

BTW Company Ltd
Oeo Landfarm
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-86

ISSN: 1178-1467 (Online)
Document: 1763046 (Word)
Document: 1766889 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

January 2017

Executive summary

BTW Company Ltd (the Company/BTW) operates a drilling waste disposal landfarm which is located on South Road near Manaia, in the Rawa catchment, South Taranaki. The site was operational from September 2012 to November 2013 when synthetic, water based muds and rock cuttings were disposed to land under the process of landfarming. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds one resource consent, this includes a total of 24 conditions setting out the requirements that the Company must satisfy.

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

The Council's monitoring programme for the year under review included seven inspections, nine groundwater samples and five composite soil samples collected for physicochemical analysis.

The main environmental effects associated with the exercise of this consent are centred on a legacy issue, whereby the historical holding of landfarmable material in unlined storage cells resulted in elevated saline and trace hydrocarbon impacts on the groundwater in the direct locality of the storage cells. Specifically, the downgradient monitoring well (GND2287) had indicated elevated salinity since it was installed in 2012.

While there have been elevated TDS concentrations observed in this monitoring period and in the long term record, above the conditional concentration prescribed by the consent of 2,500g/m³. Recent analysis undertaken in the upcoming monitoring period has detailed a reduction in these concentrations in both monitoring wells to below the conditional limit.

TPH concentrations in GND2287 (3.3 to 5.6 g/m³ TPH- 2016) in this monitoring period were slightly elevated when compared to the previous years analysis of the same well, with a greater range (4.2 to 4.3 g/m³ TPH- 2015). Although unlike last year, the analysis detected trace toluene, ethylbenzene and xylenes in three of the five samples collected from this well, though at low concentrations. Note that only benzene (0.11g/m³) and TPH C₁₅-C₃₆ (0.5 g/m³) were detected in the final sample collected in June 2016 and these values were very close to the limit of detection for these analytes.

Although there were detections throughout the year of additional analytes, the low concentrations recorded were classified as suitable by the Ministry for the Environment for irrigation water.

Soil sampling indicated that the TPH concentrations had detailed a significant decrease when compared to the previous year's analysis. Specifically mid range hydrocarbons C₁₀-C₁₄ are decreasing in concentration in area F3. F3 is the only area which remains above the surrender criteria. There still remains a good deal of variation within area F3 as observed over the long term sampling record. The Council will continue to monitor this area until it has been classified as acceptable for surrender under the specific consented criteria.

During the year, the Company demonstrated a good level of environmental and a high level of administrative performance with the resource consents.

For reference, in the 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

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

This report includes recommendations for the 2016-2017 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 description and location	5
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	8
1.5.4 Chemical sampling	9
2. Results	11
2.1.1 Inspections	11
2.1.2 Results of discharge monitoring	14
2.1.3 Provision of consent holder data	15
2.1.4 Results of receiving environment monitoring	16
2.2 Investigations, interventions, and incidents	22
3. Discussion	24
3.1 Discussion of site performance	24
3.2 Environmental effects of exercise of consents	24
3.3 Evaluation of performance	25
3.4 Recommendations from the 2014-2015 Annual Report	27
3.5 Alterations to monitoring programmes for 2016-2017	27
4. Recommendations	28
Glossary of common terms and abbreviations	29
Bibliography and references	31
Appendix I Resource consents held by BTW Company Ltd Oeo Landfarm	
Appendix II BTW Company report	

List of tables

Table 1	Geology related to monitoring well construction	7
Table 2	Soil analytes	9
Table 3	Groundwater analytes	10
Table 4	Landfarm application dates	14
Table 5	Council soil samples Oeo landfarm 2015-15 monitoring year	16
Table 6	GND2286 2015-16 monitoring year	21
Table 7	GND2287 2015-16 monitoring year	22
Table 8	Summary of performance for consent 7613-1.1	25

List of figures

Figure 1	Oeo landfarm with region inset	6
Figure 2	Council soil sample locations Area F3 2015-16 monitoring period	18
Figure 3	Oeo landfarm groundwater monitoring well network	19
Figure 4	Long-term TDS concentration GND2286 - 2287 Sep 2012-Nov 2016	20

List of photos

Photo 1	An example of an extracted soil core	10
Photo 2	Company supplied spreading map of the Oeo landfarm	13

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 2015-June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by BTW Company Limited (the Company). The Company operates a drilling material landfarm situated on South Road at Manaia (Oeo Landfarm).

The Oeo Landfarm site became operational in the 2012-2013 monitoring year; during which there were eight disposals of approximately 4,278 m³ of water/synthetic-based cuttings and fluid over a combined area of approximately 61,047 m². Operations at the site ceased in the 2013-2014 monitoring year, and the decision was made to not utilise the remaining small area available to spread to the east of the Rawa Stream. The Company and the Council will continue to monitor this site until surrender criteria are met and the resource consent may be surrendered.

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. The 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 material onto and into land via landfarming. This is the fourth annual report to be prepared by the Council to cover the Company's discharges and their effects at this site.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- the resource consents held by the Company/companies in the Rawa/Waimate 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 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

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

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

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

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

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

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

Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving 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 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents

1.2 Process description

1.2.1 Drilling waste

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

Drilling fluids

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (diesel/crude oil based) have also been used. Their use has declined since the 1980s due to their ecotoxicity; they have been replaced by SBM. SBM use olefins, paraffins or esters as a base material. While this is technically still a form of oil based fluid, these fluids have been engineered to remove polycyclic aromatic hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

Common constituents of WBM and SBM include weighting agents, viscosifiers, thinners, lost circulation materials (LCM), pH control additives, dispersants, corrosion inhibitors, bactericides, filtrate reducers, flocculants and lubricants. Of these, the naturally occurring clay mineral barite (barium sulphate) is generally the most common additive. It is added to most drilling muds as a wetting and weighting agent.

Drilling fluids may be intentionally discharged in bulk for changes to the drilling fluid programme or at the completion of drilling. Depending on operational requirements and fluid type and properties, fluids may be re-used in multiple wells.

Cuttings

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

1.2.2 Landfarming

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

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

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

The landfarming process utilised at the Oeo Landfarm was on a single application basis. This meant that dedicated spreading areas received only a single application of material. When disposal was complete, the area was reinstated and monitored until consent surrender criteria had been met.

1.3 Site description and location

The consented site consists of two land parcels totaling 13.8 ha of available spreading area. The site is located on privately owned marginal coastal land situated on reworked dune fields. The predominant soil type has been identified as black loamy sand, and vegetation growth is primarily a mixture of pasture and dune grasses. Average annual rainfall for the site is 1,122 mm (taken from the nearby Glenn Road monitoring station). Two significant surface water bodies run adjacent to the spreading areas. The Waimate

Stream flanks the north-western side of the main western site, whilst the Rawa Stream runs adjacent to the north-western side of the smaller eastern site. The Waimate Stream in the immediate vicinity of the site is essentially ephemeral and only flows during periods of prolonged wet weather. Prior to landfarming, the site had suffered from extensive dune ablation, visible in Figure 1. Basic subsurface soil stratigraphy is provided in Table 1.

Site data

Location

Word descriptor:	South Road, Manaia, Taranaki
Map reference: (NZTM)	E 1684821 N 5621560
Mean annual rainfall:	1,122 mm
Mean annual soil temperature:	~26.2°C
Mean annual soil moisture:	~15.88%
Elevation:	~25 m asl
Geomorphic position:	Cliff/dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free/well draining
Previous Land use:	Dry stock grazing



Figure 1 Oeo landfarm with region inset

Table 1 Geology related to monitoring well construction

Bore	Depth (m)	Drilling Formation
GND2286	0.00 – 0.50	Sandy topsoil
	0.50 – 2.00	Soft sandy clay
	2.00 – 10.00	Soft tephra
GND2287	0.00 – 0.50	Sandy topsoil
	0.50 – 3.00	Soft sandy clay
	3.00 – 10.50	Tephra
GND2288	0.00 – 0.50	Sandy topsoil
	0.50 – 2.50	Sandy soft clay
	2.50 – 10.00	Tephra
GND2350	0.00 – 0.50	Sandy topsoil
	0.50 – 3.50	Sandy clay
	3.50 – 5.00	Conglomerated sand, small gravels, hard
	5.00 – 7.50	Sandy clay
	7.50 – 8.50	Sandy clay, firm
	8.50 – 9.00	Solid rock
	9.00 – 10.50	Conglomerated sand, small gravels, firm

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 consent 7613-1.1, to discharge drilling wastes (consisting of drilling cuttings and fluids) from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming. This consent was issued by the Council on 23 March 2010 as a resource consent under Section 87(e) of the RMA. It is due to expire on 1 June 2024.

Condition 1 sets out definitions.

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

Conditions 3 and 4 require notification and the provision of information and analytical data prior to receipt of wastes on site for stockpiling, and prior to discharge.

Condition 5 and 6 require the notification and the provision of information and analytical data, of which will be made available to the Council via report annually.

Condition 7 states that the monitoring is now limited to area F3 and the associated monitoring bore network.

Conditions 8 to 11 stipulate the manner and dispersal of wastes, while condition 11 requires a buffer zone between areas of disposal and surface water bodies and site boundaries.

Conditions 12 to 14 specify further site management requirements.

Conditions 15 to 20 specify receiving environment limits for both soil and water.

Condition 21 concerns site surrender.

Condition 22 is related to archaeological discovery.

Conditions 23 and 24 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 obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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

The monitoring programme for the Oeo landfarm site consisted of three 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

The Oeo site was inspected twice during this monitoring period. It was also inspected by staff undertaking soil and groundwater testing, whereby an additional five visits were undertaken by a Council officer.

Inspections focused on the following aspects:

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

1.5.4 Chemical sampling

The Council undertook compliance environmental sampling at the Oeo in this monitoring period. As in previous monitoring years; this sampling included the analysis of soil and groundwater specific to the Oeo site.

In previous years the Rawa Stream, which is situated to the east of the site (Figure 2) would have also been sampled to ascertain for any potential adverse environmental effects. However it was omitted from this year's monitoring as the long term analysis of the Rawa indicated negligible impacts from the exercise of this consent.

Thus in this monitoring period the main analysis was centred on soil sampling and groundwater analysis.

Soil Sampling

During the monitoring period the Council would collect soil samples from areas of a landfarm which were utilised for the practice of landfarming. In this period six soil samples were collected. These samples were the result of a composite sample which was composed of ten soil cores (Photo 1) inserted to a nominal depth of 400 mm bgl¹. The ten soil cores would then be combined and analysed for the following analytes Table 2.

Table 2 Soil analytes

Council Soil Analysis		Hill Laboratory Soil Analysis	
Calcium	Magnesium	Total Petroleum Hydrocarbon	Total Heavy Metals
Chloride	Sodium	C ₇ -C ₉	Arsenic
Conductivity	Ammoniacal nitrogen	C ₁₀ -C ₁₄	Cadmium
Total Petroleum Hydrocarbon	Nitrite/Nitrate Nitrogen	C ₁₅ -C ₃₆	Chromium
Potassium	pH	BTEX	Copper
Moisture factor	Sodium Adsorption Ratio (SAR)		Nickel
	Total Soluble Salts		Lead
			Zinc

¹ The aim is to encapsulate the zone of application which may exist between 150mm-400mm+/- bgl, this method is modified from the Guidelines for the Safe Application of Biosolids to land in NZ (2003)



Photo 1 An example of an extracted soil core

Groundwater analysis

The Oeo site contains an active groundwater monitoring network (Figure 1), which originally consisted of four monitoring bores. Two of the four bores were omitted from further analysis due to the long term record which detailed no adverse effects, while the remaining two wells were retained within the programme due to analyses results above certain criteria which warranted further analysis.

The analysis undertaken for the two monitored groundwater wells are provided in the following Table 3. The Council Officer whom undertook the sampling did so through the use of a low-flow peristaltic pump, fitted to a YSi flow cell to obtain field readings. Samples would be collected once field parameters had stabilised over the course of a fifteen minute period or three well volumes had been removed.

Table 3 Groundwater analytes

Council Groundwater Analysis	
Chloride	pH
Conductivity	Temperature
Level	Sodium
Total Dissolved Salts	
Hill Laboratory Groundwater Analysis	
Total Petroleum Hydrocarbons	Benzene
C ₇ -C ₉	Toluene
C ₁₀ -C ₁₄	Ethylene
C ₁₅ -C ₃₆	Meta-Xylene
	Ortha-Xylene

2. Results

2.1.1 Inspections

28 July 2015

At the time of inspection the following was observed: The wind was from south east. At the time no objectionable odours or visible emissions were found during the inspection. No recent disposal activities had occurred at the site. Stockpiled gravel and rock remained at the site entrance.

Pasture cover across the southern end of the spreading areas looked good and the pasture appeared healthy. The northern end of the spreading areas had large patches of mud pan surface layers which are bare of pasture, weathered drilling muds easily identified within the soil profile within these areas, the material was odorous and broke apart easily. Shoreline inspected below spreading areas, no effects were observed.

21 October 2015

An inspection was conducted in conjunction with groundwater sampling. Two groundwater bores were sampled: GND2286 and GND2287 in line with recent change to consent. No odour, sheen or foaming encountered in any samples, all clear and uncoloured.

Pasture establishment ongoing in F3. Rawa Stream was flowing at steady, moderate flow. Clear, light brown colour, no sheen or foaming present.

29 January 2016

The inspection was conducted in conjunction with soil sampling in fine conditions with a slight south east breeze. Spreading area F3 was soil sampled, with the compositing of ten cores to approximately 400 mm depth. A layer of drilling mud was encountered and found to be 150 mm thick at around 200 mm below ground level (bgl) in the transect. No odour was noticeable.

The soils were dark brown, dry sands. The beet crop in the spreading area appeared patchy in growth in some places. Duplicate sample collected and sent to Hills Labs for hydrocarbon breakdown analysis.

The following action was required: When conditions are favorable establish pasture across all bare spreading areas.

18 March 2016

This inspection was conducted in conjunction with groundwater sampling during fine, calm conditions. Two groundwater bores were sampled. No odour or sheen was encountered; while a slight foaming was apparent in GND2287. All samples were clear with a slight orange tinge in GND 2287. Pasture establishment in paddock was ongoing, beet crop had been harvested and area was re-grassing well.

15 April 2016

At the time of the inspection the following was found: The wind was from the south west, no objectionable odours or visible emissions were found during the inspection. No recent spreading or storage activities had occurred. Historic spreading areas have been worked and had pasture sown, vegetation regrowth was occurring in the barren areas and all pasture appeared healthy and stable. No detrimental effects observed on

the beach below and the groundwater discharge onto the beach was clear and appeared free of site influences.

14 June 2016

Final site inspection of the monitoring year was conducted in conjunction with groundwater and soil sampling in overcast, showery conditions with a gusty south west wind.

The site was unoccupied, with the pasture/clover establishing slowly. Observed were the occasional barren patches visible in windy, exposed areas.

Two soil transects were undertaken in F3 spreading area. Drilling muds were encountered at approximately 100 to 250 mm bgl in one transect, which contained a noticeable, though slight hydrocarbon odour. Flecks of muds were encountered in other transects, though no odour. Described as damp, dark grey, sandy soils.

Groundwater samples collected, slight odour and foaming in GND2287. No odour, sheen or foaming in GND2286.

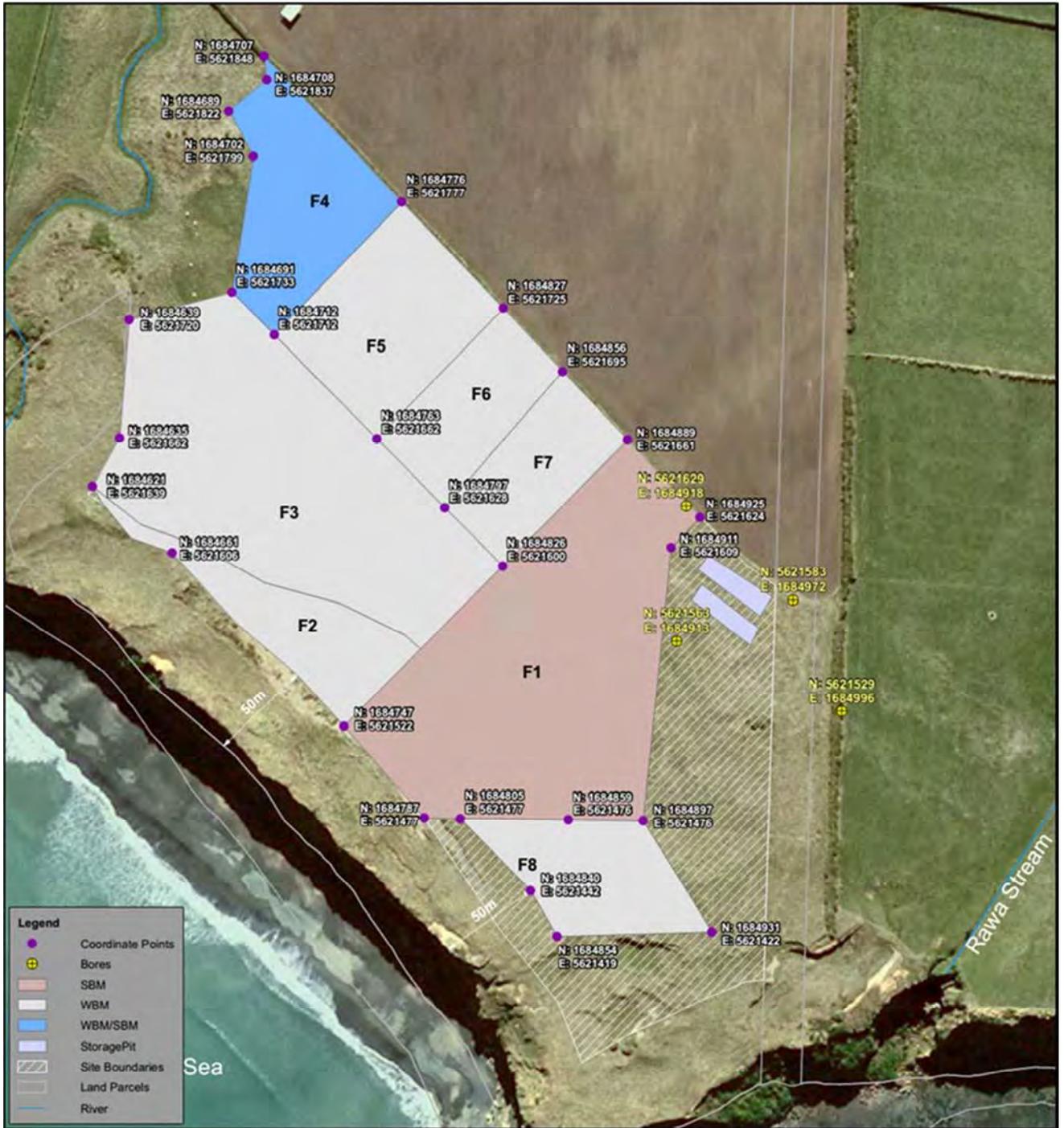


Photo 2 Company supplied spreading map of the Oeo landfarm

2.1.2 Results of discharge monitoring

The Company initiated landfarming at the Oeo landfarm in September 2012 when Mangahewa D SBM were spread across area F1. Seven additional areas were farmed between September 2012 and June 2013, these are detailed in Table 4, the location of the application areas is provided in Photo 2.

Table 4 Landfarm application dates

Area ID	Mud Type	Date farmed	Well name
F1	SBM	September 2012	Mangahewa D
F2	WBM/SBM/ CS/CS	November 2012	Mangahewa D, Mangahewa C Cheal B & C, Maui B Cheal A
F3	WBM/SBM/ CS/CS/WW	December 2012	Mangahewa D, Mangahewa C, Cheal B & C, Maui B, Cheal A
F4	WBM/SBM	March 2013	Mangahewa C9, Sidewinder 6A
F5	WBM/CW	April 2013	Mangahewa C12, Sidewinder 7A, STOS KA20A
F6	WBM/CW	April 2013	Mangahewa C12, Sidewinder 7A, KA20A
F7	WBM	April 2013	Mangahewa C12, Sidewinder 7A, KA19/20A
F8	WBM	June 2013	Mangahewa C12, Sidewinder 7A, KA19/20A

The application of landfarmable material finished in June 2013 as stated in the above Table 4. Since this date the Company had provided annually to the Council analysis of the areas of the site which had been utilised for landfarming.

In the previous monitoring period the Company provided, to the satisfaction of the Council, analysis which stipulated that certain areas of the site had met their conditional value for surrender². They did so by meeting the following conditions.

Extracted from Consent 7613-1 Consent conditions

16. *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.*
17. *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.*
18. *The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Guidelines for the safe application of biosolids to land in New Zealand [Ministry for the Environment and New Zealand Water & Wastes Association, 2003].*

² Consent 7613 Condition 20

19. From 1 March 2024 (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	2,500 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 2024, the consent holder applies for a new consent to replace this consent when it expires.

20. This consent can not be surrendered until the standards in condition 19 are being met.

BTW Company lodged an application to change the conditions of consent 7613, to discharge drilling wastes consisting of drilling cuttings and drilling fluids from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming. Note this occurred on the 27 March 2015.

The application was to surrender the consent for the areas of the site that had met surrender criteria as stipulated by condition 19 of the consent. The consent will remain active for the remaining area (F3) which has yet to meet the surrender conditions. As well as area F3, specific groundwater monitoring wells (GND2286 and 2287) which detail a dissolved salt concentration above condition 14 in the consent, which is a dissolved salt concentration above 2,500 g/m³, or detail the potential to rise above the conditional benchmark had been included in this change.

Thus moving forward the consented obligational area was now limited to area F3 and two of the four monitoring wells. The analysis provided by the Company is provided in their attached annual report. Note that there is now no obligation for the Company to undertake additional soil sampling to ascertain the conditions as the Council now undertakes the soil sampling at this location. Analysis undertaken by the Company over time is provided in their annual report which is attached in Appendix II.

2.1.3 Provision of consent holder data

The consent holder provided the Council with an annual report which stated the historical analysis which had occurred on this site since its inception in 2012. This report is provided in Appendix II.

2.1.4 Results of receiving environment monitoring

2.1.4.1 Council soil results

As regarded in Section 1.5.4 Chemical sampling, the Council collected six composite soil samples from the spreading area F3. The analysis of the six soil samples is provided in the following Table 5.

Table 5 Council soil samples Oeo landfarm 2015-15 monitoring year

		Consent 7613-1.1	18 Aug 2015	29 Jan 2016	05 May 2016	05 May 2016	05 May 2016	14 Jun 2016	14 Jun 2016
Total Arsenic	mg/kg	20	-	-	-	3	-	-	-
Total Cadmium	mg/kg	1	-	-	-	0.12	-	-	-
Total Chromium	mg/kg	600	-	-	-	8	-	-	-
Total Copper	mg/kg	100	-	-	-	18	-	-	-
Total Nickel	mg/kg	60	-	-	-	8	-	-	-
Total Lead	mg/kg	300	-	-	-	4.3	-	-	-
Total Zinc	mg/kg	300	-	-	-	49	-	-	-
TPH C ₇ -C ₉	mg/kg	120	<10	<8	-	-	-	<8	<8
TPH C ₁₀ -C ₁₄	mg/kg	58	600	52	-	-	-	<20	380
TPH C ₁₅ -C ₃₆	mg/kg	4,000	3900	690	-	-	-	<40	2200
Total Petroleum Hydrocarbon (Hill)	mg/kg DW	-	4500	740	-	-	-	<70	2500
Total Petroleum Hydrocarbon (Council)	mg/kg	-	-	819	239	-	429	-	3654
Benzene	mg/kg	1.1	<0.07	<0.05	-	-	-	<0.05	<0.05
Toluene	mg/kg	68	<0.07	<0.05	-	-	-	<0.05	<0.05
Ethylbenzene	mg/kg	53	<0.07	<0.05	-	-	-	<0.05	<0.05
Xylene-m&p	mg/kg	48	<0.14	<0.10	-	-	-	<0.10	<0.10
Xylene-o	mg/kg	48	<0.07	<0.05	-	-	-	<0.05	<0.05
Calcium	mg/kg	-	-	244.3	197.1	-	117.9	-	184.9
Chloride	mg/kg	700	-	85.8	84.6	-	49.8	-	86.8
Conductivity	mS/m @20° C	290	-	147.2	143.4	-	82.3	-	134.8
Potassium	mg/kg	-	-	204.4	118.2	-	77.2	-	187.5
Moisture Factor	nil	-	-	1.078	1.082	-	1.063	-	1.142
Magnesium	mg/kg	-	-	13.8	17.5	-	9.1	-	8.3
Sodium	mg/kg	460	-	68	65	-	35.7	-	107.4
Ammoniacal Nitrogen	mgN/kg	-	-	0.05	2.14	-	1.81	-	1.33
Nitrite/Nitrate Nitrogen	mgN/kg	-	-	4.7	10.06	-	3.45	-	0.1
pH	pH	-	-	7.9	7.5	-	7.6	-	8
Sodium Adsorption Ration (SAR)	None	18	-	1.14594	1.19084	-	0.8528	-	2.09885
Total Soluble Salts	mg/kg	2,500	-	1152	1122.2	-	644.1	-	1054.9

Soil analysis from the spreading area F3 is provided in Table 5. The Council collected seven composite soil samples in this monitoring period (Figure 2); of these seven

samples, four were sent to Hill laboratory for TPH speciation and BTEX analysis and one for total heavy metal analysis.

The rationale for sending samples to Hill laboratory was to undertake the TPH speciation analysis which allows for further quantification of specific hydrocarbon chains in respect to the consent conditions (see Section 2.1.3). A spot analysis to check confirmation with heavy metal concentrations was also undertaken, of which all values were within acceptable ranges when compared to the consent conditions (Table 5) b, which also corresponds with the long term analysis undertaken by BTW.

The soil analysis results in Table 5 contain a good deal of variation, as was evident in previous years monitoring results. TPH concentrations in this monitoring year ranged from 0-4,500 mg/kg across the F3 area, in comparison to the previous monitoring year where the range was 6,129-18,244 mg/kg TPH. The concentration of TPH has detailed a significant decrease in this monitoring period.

Council officers whom undertake the soil sampling do so with a GPS referenced soil transect (reference the transect map) to enable hot spots or hot lines to be monitored for future occurrence.

In this period, the speciated soil analysis of the TPH detailed that the mid range hydrocarbon C₁₀-C₁₄, are still elevated above its consented limit with respect to the acceptable surrender concentrations for this parameter, which is set at a low concentration of 58 mg/kg. The final soil sample collected on the 14 June 2016 detailed a mid range of 380 mg/kg, which had dropped from 600 mg/kg at the inception of the monitoring year in August 2015. The Council will continue to monitor the degradation of this hydrocarbon chain moving forward.

Salt concentrations in terms of sodium (37-107 mg/kg), chloride (49-88 mg/kg), and total soluble salts (644-1152 mg/kg) were below there consented limit for surrender. The sodium adsorption ratio (SAR) was low (0.8-2.0) and well below the consented limit.

Conductivity readings were in an acceptable range (82-147) and below there consented limited for surrender of 247 mS/m 20°C.

Benzene, toluene, ethylene and xylene (BTEX) concentrations were all below the limit of detection in the four samples which were collected.

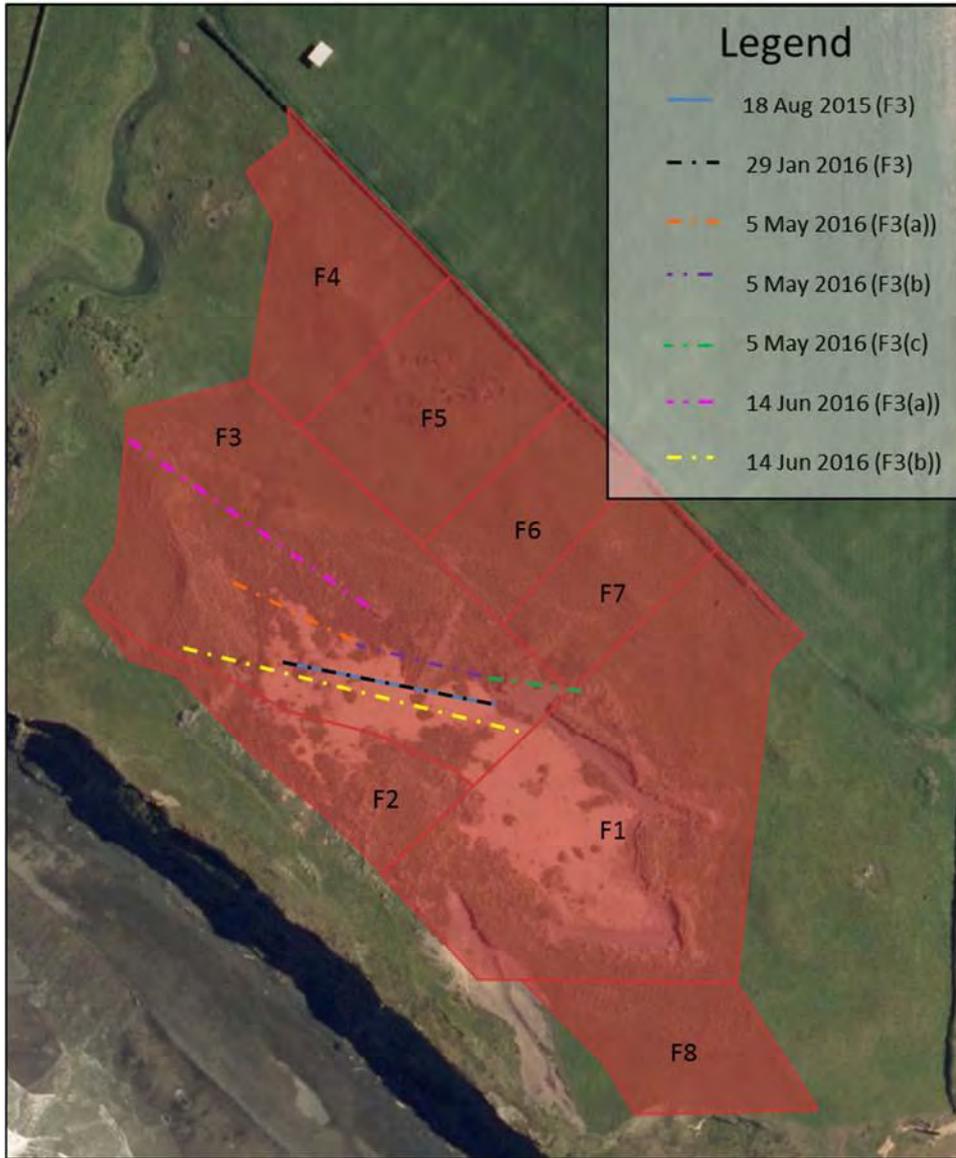


Figure 2 Council soil sample locations Area F3 2015-16 monitoring period

2.1.4.2 Council Groundwater analysis

The Oeo site contains four active groundwater monitoring wells of which two were retained in this monitoring period. These two wells detailed total dissolved salts (TDS) concentrations above the consent concentration ($>2,500 \text{ g/m}^3$) with trace benzene in both of these wells and TPH all chains in one of two of the wells (TPH 3.4 to 3.6 g/m^3).

The two wells which were retained for further analysis were GND2286 and GND2287 respectively. These wells were sampled quarterly throughout the year to ascertain for seasonal variation within the groundwater of the site. The location of the wells is provided in Figure 3.



Figure 3 Oeo landfarm groundwater monitoring well network

Analyses of the two groundwater monitoring well specific to the Oeo site are provided in Tables 6 and 7 respectively. Of the two wells, GND2286 and GND 2287, GND 2287 is the impacted well.

Conditions 15 and 16 of the consent 7613-1.1 stipulate the following:

15. *The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding $2,500 \text{ g/m}^3$.*
16. *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.*

As stated, the well GND 2287 (Table 7) is the more impacted well of the two wells which are sampled on the site. Impacted in terms of high concentrations of TDS which were above condition 15, the TDS ranged from 1,800 to 5,100 g/m³ prior to settling at 2,600 g/m³ by the end of the year. Inline with this was the corresponding chloride and sodium concentrations which followed similar fluctuations to the TDS.

TPH concentrations in GND2287 (3.3 to 5.6 g/m³ TPH) were slightly elevated when compared to the previous years analysis of the same well, with a greater range (4.2 to 4.3 g/m³ TPH). Although unlike last year, the analysis detected trace toluene, ethylbenzene and xylenes in three of the five³ samples collected from this well, though at low concentrations. Note that only benzene (0.11g/m³) and TPH C₁₅-C₃₆ (0.5 g/m³) were detected in the final sample collected in June 2016 and these values were very close to the limit of detection for these analytes.

While there were detections throughout the year of additional analytes, the low concentrations recorded were classified as suitable by the Ministry for the Environment for irrigation water. The values have been added to Table 7 to allow the reader easy reference.

GND2286 (Table 6), which was retained for analysis this monitoring period due to an increasing TDS trend in the previous year, maintained the same concentration range (1,145 to 1,237 g/m³ 2015-16, 1,377 to 1,431 g/m³ 2014-15), albeit with a slightly lower concentration than the previous period.

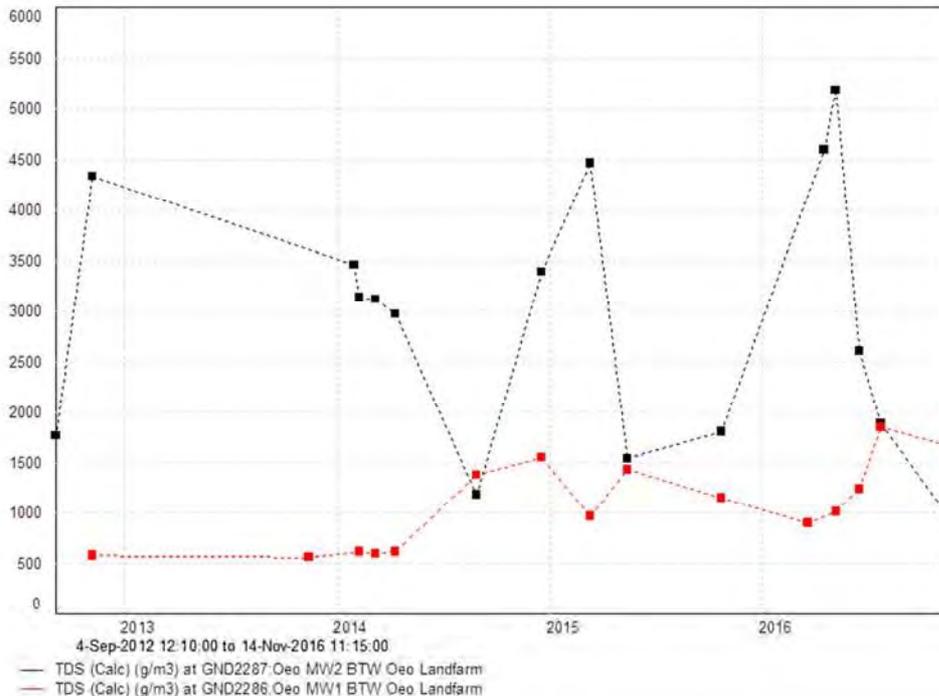


Figure 4 Long-term TDS concentration GND2286 - 2287 Sep 2012-Nov 2016

³ Initially four sampling rounds were scheduled, however an operator error with respect to analysis required an additional round to be undertaken at well GND2287

A spot hydrocarbon sample was collected at the end of the monitoring period to ascertain for any signs of hydrocarbons, of which there were none, whereas in the previous monitoring period a trace detection of benzene was reported.

The rationale for why there are high concentrations of salts within the groundwater in this location was due to the original storage of material in unlined storage cells. As such given the saline nature of the drilling mud, egress into the groundwater had occurred as is evident from the long term TDS record of GND2287, Figure 4. Note that these concentrations of TDS are acceptable for stock watering purposes.

While there have been elevated TDS concentrations observed in the long term record (Figure 4), which had been above the conditional concentration prescribed by the consent of 2,500g/m³, recent analysis undertaken in the upcoming monitoring period has detailed a reduction in these concentrations to below the conditional limit.

Of note, no landfarms now in Taranaki have unlined storage cells; all active landfarms are fitted with synthetic 'fit for purpose' liners to prevent this occurrence in the future.

Table 6 GND2286 2015-16 monitoring year

		GND2286	GND2286	GND2286	GND2286
Parameter	Unit	21 Oct 2015	18 Mar 2016	05 May 2016	14 Jun 2016
Benzene	g/m ³	-	-	-	<0.0010
Toluene	g/m ³	-	-	-	<0.0010
Ethylbenzene	g/m ³	-	-	-	<0.0010
XYLENE-O	g/m ³	-	-	-	<0.002
XYLENE-M	g/m ³	-	-	-	<0.0010
HC C ₇ -C ₉	g/m ³	-	--	-	<0.10
HC C ₁₀ -C ₁₄	g/m ³	-	-	-	<0.2
HC C ₁₅ -C ₃₆	g/m ³	-	-	-	<0.4
TPH	g/m ³	-	-	-	<0.7
Chloride	g/m ³	338	286	343	421
Sodium	g/m ³	252	143	149	194
Total Dissolved Salts	g/m ³	1145.1	893.6	1005.8	1237.9
Conductivity	mS/m@20°C	148	115.5	130	160
Dissolved Oxygen	g/m ³	-	-	-	-
PERSAT	%	-	-	-	-
Water level	m	4.078	4.835	4.98	4.72
pH	pH	6.8	6.4	6.5	6.4
Temperature	°C	15.3	16.4	17.4	15.8

Table 7 GND2287 2015-16 monitoring year

		Tier 1 GW criteria	GND2287	GND2287	GND2287	GND2287	GND2287
Parameter	Unit	Irrigation (MfE) ⁴	21 Oct 2015	18 Mar 2016	15 Apr 2016	05 May 2016	14 Jun 2016
Benzene	g/m ³	0.8	<0.0010	0.0037	-	0.0072	0.0011
Toluene	g/m ³	39	<0.0010	0.0024	-	0.007	<0.0010
Ethylbenzene	g/m ³	18	<0.0010	<0.0010	-	0.0011	<0.0010
XYLENE-O	g/m ³	13	<0.002	0.003	-	0.006	<0.002
XYLENE-M	g/m ³	13	<0.0010	0.0018	-	0.0032	<0.0010
HC C ₇ -C ₉	g/m ³	-	<0.10	<0.10	-	<0.10	<0.10
HC C ₁₀ -C ₁₄	g/m ³	1.8	<0.2	0.7	-	1.5	<0.2
HC C ₁₅ -C ₃₆	g/m ³	-	<0.4	2.6	-	4.1	0.5
TPH	g/m ³	-	<0.7	3.3	-	5.6	<0.7
Chloride	g/m ³	-	734	-	1630	1900	786
Sodium	g/m ³	-	322	-	1130	1066	668
Total Dissolved Salts	g/m ³	2,500 ⁵	1802.7	-	4595.8	5191.6	2607.4
Conductivity	mS/m@20°C	-	233	-	594	671	337
Dissolved Oxygen	g/m ³	-	-	-	2.62	-	-
PERSAT	%	-	-	-	27.4	-	-
Water level	m	-	4.31	5.413	5.49	5.52	4.73
pH	pH	-	6.3	-	6.8	6.7	6.8
Temperature	°C	-	15.3	16.4	16.8	16.5	16

2.2 Investigations, interventions, and incidents

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

⁴ Tier groundwater acceptance criteria for irrigation use: MfE Module 5 Tier 1 groundwater acceptance criteria 1999 (revised 2011)

⁵ Consent 7913-1.1 Condition 15

In the 2015-2016 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Discussion of site performance

In terms of the Company performance with respect to the Oeo landfarm in this monitoring year. The site is closed to the receipt of additional material post the final application to land which occurred in June 2013. Since this date the storage pits have been removed and the Company do not intend to continue landfarming at this location, although there is facility to do so.

Since the final application of material in June 2013, the site has been in a remediation phase as the levels of biodegradable contaminants slowly decrease in concentration over time. As such area F3 remains the primary and only area above the criteria for surrender at the Oeo landfarm.

In terms of site performance by the Company this term, not much was required to be undertaken with respect to the consent conditions. However, the Company did bring in further clean fill material to mix and agitate area F3, with a view to further augment the speed of biodegradation in this specific area. They also replanted seed which has taken well by striking across the site; this includes planting the coastal cliff line to the southwest of the landfarm.

While the action of re-agitating and blending the area F3 with additional clean fill may further stimulate the soil and perhaps enhance the biodegradation rates, this site has contained a good deal of variation. This has been observed in the Council's analysis over the past few years, and it will be prudent to gain successive analysis of the area which will confirm the surrender criteria has indeed been reached across the whole of area F3.

3.2 Environmental effects of exercise of consents

The main environmental effects associated with the exercise of this consent are centered on a legacy issue, whereby the historical holding of landfarmable material in unlined storage cells resulted in elevated saline and trace hydrocarbon impacts on the groundwater in the direct locality of the storage cells. Specifically, the downgradient monitoring well (GND2287) had indicated elevated salinity since its inception in 2012.

Linked to the high salinity are the trace hydrocarbon concentrations. In this monitoring period the concentration of the TPH showed a slight increase increase of 1.0 g/m³ TPH, prior to decreasing to below the limit of detection for this parameter in the final sampling round of the year. Of interest was the trace detection of benzene which detailed three detections which ranged from (0.0072 to 0.0011 g/m³ benzene). Note the concentration of 0.0072 g/m³ was slightly higher than in the previous monitoring period which was 0.0061 g/m³ for well GND2287.

While benzene detailed a slight increase in concentration, trace values for toluene, ethylene and xylenes were also recorded in GND2287. The low concentrations recorded were classified as suitable by the Ministry for the Environment for irrigation water.

While these elevated contaminants (TDS, BTEX and TPH) are in breach of two consent conditions (Section 2.1.4.2 Condition 15 and 16) it is noteworthy to mention that there is no adverse effects as a direct result of the level of contamination.

The site is situated close to the coastal environment; as such the elevated saline groundwater will have no effect on this environment. The hydrocarbons will be reduced within 100 m of their source as is common as natural attenuation continues.

While GND2287 detailed elevated saline and hydrocarbon concentrations, including its highest salinity value recorded thus far in the long term record. GND2286 which was retained due to an increasing trend in salinity in the previous period detailed a steady concentration this year. This well location, in terms of TDS which was below the consented limit, also it did not return any hydrocarbon detections when processed for analysis this period.

While there have been elevated TDS concentrations observed in the long term record (Figure 4), which had been above the conditional concentration prescribed by the consent of 2,500g/m³, recent analysis undertaken in the upcoming monitoring period has detailed a reduction in these concentrations in both monitoring wells to below the conditional limit.

The Council will continue to monitor these two wells until the parameters of concern have returned to below their consented concentration.

The Council will continue to sample area F3 until the analysis satisfies the consented requirements.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 8.

Table 8 Summary of performance for consent 7613-1.1

Purpose: To discharge drilling material (consisting of drilling cuttings and drilling fluids) from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	N/A	N/A
2. Best practicable option to be adopted	Inspections and liaison with consent holder	Yes
3. Notify TRC in writing prior to stockpiling	Notifications received	N/A
4. Notify TRC in writing prior to landfarming	Notifications received	N/A
5. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes

Purpose: To discharge drilling material (consisting of drilling cuttings and drilling fluids) from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Report on records in condition 5 to Council by 31 August each year	Report received 30 August 2016	Yes
7. Discharge depth limited to 100 mm for waste with hydrocarbons <5%, or 50 mm for waste with hydrocarbons >5%	Company records and inspection	N/A
8. Incorporation into soil as soon as practicable so that top 250 mm layer contains less than 5% hydrocarbons	Inspection and sampling	N/A
9. Single application of wastes to each area of land	Company records and inspection	Yes
10. No discharge within 25 m of a water body or property boundaries	Inspection	N/A
11. Maximum volume of stockpiling 6,000 m ³ , discharge within 12 months of arrival on site	Company records and inspection	N/A
12. Re-vegetate landfarmed areas as soon as practicable	Company records and inspection	Yes
13. No destabilisation of neighbouring land	Inspection	Yes
14. Total dissolved salts in any fresh water body shall not exceed 2,500 g/m ³	Sampling	Exceeded in bore GND2287
15. Disposal of waste shall not lead to contaminants entering surface water or groundwater exceeding background concentrations	Sampling	TPH/TDS/BTEX contaminants still elevated in bore GND2287
16. 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
17. 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
18. Levels of metals in soil shall comply with guidelines	Sampling	Yes
19. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mSm ⁻¹ b. chloride, 700 g/m ³ c. dissolved salts, 2,500 g/m ³ d. sodium, 460 g/m ³	Sampling prior to surrender	F3 still above surrender criteria in terms of mid range hydrocarbons
20. If condition 19 not met, consent cannot be surrendered	Sampling	N/A

Purpose: To discharge drilling material (consisting of drilling cuttings and drilling fluids) from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
21. Notification of discovery of archaeological remains	None found	N/A
22. Lapse condition	Inspection for evidence of exercise	N/A
23. Optional review provision re environmental effects	Next optional review June 2018	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

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

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

1. THAT monitoring of consented activities at Oeo Landfarm in the 2015-2016 year be amended from that undertaken in 2014-2015, by restricting groundwater monitoring to bores GND2286 and GND2287 only, and restricting soil sampling to the F3 spreading area only. *Undertaken.*

3.5 Alterations to monitoring programmes for 2016-2017

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
- to report to the regional community.

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

It is proposed that for 2016-2017 the monitoring programme for the Oeo landfarm remains as it was for the 2015-2016 monitoring year

4. Recommendations

1. THAT monitoring of consented activities at Oeo landfarm in the 2016-2017 year continue at the same level as in 2015-2016.

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.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m ³ s ⁻¹).
DO	Dissolved oxygen.
g/m ² /day	grams/metre ² /day.
g/m ³	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident register	The incident register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m ²	Square Metres.
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).
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.
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 1991</i> and including all subsequent amendments.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
Zn*	Zinc.

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

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

Bibliography and references

BTW Company Ltd Annual report Special Condition 6 – Monitoring and reporting – Oeo landfarm Annual report – Consent 761- 09389-2016

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

Ministry for the Environment and New Zealand Water and Wastes Association 2003: Guidelines for the safe application of biosolids to land in New Zealand.

Taranaki Regional Council (2015): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2013-2014*. Technical Report 2015-97

Taranaki Regional Council (2014): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2013-2014*. Technical Report 2014-39

Taranaki Regional Council (2013): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2012-2013*. Technical Report 2013-54

Appendix I

**Resource consents held by
BTW Company Ltd
Oeo Landfarm**

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

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, but without subsequently spreading, or incorporating the discharged material into the soil within 24 hours; and
 - b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, 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. 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 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 7613-1.1

5. The consent holder shall keep records of the following:
 - a) wastes from each individual well;
 - b) composition of wastes (including concentrations of chloride, nitrogen and total petroleum hydrocarbons);
 - 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;
 - 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.

6. 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 5, for the period of the previous 1 July to 30 June.

Discharge limits

7. This consent only applies to area F3 and the associated groundwater monitoring bore network. Area F3, as shown in Figure 1, attached.
8. 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.

9. As soon as practicable following the application of drilling wastes to land in accordance with condition 8 of this consent, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm, so that the hydrocarbon concentration at any point in the soil/waste mix is less than 50,000 mg/kg dry weight, anywhere in the 250 mm layer below the topsoil layer.
10. An area of land used for the landfarming of drilling wastes in accordance with conditions 8 and 9 of this consent, shall not be used for any subsequent discharges of drilling waste.
11. No discharge shall take place within 25 metres of surface water or property boundaries.

Operational requirements

- 12. The stockpiling of material authorised by this consent is limited to a maximum volume of 6000 cubic metres at any one time on the property. All stockpiled material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
- 13. 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.
- 14. The exercise of this consent shall not result in the destabilisation of neighbouring land.

Receiving environment limits - water

- 15. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m³.
- 16. The exercise of this consent shall not result in any contaminant concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.

Receiving environment limits - soil

- 17. 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.
- 18. 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.
- 19. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Guidelines for the safe application of biosolids to land in New Zealand (Ministry for the Environment and New Zealand Water & Wastes Association, 2003).
- 20. From 1 March 2024 (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 2024, the consent holder applies for a new consent to replace this consent when it expires.

Consent 7613-1.1

21. This consent can not be surrendered until the standards in condition 20 are being met.

Archaeological remains

22. 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, Taranaki Regional Council, has considered: tangata whenua interest and values, the consent holder's interests, the interest 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 authorisation or consent has been obtained.

Lapse and review

23. This consent shall lapse on 31 March 2015, 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.
24. 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 2012 and/or June 2018, 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 13 October 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

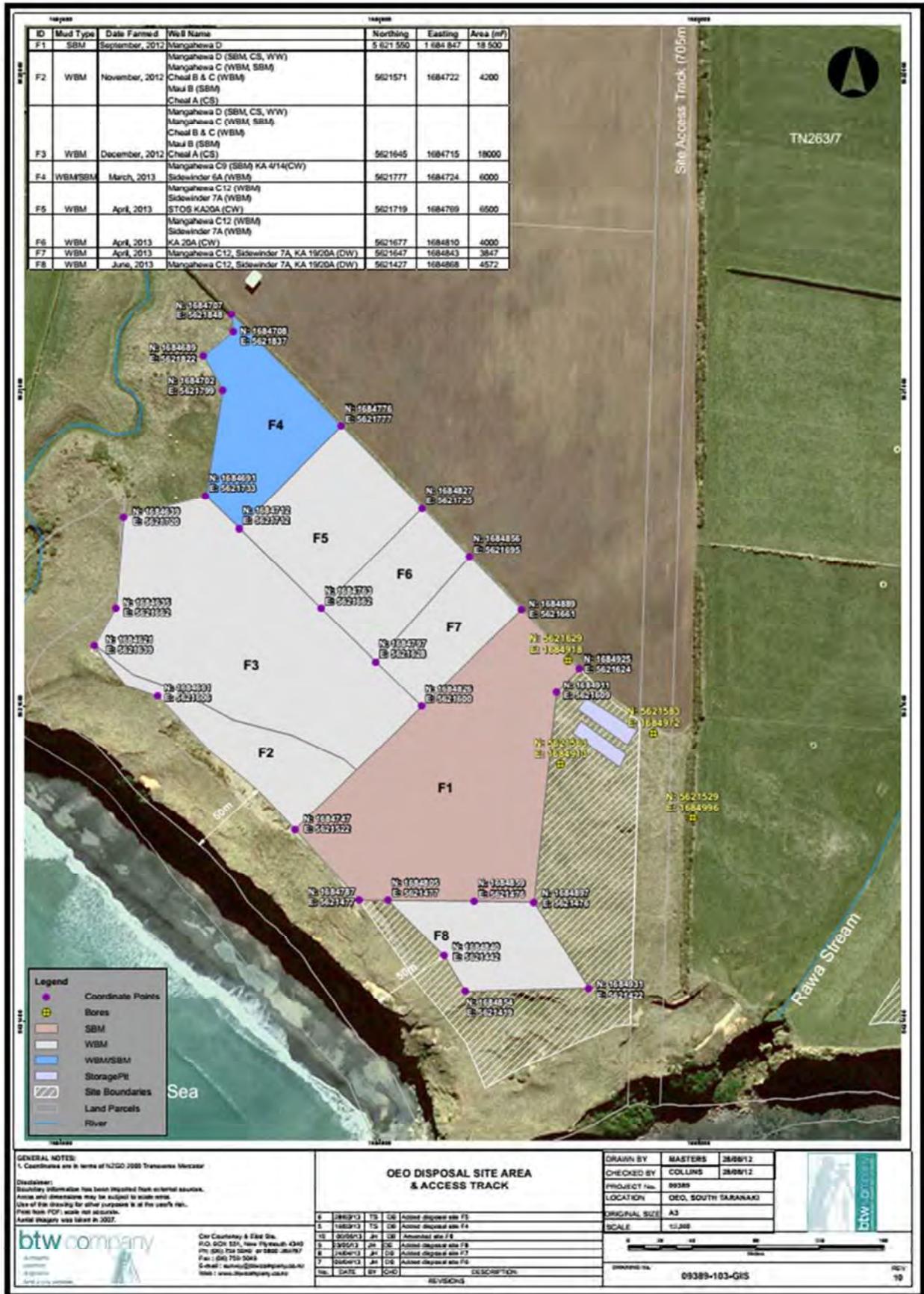


Figure 1 Oeo Site Map Drawing 09389-103-GIS

Appendix II

Oeo Landfarm Annual Report

Annual Report

Special Condition 6 - Monitoring and Reporting

Oeo Land Farm Annual Report - Consent 7613

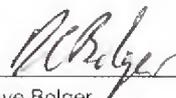
by *BTW Company*



Oeo Land Farm Annual Report - Consent 7613 09389

Reviewed

Report Author



Dave Bolger
Senior Environmental Scientist

30/8/16

Date

Reviewed by



Cameron Twigley
Director, Planning and Environment

30/8/16

Date

09389
30/08/2016

CONTENTS

1	INTRODUCTION	2
1.1	Special Condition 6.....	2
1.2	July 2015 to June 2016 - Summary	2
1.3	Records required under Special Condition 5.....	3
1.4	Report Overview.....	3
2	MATERIAL STORAGE AND TREATMENT	5
2.1	Material Volumes.....	5
2.2	Sowing and Treatments.....	6
3	MONITORING INFORMATION	8
3.1	Monitoring.....	8
3.2	Sampling Locations	8
3.3	Methods	8
3.4	Inspection Notices	9
3.5	Infringement Notices.....	9
3.6	Abatement Notices	9
4	ANALYSIS OF RESULTS	10
4.1	Compliance with SC's 14 and 15	12
4.2	Compliance with SC's 16 - 20.....	12
4.2.1	<i>Condition 16 – Soil Conductivity</i>	12
4.2.2	<i>Condition 17 – SAR</i>	12
4.2.3	<i>Condition 18 – Heavy Metals</i>	12
4.2.4	<i>Condition 19 and 20 – Constituent Closure Criteria</i>	13
4.2.5	<i>Chloride</i>	13
4.2.6	<i>Sodium</i>	13
4.2.7	<i>Dissolved Salts</i>	13
4.2.8	<i>TPH C7 – C9</i>	14
4.2.9	<i>TPH C10 – C14</i>	14
4.2.10	<i>TPH C15 – C36</i>	14
5	SUMMARY	15
APPENDIX A	COMPOSITION OF WASTE	16
APPENDIX B	SITE MAP	17
APPENDIX C	PHOTOGRAPHIC RECORD OF LANDFARMING	18

1 INTRODUCTION

1.1 Special Condition 6

In accordance with Special Condition 6 (SC6) of resource consent 7613-1 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 5 (SC5), for the period of the previous 1 July to 30 June.

This report therefore includes all information related to activities provided for under consent 7613-1 from 1 July 2015 to 30 June 2016 as well as monitoring required under SC 14-20.

1.2 July 2015 to June 2016 - Summary

The site was completely decommissioned during the monitoring period (2013-14). Therefore no new material has been taken to the site during this monitoring period and no areas were landfarmed during this monitoring period.

In general the pasture establishment has been excellent across the site, especially considering the exposed nature of the site. The only area to demonstrate patchy vegetation establishment was the F3 area. It has been identified in the past the F3 area had higher levels of hydrocarbons and a significant iron pan runs through this section which also creates difficult conditions such as ponding for pasture establishment.

Some further remediation work of the F3 area did take place during the monitoring year, with some additional clean fill brought onto the site to assist with pasture establishment and reduce any potential sand blow outs over the site. A new strike of pasture has just taken place and it is considered the site should have comprehensive vegetation cover by the end of spring.

All soil and surface water sampling has ceased at the site as surrender criteria has been met by the consent holder.

A significant number of the native plants that were planted along the coastal buffer zone and the Waimate stream edge have survived. It is considered over time the establishment of these native species will provide some natural habitat and protection from the harsh elements at this location; this is seen as a positive along this section of coast. Refer to figure 2.2 for a photograph of the coastal planting.

1.3 Records required under Special Condition 5

The consent holder shall keep records of the following:

- a) wastes from each individual well;

composition of waste (including concentrations of chloride, nitrogen and total petroleum hydrocarbons)

- b) stockpiling area(s);
- c) volume of material stored;
- d) landfarming areas, including a map showing individual disposal area with GPS co-ordinates;
- e) volumes and weight of wastes landfarmed;
- f) dates of commencement and completion of storage and landfarming events;
- g) dates of sowing landfarming areas;
- h) treatment applied;
- i) 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 Special Condition (SC)6 of consent 7613-1. Information is supplied generally in the order as requested within SC5 a-j.

- Records required under SC 5 condition 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 stored on well sites.

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 SC5 c), e) & g). This includes:
 - stockpiling Area's;
 - 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 SC5 which are listed below;
 - volumes of material stored;
 - volumes and weights of wastes landfarmed;
 - dates of sowing landfarmed areas;
 - treatments applied.

Material volumes have been calculated based on the area of disposal and the thickness of disposal which has been undertaken. This 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 SC5, condition j.
 - Section 4 provides the results of analysis as required by SC5, condition j. Special Conditions 14-20 of Consent 7613-1 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 SC5 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

No new material was disposed of or stockpiled during the monitoring year. The site was totally decommissioned during the monitoring period 2013-14.

Historical volumes of material landfarmed can be ascertained in previous annual monitoring reports and also on the site map provided in Appendix B.

2.2 Sowing and Treatments

Additional clean fill was added in the F3 area to assist with pasture established. Once the clean fill was added further sowing has taken place. As of 15-8-16 there was a good pasture strike in these isolated areas of F3. It is considered by the middle of spring the whole site should have excellent pasture cover.



Figure 2.1: F3 Area, additional clean fill, reworked and re sown, 15-8-16



Figure 2.2: Coastal Planting 15-8-16

3 MONITORING INFORMATION

The following section provides the details of soil and surface monitoring, including sampling locations and sampling methodology.

3.1 Monitoring

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 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.

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 areas landfarmed meet soil surrender criteria. No further soil sampling will take place by the consent holder as the soil surrender criterion has been met as demonstrated in section 4 of this report.

All past receiving environment samples were tested by Hill Laboratories and sampling methodology is in accordance with the TRC landfarm sampling procedures.

In the past the consent holder has monitored the Rawa Stream. The monitoring of the Rawa Stream ceased during the previous monitoring year due to no adverse effect recorded from the past landfarming activity.

3.2 Sampling Locations

Specific land farmed areas are located through the use of a GPS navigational system. These co-ordinates are contained within the "Oeo Landfarm Area and Track Access" plan (Appendix B) which shows areas of disposal and is updated following landfarming events. A central point is located within each area and a composite sample retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material.

3.3 Methods

Sampling involves collecting a composite of 5 sub-samples along a transect line from the central GPS point on the specific landfarmed area. Typically, samples are retrieved from an approximate depth of 250mm but this can vary depending on the location of the drilling mud layer.

Once the 5 sub samples have been collected the soil is mixed together and the appropriate sampling containers are filled and sent to Hill Laboratories for testing for specific constituents as required by the consent.

The sampling methodology is consistent with the TRC methodology. The goal is to achieve a representative sample of each specific landfarmed area. As the actual level of constituents is known in the materials to be landfarmed via the pre disposal sampling, it is considered this methodology provides a representative sample of the material once mixed (power harrowed into the soil) on the land farming area, and also gives data on constituent levels within the top 250mm of the soil profile, which in essence is for the protection of human and livestock health.

3.4 **Inspection Notices**

All routine site inspections by TRC compliance 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.

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the monitoring results undertaken for the Oeo Landfarm during the reporting period. Please note we have provided the complete sampling results from the initial soil sampling at the site, we believe this is useful to observe trends of constituent breakdowns over time at the site. Analysis of the results of monitoring are required by SC5, condition j. Special Conditions 14-20 of Consent 7613-1 are also addressed in this section.

We have colour coded table 4.1 for ease of quick interpretation. Green indicates that the level of a specific constituent meets consent surrender criteria, and red indicates that surrender criteria has not been met yet. As demonstrated in table 4.1 all areas now have met the surrender criteria from the consent holder.

We note no further soil sampling was undertaken by the consent holder during the monitoring period, however the TRC still sample the F3 area for completeness to demonstrate surrender criteria had been met.

Analysis of the monitoring results is undertaken over the following Sections 4.1 and 4.2, with a summary proved in Section 5.

Date	Consent Surrender limit meet			Consent Surrender limit not meet														TPH					Material		
	Soil conductivity <290m Sm-1 (see Consent if PD is greater than 400)	SAR <18	Total Soluble salts 2500 mg/kg	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/g/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/g/kg)	C7-C9 (120) (m)	C10-C14 (58) (x)	C15-C36 (4000) (7,x)	nitrogen mg/kg		Chloride 700 mg/kg	Sodium 460 mg/kg
F1	26/10/2012	1450	18	9560	<0.05	<0.05	<0.05	<0.1	<0.14	0.04	<0.03	2	<0.1	7	13	6.7	<0.1	5	43	12	5100	11000	0.08	930	
	3/04/2013	1040	10.5	6840	<0.05	<0.05	<0.05	<0.1	<0.12	<0.03	<2	<0.1	9	13	5.5	<0.1	6	45	8	1000	4500	0.14	660	808	
	4/07/2013	310	5.9	2060	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<2	<0.10	8	14	3.8	<0.10	6	37	8	770	2800	0.11	280	227	
	15/11/2013	130	4.3	851	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<2	0.12	9	14	3.2	<0.10	6	44	8	61	470	2	82	111	
	11/04/2014				<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03								8	20	210				
F2	15/01/2013	550	11.7	3640	<0.05	0.05	<0.05	<0.1	<0.14	<0.03	<2	0.1	8	24	3.6	<0.1	4	49	8	20	40	0.17	290	612	
	3/04/2013	710	12.4	4690	<0.05	<0.05	<0.05	<0.1	<0.12	<0.03	<2	<0.1	7	17	2.6	<0.1	4	39	8	38	520	0.15	450	829	
	4/07/2013	50	4	337	<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<2	0.11	11	16	2.5	<0.10	6	39	9	20	40	15	62	66	
F3	15/01/2013	750	9.9	4920																				708	
	3/04/2013	1310	22.8	8660	<0.05	<0.05	<0.05	<0.1	<0.13	0.15	<0.03	<2	<0.1	11	19	4.6	<0.1	7	47	8	2400	10200	0.12	940	1587
	4/07/2013	180	4.2	1221	<0.05	<0.05	<0.05	<0.05	<0.14	0.06	<0.03	2	0.14	12	23	4	<0.10	8	42	9	450	2800	0.17	220	166
	15/11/2013	360	7.8	2380	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	<0.03	<2	0.14	10	19	4.6	<0.10	7	49	8	900	6100	1	360	363
	11/04/2014				<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03								9	8	620	2800			
	9/10/2014				<0.05	<0.05	<0.05	<0.05	<0.13	0.05	<0.03								8	8	690	3700			
	23/02/2015			180															8	8	151	1990			
	23/02/2015			190															8	8	131	1800			
	26/06/2015																		8	8	20	670			
	26/06/2015																		8	8	20	670			
F4	4/07/2013	120	2.6	779	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.16	8	13	2.5	<0.10	6	46	8	23	189	0.23	59	88
	17/01/2014	150	2.6	970	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.15	9	14	2.9	<0.10	5	46	8	270	1390	1	72	112
	11/04/2014				<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03								8	8	20	40			
F5	4/07/2013	200	4.6	1320	<0.06	<0.06	<0.06	<0.11	<0.14	<0.03	<0.03	<2	0.13	9	14	3.1	<0.10	6	46	9	250	1010	0.2	165	195
	15/11/2013	130	5.4	858	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	0.2	10	15	2.4	<0.10	5	54	8	97	510	6	117	151
	11/04/2014				<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03								8	8	20	86			
F6	16/07/2013	50	2.1	343	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.12	7	11	1.8	<0.10	4	38	8	20	131	22	22	42
	17/01/2014	20	1	138	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.13	9	14	2	<0.10	5	49	8	153	650	1	8	17
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03								8	8	20	40			
F7	16/07/2013	70	2.6	436	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.11	7	12	1.7	<0.10	4	40	8	68	370	0.13	39	58
	17/01/2014	80	3.8	521	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	8	13	1.8	<0.01	5	50	8	83	610	1	51	83
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03								8	8	20	40			
F8	25/09/2013	70	3.2	462	<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03	<2	0.17	10	16	2.9	<0.10	6	52	<9	420	1470		79	71
	17/01/2014	70	2.9	449	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	2	0.17	9	16	2.6	<0.10	5	50	8	20	119	9	34	67
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03								9	9	20	40			

Table 4.1: Monitoring Results from Oeo Landfarm

4.1 Compliance with SC's 14 and 15

Conditions 14-15 require:

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

15. 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.

Sampling of the Rawa Stream ceased the last monitoring period, due to no adverse effects from the activity on the stream since the start of the operation. The Rawa stream is some distance from the landfarming site and old stock piling area. The TRC continue to sample two groundwater monitoring bores on the site.

4.2 Compliance with SC's 16 - 20

4.2.1 Condition 16 – Soil Conductivity

For the monitoring period all landfarmed area's demonstrated compliance with consent conditions and meet surrender criteria, as demonstrated in table 4.1 above.

Area/s not within consent surrender limits: **None**

4.2.2 Condition 17 – SAR

Condition 17 requires:

17. 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.

As shown in table 4.1 above, all the landfarmed areas are within the surrender criteria for the consent.

Area/s not within consent surrender limits: **None**

4.2.3 Condition 18 – Heavy Metals

Condition 18 requires:

18. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of 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 Table 4.1, all metal concentrations are compliant with Table 7.1, Section 7 of 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).

4.2.4 Condition 19 and 20 – Constituent Closure Criteria

Condition 19 requires:

19. From 1 March 2024 (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.

20. This consent may not be surrendered at any time until the standards in condition 19 are being met.

The monitoring data of these constituent surrender levels has been met as demonstrated in table 4.1 above. These guideline values are still considered the most appropriate values to protect livestock and public health.

4.2.5 Chloride

As shown in table 4.1 above, all landfarmed areas meet consent surrender criteria for Chloride.

4.2.6 Sodium

As shown in table 4.1, consent surrender requirements for Sodium have been reached for all monitored areas of the landfarm.

4.2.7 Dissolved Salts

As shown in table 4.1, consent surrender requirements for Dissolved Salts have been reached for all monitored areas of the landfarm

4.2.8 TPH C7 – C9

As shown in table 4.1, all results for TPH C7-C9 at the Oeo landfarm were within the consent surrender limits for all areas.

4.2.9 TPH C10 – C14

As shown in table 4.1, all landfarmed areas meet surrender limits. Further remediation work within the F3 area during the monitoring period, would have likely helped further reduce constituent levels within the F3 area.

4.2.10 TPH C15 – C36

Table 4.1 above shows results for TPH C15-C36 for all sites. All areas are now within the surrender criteria for the consent.

5 SUMMARY

For the monitoring period the site was only monitored by TRC. The site has continued to demonstrate the reduction of hydrocarbons in the soil as the bioremediation process continues. Further mixing of clean fill in the F3 area and re sowing of the site has had excellent results in establishing pasture and reducing sand erosion over the site.

The areas that have been landfarmed have only ever shown background levels of heavy metals as demonstrated in the comprehensive suite of sampling of heavy metals at the site over time.

It is worth noting the surrender criterion on the consent is a stringent standard to meet. These guidelines are set by the Ministry for the Environment to ensure constituents in the soil are at a level that poses negligible risk to agricultural activities, this includes pathways such as ingestion by stock. This standard is more stringent than what is required for a residential landuse scenario.

As demonstrated in the consent holder's comprehensive suite of soil sampling at the site, all constituents required to be tested as part of the consent conditions have now met consent surrender criteria. The site has been partially surrendered in the past, however from recently sampling it is expected the site will be completely surrendered during the next monitoring year.

APPENDIX A COMPOSITION OF WASTE

WBM – TYPICAL CHEMICALS

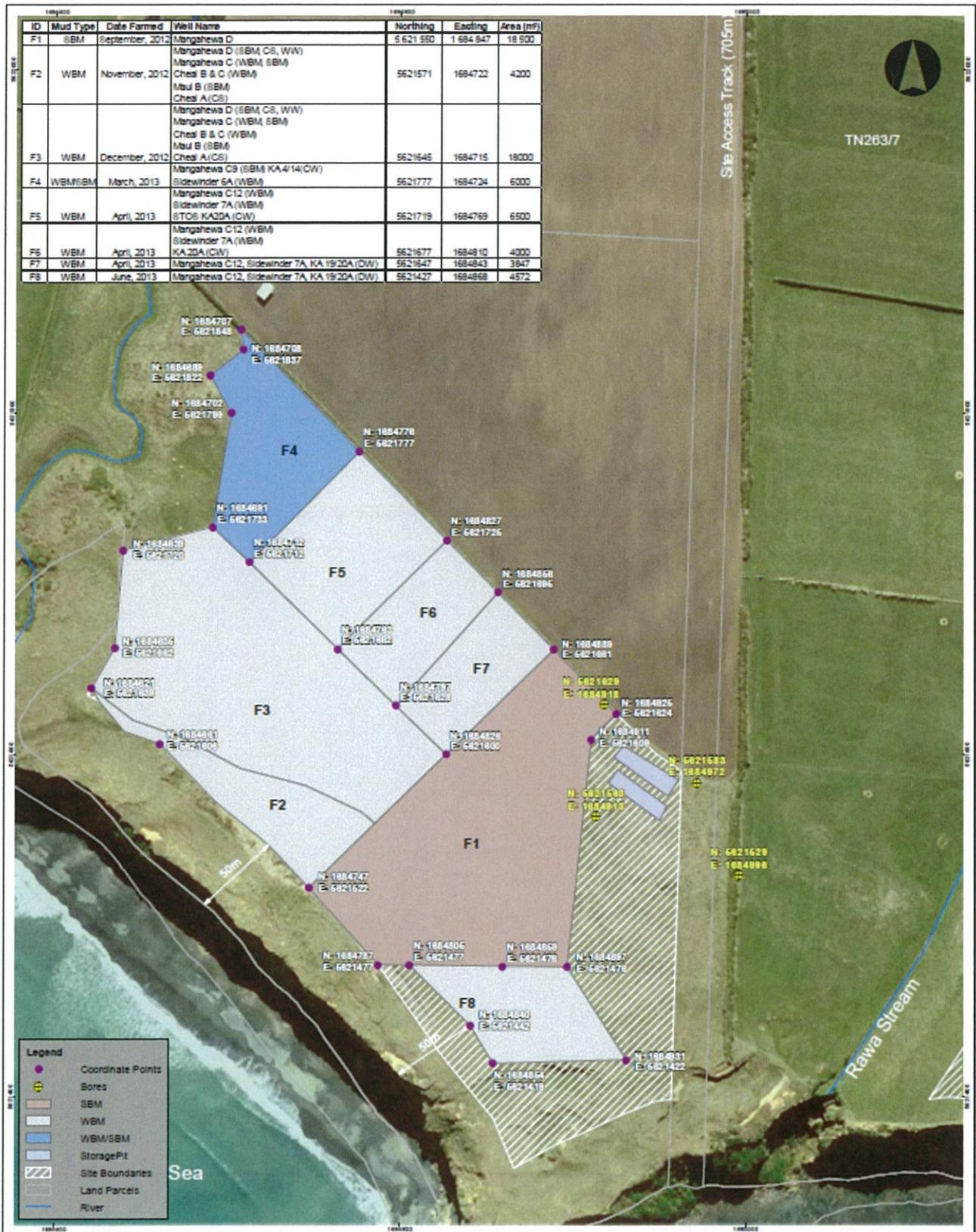
Table 1: Typical Chemicals used in Drilling

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-glycollether 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 aminos	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



APPENDIX C PHOTOGRAPHIC RECORD OF LANDFARMING



November 2014 Pasture establishment