Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE 1999)	Sampling prior to surrender	Yes, supplied, see annual report appendix II
23. If condition 22 not met, consent cannot be surrendered	Sampling	Yes, consent partially surrendered in this period
24. Notification of discovery of archaeological remains	None found	N/A
25. Lapse condition	Inspection for evidence of exercise	N/A
26. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative compliance in respect of this consent		High

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

3.4 Recommendations from the 2013-2014 Annual Report

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

1. THAT monitoring of the consented activities at Vanner landfarm on the 2014-2015 year continues at the same level as in 2013-2014.

3.5 Alterations to monitoring programmes for 2015-2016

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

It is proposed that for 2015-2016 monitoring year soil and groundwater/surface analysis be removed from the monitoring programme. The Company has finalised there requirement to landfarm with this facility. The mud storage cells and associated wash down pad have been removed and the land reinstated and re-contoured. As the Company had lined the storage cells prior to delivery of any material at the inception of the facility, there are no legacy issues from potential storage leeching. As discussed, the Company applied for a change of consent conditions, this effectively will prevent the discharge of any future drilling materials to these previously landfarmed areas.

Moving forward, the monitoring programme for 2015-2016 will centre on the re-vegetation of the remaining areas of site which have been subject to erosion issues, namely areas F9 and F10 respectively.

3.6 Exercise of optional review of consent

Resource consent 7942-1.1 provides for an optional review of the consent in June 2016. Condition 26 allows the Council to review the consent.

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

4. Recommendations

1. THAT monitoring of consented activities at Vanner Landfarm in the 2015-2016 year be amended from that undertaken in 2014-2015 due to the fact the site is inactive and partially surrendered with only re-vegetation issues. The re-vegetation monitoring will form the basis for monitoring in the 2015-2016 year.
2. THAT the option for a review of resource consent(s) in June 2016, as set out in condition 26 of the consent, not be exercised, on the grounds that it is not required.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m ² /day	grams/metre ² /day.
g/m ³	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
IR	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m ²	Square metres.
mS/m	Millisiemens per metre.
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 consisting 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	<i>Resource Management Act</i> 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).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
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

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.

Taranaki Regional Council (2013): *BTW Limited Vanner Landfarm Monitoring Programme Annual Report 2012-2013*. Technical Report 2013 – 58.

Taranaki Regional Council (2014): *TAG Oil (NZ) Limited Vanner Landfarm Monitoring programme Annual report 2013-2014*. Technical Report 2014 – 47.

Appendix I

Resource consents held by Tag Oil (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: TAG Oil (NZ) Limited
PO Box 402
New Plymouth 4340

Decision Date
(Change): 27 March 2015

Commencement Date
(Change): 27 March 2015 (Granted Date: 21 October 2011)

Conditions of Consent

Consent Granted: To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds) onto and into land via landfarming

Expiry Date: 1 June 2028

Review Date(s): June 2016, June 2022

Site Location: Lower Ball Road, Kakaramea

Legal Description: Lot 1 DP 8481 Sub 2 & 3 Blk II Carlyle SD (Discharge site)

Grid Reference (NZTM) 1721037E-5602605N

Catchment: Mangaroa

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

General condition

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

Special conditions

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

Notifications, monitoring and reporting

3. 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.
4. 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.

Consent 7942-1.1

5. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
 - a) total petroleum hydrocarbons (C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆);
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening; and
 - d) chloride, nitrogen, pH, potassium, and sodium.

6. 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.

7. 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

8. The discharge shall only occur on the area East of area F1 as shown in Drawing No 13314-109-GIS Rev 0 attached.

9. Notwithstanding condition 8, there shall be no discharge within 25 metres of the Mangaroa Stream or property boundaries.

10. 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; or
 - 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.

11. 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.

Consent 7942-1.1

12. 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.
13. 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

14. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
15. 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

16. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m³.
17. Other than as provided for in condition 15, 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.
18. The exercise of this consent shall not result in any of the following effects in the Mangaroa Stream:
 - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
 - b) any conspicuous change in the colour or visual clarity;
 - c) any emission of objectionable odour;
 - d) the rendering of fresh water unsuitable for consumption by farm animals;
 - e) any significant adverse effects on aquatic life.

Receiving environment limits - soil

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

Consent 7942-1.1

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

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

22. 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 - naphthalene, non-carc. (pyrene), benzo(a)pyrene eq.

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

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

23. This consent may not be surrendered at any time until the standards in condition 22 have been met.

Archaeological remains

24. 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.

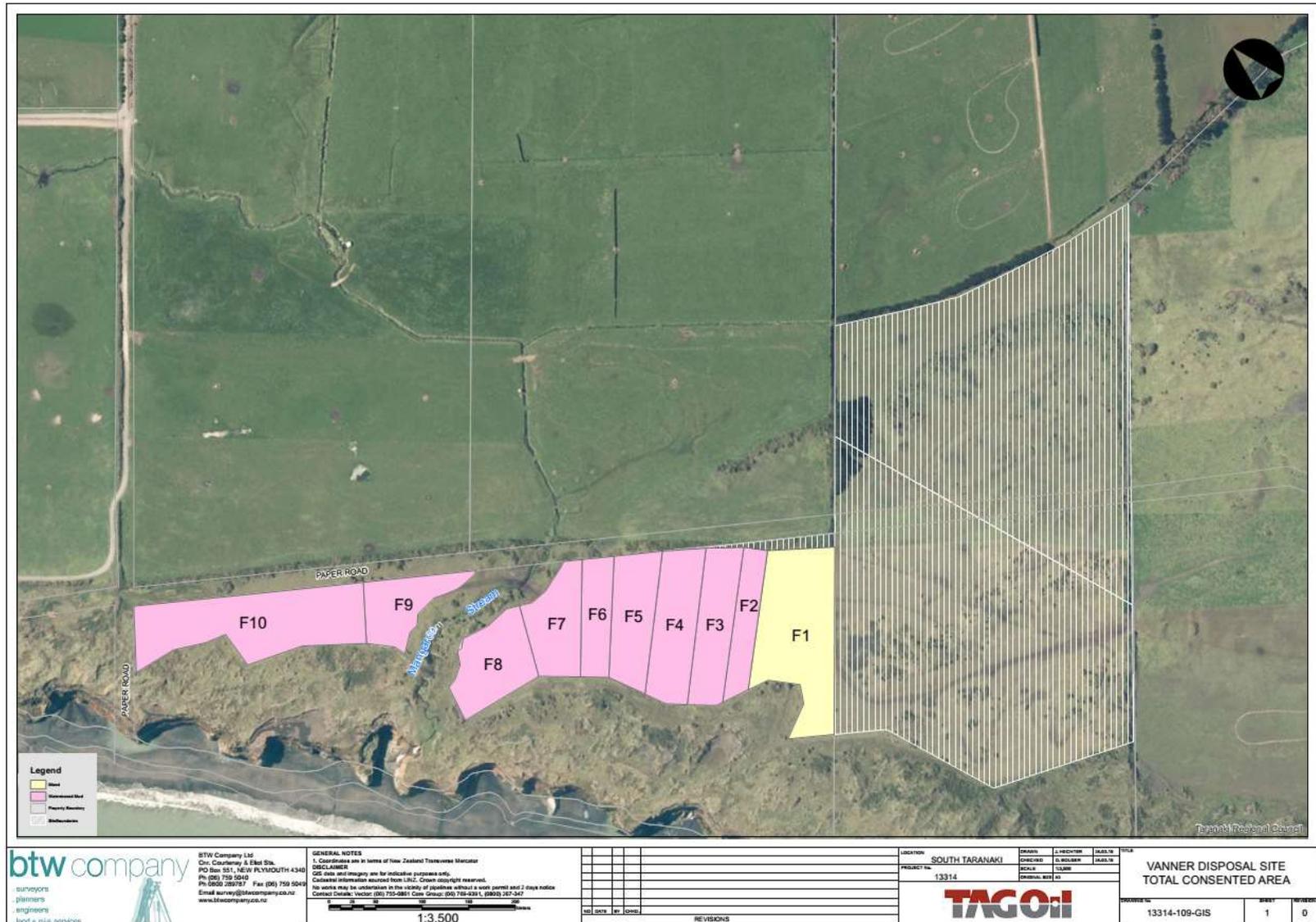
Lapse and review

25. This consent shall lapse on 31 December 2016, 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.
26. 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 27 March 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management



Appendix II
BTW Annual Report

Annual Report

Special Condition 7 - Monitoring and Reporting

TAG OIL (NZ) Limited Landfarm Annual Report - Consent 7942

by *BTW Company*



TAG OIL (NZ) Limited Landfarm Annual Report - Consent 7942

Reviewed

Report Author



Dave Bolger

22/7/15.

Date

Reviewed by



Cameron Twigley

22/7/15.

Date

13314
22/07/2015

CONTENTS

1	INTRODUCTION	2
1.1	Special Condition 7	2
1.2	July 2014 to June 2015 - Summary	2
1.3	Records required under Special Condition 7	3
1.4	Report Overview	3
2	MATERIAL STORAGE AND TREATMENT	4
2.1	Material Volumes	4
2.2	Sowing and treatments	4
3	MONITORING INFORMATION	6
3.1	Monitoring	6
3.2	Sampling Locations	7
3.3	Methods	7
3.4	Inspection Notices	7
3.5	Infringement Notice	7
3.6	Abatement Notices	7
3.7	Site Improvements	7
4	ANALYSIS OF RESULTS	11
4.1	Compliance with SC's 16 and 18	13
4.2	Compliance with SC's 19 - 23	13
4.2.1	<i>Condition 19 – Soil Conductivity</i>	13
4.2.2	<i>Condition 20 – Sodium Absorption Ratio</i>	14
4.2.3	<i>Condition 21 – Heavy Metals</i>	15
4.2.4	<i>Condition 22 – Conductivity, chloride, sodium, total soluble salts & hydrocarbons</i>	16
4.2.5	<i>Conductivity</i>	16
	<i>As demonstrated in section 4.2.1 all the landfarmed areas now meet the surrender criteria for soil conductivity</i>	16
4.2.6	<i>Chloride</i>	17
4.2.7	<i>Sodium</i>	18
4.2.8	<i>Total Soluble Salts</i>	19
4.2.9	<i>Total Percentage of Hydrocarbons C7-C9</i>	20
4.2.10	<i>Total Percentage of Hydrocarbons C10-C14</i>	21
4.2.11	<i>Total Percentage of Hydrocarbons C15-C36</i>	22
APPENDIX A	COMPOSITION OF WASTE	23
APPENDIX B	SITE MAP	24
APPENDIX C	MANGAROA STREAM – SURFACE WATER RESULTS	26
APPENDIX D	PHOTOGRAPHIC RECORD OF LANDFARMING	29
APPENDIX E	SAMPLING PLAN	30

1 INTRODUCTION

1.1 Special Condition 7

In accordance with Special Condition 7 (SC7) of resource consent 7942-1 it is a requirement that:

The consent holder 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 Special Condition 6 (SC6), for the period of the previous 1 July to 30 June.

This report therefore includes all information related to activities provided for under consent 7942-1 from 1 July 2014 to 30 June 2015 as well as monitoring required under SC 16-23.

1.2 July 2014 to June 2015 - Summary

During the annual monitoring year the site was completely decommissioned and only one area (F10) was landfarmed. The site is now inactive.

The area landfarmed was 1.47ha and the material landfarmed was only water based drilling cuttings and fluids, only from TAG Oil operations. This area was completed over the 2014 -15 summer and planted in oats early autumn, however establishment of the oats was limited due to the environmental conditions experienced after sowing. This area is to be re-sown once conditions allow, which is likely to be spring time 2015.

During this annual monitoring period all areas that had been landfarmed have now met the soil surrender criteria as specified in the consent. Confirmation from the TRC was received by the way of an approved consent variation to the existing consent, which confirmed soil surrender had been met on all areas landfarmed and no further landfarming would take place in the areas already landfarmed. This is considered to be an exceptional result considering some areas have only been landfarmed for 6 months.

There have been no environmental issues arising during the monitoring year, the site has been fully compliant with this resource consent, and now all the areas landfarmed meet surrender criteria as stated in the conditions of the consent.

Overall this site has demonstrated a very positive result for this type of activity that is now heavily monitored and scrutinised. This site does provide evidence that if a landfarm is well managed and that specific environmental characteristics are present, landfarming is a sustainable solution using a natural process to break down any elevated levels of constituents.

1.3 Records required under Special Condition 7

The consent holder shall keep records of the following:

- a) wastes from each individual well;
- b) composition of waste (in accordance with Condition 5);
- c) stockpiling area (s);
- d) volume of material stored;
- e) landfarming areas, including a map showing individual disposal area with GPS co-ordinates;
- f) volumes and weight of wastes landfarmed;
- g) dates of commencement and completion of storage and landfarming events;
- h) dates of sowing landfarming areas;
- i) treatment applied;
- 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.

1.4 Report Overview

The following information has been collated for the purpose of demonstrating compliance with SC7. Information will be supplied generally in order as requested within SC6 a-j.

- Records required under SC 6 a) Wastes from each individual well and b) Composition of waste, is provided in Appendix A of the Report. Appendix A provides a list of all chemical products and lists of possible constituents which may be added to alter the consistency of drilling mud.

Condition b) is also addressed in Section 4 of the report.

- A map of the site showing individual disposal areas, GPS co-ordinates and stockpiling areas is located in Appendix B displaying compliance with SC6 c), e) & g). This includes:
 - stockpiling areas;
 - landfarming areas, including a map showing individual disposal area with GPS co-ordinates;
 - dates and commencement and completion of storage and landfarming events.
- Section 2 provides the information related to the recording of details required within conditions d), f), h), and i) of SC6 which are listed below;
 - volumes of material stored;
 - volumes and weights of wastes landfarmed;
 - dates of sowing landfarmed areas;
 - treatments applied.

Volumes of material leaving a wellsite and volumes of each individual truck load entering the landfarm are recorded at the landfarm site. Further information is available on the site map provided in Appendix B.

- Section 3 provides details of monitoring, including sampling locations and sampling methods as required by SC6, condition j.
- Section 4 provides the results of analysis as required also by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

2 MATERIAL STORAGE AND TREATMENT

- The following section provides the information related to recording of details required within conditions d), f), h), and i) of SC6 which are listed below;
 - *volumes of material stored;*
 - *volumes and weights of wastes landfarmed;*
 - *dates of sowing landfarmed areas;*
 - *treatments applied.*

2.1 Material Volumes

The volume of material stored over the reporting year was 886m³. This material has now been landfarmed into area F10. As can be seen in Table 2.1 the area landfarmed is 1.47 hectares which is greater than the area required by the consent. To comply with consent conditions only 886m² of area is required for 886m³ of material. However it is best practice to have a contingency factor of at least 10% which has been generously applied to the last area landfarmed.

Table 2.1 provides the information required relating to the volumes of material landfarmed and also provides information on the material type, the thickness of material and the overall area landfarmed. This information is available on the site map provided in Appendix B.

Table 2.1: Volumes of Material Landfarmed – July 2014 to June 2015

Location	Material Type	Date Landfarmed	Area of cover (ha)	Thickness of material (mm)	Volume landfarmed (m ³)
F10	WBM	November 2014	1.47	100mm	886

2.2 Sowing and treatments

No treatments have been applied to materials landfarmed to date, however application of fertiliser is likely in the next few months. However there was some clay/topsoil added to stripped areas within the F7 and F8 area. These areas are very exposed to the prevailing West to North West winds at this coastal location. So far the added clay/topsoil has been retained in these areas, therefore pasture establishment is starting to take place on these isolated areas with minimal vegetation cover.

Overall areas F1 to F8 have got reasonable pasture establishment now, however on-going farm management is required to ensure pasture establishment is maintained in the future. This may require irrigation in the future due to the harsh environmental conditions at the site in summer.

The F9 and F10 areas were sown in oats at the end of April, however due to adverse weather conditions in May, plus the oats being attacked by the argentine stem weevil, establishment has been limited. It is planned to re-sow these areas in a more hardy permanent pasture once weather conditions allow and soil temperature is more favourable, likely to be August/September 2015.

Refer to Figure 2.2 below which provides photographic evidence of pasture establishment at the site from the F1 area looking west to the F8 area.

Figure 2.2: Pasture strike looking south 22/12/14



3 MONITORING INFORMATION

The following section provides the details of monitoring, including sampling locations, sampling methods and the results of analysis.

3.1 Monitoring

A pre-disposal sample of all material is analysed for a variety of constituents before the material is stockpiled on site in lined pits. Testing takes place prior to stockpiling because on occasions it is added to other material already stored and therefore unable to be sampled separately once on-site. The material is tested by an independent accredited laboratory (Hill Laboratories), the analysis includes testing for hydrocarbons, including Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, BTEX, Heavy Metals and individual tests such as for Barium, Potassium, Sodium, Chloride, Nitrogen and pH.

When an appropriate volume of material has been stockpiled which justifies mobilising equipment for a landfarming operation, an assessment is made of all predisposal results to determine whether a composite sample needs to be taken. If hydrocarbon levels can be determined without the need for a composite sample, the landfarm area is designated and landfarming commences.

Monitoring of the landfarmed area begins within the first month of topsoil being re-applied to the landfarmed area. At this point, an entire suite of tests (both environmental and agricultural) is undertaken to assess the receiving environment against consent conditions.

For WBM material, monitoring is undertaken every six months for the first year following application, and then 6-monthly sampling continues until compliance with consent conditions is achieved. For SBM material, monitoring is undertaken every three months for the first year following application, and then 6-monthly until compliance is achieved. Within the first year, if results are compliant with surrender conditions, monitoring ceases. To ensure compliance best practice, all individual landfarmed areas must meet surrender criteria on two consecutive occasions, before sampling of an individual area ceases.

Monitoring results have been provided in a spread sheet form to assist with compliance and consent requirements for surrender (See Section 4).

The results demonstrate that all landfarmed areas meet surrender criteria for this consent. Surrender criteria data and analysis is discussed in section 4.

All receiving environment samples are tested by Hill Laboratories and sampling methodology is in accordance with the TRC procedure for soil sampling at landfarm sites. In addition BTW Company has its own sampling procedure which is strictly adhered to and adopts best current practices for specific sampling requirements.

Apart from the soil sampling, additional surface water sampling of the Mangaroa Stream has taken place on two occasions during the monitoring year. The results of the sampling are contained in Appendix C and demonstrate compliance with special conditions 16, 17 and 18. The sampling results demonstrate background constituent levels have been consistent with results before the activity took place adjacent to the Mangaroa Stream. Therefore no adverse effects on the surface water has been identified by water sampling.

3.2 Sampling Locations

Specific landfarmed areas are located through the use of a GPS navigational system. These coordinates are contained within the 'Vanner Disposal Site Sampling Plan' (Appendix E) which shows individual areas of disposal and is updated following landfarming events. A central point is located within each area and a composite sample is retrieved in a transect line from the central point. The transect line is approximately 60 meters long and the extent of each transect line is defined by coordinates on the sampling plan. The line direction is dependent on the underlying orientation of the landfarmed material.

3.3 Methods

Soil sampling involves collecting a composite of a maximum of 10 sub-samples along each individual transect line for each specific landfarm area. Typically, samples are retrieved to a maximum depth of 250mm but this can vary depending on the location of the drilling mud layer.

The samples are collected from a stainless steel core sampler and homogenised in a stainless steel bucket before a composite sample is collected into the appropriate container for analysis. All equipment is decontaminated with Triple S solution after each sampling transect is completed.

Strict chain of custody requirements are adhered to for the laboratory to accept the sample and process for analysis.

3.4 Inspection Notices

All inspection notices issued by TRC Officers have found activities on the site to **comply** with conditions of consent 7942-1.

3.5 Infringement Notices

No infringement notices have been issued by the TRC for this site.

3.6 Abatement Notices

No abatement notices have been issued by the TRC for this site.

3.7 Site Improvements

A collaborative approach from the consent holder and the TRC has seen improvements at the site, which include; all stockpiling pits being lined since the first load of material was stockpiled. Groundwater monitoring bores were installed before the site became operational. Background sampling of soil, surface water and groundwater has taken place by both the consent holder (initially BTW) and the TRC. Having this background data is paramount for the consent holder and the TRC to monitor the site in relation to pre-existing background levels

Most of the improvements achieved for the year have been around administration and compliance monitoring of the actual landfarming area. A robust sampling methodology has been used and a separate sampling plan has been provided to assist the Council with the locations of the sampling, refer to Appendix E. A full suite of soil sampling has taken place to ensure full compliance with the

consent and as demonstrated in Figure 3.7 the soil sampling is comprehensive and goes well beyond consent requirements. This provides reassurance and greater data capture for future land use activities on the site. It is considered this is an important point, as the consent holder is not just doing the bare minimum to comply with consent conditions, instead they are testing for a range of constituents that could be considered to have adverse effects on the receiving environment at certain concentrations.

This significant data set supplied provides additional evidence to the Council that consent conditions have been met. This intensive monitoring by the applicant is vital to ensure applicable guideline standards are being met by the applicant during initial loading and meeting surrender criteria.

The site did have a designated wash down area that was lined (now decommissioned) and liquids from the wash down area would flow back into a liquid holding pit. It is considered that a designated wash down area is an essential requirement to ensure there is no uncontrolled discharge at any landfarm site. It is considered that this should be mandatory at all sites.

A sampling plan has been provided, showing the position of each sampling transect within each individual land farmed area. The plan gives coordinates not only for the central point, however from the extent of the transect. It also provides orientation and distance of the sampling transect line.

Extensive monitoring of the site has continued. BTW Company has actively maintained a presence on the site to ensure all disposal is well managed and no spills or unauthorised disposal takes place. Due to the nature of the activity site presence is paramount to ensure compliance with consent and that no adverse effects from the activity occur. Now the site is inactive and has been decommissioned site inspections are very minimal.

With BTW Company retaining the management of the site, there has been a continuation of best practices in terms of spreading area requirements. The management option of having larger areas than required under the resource consent has ensured no overloading of material into the receiving environment, and the results for all the landfarmed areas show consent surrender criteria has been met and this has been confirmed by the TRC via the approval of a consent variation for the site. The surrendering of each individual area has provided certainty to the landowner that the soil is safe for agricultural activities and there is no risk to food safety or animal welfare. This has recently been confirmed in the latest guideline document by the Ministry for Primary Industries for landfarming operations, that if specific guideline values are met for Assessing and Managing Petroleum Hydrocarbon Contaminated site in New Zealand as set by the Ministry for the Environment there is no risk to food safety or animal welfare.

Figure 3.7 Soil Sampling Constituents testing regime



Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited | Tel +64 7 858 2000
1 Clyde Street | Fax +64 7 858 2001
Private Bag 3205 | Email mail@hill-labs.co.nz
Hamilton 3240, New Zealand | Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Limited	Lab No:	1387251	SPv1
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	19-Feb-2015	
		Date Reported:	03-Mar-2015	
		Quote No:	36604	
		Order No:	13314	
		Client Reference:		
		Submitted By:	Dave Bolger	

Sample Type: Soil					
Sample Name:		F10A - Vanner	F10B - Vanner		
Lab Number:		17-Feb-2015	17-Feb-2015		
		1387251.1	1387251.2		
Individual Tests					
Dry Matter	g/100g as rcvd	99	96	-	-
Total Recoverable Barium	mg/kg dry wt	1,060	460	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	< 20	-	-
Total Recoverable Vanadium	mg/kg dry wt	194	177	-	-
Chloride*	mg/kg dry wt	64	85	-	-
Total Nitrogen*	g/100g dry wt	0.05	< 0.05	-	-
Benzo[a]pyrene Potency	mg/kg dry wt	< 0.06	< 0.06	-	-
Equivalency Factor (PEF) NES					
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	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	14	13	-	-
Total Recoverable Copper	mg/kg dry wt	11	10	-	-
Total Recoverable Lead	mg/kg dry wt	1.8	1.4	-	-
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	69	62	-	-
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	-	-



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

Sample Type: Soil					
Sample Name:		F10A - Vanner 17-Feb-2015	F10B - Vanner 17-Feb-2015		
Lab Number:		1387251.1	1387251.2		
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Naphthalene	mg/kg dry wt	< 0.11	< 0.11	-	-
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	-	-



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

Page 1 of 4

Client:	BTW Company Limited	Lab No:	1386926	shpv1
Address:	PO Box 551 NEW PLYMOUTH 4340	Date Registered:	19-Feb-2015	
		Date Reported:	24-Feb-2015	
		Quote No:	36604	
		Order No:	13314	
		Client Reference:		
Phone:	06 759 5040	Submitted By:	Dave Bolger	

Sample Name: F10A - Vanner Lab Number: 1386926.1
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range	Low	Medium	High
pH	pH Units	7.0	5.8 - 6.3			
Potassium	me/100g	0.50	0.50 - 0.80			
Calcium	me/100g	1.9	6.0 - 12.0			
Magnesium	me/100g	0.42	1.00 - 3.00			
Sodium	me/100g	0.15	0.20 - 0.50			
CEC	me/100g	3	12 - 25			
Total Base Saturation	%	100	50 - 85			
Volume Weight	g/mL	2.04	0.60 - 1.00			
Total Soluble Salts*	mg/L	1,280				
Electrical Conductivity (Sat Paste)*	mS/cm	1.9				
Nitrate-N (Sat Paste)*	mg/L	18				
Ammonium-N (Sat Paste)*	mg/L	6				
Phosphorus (Sat Paste)*	mg/L	1				
Potassium (Sat Paste)*	mg/L	199				
Calcium (Sat Paste)*	mg/L	103				
Magnesium (Sat Paste)*	mg/L	25				
Sodium (Sat Paste)*	mg/L	110				
Sodium Absorption Ratio*		2.5				
Lime Requirement (7.5cm)	tonne/ha	< 0.1				

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information. IANZ Accreditation does not apply to comments and interpretations, i.e. the 'Range Levels' and subsequent graphs.

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the soil monitoring results for areas F1 to F10 over the reporting period and beyond. Analysis of the results of monitoring are required by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

Table 4.1 demonstrates that all the landfarmed areas have meet surrender criteria, as indicated by the fields coloured in green. Some areas initially had constituent levels above the surrender criteria thresholds; however now all areas landfarmed meet surrender limits and this has been confirmed by the TRC via the approval of a consent variation for the consent. The surrender limits on the consent are based on the most current environmental guideline standards in New Zealand for managing petroleum hydrocarbons and the safe application of biosolids to land. These guidelines have been produced by the Ministry for the Environment and are agricultural based guidelines which are the most stringent values in this guideline.

As Table 4.1 demonstrates the areas that have been landfarmed have responded well to the landfarming process. Testing has shown that with water based muds there are generally very low hydrocarbon levels and sometimes not even detectable limits. With the water based muds the main elevated constituents are salts such as chloride. However the high initial salt concentrations are leached through the soil during rain events and natural attenuation through the sandy soil matrix takes place. It is important to remember this is a coastal location and concentrations of salts are naturally higher at this location. Other constituents like hydrocarbons are generally held within the soil matrix and bio remediated, as microbes break down the hydrocarbon molecules by using oxygen.

As this site is coastal, consideration must be given to the baseline environment and surrounding environment. Coastal locations have naturally high levels of salts, and from background soil sampling a level of total soluble salts of 548 mg/L was recorded in the soil. Therefore it is considered that initial high applications of salt in this environment are likely to have minimal effect. Also when you include a natural buffer zone and significant depth to groundwater the effects are likely to be negligible and to date all the soil, surface water and groundwater results reflect this.

Also worth pointing out is that all the results demonstrate no elevated levels of heavy metals in the soil. All levels fall well below the biosolids guideline values set by the Ministry for the Environment to protect public health and the environment and to safeguard the life-supporting capacity of soils.

All landfarmed areas from F1 to F10 have now met surrender criteria and this has been confirmed by the TRC. No further soil monitoring is required by the consent holder unless further landfarming takes place in the future on areas that have not been landfarmed and are consented for landfarming.

	Date	Meets TRC Surrender Criteria				Does not meet TRC Consent surrender criteria																	Material				
		Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Total Soluble salts <2500gm-3	Benzene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)	Xylenes (48) (4.m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)p yrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 120 (m)	C10-C14 58 (x)		C15-C36 (4000) (7.x)	nitrogen g/100g dry wt	Chloride 700 mg/kg	
F1	1/07/2013	220	126	2.8	1419	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	8	1.4	<0.10	7	60	8	220	620	0.12	70	SBM	
	1/11/2013	90	82	3.2	581	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	18	10	1.2	<0.10	8	71	8	20	92	1	29	SBM	
	8/11/2014					<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	18	9	1.1	<0.10	8	75	8	20	40	0.08	15	SBM	
F2	1/08/2013	40	30	1.5	264	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	7	67	8	20	<40	17	11	WBM	
	11/02/2014	80	34	1.1	548	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	10	1.1	<0.10	7	61	8	27	71	0.07	33	WBM	
F3	1/08/2013	520	162	2.6	3460	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	18	10	1.4	<0.10	7	69	8	20	350	1040	1	280	WBM
	11/02/2014	230	83	1.7	1544	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.5	<0.10	8	64	8	420	1120	0.07	117	WBM	
	18/06/2014	70	23	0.7	449	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	57	8	29	185	0.07	17	WBM	
																											WBM
F4	1/12/2013	540	178	3.3	3570	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	10	1.5	<0.10	8	54	8	20	85	0.06	320	WBM	
	11/02/2014	770	258	4.1	5090	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	60	8	20	91	0.07	360	WBM	
	1/05/2014	60	19	0.7	416																						WBM
F5	1/12/2013	520	162	2.60	3440.00	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	2.1	<0.10	10	64	8	39	177	0.11	330	WBM	
	11/02/2014	270	101	1.9	1802	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	8	1.1	<0.10	7	59	8	20	40	0.07	106	WBM	
																											WBM
																											WBM
																											WBM
F6	1/01/2014	130	61	1.8	865	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	8	66	8	20	40	0.09	53	WBM	
	28/05/2014	180	74	2.1	1214	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.4	<0.10	8	63	8	20	40	0.08	126	WBM	
																											WBM
F7	6/03/2014	740	266	3.4	4990	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.3	<0.10	7	67	8	20	40	0.12	460	WBM	
	1/05/2014	520	145	2.90	3440.00																					WBM	
	28/05/2014	490	148	2.7	3230	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	1.8	<0.10	8	75	8	20	40	0.08	195	WBM	
	18/06/2014	190	60	1.7	1280																						WBM
F8	6/03/2014	1200	426	5.1	7930	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	19	12	1.9	<0.10	9	83	8	76	340	0.1	750	WBM	
	7/04/2014	870	365	4.30	5730.00	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	17	11	1.3	<0.10	7	71	8	33	240	0.12	390	WBM	
	1/05/2014	200	68	2.3	1307																						WBM
F9	18/06/2014	170.00	87	2.2	1096	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	11	1.7	<0.10	8	62	8	20	40	0.12	71	WBM	
	3/12/2014	260.00	148	3.3	1723	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	12	1.7	<0.10	7	70	8	20	40	0.1	143	WBM	
																											WBM
F10	19/02/2015 (A)	190.00	110	2.5	1280	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	14	11	1.8	<0.10	7	69	8	20	40	0.05	64	WBM	
	19/02/15 (B)	190.00	103	2.2	1280	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	13	10	1.4	<0.10	6	62	8	20	40	<0.05	85	WBM	

Table 4.1 Monitoring Results from TAG Oil Landfarm

4.1 Compliance with SC's 16 and 18

Conditions 16-18 require:

16. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m³

17. Other than as provided for in condition 15, the exercise of this consent shall not result in any containment concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.

18. The exercise of this consent shall not result in any of the following effects in the Mangaroa Stream:

- a) The production of an conspicuous oil or grease films, scums of foams, or floatable or suspended materials;*
- b) Any conspicuous change in the colour or visual clarity;*
- c) Any emission of objectionable odour;*
- d) The rendering of fresh water unsuitable for consumption by farm animals;*
- e) Any significant adverse effects on aquatic life.*

Compliance with SC's 16-18 has been achieved; refer to Appendix C for results

4.2 Compliance with SC's 19 - 23

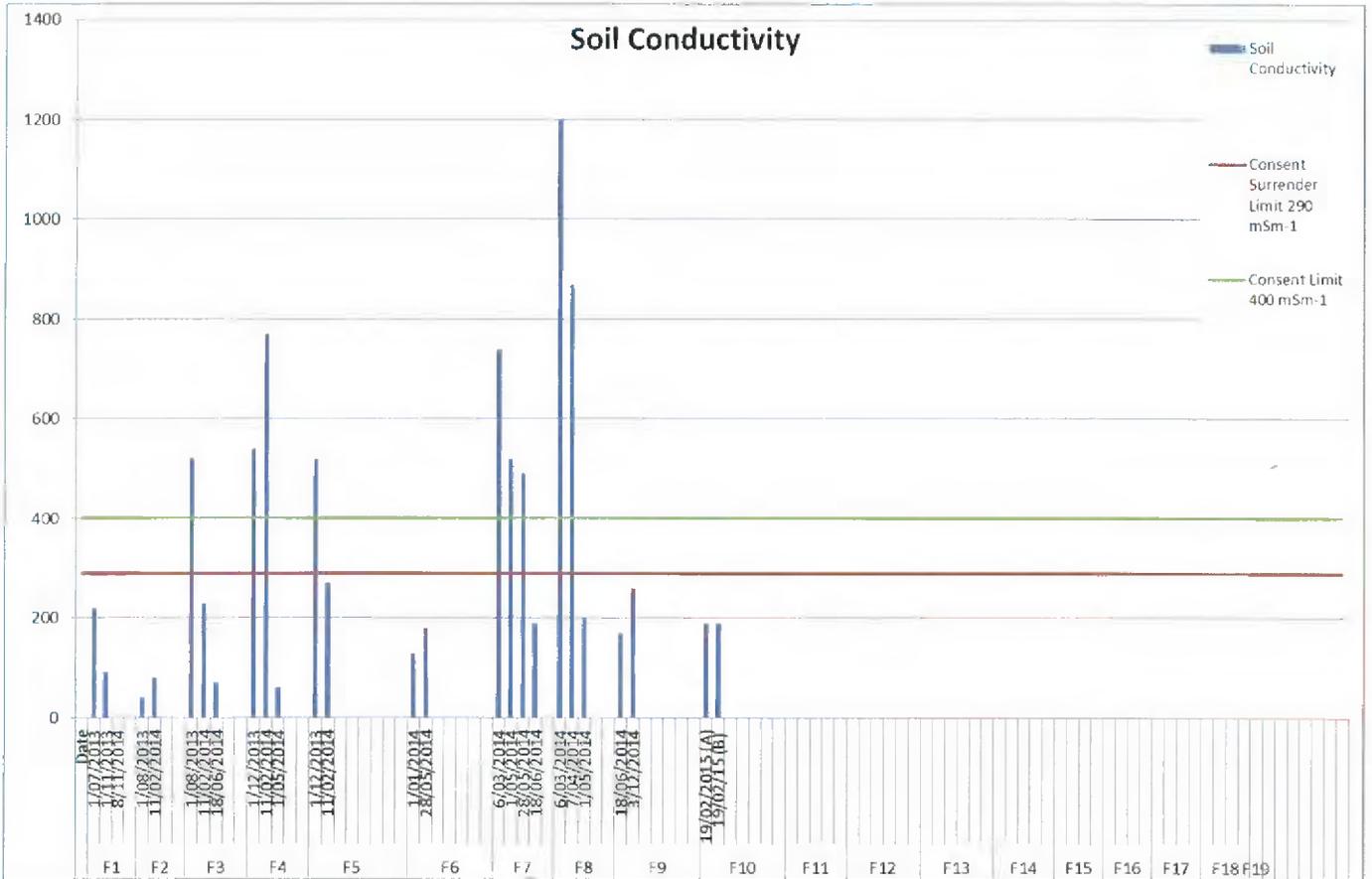
Conditions 19-23 require:

4.2.1 Condition 19 – Soil Conductivity

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

It was identified during initial soil sampling that area's F3, F4, F5, F7 and F8 had elevated soil conductivity, however all these areas now meet surrender criteria.

Figure 4.2.1. Soil Conductivity

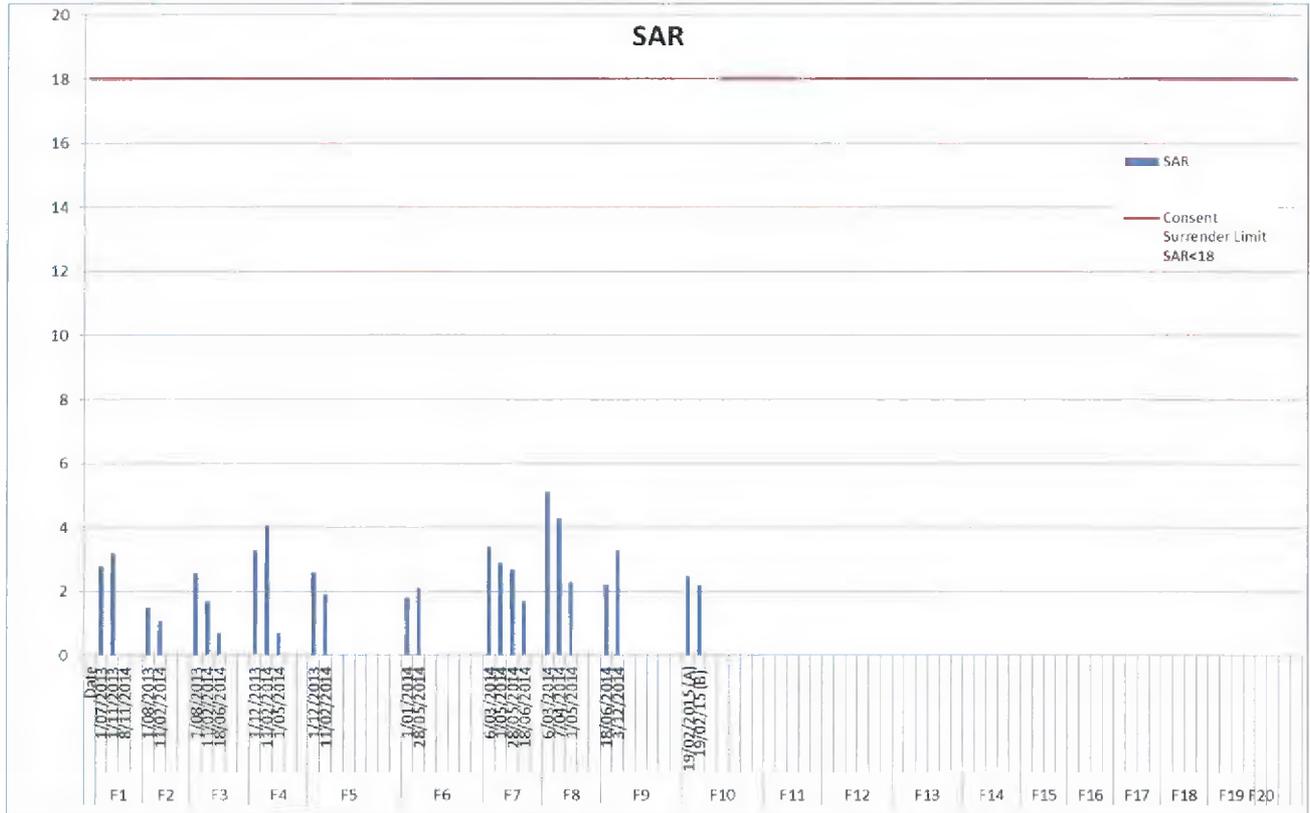


4.2.2 Condition 20 – Sodium Absorption Ratio

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

All landfarmed areas have met surrender criteria in all sampling results.

Figure 4.2.2 Sodium Absorption Ratio



4.2.3 Condition 21 – Heavy Metals

“The concentration of metals in the soil shall at all times comply with the Ministry of the Environment and New Zealand Water and Wastes Association’s Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:”

Table 4.1: Consent Compliance Limits – Metals

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

As demonstrated in Table 4.1 no elevated heavy metals were detected in the receiving environment soil after landfarming. All heavy metal levels were well below the guideline values for the safe application of biosolids to land, and are basically at the background level you would expect in the soil at this specific location.

4.2.4 Condition 22 – Conductivity, chloride, sodium, total soluble salts & hydrocarbons

“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:”

Table 4.2: Consent Surrender Limits

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 – naphthalene, non coarc. (Pyrene) benzo(a)pyrene eq.

TPH – Total petroleum hydrocarbons (C₇-C₉, C₁₀-C₁₄, and C₁₅-C₃₆).

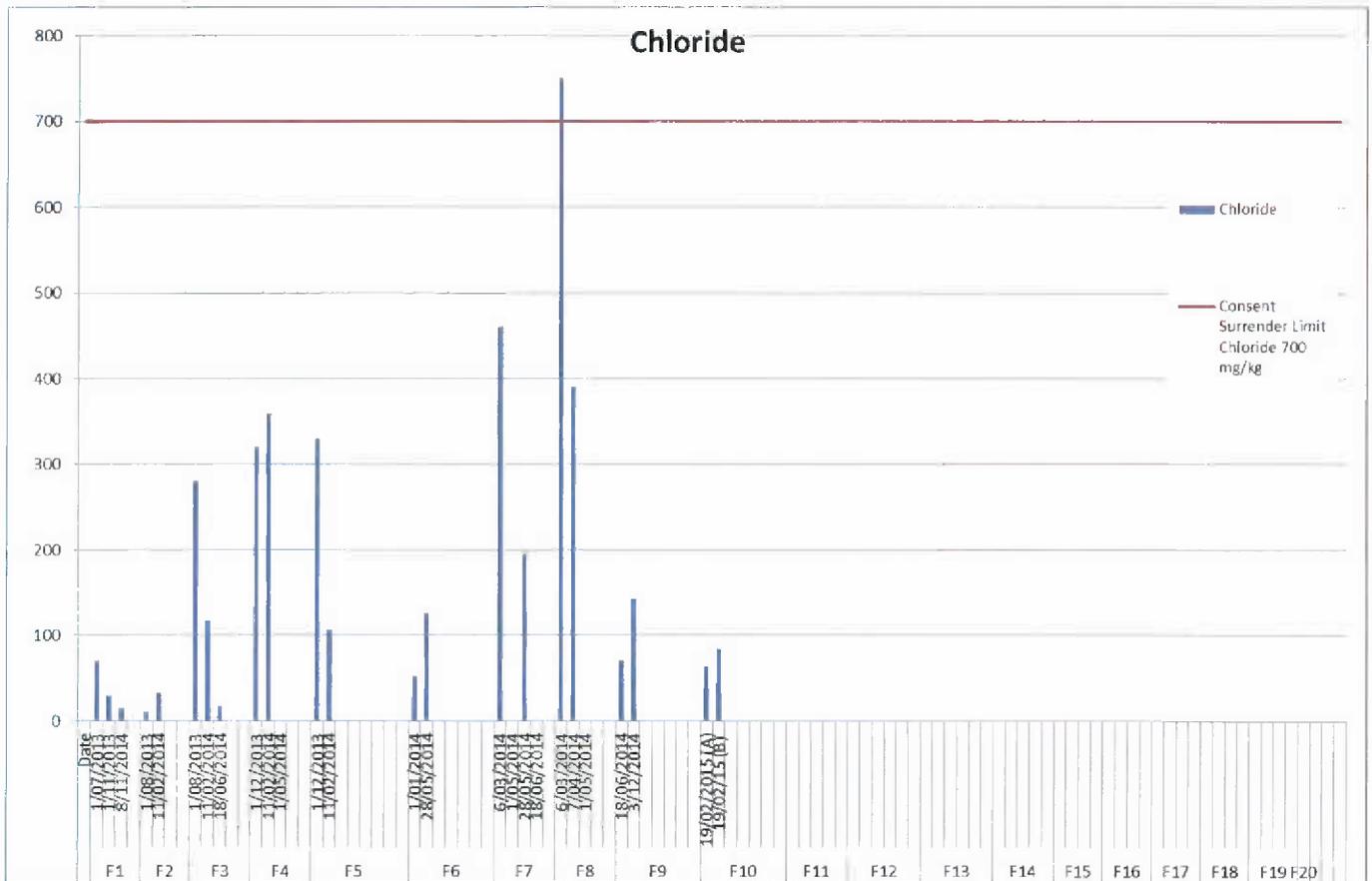
The requirement to meet these standards shall not apply if, before 1 March 2028, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

4.2.5 Conductivity

As demonstrated in section 4.2.1 all the landfarmed areas now meet the surrender criteria for soil conductivity.

4.2.6 Chloride

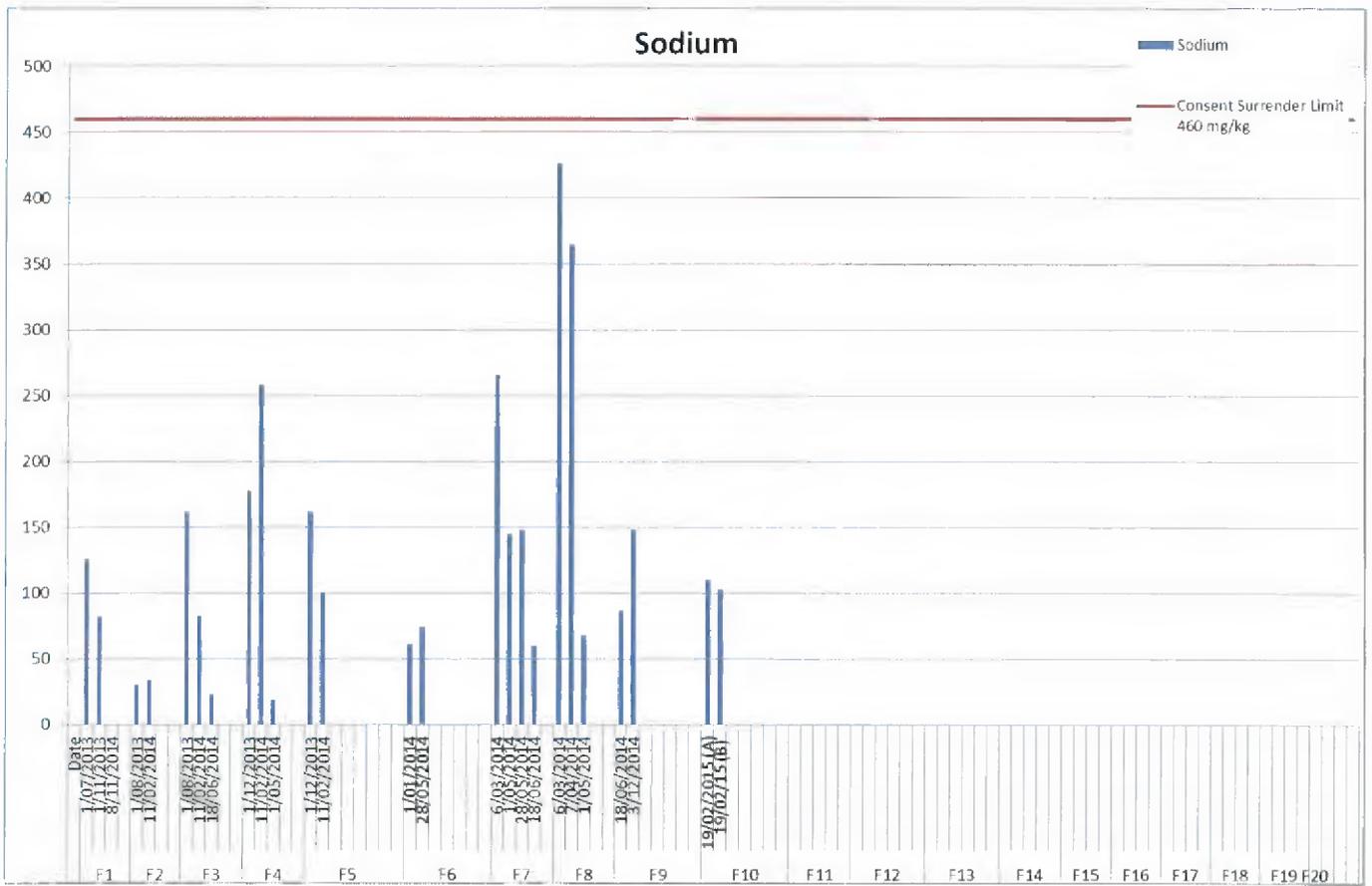
Figure 4.2.6 Chloride



As demonstrated in the graph above and in Table 4.1 all of the landfarmed areas meet surrender criteria for the consent. The F8 area was initially above the surrender criteria, however from the last sample taken has now reduced and meets surrender criteria. The Chloride levels are pleasing considering Chloride is one of the main constituents that has been elevated within the water based drilling muds pre-disposal samples. This would suggest that the process of mixing the soil with the muds is diluting the chloride levels and also Chloride does readily leach out of the top soil profile and naturally attenuate through the soil profile.

4.2.7 Sodium

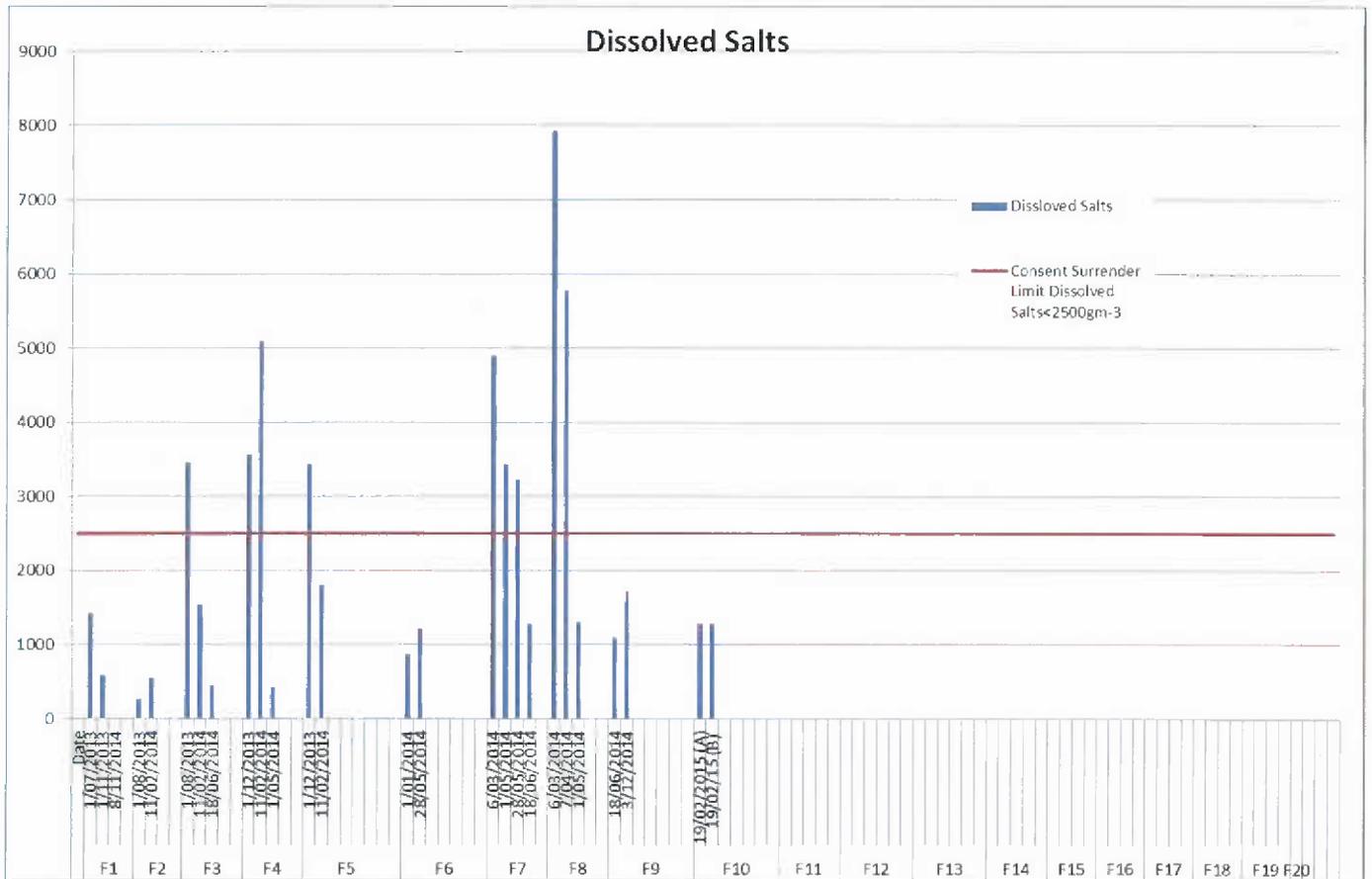
Figure 4.2.7 Sodium



As demonstrated in the graph above and in Table 4.1 all sodium levels have been below the consent surrender limit.

4.2.8 Total Soluble Salts

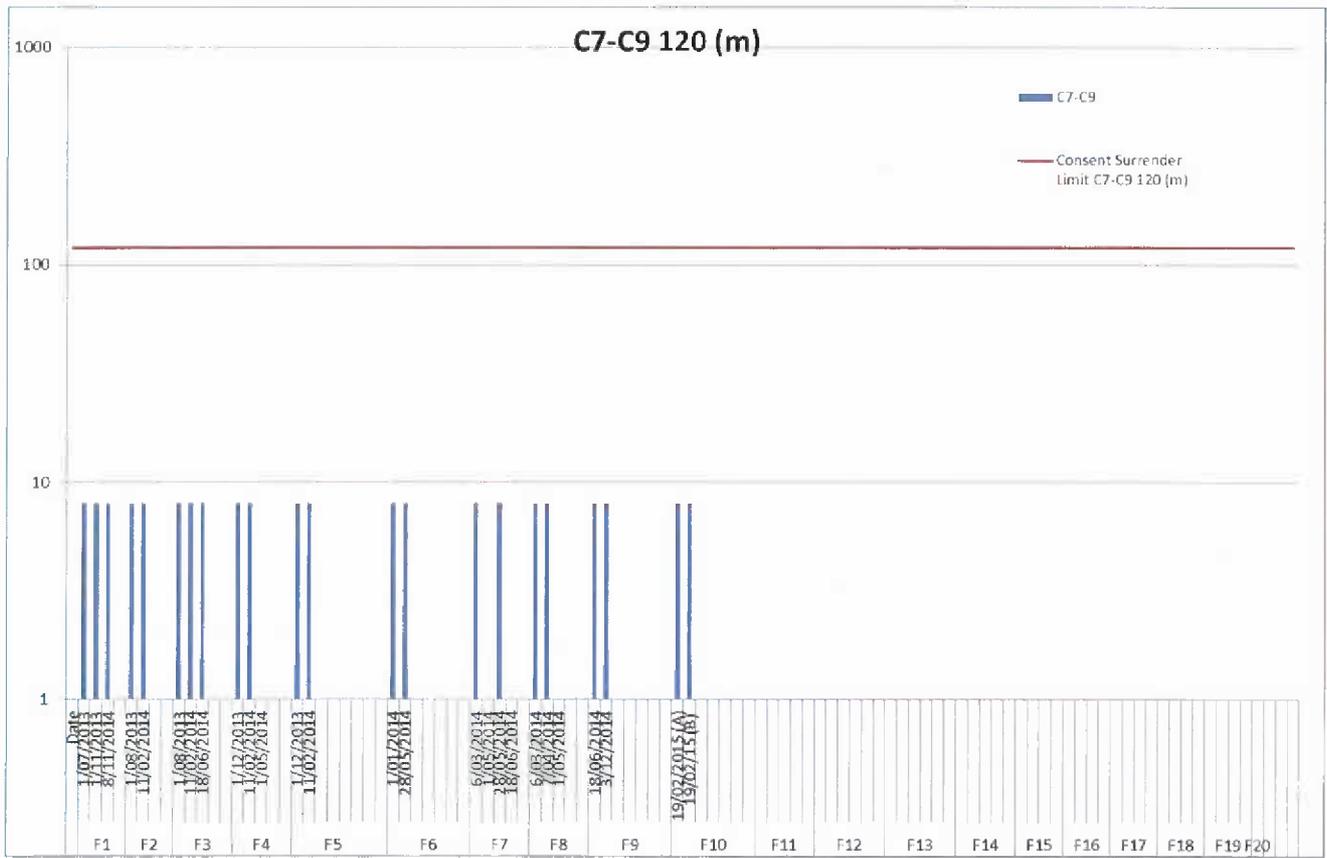
Figure 4.2.8 Total Soluble Salts



As shown on the graph above there were some initial areas that were above surrender criteria for total soluble salts. All landfarmed areas now meet the surrender criteria for total soluble salts.

4.2.9 Total Percentage of Hydrocarbons C7-C9

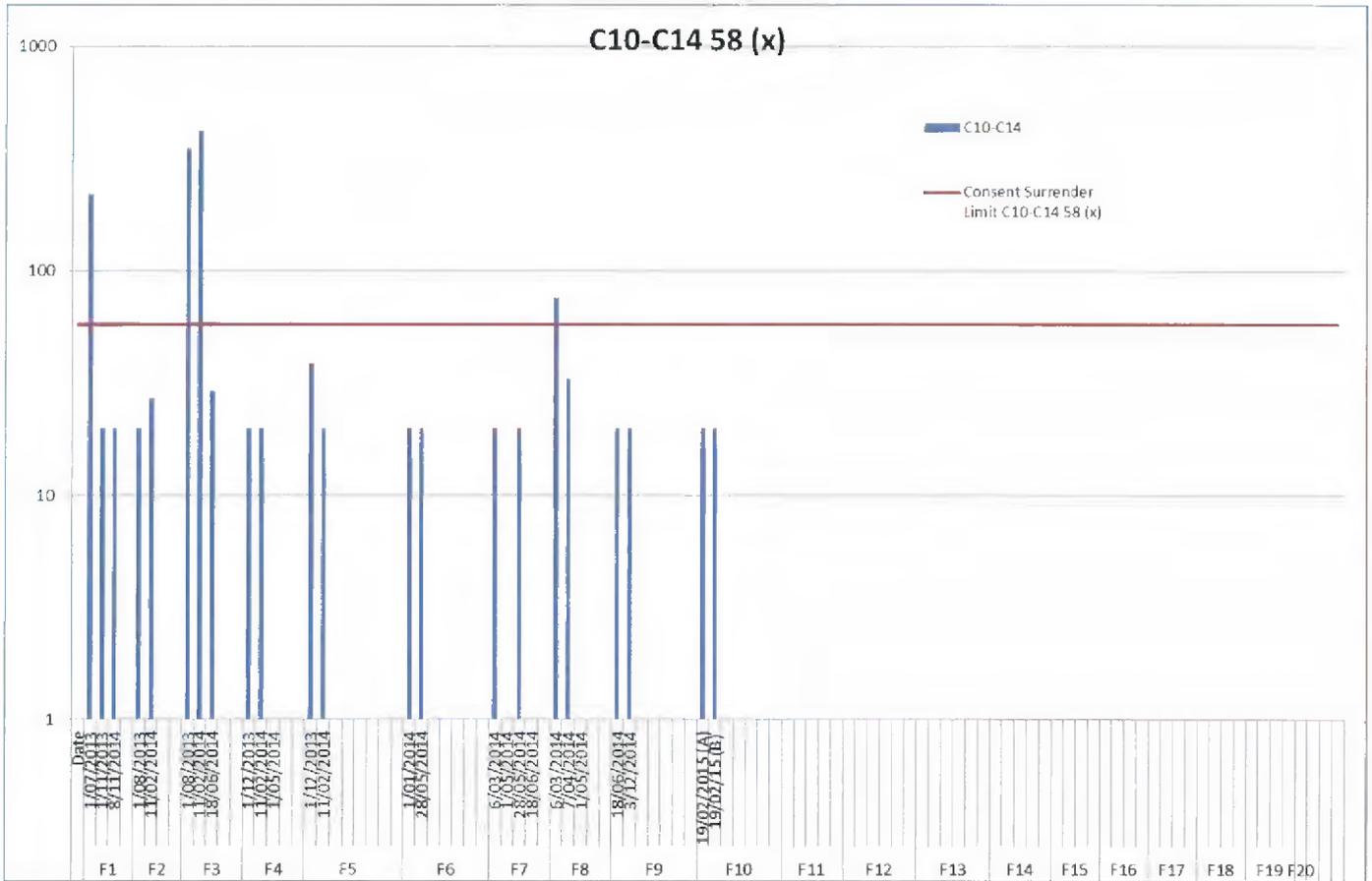
Figure 4.2.9 TPH C7-C9



All landfarmed areas have been below surrender criteria for C7 – C9 hydrocarbon chains.

4.2.10 Total Percentage of Hydrocarbons C10-C14

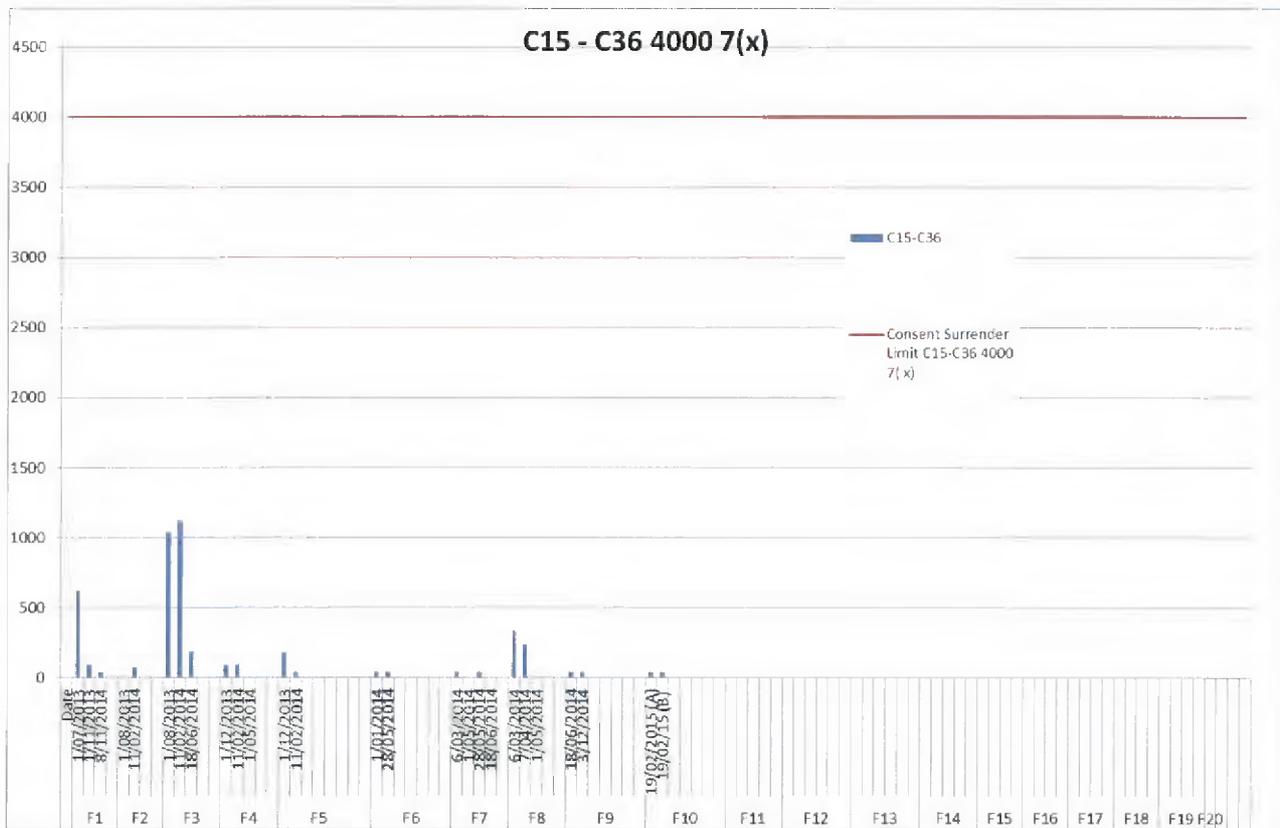
Figure 4.2.10 TPH C10-C14



Some initial soil sampling results showed areas F1, F3 and F8 were above surrender criteria, however well below consent requirements. All areas now for the C10 – C14 chain of hydrocarbons meet surrender criteria.

4.2.11 Total Percentage of Hydrocarbons C15-C36

Figure 4.2.11 TPH C15-C36



All sampling results show that all landfarmed areas are below the surrender criteria.

Condition 23. This consent may not be surrendered at any time until the standards in condition 22 have been met.

The monitoring of the soil in the land farmed areas (F1 to F10) has ceased as the applicant has had a consent variation approved by the TRC that all areas landfarmed have met the soil surrender criteria as per condition 23 of the consent.

The monitoring of the surface water will continue by the applicant until the consent is completely surrendered.

It is considered the consent in its current state could be completely surrendered. A decision has not been made by the consent holder to completely surrender the consent at this stage as there is still a considerable area approved that could be land farmed in the future.

APPENDIX A COMPOSITION OF WASTE

WBM – TYPICAL CHEMICALS

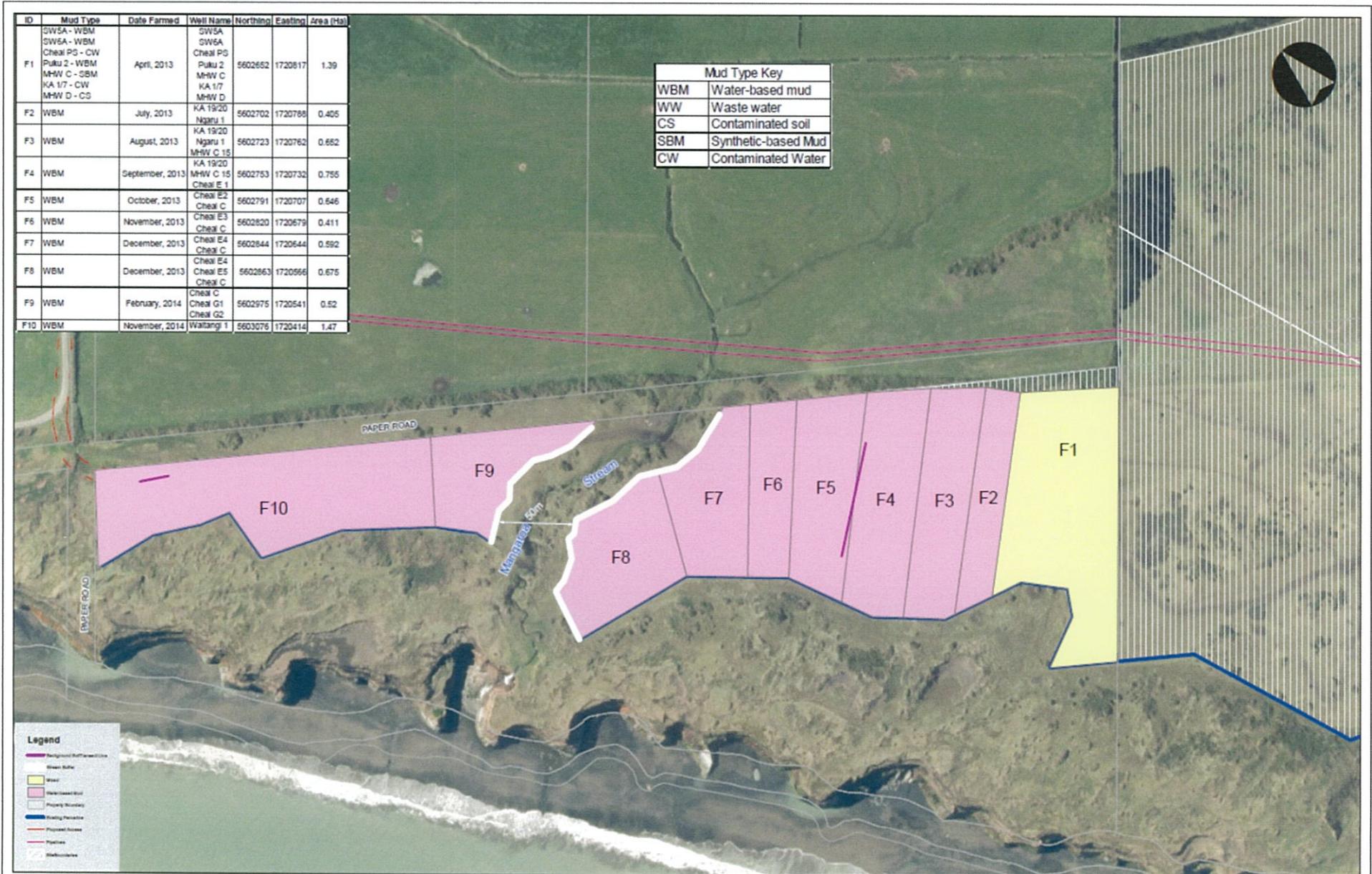
Table 1: Typical Chemicals used in Drilling

Chemical Description	Use	Phase
Sodium Sulphite with 2% Cobalt Chloride catalyst	Oxygen scavenger	Solid
Non-ionic Isothiazolin Solid	Biocide	Solid
Cationic Polymer	Shale stabiliser	Liquid
Sodium Hydroxide	PH control	Solid
Sodium Montmorillonite	Viscosifier	Solid
Polyanionic Cellulose	Filtrate control	Solid
Xanthan Gum	Viscosifier	Solid
Calcium Hydroxide	Flocculant	Solid
Ground Peanut Shells (Liquid casing)	Lost circulation material	Solid
Ammonium thiocyanate	Tracer in well	Solid
Potassium Chloride		

Table 2: Drilling Fluid Contingency Items

Chemical Description	Use	Phase
Zinc Oxide	Sulphide scavenger	Solid
Alcohol ethoxylate blend	Defoamer	Liquid
Sodium Bicarbonate	Calcium precipitation	Solid
Sodium Chloride	Clear Brine	Solid
Poly-glycol/Poly-glycol ether Surfactant blend	Well lubricant	Liquid
Calcium Carbonate	Lost circulation material	Solid
Acrylamide acrylate polymer	Shale encapsulator	Solid/Liquid
Polymino Acid	Shale Stabiliser	Liquid
Barium Sulfate (barite)	Inert weighting agent	Solid
Citric Acid	PH control	Solid
Mica	Lost circulation material	Solid
Ground Walnut Shells	Lost circulation material	Solid
Sodium Carbonate	Calcium precipitation	Solid
Chrome free Lignosulfonate	Dispersant	Solid
Surfactant/Emulsifier blend	Stuck pipe compound	Liquid
Blended filming amines	Corrosion Inhibitor	Liquid
Phosphate ester salt	Corrosion Inhibitor	Liquid
Sodium Silicate (Cementing)	Lost circulation material	Solid
Calcium Chloride (cementing)	Inhibitor	Solid

APPENDIX B SITE MAP



ID	Mud Type	Date Filled	Well Name	Northings	Eastings	Area (Ha)
F1	SW5A - WBM	April, 2013	SW5A	5602652	1720617	1.39
	SW5A - WBM		SW5A			
	Cheal P3 - CW		Cheal P3			
	Puku 2 - WBM		Puku 2			
	MHW C - SBM		MHW C			
F2	WBM	July, 2013	KA 19/20	5602702	1720788	0.405
			Ngaru 1			
F3	WBM	August, 2013	KA 19/20	5602723	1720762	0.652
			Ngaru 1			
F4	WBM	September, 2013	KA 19/20	5602753	1720732	0.755
			MHW C 15			
F5	WBM	October, 2013	KA 19/20	5602791	1720707	0.546
			Cheal C			
F6	WBM	November, 2013	Cheal E3	5602820	1720679	0.411
			Cheal C			
F7	WBM	December, 2013	Cheal E4	5602844	1720644	0.592
			Cheal C			
F8	WBM	December, 2013	Cheal E4	5602863	1720596	0.676
			Cheal E5			
F9	WBM	February, 2014	Cheal C	5602975	1720541	0.52
			Cheal G1			
F10	WBM	November, 2014	Cheal G2	5603076	1720414	1.47
			Waitangi 1			

Mud Type Key	
WBM	Water-based mud
WW	Waste water
CS	Contaminated soil
SBM	Synthetic-based Mud
CW	Contaminated Water

Legend	
	Permitted Buffer Boundary
	Stream Buffer
	Water
	Water-based Mud
	Synthetic-based Mud
	Property Boundary
	Shading Perimeter
	Proposed Access
	Pipeline
	Infrastructure

btw company
 surveyors
 planners
 engineers
 land & gas services

BTW Company Ltd
 Cnr. Courtenay & Elliot Sts.
 PO Box 551, NEW PLYMOUTH 4340
 PH 0800 759 5040 PH 0800 240747 Fax (06) 759 5048
 Email survey@btwcompany.co.nz www.btwcompany.co.nz

GENERAL NOTES
 1. Coordinates are in terms of New Zealand Transverse Mercator
DISCLAIMER
 Boundary information and aerial imagery has been imported from external sources. Areas and dimensions may be subject to scale error. Use of this drawing for other purposes is at the user's risk.

Scale: 1:2,500

NO.	DATE	BY	DESCRIPTION
1	10/10/14	JA	Issue for P10
2	11/03/14	JA	Issue for P10
3	11/03/14	JA	Issue for P10
4	11/03/14	JA	Issue for P10
5	11/03/14	JA	Issue for P10
6	11/03/14	JA	Issue for P10
7	11/03/14	JA	Issue for P10
8	11/03/14	JA	Issue for P10
9	11/03/14	JA	Issue for P10
10	11/03/14	JA	Issue for P10

LOCATION: SOUTH TARANAKI
 PROJECT No: 13314
TAG Oil

TITLE: VANNER DISPOSAL SITE
 DRAWING No: 13314-102-GIS
 SHEET: 1
 REVISION: 6

APPENDIX C
RESULTS

MANGAROA STREAM – SURFACE WATER



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

Page 1 of 2

Client:	BTW Company Limited	Lab No:	1321339	SPv1
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	05-Sep-2014	
		Date Reported:	16-Sep-2014	
		Quote No:	45045	
		Order No:	13314	
		Client Reference:	Tank Water	
		Submitted By:	Dave Bolger	

Sample Type: Aqueous

Sample Name:		Mangaroa - Lower	Mangaroa - Upper			
Lab Number:		04-Sep-2014 11:30 am	04-Sep-2014 12:00 pm			
Individual Tests						
pH	pH Units	7.6	7.9	-	-	-
Electrical Conductivity (EC)	mS/m	43.9	44.1	-	-	-
Total Dissolved Solids (TDS)	g/m ³	270	280	-	-	-
Specific Gravity*	20°C/20°C	1.00	1.00	-	-	-
Total Potassium	g/m ³	3.3	3.2	-	-	-
Total Sodium	g/m ³	39	38	-	-	-
Chloride	g/m ³	65	66	-	-	-
Total Nitrogen	g/m ³	2.5	2.6	-	-	-
Nitrate-N + Nitrite-N	g/m ³	2.3	2.3	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.25	0.34	-	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m ³	< 0.0011	< 0.0011	-	-	-
Total Cadmium	g/m ³	< 0.000053	< 0.000053	-	-	-
Total Chromium	g/m ³	0.00084	0.00068	-	-	-
Total Copper	g/m ³	0.00159	0.00075	-	-	-
Total Lead	g/m ³	< 0.00011	< 0.00011	-	-	-
Total Nickel	g/m ³	< 0.00053	< 0.00053	-	-	-
Total Zinc	g/m ³	0.0011	< 0.0011	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m ³	< 0.0010	< 0.0010	-	-	-
Toluene	g/m ³	< 0.0010	< 0.0010	-	-	-
Ethylbenzene	g/m ³	< 0.0010	< 0.0010	-	-	-
m&p-Xylene	g/m ³	< 0.002	< 0.002	-	-	-
o-Xylene	g/m ³	< 0.0010	< 0.0010	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	-	-	-
C10 - C14	g/m ³	< 0.2	< 0.2	-	-	-
C15 - C36	g/m ³	< 0.4	< 0.4	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	-	-	-



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

Page 1 of 2

Client:	BTW Company Limited	Lab No:	1370095	SPV
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	07-Jan-2015	
		Date Reported:	12-Jan-2015	
		Quote No:	45045	
		Order No:	13314	
		Client Reference:	Tank Water	
		Submitted By:	Dave Bolger	

Sample Type: Aqueous

Sample Name:	Manga - Lower 06-Jan-2015 1:00 pm	Manga - Upper 06-Jan-2015 12:30 pm			
Lab Number:	1370095.1	1370095.2			

Individual Tests

pH	pH Units	7.9	7.9	-	-
Electrical Conductivity (EC)	mS/m	46.2	46.2	-	-
Total Dissolved Solids (TDS)	g/m ³	290	290	-	-
Specific Gravity*	20°C/20°C	1.00	1.00	-	-
Total Potassium	g/m ³	4.3	4.2	-	-
Total Sodium	g/m ³	40	40	-	-
Chloride	g/m ³	71	70	-	-
Total Nitrogen	g/m ³	2.2	2.2	-	-
Nitrate-N + Nitrite-N	g/m ³	1.50	1.52	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.66	0.70	-	-

Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn

Total Arsenic	g/m ³	< 0.0011	< 0.0011	-	-
Total Cadmium	g/m ³	< 0.000053	< 0.000053	-	-
Total Chromium	g/m ³	< 0.00053	0.00076	-	-
Total Copper	g/m ³	0.00084	0.00076	-	-
Total Lead	g/m ³	< 0.00011	< 0.00011	-	-
Total Nickel	g/m ³	< 0.00053	< 0.00053	-	-
Total Zinc	g/m ³	< 0.0011	< 0.0011	-	-

BTEX in Water by Headspace GC-MS

Benzene	g/m ³	< 0.0010	< 0.0010	-	-
Toluene	g/m ³	< 0.0010	< 0.0010	-	-
Ethylbenzene	g/m ³	< 0.0010	< 0.0010	-	-
m&p-Xylene	g/m ³	< 0.002	< 0.002	-	-
o-Xylene	g/m ³	< 0.0010	< 0.0010	-	-

Total Petroleum Hydrocarbons in Water

C7 - C9	g/m ³	< 0.10	< 0.10	-	-
C10 - C14	g/m ³	< 0.2	< 0.2	-	-
C15 - C36	g/m ³	< 0.4	< 0.4	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	-	-

APPENDIX D PHOTOGRAPHIC RECORD OF LANDFARMING

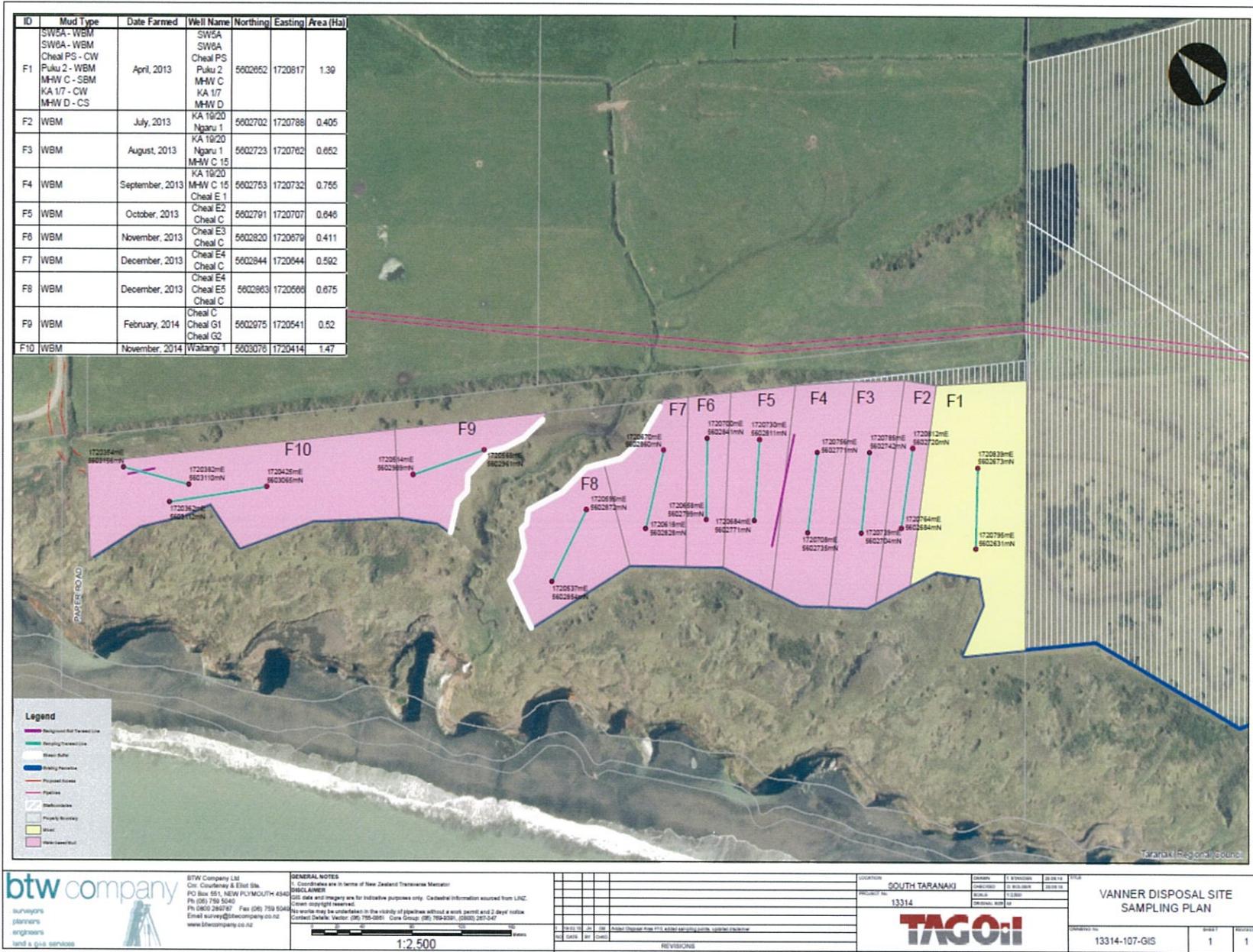
July 2014



Late December 2014



APPENDIX E SAMPLING PLAN



btw company
 land & civil services

BTW Company Ltd
 Cnr Courtenay & Ellet Sts
 PO Box 551, NEW PLYMOUTH 4340
 Ph (06) 759 5040
 Ph (06) 759 5047 Fax (06) 759 5046
 Email survey@btwcompany.co.nz
www.btwcompany.co.nz

GENERAL NOTES
 1. Coordinates are in terms of New Zealand Transverse Mercator
DISCLAIMER
 2. Data and imagery are for indicative purposes only. Detailed information sourced from LINC.
 Crown copyright reserved.
 No liability may be undertaken in the vicinity of pipelines without a visit, permit and 2 day's notice.
 Contact Details: Vector (06) 759-0851, Core Group (06) 759-0331, (06) 759-5147



NO	DATE	BY	REVISIONS

LOCATION: SOUTH TARANAKI
 PROJECT NO: 13314

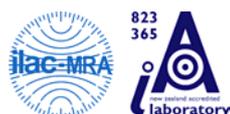
VANNER DISPOSAL SITE
 SAMPLING PLAN
 DRAWING NO: 13314-107-GIS
 SHEET: 1
 REVISION: 1



ANALYSIS REPORT

Client:	BTW Company Limited	Lab No:	1304842	SPV1
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	30-Jul-2014	
		Date Reported:	08-Aug-2014	
		Quote No:	32966	
		Order No:	13314	
		Client Reference:		
		Submitted By:	Dave Bolger	

Sample Type: Soil						
Sample Name:		Waitangi - WBM 28-Jul-2014 9:00 am				
Lab Number:		1304842.1				
Individual Tests						
Dry Matter	g/100g as rcvd	77	-	-	-	-
Density*	g/mL at 20°C	1.52	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	42	-	-	-	-
Total Recoverable Boron	mg/kg dry wt	23	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	15,600	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	2,200	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	< 100	-	-	-	-
Chloride*	mg/kg dry wt	10,700	-	-	-	-
pH*	pH Units	8.9	-	-	-	-
Total Nitrogen*	g/100g dry wt	0.22	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	8	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	34	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	18	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	9.2	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	42	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	67	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	-	-	-	-
Toluene	mg/kg dry wt	< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt	0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt	0.17	-	-	-	-
o-Xylene	mg/kg dry wt	0.11	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-



Sample Type: Soil						
Sample Name:		Waitangi - WBM 28-Jul-2014 9:00 am				
Lab Number:		1304842.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.15	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

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	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
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
eslCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable 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
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
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
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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

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

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



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

ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Limited	Lab No:	1313466	SPV1
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	20-Aug-2014	
		Date Reported:	03-Sep-2014	
		Quote No:	32966	
		Order No:	13314	
		Client Reference:	Predisposal-Drilling Muds/Cutting	
		Submitted By:	Dave Bolger	

Sample Type: Soil						
Sample Name:	Waitangi-1-WBM 18-Aug-2014 12:00 pm					
Lab Number:	1313466.1					
Individual Tests						
Dry Matter	g/100g as rcvd	76	-	-	-	-
Density*	g/mL at 20°C	2.17	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	690	-	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	15,200	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	4,200	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	< 100	-	-	-	-
Chloride*	mg/kg dry wt	13,800	-	-	-	-
pH*	pH Units	8.9	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	6	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.15	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	17	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	17	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	42	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.14	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	18	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	109	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	-	-	-	-
Toluene	mg/kg dry wt	< 0.06	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.11	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.06	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-

Sample Type: Soil						
Sample Name:		Waitangi-1-WBM 18-Aug-2014 12:00 pm				
Lab Number:		1313466.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.14	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

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	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
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
eslCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen orthophosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable 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
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
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
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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

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

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



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

ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Limited	Lab No:	1337856	SPV1
Contact:	Dave Bolger C/- BTW Company Limited PO Box 551 NEW PLYMOUTH 4340	Date Registered:	11-Oct-2014	
		Date Reported:	21-Oct-2014	
		Quote No:	32966	
		Order No:	13314	
		Client Reference:	Predisposal-Drilling Muds/Cutting	
		Submitted By:	Dave Bolger	

Sample Type: Soil						
Sample Name:	Waitangi - WBM 09-Oct-2014 1:00 pm					
Lab Number:	1337856.1					
Individual Tests						
Dry Matter	g/100g as rcvd	87	-	-	-	-
Density*	g/mL at 20°C	1.62	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	670	-	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	6,600	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	1,780	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	< 100	-	-	-	-
Chloride*	mg/kg dry wt	5,300	-	-	-	-
pH*	pH Units	10.4	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	6	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.18	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	14	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	11	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	41	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.17	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	12	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	100	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	-	-	-	-
Toluene	mg/kg dry wt	< 0.05	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.05	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-

Sample Type: Soil						
Sample Name:		Waitangi - WBM				
		09-Oct-2014 1:00 pm				
Lab Number:		1337856.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.13	-	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1
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
eslCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable 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
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
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
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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

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

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



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