

TAG Oil (NZ) Ltd
Vanner Landfarm
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-90

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Executive summary

BTW Company Ltd (BTW) managed a drilling waste landfarm on behalf of consent holder TAG Oil (NZ) Ltd (The Company). Vanner Landfarm is located on Lower Ball Road, Kakaramea, in the Mangaroa catchment. It has been operated at this location since November 2012. During the 2013-14 monitoring period, the resource consent was transferred from BTW Company Limited to the Company. During the 2015-16 monitoring period the management of the facility was transitioned to the Company.

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, and the results and environmental effects of the Company's activities.

The Company holds one resource consent, this includes a total of 26 conditions setting out the requirements that the Company must satisfy.

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

The Council's monitoring programme for the year under review included four inspections. No chemical analysis was undertaken this monitoring period as the site has been partially surrendered and the site has been decommissioned. The main action item in this monitoring year from the Company's perspective would be the revegetation, which the Company is addressing. This follows on from the previous years where the management and the Company have undertaken work at this site to a high standard.

The Company has finalised their requirement to landfarm with this site; however they have the facility in the southern portion of the Vanner site to landfarm again if so required. The mud storage cells and associated wash down pad have been removed and the land reinstated and re-contoured. As the Company had lined the storage cells prior to delivery of any material at the inception of the facility, there are no legacy issues from potential storage leaching.

During the year, the Company demonstrated a high level of environmental and 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 is at a high level.

This report includes recommendations for the 2016-2017 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by TAG Oil (NZ) Ltd (the Company). BTW (on behalf of TAG Oil) managed the landfarm (Vanner Landfarm), which was transitioned to the Company in this monitoring period. The landfarm is situated on Lower Ball Road at Kakaramea, in the Mangaroa catchment.

The Vanner site became operational during the 2011-2012 monitoring period, when there was a single disposal of 1,390 m³ of primarily water/synthetic based cuttings and fluids, with smaller quantities of contaminated water and soil. The waste spread in 2012-2013 was sourced from the Mangahewa C and D, Sidewinder, Puka and KA-1 wellsites and Cheal production station. On 30 July 2013 consent 7942-1 was transferred from BTW to the Company and the site began exclusively disposing of the Company's mud. The site remained under BTW management and had continued to stockpile and landfarm muds and cuttings for the remainder of the 2013-2014 monitoring period.

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

Post the final application of material to area F10, the land was reinstated. The site is now inactive. The Company provided the Council with sufficient information to allow for a partial surrender of the portions of land which had historically been utilised for the practice of landfarming.

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

The main focus of the Council's monitoring in the 2015-16 year was to assess the re-vegetation of the last landfarmed area, F10, and to monitor the central portions of the site which have been subject to wind blown erosion.

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

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental

perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly.

1.1.2 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.

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

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

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

Section 4 presents recommendations to be implemented in the 2016-2017 monitoring year.

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

1.1.4 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.

1.2.1.1 Drilling fluids

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

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

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

1.2.1.2 Cuttings

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

1.2.2 Landfarming

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

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

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

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

In the previous monitoring period (2015-16) the Company provided the Council with sufficient information to allow for the partial surrender of the Vanner site.

1.3 Site location and description

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

The predominant soil type has been identified as black loamy sand and vegetation growth is primarily a mixture of pasture and dune grasses. Test pitting and the logging of boreholes on site indicated a relatively deep water table (especially in the proximity of the storage areas). Test bores were augured to 10 m in the pit area, mostly through coarse sand without intercepting significant soil moisture. Pit construction revealed mostly coarse sand at the pit bases (approximately 3-4 m below surface).

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

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

Site data**Location**

Word descriptor:	Lower Ball Road, Kakaramea, Taranaki
Map reference:	E 1720685
(NZTM)	N 5602731
Mean annual rainfall:	1,043 mm
Mean annual soil temperature:	~15.1°C
Mean annual soil moisture:	~32.9%
Elevation:	~25 m asl
Geomorphic position:	Cliffed / dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining
Land use:	Active disposal



Figure 1 Site location and regional inset

1.4 Resource consents

1.4.1 Discharges of wastes to land

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

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

Condition 1 sets out definitions.

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

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

Condition 8 stipulates the discharge area.

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

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

Conditions 14 and 15 specify further site management requirements.

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

Condition 24 concerns archaeological remains.

Conditions 25 and 26 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

1.5 Monitoring programme

1.5.1 Introduction

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

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

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

1.5.2 Programme liaison and management

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

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

1.5.3 Site inspections

A total of three scheduled inspections were conducted during the monitoring period, these were undertaken by the Council's Inspectorate Officer. The inspections focussed on the following aspects:

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

1.5.4 Chemical sampling

In a monitoring year where the site is actively stockpiling, or for example, further along in the process of remediation, the Council would have collected six composite soil samples from the Vanner site. The samples would have been analysed for chloride, conductivity, hydrocarbons, pH, sodium absorption ratio (SAR) and total soluble salts.

As discussed previously, the Company applied for a partial surrender in the previous monitoring period. This was achieved by providing the Council with analytical evidence of the soil condition to support the idea that areas of land which had been utilised for the practice of landfarming had met the conditional limit for surrender as detailed in their consent 7942-1.1¹. As such the Council does not require additional samples to be collected in this monitoring period.

The site also contains two active groundwater monitoring wells. Throughout the tenure of the landfarm these wells were monitored four times per annum. The Council collected groundwater samples, post well development, and had the groundwater samples analysed for pH, temperature, conductivity, chloride, total dissolved salts, sodium, barium, Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylene and Xylene (BTEX).

¹ Consent 7942-1.1 attached in Appendix I

Since the landfarms inception there have been no detections in either monitoring well in terms of possible contaminants of concern.

The Mangaroa Stream which flows through the site was also sampled twice, at two sites (upstream and downstream) for standard surface water quality parameters and hydrocarbons. This was undertaken through out the operational phase of the facility. In similarity to the groundwater, the analysis of the Managaroa did not detect anything other than background concentrations throughout the monitoring tenure.

1.5.5 Review of analytical results

In an active monitoring year when the site is stockpiling or in the mode of remediation, the Company would supply a certain amount of analytical soil samples to meet the specific consent conditions. The initial sampling would have focussed on a representative pre-storage sample from each individual waste stream prior to storage on site. This would allow the Company to ascertain the concentrations of specific chemicals in the waste stream prior to applying it to the receiving environment. Once the Company has understood the concentrations in the drilling mud waste stream, they are able to apply the material to land at a specific concentrated rate. The rates are defined in the consent by the conditions (Appendix I).

The second round of sampling which is undertaken by the Company is the post landfarming soil samples. These samples are collected from the receiving environment from all spreading areas post waste application. These samples, when required by the Council in an active year, are sent to an independent laboratory for analysis for a wider range of contaminants.

Chemical parameters tested were (all solid/sludge samples):

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

Receiving environment soil samples were also tested for electrical conductivity, sodium absorption ratio (SAR) and total soluble salts (TSS).

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

As discussed, as the site was partially surrendered in the previous monitoring period, there remained no requirement from the Company's prospective to provide analysis of the soil.

2. Results

Advice and information from the partial surrender of the Vanner site.

27 March 2015²

TAG Oil (NZ) Limited lodged an application to change the conditions of consent 7942-1.1 to discharge drilling wastes (consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds) onto and into land via landfarming.

The application was to surrender the portions of the site which have received drilling wastes as stipulated in the original discharge permit 7942-1. Areas F1, F2, F3, F4, F5, F6, F7, F8, F9 and F10 have met surrender criteria as stipulated by special condition 22 of the permit and the applicant would like them removed from the future applications of waste. The areas on the site where drilling wastes as detailed in this permit are permitted to be landfarmed is described as the areas East of parcel F1 as detailed in the application.

Note the operator has obligations to the landowner to meet the consent conditions which state they must revegetate the site.

2.1 Inspections

26 January 2016

A north westerly wind was noted at the time of inspection, with a speed of 3-4 kilometers per hour. No objectionable odours or visible emissions were found during the inspection. No recent stockpiling or land-farming activities had occurred at the site. The area where the storage pits were located was completely barren of pasture, some natural coastal weeds were observed to be establishing. Some drilling muds were visible as they had migrated to the surface in small clumps. These clumps were dry and broke apart easily. It was outlined by the site owner that dairy effluent had been applied to the area to help pasture establish, the area had been sown three times. No dust was being generated during the inspection but considered likely during high winds.

The original spreading area appeared stable and dry with sparse pasture present across all areas. Very little mud was visible at the surface except where motorbikes have cut a track to the effluent hydrant. No evidence of recent grazing was observed.

28 April 2016

The wind direction was noted as south west at a speed of 4 kilometers per hour during this inspection. At the time, no objectionable odours or visible emissions were found. No recent spreading or storage activities had occurred at the site. After a visual inspection of the original spreading area it was noted that pasture had essentially covered the entire spreading area. Very little drilling muds were present at the surface, as had been noted in previous inspections. Of the surface muds which were observed,

² Note that this date was prior to the monitoring period for this report (1st July 2015- 30th June 2016), however it has been included to provide the reader with background information.

they were found to be dry and broke apart easily with very little mud/hydrocarbon odour.

The most recent spreading area was observed to be bare of pasture. The soil and visible surface muds appeared stable and were weathering. Dune weeds were the establishing vegetation cover over the area, very little mud/hydrocarbon odour noted in the visible mud material.

14 June 2016

During the inspection the wind direction was noted as west, speed 4. No objectionable odours or visible emissions were found during the inspection. No recent storage or spreading activities have occurred at the site, no storage pits were present. Areas which were originally sown were found to have very good pasture cover growing well across all areas, the grass was approximately 30 cm long and all appeared healthy.

The recent spreading area where the storage pits were had also been sown again, pasture strike looked good but some areas were struggling due to wind exposure.

2.1.1 Results of discharge monitoring

The site received and discharged its last delivery of land farmable material in November 2014. This material originated from the Waitangi 1 wellsite and consisted of WBM. While this discharge was outside of the monitoring period of this report it has been included as it was the final discharge to this site prior to partial surrender. A full list of the discharges to the site is provided in Table 1, this is also provided graphically in Figure 2.

Table 1 Vanner Landfarm application dates and details

Location ID	Mud type	Date farmed	Well name	Area (Ha)
F1	WBM WBM CW WBM SBM CW CS	April 2013	SW5A SW6A Cheal PS Puku-2 MHW-C KA 1/7 MHW D	1.39
F2	WBM	July 2013	KA 19/20 Ngaru 1	0.405
F3	WBM	August 2013	KA 19/20 Ngaru 1 MHW C	0.652
F4	WBM	September 2013	KA 19/20 MHW C Cheal E 1	0.755
F5	WBM	October 2013	Cheal E2 Cheal C	0.646
F6	WBM	November 2013	Cheal E3 Cheal C	0.411
F7	WBM	December 2013	Cheal E4 Cheal C	0.592

Location ID	Mud type	Date farmed	Well name	Area (Ha)
F8	WBM	December 2013	Cheal E4 Cheal E5 Cheal C	0.675
F9	WBM	February 2014	Cheal C Cheal G1 Cheal G2	0.52
F10	WBM	November 2014	Waitangi 1	1.47
Mud key: WBM: Water based mud; WW: Waste Water; CS: Contaminated soil; SBW: Syntetic based mud and CW: Contaminated water.				

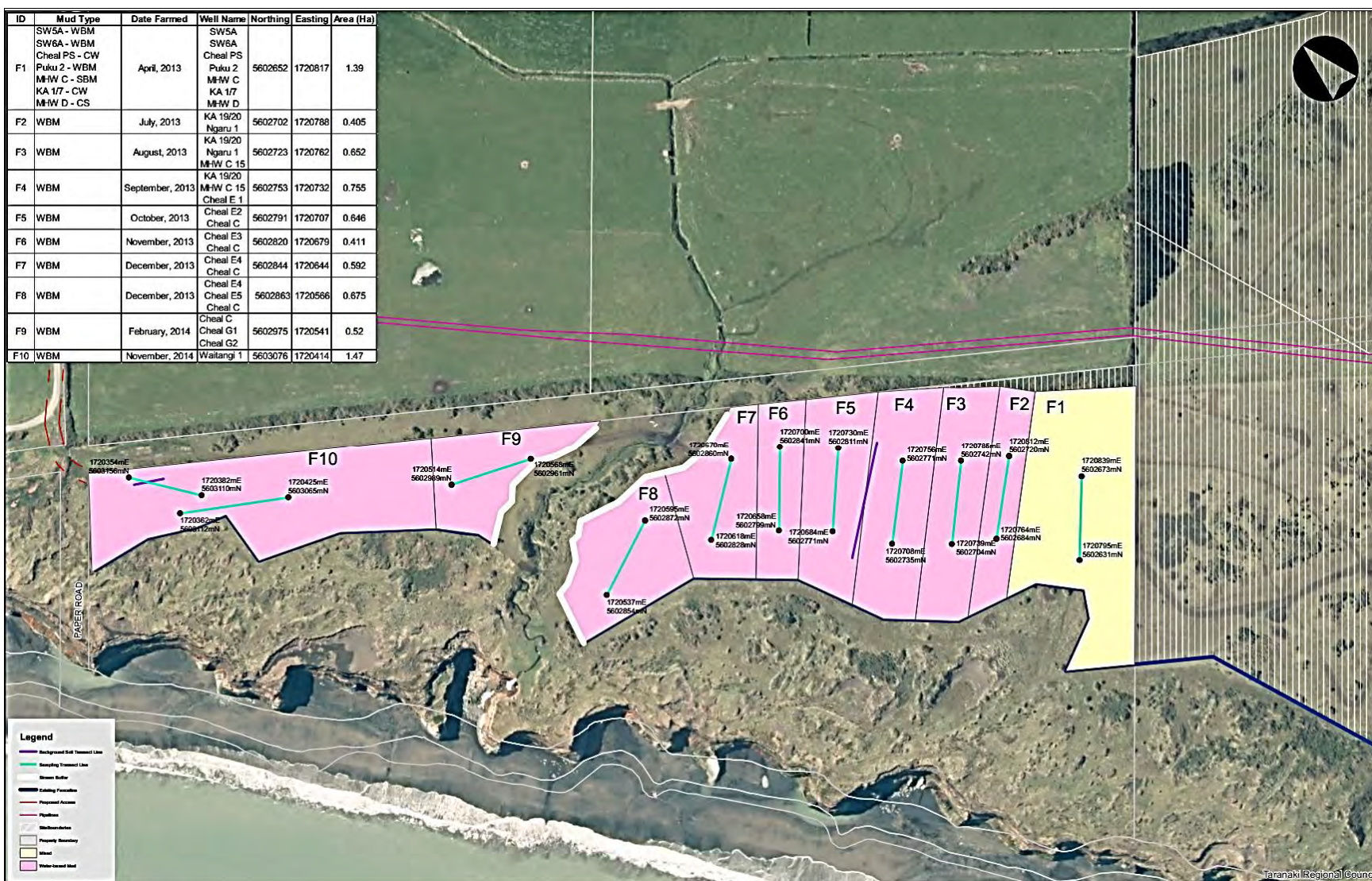


Figure 2 Site map of the Vanner Landfarm with application area, dates and BTW soil sample transects

2.2 Results of receiving environment monitoring

2.2.1 Council soil sampling results

During a normal monitoring year the Council would have collected six composite soil samples from the areas of site which had been utilised for the practice of landfarming. These soil samples would have been collected via a soil corer which was inserted to a nominal depth of 400 mm+/- below ground level (bgl) to encapsulate the zone of application.

The procedure for soil sample collection is adapted from the Safe Application of Biosolids to land New Zealand (2003), whereby ten soil cores (Photo 1) are collected at 10 m intervals across a spread area and then composted to gain one representative sample of the area of application.



Photo 1 An example of a soil core

The soils are sampled to ascertain the quality of the landfarming in the first instance, secondly to understand the specific concentrations of contaminants which have been landfarmed and lastly to monitor the degree of remediation which will have occurred over time.

The Council began soil sampling at this site in the 2012-2013 monitoring year, where one site was sampled in line with the newly landfarmed location F1. This was followed by the soil sampling of six additional locations in the 2013-2014 year, namely F2, F3, F4, F5, F7 and F8. In the 2014-2015 year, locations F6, F7, F8, F9 and F10 were sampled. A full table of Council soil results is provided in Table 2.

Table 2 Council soil results across all locations Vanner Landfarm

Location		F1	F2	F3	F4	F5	F6	F7	F8	F9	F8	F10
Date		26-Jun-13	13-Sep-13	15-Jan-14	15-Jan-14	06-Jan-14	12-Dec-14	22-Dec-14	11-Feb-15	11-Feb-15	18-May-15	18-May-15
Time		10:15	11:56	10:35	11:00	13:30	13:40	9:45	12:15	12:45	12:45	13:30
Calcium	mg/kg	72.7	11.2	146	184	112	37	89.7	107	121.1	49.6	83.1
Chloride	mg/kg	105	24.3	276	839	225	169	209.9	537.7	99	5	6.5
Conductivity	mS/m@20°C	89.1	15.8	211	425	148	17.7	136.3	63.4	150.8	7.6	74
Total Hydrocarbon i	mg/kg	920	140	1,200	410	200	34	358	2,748	74	16	61
Potassium	mg/kg	-	-	-	-	-	239.5	439.3	678.4	221.1	49	135.5
Moisture factor	nil	1.099	1.007	1.003	1.004	1.005	1.1	1.002	1.061	1.005	1.068	1.007
Magnesium	mg/kg	9.2	3.8	9.4	13.8	15.4	5.9	6.8	6.5	8	6.9	9.2
Sodium	mg/kg	40.4	18.4	55.9	129	53.3	43.1	57.8	122.6	41.7	8.8	11.5
Ammonical Nitrogen	g/m ³ N	-	-	-	-	-	0.25	0.032	0.484	1.54	0.442	0.387
Ammonical Nitrogen	mgN/kg	-	-	-	-	-	1.26	0.16	2.43	7.74	2.22	1.95
Nitrate/ Nitrite Nitrogen	mgN/kg	-	-	-	-	-	1.21	0.4	0.3	4.92	0.6	0.96
pH	pH	7.5	6.4	8	8.3	7.6	7	8	8.1	7.5	7.3	7.8
Sodium Absorption Ratio	None	1.18	1.2	1.2	2.5	1.25	1.73634	1.58455	3.11187	0.99098	0.31035	0.31948
Total Soluble Salts	mg/kg	697.3	123.7	1,651.3	3,326	1,158.2	701.2	1,066.7	2,493.4	1,180.2	298.2	579.1

Through out the life cycle of this site the concentrations of contaminants of concern have remained low. On two occasions, higher concentrations in terms of total soluble salts and total hydrocarbons were detected, these are highlighted above. Note that this is not an un-common occurrence following recent landfarming operations. However, follow up analysis of these locations indicated that bio-remediation had decreased these concentrations to below the specific surrender criteria.

2.2.2 Company provided soil data

The Company undertook post spread analysis of the soils in locations where landfarming had occurred. As previously discussed this allowed for greater transparency as to the specific concentrations contained in the soil, post application. The Company contracted BTW to undertake the management of the site on behalf of the Company. BTW collected and submitted soil samples for a greater variety of parameters than the Councils³, this analysis included speciated hydrocarbon analysis, mono aromatic analysis of benzene, toluene, ethylene, xylene as well as the complete list of poly aromatic hydrocarbons and heavy metals (Table 3). BTW provided the Council with analytical soil samples on an annual basis⁴, this was undertaken to ascertain the degree of compliance with the consented conditions for each specific area landfarmed. The long term goal was to submit these soil samples for review by the Council once the areas in question had reached their conditional limit for surrender. The data provided by BTW is detailed in the following Table 3.

³ Council soil sampling is undertaken to check for any variation which may exist between Company provided data and the Councils. For example: The Council does not undertake speciated analysis of hydrocarbons unless variation exists between Council and Company results and further analysis is warranted.

⁴ As required by Consent Condition 7 of consent 7942-1.

Table 3 BTW provided soil sample results (extracted from 2014-15 annual report)⁵

		Meets TRC Surrender Criteria				Does not meet TRC Consent surrender criteria																				
	Date	Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Total Soluable salts <2500gm-3	Benzene <1.1(v)	Toulene <68(4m)	Ethylbenz one (53)(4.v)	Xylenes (48) (4,m)	Naphthale ne (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/k g)	Copper (100mg/k g)	Lead (300mg/k g)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg g)	C7-C9 120 (m)	C10-C14 58 (x)	C15-C36 (4000) (7.x)	nitrogen g/100g dry wt	Chloride 700 mg/kg	Material
F1	1/07/2013	220	126	2.8	1419	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	8	1.4	<0.10	7	60	8	20	620	0.12	70	SBM
	1/11/2013	90	82	3.2	581	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	18	10	1.2	<0.10	8	71	8	20	92	1	29	SBM
	8/11/2014					<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	18	9	1.1	<0.10	8	75	8	20	40	0.08	15	SBM
F2	1/08/2013	40	30	1.5	264	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	7	67	8	20	<40	17	11	WBM
	11/02/2014	80	34	1.1	548	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	10	1.1	<0.10	7	61	8	27	71	0.07	33	WBM
																										WBM
F3	1/08/2013	520	162	2.6	3460	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	18	10	1.4	<0.10	7	69	8	350	1040	1	280	WBM
	11/02/2014	230	83	1.7	1544	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.5	<0.10	8	64	8	320	1120	0.07	117	WBM
	18/06/2014	70	23	0.7	449	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	57	8	29	185	0.07	17	WBM
																										WBM
F4	1/12/2013	540	178	3.3	3570	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	10	1.5	<0.10	8	54	8	20	85	0.06	320	WBM
	11/02/2014	770	258	4.1	5360	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	60	8	20	91	0.07	360	WBM
	1/05/2014	60	19	0.7	416																					WBM
F5	1/12/2013	520	162	2.60	3460	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	2.1	<0.10	10	64	8	39	177	0.11	330	WBM
	11/02/2014	270	101	1.9	1802	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	8	1.1	<0.10	7	59	8	20	40	0.07	106	WBM
																										WBM
																										WBM
																										WBM
F6	1/01/2014	130	61	1.8	865	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	8	66	8	20	40	0.09	53	WBM
	28/05/2014	180	74	2.1	1214	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.4	<0.10	8	63	8	20	40	0.08	126	WBM
																										WBM
																										WBM
F7	6/03/2014	740	266	3.4	3900	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.3	<0.10	7	67	8	20	40	0.12	460	WBM
	1/05/2014	520	145	2.90	3440	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	1.8	<0.10	8	75	8	20	40	0.08	195	WBM
	28/05/2014	190	148	2.7	1230	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	1.8	<0.10	8	75	8	20	40	0.08	195	WBM
	18/06/2014	190	60	1.7	1280																					
F8	6/03/2014	1200	426	5.1	3930	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	19	12	1.9	<0.10	9	83	8	33	340	0.1	750	WBM
	7/04/2014	870	365	4.30	5720	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	17	11	1.3	<0.10	7	71	8	33	240	0.12	390	WBM
	1/05/2014	200	68	2.3	1307																					
F9	18/06/2014	170.00	87	2.2	1096	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	11	1.7	<0.10	8	62	8	20	40	0.12	71	WBM
	3/12/2014	260.00	148	3.3	1723	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	12	1.7	<0.10	7	70	8	20	40	0.1	143	WBM
F10	19/02/2015 (A)	190.00	110	2.5	1280	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	14	11	1.8	<0.10	7	69	8	20	40	0.05	64	WBM
	19/02/15 (B)	190.00	103	2.2	1280	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	13	10	1.4	<0.10	6	62	8	20	40	<0.05	85	WBM

⁵ A larger version of these results is provided in Appendix II

The soil sample results provided by BTW, presented in Table 3, detail samples collected from each individual spread area, F1-F10 inclusive. Note that the green portions of Table 3 indicate the analyte is below the relevant consent condition. On average, BTW undertook three soil samples per area, with the remediation occurring over the course of year, in some cases it may be slightly longer or shorter and this can be dependent on a couple of factors.

- Stockpiling allows for the volatilisation of volatile substances contained within the drilling mud, such as lower chain hydrocarbons for instance TPH C7-C9. The stockpiling cells were lined with fit for purpose synthetic liners; as such storage would not present an adverse effect on the receiving environment.
- The application of aged drilling mud also served a similar purpose to stockpiling in as much as it has already volatilised much of the volatile substances.
- The quality of the landfarming operation. This included the blending of material with the top soil once it has been applied to the ground, as when this is completed well, the time for remediation to occur will be shortened.
- Application of organic material. In some cases operators have blended their landfarmable material with saw dust, or applied dairy shed effluent.

The analysis provided by BTW indicated that the areas of the site which had been utilised for the application of drilling muds and related contaminated soil to land under the practice of landfarming, had met the conditional limit for surrender. In order to surrender portions of the site the following must occur.

2.2.3 Surrender sampling

In order for a portion of the site to be surrendered in relation to consent 7942-1, the following consent conditions must be satisfied:

Consent 7942-1.1 Condition 21

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

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

This condition, while not strictly a surrender condition, stipulates that the areas of land utilised must continually be below these concentrations for target heavy metals in the soil. If an area is above these proposed levels of contaminants, then it will not be

processed for surrender. Of note, no post spread soil samples returned analysis above these conditional concentrations throughout the tenure of the landfarm.

Consent 7942-1.1 Condition 22

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

Constituent	Standard
Conductivity	290 mS/m
Chloride	700 mg/kg
Sodium	460 mg/kg
Total soluble salts	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)

While condition 21 is a set limit which should not be exceeded, the true surrender sampling condition, condition 22, sets the limits which analytes must meet at the time the sample is considered for surrender. It is not uncommon for the concentrations of the analytes to be above the limits set in this condition during the remediation stage of landfarming, however, they are required to be remediated to below these set limits for the parcel of land to be considered for surrendered.

In relation to Table 3, where there have been multiple samples collected over the course of six months, this would be an example of the Company seeking to measure the degree of remediation.

The Company submitted Table 3 in March 2015 to the Council; the intention was to gain a partial surrender for the locations of the site which had received discharges of drilling mud. The Council, having reviewed the Company provided data and compared it to the Council data, granted the Company a partial surrender for the locations (F1-F10 inclusive) which had been utilised for the practice of landfarming.

This resulted in a reduced monitoring programme moving forward, the site has since been decommissioned, with the storage cells removed and the land recontoured.

2.2.4 Council groundwater monitoring

In an active monitoring year the Council would have sampled the two site specific groundwater monitoring wells four times per annum. This was undertaken to understand the seasonal fluctuations which may exist on site and also to ascertain if any adverse effects were permeating from the exercise of the consent. The locations of the monitoring wells are depicted in Figure 3.



Figure 3 Vanner Landfarm groundwater monitoring well and Mangaroa Stream sample locations

As previously discussed the site has been partially surrendered, there is no longer the requirement to monitor the groundwater at this facility. Throughout the tenure of the site the wells were monitored a total of ten times, this began in February 2013 until May 2015. During this time minimal effects were noted in the groundwater, no hydrocarbons or related contaminants such as benzene, were detected in either well over the three year period. The results from the previous monitoring year (Tables 4 and 5) have been included for reference as it allows the reader to understand the degree of analysis which has been undertaken by the Council.

Of note, in terms of groundwater protection, the consent contains a condition which stipulates the following:

Consent 7942-1.1 Condition 17

The exercise of this consent shall not result in any contaminant concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background for that particular contaminant.

Inline with the soil meeting the specific criteria in relation to surrender, any adverse effects measured in the groundwater will also limit a Company's ability to submit their site for surrender. As this is not the case with this facility, it was allowed to be surrendered.

Table 4 Final groundwater monitoring results from GND2316 collected during the previous monitoring period 14-15

	TRC ID	TRC1410811	TRC1411945	TRC150641	TRC151748
	Location	GND2316	GND2316	GND2316	GND2316
	Date	14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:35	9:40	10:50	12:00
Acid soluble barium	g/m ³	0.1	0.125	0.15	0.05
Dissolved barium	g/m ³	0.07	0.043	0.045	0.037
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m ³	221	123	120	106
Conductivity	mS/m@20°C	97.3	60.4	68.7	57.8
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m ³	<0.10	<0.7	<0.10	<0.7
HC C7-C9	g/m ³	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4
LEVEL	m	8.923	8.97	9.122	8.687
Sodium	g/m ³	117	61	60.2	44.2
PH	pH	6.2	6.4	6.4	6.1
Total dissolved salts	g/m ³	752.8	467.3	531.5	447.2
Temperature	°C	14.9	No result	15.6	16.9
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m ³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010

Table 5 Final groundwater monitoring results from GND2317 collected during the previous monitoring period 14-15

TRC ID		TRC1410812	TRC1411946	TRC150642	TRC151749
Location		GND2317	GND2317	GND2317	GND2317
Date		14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:55	10:20	11:40	11:30
Acid soluble barium	g/m ³	0.14	0.122	0.11	0.13
Dissolved barium	g/m ³	0.1	0.083	0.08	0.093
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m ³	213	200	191	220
Conductivity	mS/m@20°C	87.9	73.7	83.4	83.2
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m ³	<0.4	<0.7	<0.7	<0.4
HC C7-C9	g/m ³	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4
Static water level	m	7.485	7.685	7.902	7.313
Sodium	g/m ³	70.4	67	69.4	74.1
PH	pH	6.7	6.6	6.6	6.5
Total dissolved salts	g/m ³	680.1	570.2	645.3	643.7

TRC ID		TRC1410812	TRC1411946	TRC150642	TRC151749
Location		GND2317	GND2317	GND2317	GND2317
Date		14-Aug-14	18-Nov-14	10-Feb-15	18-May-15
Parameter	Time	10:55	10:20	11:40	11:30
Temperature	°C	14.5	No result	15.6	15
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m ³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010

2.2.5 Council surface water

The Managaroa Stream flows from North to South across the middle of the site (Figure 3). The Council began monitoring this stream in June 2013, with two established monitoring stations; one is located upstream (MAN000020) and one downstream (MAN000010).

There is a specific condition which was included for the protection of this resource.

Consent 7942-1.1 condition 18

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

- A production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material;*
- Any conspicuous change in the colour or visual clarity*
- Any emission of objectionable odour*
- The rendering of fresh water unsuitable for consumption by farm animals; and*
- Any significant adverse effects on aquatic life.*

The Council would collect samples from both locations, twice per year and would have these analysed for a similar suite of analytes as per the groundwater analysis. While no samples of the Managaroa stream were proposed in this monitoring period, due to the partial surrender of the site, the results from the previous period have been included for reader reference.

Table 6 Council surface water results for the Mangaroa Stream extracted from the 2014-15 report

TRC ID		TRC1410813	TRC1410814	TRC1411947	TRC1411948
Location		MAN000010	MAN000020	MAN000010	MAN000020
Location		MG Stream D/S	MG Stream U/S	MG Stream D/S	MG Stream U/S
Date		14-Aug-14	14-Aug-14	18-Nov-14	18-Nov-14
Parameter	Time	11:50	11:30	11:30	11:15
Acid soluble barium	g/m ³	0.015	0.013	0.011	0.011
Dissolved barium	g/m ³	0.009	0.009	No result	No result
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m ³	65.3	63.7	71.9	67.2
Conductivity	mS/m@20°C	38.6	38.4	38.3	38.3
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Total Hydrocarbon	g/m ³	<0.10	<0.7	<0.4	<0.10

TRC ID		TRC1410813	TRC1410814	TRC1411947	TRC1411948
Location		MAN000010	MAN000020	MAN000010	MAN000020
Location		MG Stream D/S	MG Stream U/S	MG Stream D/S	MG Stream U/S
Date		14-Aug-14	14-Aug-14	18-Nov-14	18-Nov-14
Parameter	Time	11:50	11:30	11:30	11:15
HC C6-C9	g/m ³	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4
Sodium	g/m ³	38.5	38.3	38.1	37.7
PH	pH	7.6	7.8	7.6	7.6
Total dissolved salts	g/m ³	298.7	297.1	296.3	296.3
Temperature	°C	9.9	9.8	No result	No result
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m ³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010

While these results were extracted from the previous monitoring period, they were collected when the site was still active. They indicated no adverse environmental effects on this body of water. The water quality parameters are within typical ranges for a coastal Taranaki stream. The upstream and downstream sample locations detailed little or no variation when compared to each other. To date there has been little in the way of variation between both sample locations.

2.2.6 Additional operational requirements

The soil, ground and surface water quality has been discussed; these were the primary routes of analysis relating to the consent, however, there is also an additional consent condition which must be satisfied and it stipulates the following:

Consent 7942-1.1 Condition 15

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

The site's location, within 200 meters of the Tasman Sea and elevated above sea level, leaves the site exposed to the strong southerly and south westerly winds which are prevalent in South Taranaki. The main issue with the site has not be related to operational management, more over the site has suffered from wind and storm erosion over the course of its tenure thus far.

The Company has been pro-active and upfront when discussing the degree of revegetation completion with the Council. The central portions of the site were difficult to revegetate during the previous monitoring period (Photo 2); however careful management enabled vegetative cover to establish across the central belt of the site (Photo 3).

The final landfarm application areas have also had difficulty in attempting to establish pasture this term, these areas; F9 and F10 respectively (Photo 4) have been subject to

wind and rain erosion which has made the job slightly more challenging. The Company had engaged Agriseed and Osflo to help mitigate the erosion issue.

Inspections undertaken by the Council this year noted that vegetation is establishing in area F9 and grass is sown in area F10, (Photos 5 and 6). The Council will continue to monitor the revegetation. The Company have described the process in more detail in the attached memorandum, Appendix II.



Photo 2 Vanner Landfarm central portion- western projection over area F8 March 2015



Photo 3 Central portion- western projection over area F8 November 2015



Photo 5 Vanner Landfarm final application areas- western projection F9 and F10 November 2015



Photo 6 Vanner Landfarm final application – eastern projection over area F9 24 May 2016



Photo 7 Vanner Landfarm final applications- eastern projection over area F10 24 May 2016

2.3 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).

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

During the 2015-16 monitoring year the Vanner Landfarm has been decommissioned and inactive. The Company has satisfied the majority of its commitments to the resource consent which govern the discharges at this facility, to the satisfaction of the Council. The site has been partially surrendered and it has the option to continue landfarming at the southern end of the site which is still unused.

As the site is inactive and partially surrendered the Company are not required to undertake additional sampling for the consent conditions.

The main action item in this monitoring year from the company's perspective would be the revegetation, which the Company is addressing. This follows on from the previous years where the management and the Company had undertaken work at this site to a high standard.

The Company, as discussed, has finalised their requirement to landfarm with this site; however they have the facility in the southern portion of the Vanner site to landfarm again if so required. The mud storage cells and associated wash down pad have been removed and the land reinstated and re-contoured. As the Company had lined the storage cells prior to delivery of any material at the inception of the facility, there are no legacy issues from potential storage leeching.

3.2 Environmental effects of exercise of consents

As previously discussed, the main environmental effect associated with the exercise of this consent, in this monitoring period has been related to the re-vegetation of the final application areas, F9 and F10.

This time last year there were issues with the central portions of the site in terms of re-vegetation and these have been addressed. Moving forward the Council would expect these areas (the final two application areas F9 and F10) to follow a similar course to the central portions of land in terms of re-vegetation.

The riparian margins have been planted along the Managaroa Stream which runs through the site and these areas have now been fenced off.

The Company has engaged Agriseed for advice moving forward (Appendix II). They have planted on three separate occasions, only to loose the majority of the crop on two occasions and 40% on the third occasion, however they intend to persevere. This underlines the Company's commitment to this site, which is pro-active.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 7.

Table 7 Summary of performance for consent 7942-1.1 in the 2015-2016 monitoring year

Purpose: To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds) onto and into land via landfarming.		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. Notify the Council 48 hrs prior to stockpiling	Notifications received	Yes
4. Notify the Council 48 hrs prior to landfarming	Notifications received	Yes
5. The consent holder shall sample for the following: a. Total Petroleum Hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes
6. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
7. Report on records in condition 6 to Council by 31 August each year	Report received	Yes
8. The discharge shall only occur on the area East of area F1	Inspection	N/A in this monitoring period
9. No discharge within 25 m of a water body or property boundary	Inspection	Yes
10. Discharge depth limited to 100 mm for waste with hydrocarbons <5%, or 50 mm for waste with hydrocarbons >5%	Company records and inspection	Yes
11. Incorporation into soil as soon as practicable to a depth of at least 250 mm	Inspection and sampling	Yes
12. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
13. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	Yes

Purpose: To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds) onto and into land via landfarming.		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
14. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
15. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	On going
16. Total dissolved salts in any fresh water body shall not exceed 2,500 g/m ³	Sampling	Yes
17. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling	Yes
18. Disposal of waste shall not result in any significant adverse environmental effects on the Mangaroa Stream	Inspection and sampling	Yes
19. Soil conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Yes
20. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
21. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling	Yes
22. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 400 mS/m b. chloride, 700 g/m ³ c. dissolved salts, 2,500 g/m ³ d. sodium, 460 g/m ³ e. PAHs, MAHs and TPH, Tables 4.12 and 4.15, Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE 1999)	Sampling prior to surrender	Yes, supplied, see annual report appendix II
23. If condition 22 not met, consent cannot be surrendered	Sampling	Yes, consent partially surrendered in previous period
24. Notification of discovery of archaeological remains	None found	N/A
25. Lapse condition	Inspection for evidence of exercise	N/A

Purpose: To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds) onto and into land via landfarming.		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
26. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative compliance in respect of this consent		High

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

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

3.5 Alterations to monitoring programmes for 2016-2017

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

- the extent of information made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor 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.

In similarity to the previous years' alteration, whereby the soil and water monitoring requirements were removed from the Company's obligation and the monitoring of the re-vegetation became the main point of focus. The re-vegetation will continue to be monitored moving forward.

3.6 Exercise of optional review of consent

Resource consent 7942-1.1 provides for an optional review of the consent in June 2016. Condition 25 allows the Council to review the consent, if there are grounds.

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

4. Recommendations

1. THAT monitoring of consented activities at Vanner Landfarm in the 2016-2017 year continue in line with what was undertaken in 2015-2016 due to the fact the site is inactive and partially surrendered with only re-vegetation issues. The re-vegetation monitoring will form the basis for monitoring in the 2016-2017 year.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
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.
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.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH ₃	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO ₃	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents

	a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<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.
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 Limited – TAG OIL (NZ) Limited Landfarm Annual Report – Consent 7942-1 – 13314 – 22 July 2014.

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

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

Taranaki Regional Council (2015): *TAG Oil (NZ) Limited Vanner Landfarm Monitoring programme Annual report 2014-2015*. Technical Report 2015-63.

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

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

Appendix I

Resource consents held by TAG Oil (NZ) Limited

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

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

Name of
Consent Holder: TAG Oil (NZ) Limited
PO Box 402
New Plymouth 4340

Decision Date
(Change): 27 March 2015

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

Conditions of Consent

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

Expiry Date: 1 June 2028

Review Date(s): June 2016, June 2022

Site Location: Lower Ball Road, Kakaramea

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

Grid Reference (NZTM) 1721037E-5602605N

Catchment: Mangaroa

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

General condition

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

Special conditions

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

Notifications, monitoring and reporting

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to permitting drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well(s) from which the waste was generated;
 - c) the type of waste to be stockpiled; and
 - d) the volume of waste to be stockpiled.
4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well(s) from which the waste was generated;
 - c) the type of waste to be landfarmed;
 - d) the volume and weight (or density) of the waste to be landfarmed;
 - e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
 - f) the specific location and area over which the waste will be landfarmed.

Consent 7942-1.1

5. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
 - a) total petroleum hydrocarbons (C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆);
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening; and
 - d) chloride, nitrogen, pH, potassium, and sodium.
6. The consent holder shall keep records of the following:
 - a) wastes from each individual well;
 - b) composition of wastes (in accordance with condition 5);
 - c) stockpiling area(s);
 - d) volumes of material stockpiled;
 - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates;
 - f) volumes and weights of wastes landfarmed;
 - g) dates of commencement and completion of stockpiling and landfarming events;
 - h) dates of sowing landfarmed areas;
 - i) treatments applied; and
 - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

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

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

Discharge limits

8. The discharge shall only occur on the area East of area F1 as shown in Drawing No 13314-109-GIS Rev 0 attached.
9. Notwithstanding condition 8, there shall be no discharge within 25 metres of the Mangaroa Stream or property boundaries.
10. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:
 - a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight; or
 - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
 - c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;prior to incorporation into the soil.
11. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.

Consent 7942-1.1

12. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:
 - a) liquid waste has been discharged; or
 - b) solid waste has been discharged and incorporated into the soil.
13. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

Operational requirements

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

Receiving environment limits - water

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

Receiving environment limits - soil

19. The conductivity of the soil/waste layer after landfarming shall be less than 400 mS/m, or alternatively, if the background soil conductivity exceeds 400 mS/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.
20. The sodium absorption ratio (SAR) of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.

Consent 7942-1.1

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

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

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

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

MAHs - benzene, toluene, ethylbenzene, xylenes

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

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

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

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

Archaeological remains

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

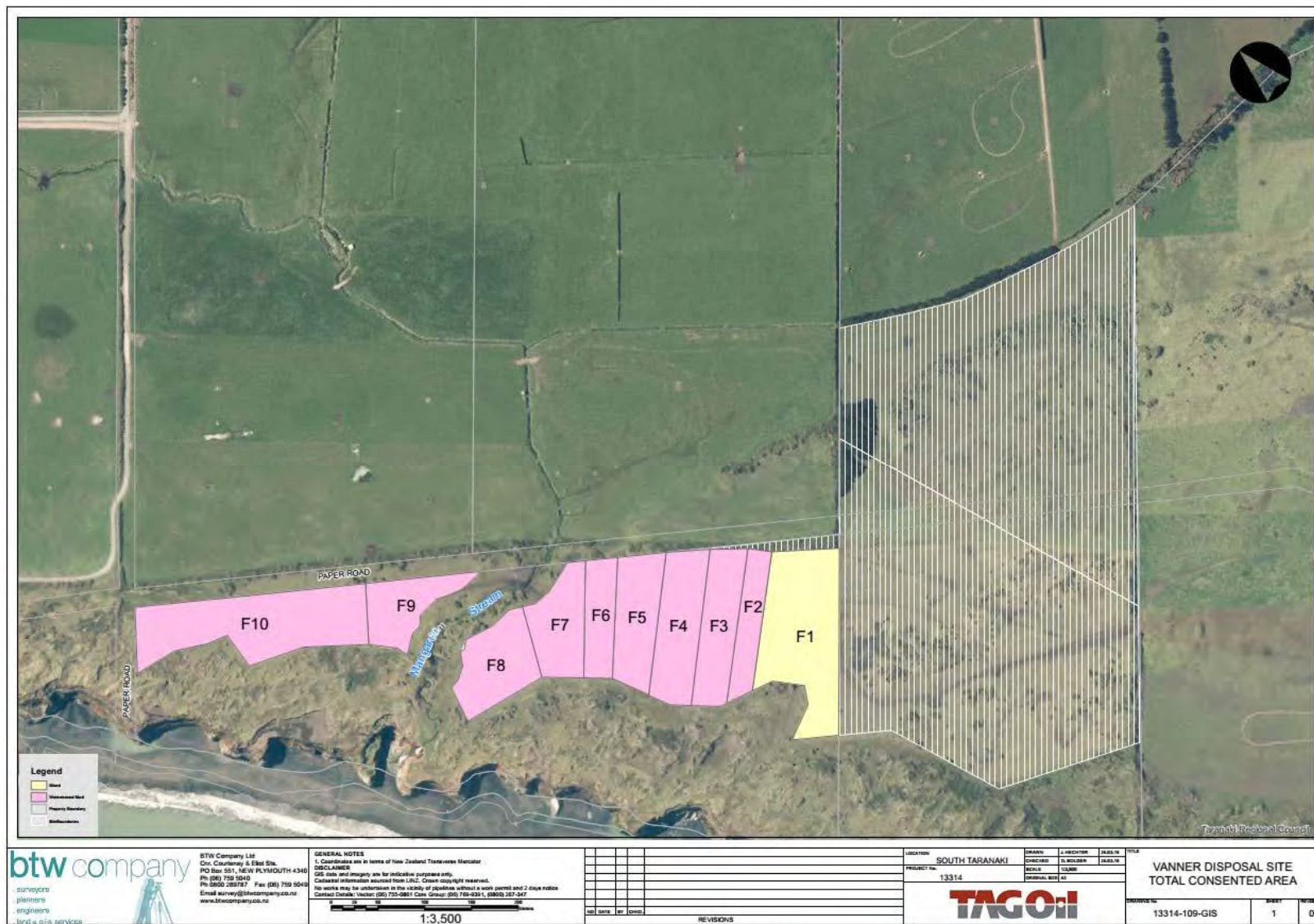
Lapse and review

25. This consent shall lapse on 31 December 2016, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
26. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 27 March 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management



Appendix II

Annual report memo

Memorandum

To: Nathan Crook

From: Rodney Hosking

Date: 10/08/16

Re: Ball Road Disposal Site

Consent 7942-1, Condition 7

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

TAG Oil reached soil surrender criteria for the areas F-1 to F10 as stipulated in the TRC resource consent 7942-1 in April 2015. Excellent establishment of vegetation has been achieved in the areas F1 to F8. In areas F9 and F10 TAG Oil have had a number of attempts to establish vegetation but these have not been successful due to difficult conditions. In June 2015 TAG Oil engaged with Agriseeds which are a respected agricultural seed company for advice on establishing vegetation in the very exposed F9 and F10 areas. Below is a list of actions and dates that TAG Oil have completed in order to comply with the consent conditions.

- June 2015, Oats were direct drilled into the land and favorable conditions led to a good seed strike. At the end of June the crop was looking very poor this was due to insect damage over the entire area. TAG Oil engaged with Agriseeds for advice going forward.
- August 2015, coated seed and clover were direct drilled into the ground along with an application of fertiliser. Ground temperature at the time was 11 degrees. Initial germination was very good but in September seedlings were showing signs of stress due to high winds causing sand and salt burn.
- October 2015, the entire crop was destroyed due to sand, salt burn and low ground temperatures. A soil sample was taken to ensure there were no underlying issues. The results of the soil tests raised no issues.
- November 2015, Agriseeds recommended to use a product called Sorghum, this product responds better in dry warm conditions. An application of osflo fertiliser was applied and the Sorghum seed was direct drilled.
- December 2015, the germination of the Sorghum was excellent but due to high winds it was already showing signs of sand and salt burn.
- February 2016, 80% of the crop had been destroyed by the strong winds salt and sand burn. There was some good weed coverage in areas suggesting that there was no issues with the soil quality.
- May 2016, A rye clover mix was direct drilled and lightly rolled at a very high application rate, the weeds were not sprayed out as this would protect the seedling, very good germination occurred to over 90% of areas F9 to F10, an application of urea was also applied to the area.
- July 2016, due to high winds 40% of the established pasture was destroyed and the remaining cover struggling. A contractor has been applying effluent every two weeks to help maintain organic matter in the soil.

Over the coming months TAG Oil will continue engaging with the landowners and Agriseeds to ensure vegetation is established in the areas F9 to F10. Riparian planting was completed in June 2016 around the Mangaroa stream, this has since been fenced off.